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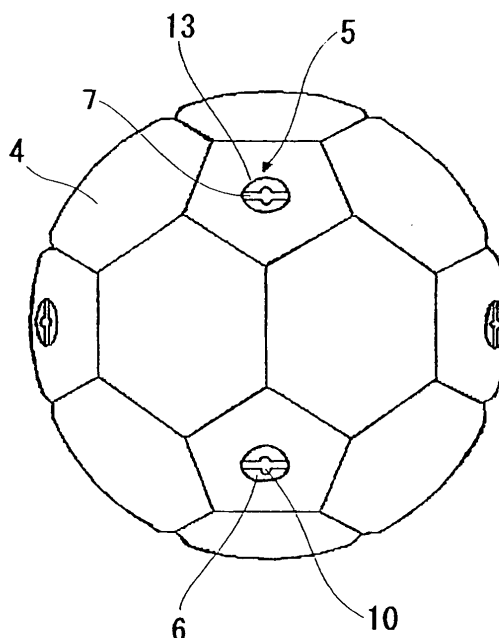
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(54) LIGHT EMITTING BALL FOR BALL GAME

(57) The present invention provides a light-emitting ball, including surface layers and a tube covered there-with, for a ball game. A plurality of light-transmissive, elastic luminescent-body fixtures including light-emitting panels and luminescent body-retaining sections are arranged in the ball such that the light-emitting panels are exposed from holes, arranged in the surface layers, having substantially a circular shape. The luminescent body-retaining sections are substantially circular and have a size greater than that of the light-emitting panels. Outer end portions of the luminescent body-retaining sections are fixed between the surface layers and the tube. Luminescent-body insertion ports laterally extending in surface portions of the light-emitting panels are connected to cavities laterally extending in the luminescent body-retaining sections; hence, luminescent bodies can be detachably attached to the ball. The ball is practical in that the ball can be hit by a hand, kicked, or thrown against a floor.

FIG. 4



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Description

Technical Field

[0001] The present invention relates to a light-emitting ball, useful in the evening or night, for a ball game.

Background Art

[0002] The term "ball" used herein covers all types of balls such as a volleyball, a soccer ball, a beach ball, a basketball, a handball, a rugby ball, and a football, including sewn surface skins and internal tubes covered with the surface skins. The inventors have investigated these types of balls and have found that there is no prior art. A luminous ball disclosed in Japanese Utility Model Registration Application No. 4-87165 includes a translucent body and a bag, disposed therein, containing a chemiluminescent material. This ball is entirely luminous and is for pleasure use and thus is outside the scope of the present invention.

[0003] It is an object of the present invention to provide a light-emitting ball which is suitable for a ball game and which is practical in that the light-emitting ball can be hit by a hand, kicked, or thrown against a floor. It is another object of the present invention to provide a regular ball which can be used for various competitions and which is useful in continuing a ball game even if this ball is used in the evening or jumps into a dark area, because this ball is visible due to its performance and the trace and/or spin of this ball can be read.

Disclosure of Invention

[0004] A ball according to the present invention includes surface layers and an internal tube, filled with air, covered with the surface layers. The surface layers (reference numeral 1 in a figure) usually include reinforced sub-layers (reference numeral 3 in a figure) and surface skins (reference numeral 2 in a figure).

[0005] The surface layers are manufactured by sewing some units (pieces) with a thread. Any ball including no reinforced sub-layers is within the scope of the present invention.

[0006] An exemplary configuration of a hand-stitched soccer ball will now be described. A global hollow tube filled with compressed air is made of special compounded rubber containing a butyl rubber component having an air permeability that is one tenth of that of natural rubber such that the amount of leaking air is minimized. The air pressure in the ball is usually 0.6 to 1.1 atm (600 to 1100 g/cm²). The surface layers are made of artificial leather having high toughness, high durability, and soft texture. The surface layers may be made of natural leather.

[0007] The reinforced sub-layers are made from a composite material made of polyester/cotton fabric and a natural rubber latex so as to have good balance be-

tween durability, texture, and rebound. The type of fabric and/or the amount of the latex is varied depending on the kind of ball game. The thread includes high-tenacity polyester twisted yarns for preventing seams from opening. The surface layers including the reinforced sub-layers and the surface skins each have a hole located at a center region of one unit.

[0008] An ordinary soccer ball is manufactured by sewing 20 hexagonal units and 12 pentagonal units. A plurality of holes are arranged in these units at equal intervals. That is, the holes are arranged such that the centers of the holes are not displaced from the barycenter of ball. The reason why the positions of the holes is limited as described above is that the soccer ball, which should be essentially balanced, is prevented from being unbalanced. If the ball is used only for pleasure, the hole positions need not be limited. In the present invention, the hole positions are set depending on a use or purpose for the ball.

[0009] Luminescent-body fixtures are fixed between the surface layers and the tube. The luminescent-body fixtures are made of an elastic, light-transmissive material such as a synthetic rubber, of which examples include soft polyvinylchloride, polyvinyl acetate, natural rubber, and a silicone rubber.

[0010] Since the luminescent-body fixtures are elastic, the luminescent-body fixtures can be formed so as to fit the curved surface of the ball. However, this is not necessarily essential. Since the luminescent-body fixtures are sandwiched between the surface layers and the tube, the luminescent-body fixtures are entirely flat.

[0011] Light-emitting panels are exposed from the holes arranged in the surface layers of the light-emitting ball. The light-emitting panels serve as insertion ports through which chemiluminescent bodies are detachably inserted and also serve as light-emitting surfaces for emitting light. The chemiluminescent bodies are used as light-emitting sources and have impact resistance that is extremely higher than that of batteries and that of LEDs; hence, the chemiluminescent bodies are suitable for such a commodity. Since the luminescent-body fixtures are sandwiched between the surface layers and the tube, the surface layers are prevented from being deteriorated in texture and/or durability.

Brief Description of the Drawings

[0012]

Fig. 1 is a plan view of a luminescent-body fixture according to a first example of the present invention; Fig. 2 is a sectional view of the luminescent-body fixture; Fig. 3 is a sectional view of the luminescent-body fixture; Fig. 4 is light-emitting ball, according to the first example, for ball game; Fig. 5 is a sectional view of the first example; Fig. 6 is a sectional view of a second example; and Fig. 7 is a sectional view of a chemiluminescent body.

Best Mode for Carrying Out the Invention

[0013] Light-emitting balls, according to embodiments of the present invention, for ball games will now be described with reference to the accompanying drawings.

[0014] Fig. 4 shows a light-emitting ball, according to a first example of the present invention, for a ball game. The light-emitting ball includes 12 pentagonal surface layers 1 having holes 13 with a diameter of 24 to 25 mm. The surface layers include reinforced sub-layers made from a composite material made of a natural rubber latex and polyester/cotton fabric. Since the texture does not uniformly stretch when compressed air is injected into the light-emitting ball, the shape of each hole is determined by calculation such that the hole has a circular shape after compressed air is injected into the ball.

[0015] Figs. 1, 2, and 3 show each luminescent-body fixture 5. The luminescent-body fixture 5 is made of transparent soft polyvinylchloride and includes a luminescent body-retaining section 9 having a diameter of 45 mm and a thickness of 7 mm and a light-emitting panel 6, connected to the luminescent body-retaining section 9, having a diameter of 25 mm and a thickness of 3 mm. The luminescent body-retaining section 9 has a cavity 8 extending laterally therethrough. The light-emitting panel 6 has an insertion port 7 which extends laterally and which is connected to the cavity 8.

[0016] The insertion port 7 has a width of 3.5 mm such that each chemiluminescent body 11 is prevented from being removed therefrom. The chemiluminescent body has a diameter of 4.5 mm and a length of 37 mm. Each groove 10 for removal extends from the insertion port 7 to the cavity 8. The groove 10, used in this example, is not necessarily essential. If there is no groove 10, the chemiluminescent body 11 may be removed through the insertion port 7 with a bar-shaped tool.

[0017] The light-emitting panels 6 are disposed in the holes 13 of the surface layers 1. The upper faces of the luminescent body-retaining sections 9 abut the reinforced sub-layers 3, that is, the rear faces of the surface layers 1. The abutting faces are fixed to each other with an adhesive or pieces of a double-faced adhesive tape. In the ball manufactured by a known method, the luminescent body-retaining sections 9 are sandwiched between a tube 4 and the surface layers 1. The luminescent body-retaining sections 9 are tightly sandwiched and fixed therebetween by injecting air into the tube 4. Faces of the light-emitting panels 6 that serve as circular light-emitting faces with a diameter of 25 mm are exposed at 12 portions of the surface of the inflated ball.

[0018] The chemiluminescent bodies 11 used herein contain a fluorescent solution and an oxidation solution. The fluorescent solution contains an oxalate ester and a fluorescent substance and the oxidation solution contains hydrogen peroxide and a catalyst. One of the fluorescent and oxidation solutions may be sealed in glass ampoules 16 disposed in bar-shaped vessels 15 having a well known structure. If the oxalate ester and/or fluo-

rescent substance contained in the fluorescent solution sealed in the glass vessels is present in the form of powder or crystals, hydrogen peroxide contained in the oxidation solution reacts with the dissolved oxalate to cause luminescence on the solid oxalate ester. Even though the amount of the oxalate ester is reduced due to the initiation of reaction, the solid oxalate ester is dissolved to react therewith; hence, luminescence is allowed to continue for a long time. Both solutions in the chemiluminescent body are stirred during a ball game; hence, the solid oxalate ester is dissolved. This allows luminescence to continue constantly.

[0019] A solvent used herein is at least one selected from the group consisting of dibutyl phthalate, dimethyl phthalate, and tributyl acetylacrylate. The amount of the oxalate ester contained therein is greater than or equal to the solubility of the solvent. Typical examples of the oxalate ester include bis(2,4-5-trichloro-carboisopentyl-oxophenyl) oxalate and bis(2,4-5-trichloro-carbopentoxophenyl) oxalate. The fluorescent substance can be freely selected and is 1-chlorobisphenylethynyl anthracene or the like. In order to allow a single ball to emit different color lights, different types of fluorescent substances may be used.

[0020] When the ball is used, the glass vessels are broken by bending the chemiluminescent bodies 11, whereby the oxidation solution is mixed with the fluorescent solution. This allows chemiluminescence to occur. The chemiluminescent bodies 11 are tilted, inserted into the cavities 8 through the insertion ports 7 of the light-emitting panels 6, and then retained therein. The insertion ports 7 have a length of 25 mm and the chemiluminescent bodies have a length of 37 mm; hence, the chemiluminescent bodies 11 are not readily removable. Twelve circular light-emitting faces with a diameter of 25 mm are spaced from each other on the ball. Since the spin of the ball kicked or thrown can be read, the movement or curve of the ball can be assessed on a dark ground or the like.

[0021] Luminescence can be caused in such a manner that the chemiluminescent bodies 11 including glass vessels which are thin and breakable are attached to the ball and an impact is applied to the ball by throwing the ball against a floor. The chemiluminescent bodies 11 are removed through the grooves 10 with a metal tool for gripping each chemiluminescent body 11.

[0022] In this example, the chemiluminescent bodies have a simple bar-shape; however, the chemiluminescent bodies may have a shape similar to that of a vessel, shown in Fig. 7, having a cavity. This vessel has a length of 32 mm and includes a bar-shaped portion with an outer diameter of 4.5 mm and a puffed portion with an outer diameter of 8.0 mm. This allows the chemiluminescent bodies to contain an increased amount of the luminescent solution, resulting in an increase in the brightness of light emitted from the light-emitting panels.

[0023] Fig. 6 shows a second example. A light-emitting panel has a luminescent body-inserting port that is a lin-

ear gap. A chemiluminescent body is tilted and forced into a luminescent body-retaining section 9 through the luminescent body-inserting port 12, whereby the chemiluminescent body is retained in the luminescent body-retaining section in such a manner that the chemiluminescent body is wrapped in the luminescent body-retaining section because of the elasticity of the luminescent body-retaining section. According to this retaining technique, the chemiluminescent body is not readily removable even if an impact is applied to a ball.

[0024] In the first or second example, some of lights emitted from the chemiluminescent bodies 11 travel outward and other lights travel inward. Therefore, if light-reflecting layers 14 which are white or have mirror surfaces are disposed on the bottoms of the luminescent body-retaining sections 9, the optical brightness can be increased by reflecting the lights traveling inward (toward the center).

Industrial Applicability

[0025] As described above, a light-emitting ball, according to the present invention, for ball game has light-emitting faces spaced from each other, although such light-emitting faces cannot be provided on balls such as conventional hand-stitched soccer balls. Therefore, the light-emitting ball is visible and useful in the night. Furthermore, spectators and players can follow the path of the light-emitting ball and thus can enjoy a ball game. The light-emitting ball is configured such that the deviation of primary function thereof is minimized; hence, the light-emitting ball can be used for an official ball game.

Claims

1. A light-emitting ball for ball game comprising, surface layers and a tube covered therewith, wherein a plurality of light-transmissive, elastic luminescent-body fixtures including luminescent body-retaining sections and light-emitting panels are sandwiched between the surface layers and the tube such that the light-emitting panels are exposed at the surface of the ball and the light-emitting panels have luminescent-body insertion ports that are arranged at surfaces thereof such that chemiluminescent bodies can be detachably inserted into the luminescent body-retaining sections through the luminescent-body insertion ports.
2. The light-emitting ball according to Claim 1, wherein the luminescent body-retaining sections have a size greater than that of the light-emitting panels and the luminescent-body fixtures are configured such that each light-emitting panel and luminescent body-retaining section are combined into one piece.
3. The light-emitting ball according to Claim 1, wherein

the luminescent-body insertion ports arranged at the light-emitting panel surfaces have a size less than that of the chemiluminescent bodies and are connected to cavities present in the luminescent body-retaining sections.

4. The light-emitting ball according to Claim 1, wherein the light-emitting panels have gaps extending from surfaces thereof to the luminescent body-retaining sections and the chemiluminescent bodies are inserted through the gaps such that the chemiluminescent bodies are retained by the elasticity of an elastic material.
5. The light-emitting ball according to Claim 1, wherein the light-emitting panels have grooves, for removal, extending perpendicularly to the insertion ports.
6. The light-emitting ball according to Claim 1, wherein the light-emitting panels arranged under the surface layers of the ball are spaced from each other at equal intervals.
7. The light-emitting ball according to Claim 1, wherein the chemiluminescent bodies include cylindrical sealed vessels that are flexible and light-transmissive and sealed glass vessels disposed in the cylindrical sealed vessels, the cylindrical sealed vessels contain one of an oxidation solution and a fluorescent solution that are mixed to cause chemiluminescence, the sealed glass vessels contain the other one, the oxidation solution principally contains aqueous hydrogen peroxide, and the fluorescent solution principally contains an oxalate ester and a fluorescent substance.
8. The light-emitting ball according to Claim 1, wherein in a system for causing chemiluminescence by mixing an oxidation solution principally containing aqueous hydrogen peroxide and a fluorescent solution principally containing a solid oxalate ester and a solid fluorescent substance, the chemiluminescent bodies include cylindrical sealed vessels that are flexible and light-transmissive and sealed glass vessels disposed in the cylindrical sealed vessels, the cylindrical sealed vessels contain the oxidation solution, the sealed glass vessels contain the fluorescent solution, and the oxalate ester and/or the fluorescent substance is present in the form of powder or crystals.
9. The light-emitting ball according to Claim 1, wherein in a system for causing chemiluminescence by mixing an oxidation solution principally containing aqueous hydrogen peroxide and a fluorescent solution principally containing a solid oxalate ester and a solid fluorescent substance, the chemiluminescent bodies include cylindrical sealed vessels that are flexible

and light-transmissive and sealed glass vessels disposed in the cylindrical sealed vessels, the cylindrical sealed vessels contain the fluorescent solution, the sealed glass vessels contain the oxidation solution, and the oxalate ester and/or the fluorescent substance is present in the form of powder or crystals.

10. The light-emitting ball according to Claim 1, wherein the luminescent body-retaining sections include light-reflecting layers disposed on the bottoms thereof.

Amended claims under Art. 19.1 PCT

[Amendment received by International Bureau on June 7, 2005. Claim 2 of the original application has been canceled. Claims 1 and 3 to 10 of the original application have been amended. (Three pages)]

(Amended) A light-emitting ball for ball game, comprising surface layers and a tube covered therewith, wherein the surface layers include surface skins and reinforced sub-layers and are prepared by sewing a plurality of pieces; a plurality of light-transmissive, elastic luminescent-body fixtures including luminescent body-retaining sections and light-emitting panels are attached to the ball such that the light-emitting panels are exposed at the surface of the ball and such that outer end portions of the luminescent body-retaining sections that have a size greater than that of the light-emitting panels are sandwiched between the surface layers and the tube; and the light-emitting panels have luminescent-body insertion ports that are arranged at surfaces thereof such that chemiluminescent bodies can be detachably inserted into the luminescent body-retaining sections through the luminescent-body insertion ports.

(Deleted)

(Amended) The light-emitting ball according to Claim 1, wherein the luminescent-body insertion ports arranged at the light-emitting panel surfaces have a size less than that of the chemiluminescent bodies and are connected to cavities present in the luminescent body-retaining sections.

(Amended) The light-emitting ball according to Claim 1, wherein the light-emitting panels have gaps extending from surfaces thereof to the luminescent body-retaining sections and the chemiluminescent bodies are inserted through the gaps such that the chemiluminescent bodies are retained by the elasticity of an elastic material.

(Amended) The light-emitting ball according to

Claim 1, wherein the light-emitting panels have grooves, for removal, extending perpendicularly to the insertion ports.

(Amended) The light-emitting ball according to Claim 1, wherein the light-emitting panels arranged under the surface layers of the ball are spaced from each other at equal intervals.

(Amended) The light-emitting ball according to Claim 1, wherein the chemiluminescent bodies include cylindrical sealed vessels that are flexible and light-transmissive and sealed glass vessels disposed in the cylindrical sealed vessels, the cylindrical sealed vessels contain one of an oxidation solution and a fluorescent solution that are mixed to cause chemiluminescence, the sealed glass vessels contain the other one, the oxidation solution principally contains aqueous hydrogen peroxide, and the fluorescent solution principally contains an oxalate ester and a fluorescent substance.

(Amended) The light-emitting ball according to Claim 1, wherein in a system for causing chemiluminescence by mixing an oxidation solution principally containing aqueous hydrogen peroxide and a fluorescent solution principally containing a solid oxalate ester and a solid fluorescent substance, the chemiluminescent bodies include cylindrical sealed vessels that are flexible and light-transmissive and sealed glass vessels disposed in the cylindrical sealed vessels, the cylindrical sealed vessels contain the oxidation solution, the sealed glass vessels contain the fluorescent solution, and the oxalate ester and/or the fluorescent substance is present in the form of powder or crystals.

(Amended) The light-emitting ball according to Claim 1, wherein in a system for causing chemiluminescence by mixing an oxidation solution principally containing aqueous hydrogen peroxide and a fluorescent solution principally containing a solid oxalate ester and a solid fluorescent substance, the chemiluminescent bodies include cylindrical sealed vessels that are flexible and light-transmissive and sealed glass vessels disposed in the cylindrical sealed vessels, the cylindrical sealed vessels contain the fluorescent solution, the sealed glass vessels contain the oxidation solution, and the oxalate ester and/or the fluorescent substance is present in the form of powder or crystals.

(Amended) The light-emitting ball according to Claim 1, wherein the luminescent body-retaining sections include light-reflecting layers disposed on the bottoms thereof.

Statement under Art. 19.1 PCT

Claim 1 specifies that luminescent bodies can be attached to a ball including surface layers and a tube that are similar to those included in a ball used for an official game or an ordinary game. Luminescent-body fixtures are fixed between the tube and reinforced sub-layers that are rear sections of the surface layers; hence, that ball is resistant to impact and suitable for practical use. 5

A cited reference, WO 00/10646, discloses a ball which is made of closed-cell plastic and which is not hollow. This ball is different in structure from that ball. This ball has a groove extending therearound. A luminescent body can be forced into the groove. 10

Another cited reference, US Patent No. 5,779,575, discloses a ball including a thin outer layer made of rubber or plastic. The thin outer layer has a light outlet extending therethrough and an LED lamp is disposed between the light outlet and an inner layer. 15

Claims 3, 4, 5, 6, 7, 8, 9, and 10 correspond with amended Claim 1. 20

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FIG. 1

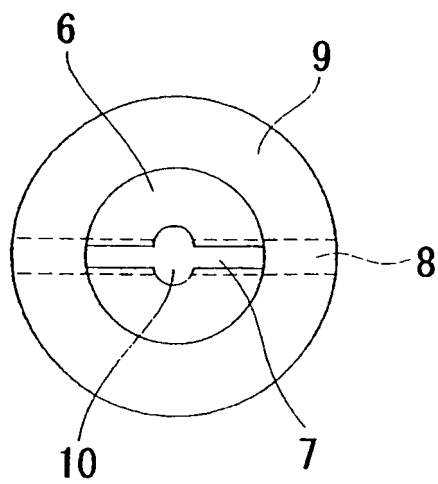


FIG. 2

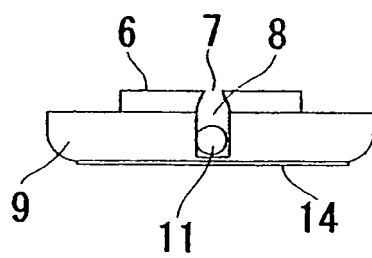


FIG. 3

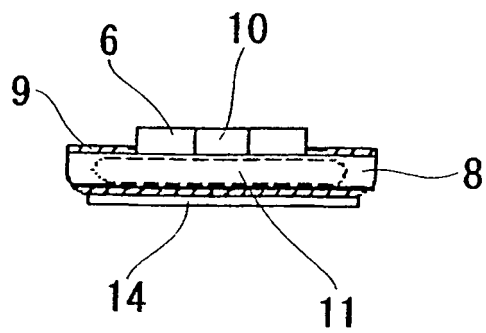


FIG. 4

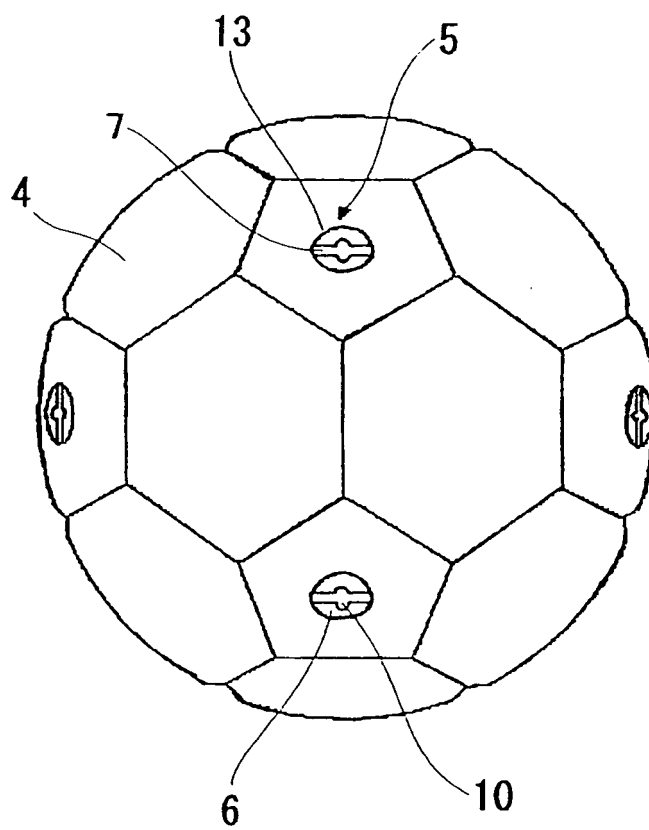


FIG. 5

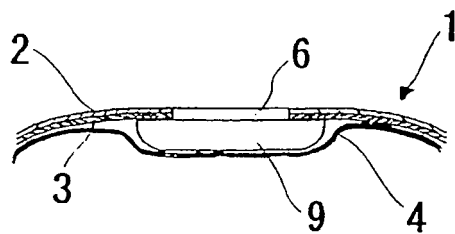


FIG. 6

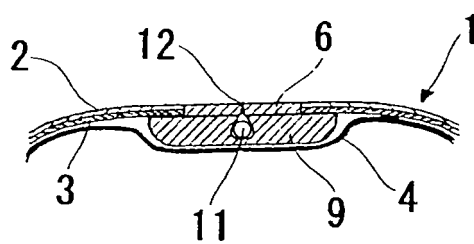
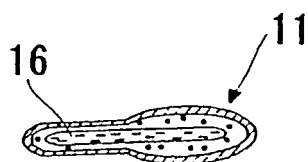


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/003549

A. CLASSIFICATION OF SUBJECT MATTER

Int . Cl⁷ A63B43/06

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 . Cl⁷ A63B43/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2005
Kokai Jitsuyo Shinan Koho	1971-2005	Toroku Jitsuyo Shinan Koho	1994-2005

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.
Y A	US 5779575 A (Frank HSIEH), 14 July, 1998 (14.07.98), Full text; Fig. 6 (Family: none)	1-4, 6-10 5
Y A	WO 00/10646 A2 (FIRE FLYZ, INC.), 02 March, 2000 (02.03.00), Page 9, lines 28 to 32; Figs. 6 to 7 & AU 5681199 A	1-4, 6-10 5
Y	JP 2003-229002 A (Lumica Corp.), 15 August, 2003 (15.08.03), Par. No. [0004] & US 2003-147234 A1	7-9

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search
08 April, 2005 (08.04.05)Date of mailing of the international search report
26 April, 2005 (26.04.05)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/003549

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 6-75608 B2 (Bridgestone Sports Co., Ltd.), 28 September, 1994 (28.09.94), Column 6, lines 32 to 35 (Family: none)	10

Form PCT/ISA/210 (continuation of second sheet) (January 2004)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4087165 U [0002]