



- (51) International Patent Classification:
A63B 41/00 (2006.01) *A63B 41/12* (2006.01)
A63B 41/10 (2006.01)
- (21) International Application Number:
PCT/US2014/040446
- (22) International Filing Date:
2 June 2014 (02.06.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/829,658 31 May 2013 (31.05.2013) US
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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, 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, KZ, LA, LC, LK, LR, LS, LT, 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, 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,

[Continued on next page]

(54) Title: SOLID SPORTS BALLS AND METHODS OF MANUFACTURE FROM REACTIVE COMPONENTS

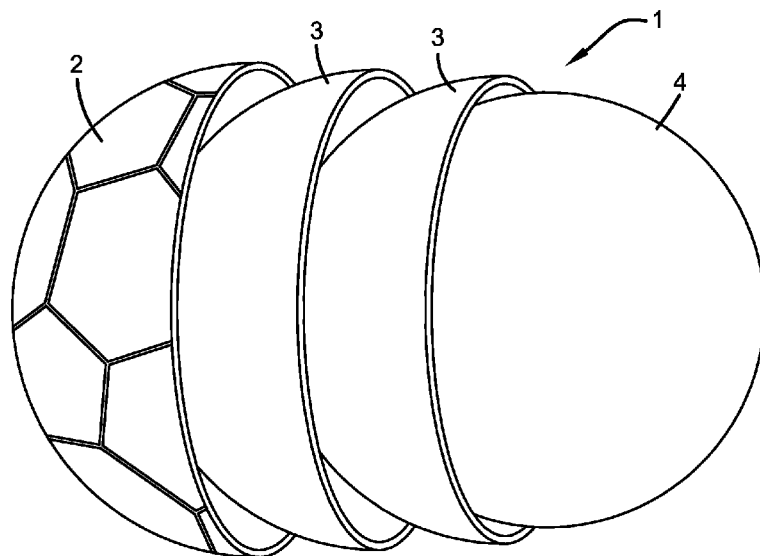


FIG. 1

(57) Abstract: A method of forming a sports ball includes providing a bladder of a flexible material, introducing a foam package including one or more reactive components into an interior volume of the bladder, the one or more reactive components being capable of activation to produce a foam, and activating the one or more reactive components to produce a foam, the foam expanding and filling at least a portion of the bladder and thereby causing the bladder to attain the general shape of the sports ball.



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).

— *before the expiration of the time limit for amending the
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Published:

— *with international search report (Art. 21(3))*

SOLID SPORTS BALLS AND METHODS OF MANUFACTURE FROM REACTIVE COMPONENTS**FIELD OF THE INVENTION**

[0001] The present invention generally relates to sports balls, and, more particularly to an improved process for forming a sports ball through the introduction of one or more reactive components into a bladder and causing the one or more reactive components to form a foam filling.

BACKGROUND OF THE INVENTION

10 [0002] As an example of the prior art, a process for manufacture of soccer balls will be shown and disclosed, but similar methods are used for other sports balls. A typical pneumatic soccer ball construction is shown in Fig. 1. The soccer ball 1 consists of a stitched cover 2, one or more liner layers 3, and bladder 4. This bladder 4 is molded and a fill valve (not shown) is affixed generally by attaching with adhesive under pressure. The stitched cover 2 and liner layer(s) 3, if employed, also have an orifice (not shown) aligned with the fill valve and adhered into the cover. Such sports balls 1 are described in U.S. Patents 4830373A, 6413177 B1, 6793597 B2, 8262519 B2 and others.

[0003] Solid balls are traditionally molded of either dense or cellular materials. Dense materials may be polymeric and have bulk densities approximately equal to the theoretical densities of the chosen polymers. The cellular materials are generally polymers having air pockets, or “cells”, created by chemical outgases produced during manufacturing or by introduction of a gas or air during manufacturing of the cellular material. In the prior art manufacturing methods, the ball is formed in a mold and then removed from the mold for use. A cover might be added to the cellular material removed from the mold. U.S. Patents 2170468 B1 and 1101782 B1 describe the manufacture of solid balls.

SUMMARY OF THE INVENTION

30 [0004] A first embodiment of this invention provides a method of forming a sports ball comprising the steps of providing a bladder of a flexible material, introducing a foam package including one or more reactive components into an interior volume of the bladder, the one or more reactive components being capable

of activation to produce a foam, and activating the one or more reactive components to produce a foam, the foam expanding and filling at least a portion of the bladder and thereby causing the bladder to attain the general shape of the sports ball.

- 5 [0005] A second embodiment provides a method as in the first embodiment, wherein the bladder includes an inlet for the reactive components for practicing said step of introducing.

[0006] A third embodiment provides a method as in either the first or second
10 volume.

[0007] A fourth embodiment provides a method as in any of the first through third embodiments, wherein the bladder includes a one-way outlet valve.

[0008] A fifth embodiment provides a method as in any of the first through fourth embodiments, wherein the bladder serves as the exterior of the sports ball.

- 15 [0009] A sixth embodiment provides a method as in any of the first through fifth embodiments, wherein, in said step of activating, the foam expands and fills the available interior volume of the bladder.

[0010] A seventh embodiment provides a method as in any of the first through sixth embodiments, wherein the foam package is selected from methylene diphenyl
20 diisocyanate-based polyurethane and water reactive components; silicone and water reactive components; polyol and isocyanate reactive components; silicone and catalyst reactive components; and at least one polymer reactive component together with one or more reactive components selected from fillers, plasticizers, vulcanizing agents and blowing agents.

- 25 [0011] An eighth embodiment provides a method as in any of the first through seventh embodiments, wherein the foam resulting from said step of activating has a density of 0.02 or more to 0.05 or less g/cc.

[0012] A ninth embodiment provides a method as in any of the first through eighth embodiments, wherein the foam resulting from said step of activating has a
30 density of 0.1 or more to 0.5 or less g/cc.

[0013] A tenth embodiment provides a method as in any of the first through ninth embodiments, wherein, after said step of activating, the foam filling fills at

least a portion of the bladder, and the stress required to compress the sports ball 20% is from 0.01 or more to 0.25 or less MPa.

[0014] An eleventh embodiment provides a method as in any of the first through tenth embodiments, wherein, after said step of activating, the foam filling
5 fills the available interior volume of the foam, and the stress required to compress the sports ball 20% is from 0.01 or more to 0.25 or less MPa.

[0015] A twelfth embodiment provides a method as in any of the first through eleventh embodiments, further comprising adding a cover around the bladder, the cover serving as the exterior of the sports ball.

10

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Fig. 1 shows a typical pneumatic soccer ball;

[0017] Fig. 2A shows a sports ball in accordance with one embodiment of the present invention, wherein a bladder filled supported by foam forms the exterior or
15 cover of the sports ball;

[0018] Fig. 2B shows a sports ball in accordance with another embodiment, shown with multiple sections removed to help show elements of the invention and explain optional constructions, wherein a cover separate from a foam-supported bladder serves as provides the exterior of the sports ball;

20 [0019] Fig. 3A shows a process for forming a sports ball of this invention, showing the initial step of adding one or more reactive components to the interior of a bladder;

[0020] Fig. 3B shows a later stage of the process of Fig. 3A, wherein the one or more reactive components have been activated to create an expanding foam; and

25 [0021] Fig. 3C shows the final formation of the sports ball at the end of the process of Figs. 3A and 3B.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0022] Herein, a “sports ball” is to be understood as a ball with a general shape
30 and appearance appreciated as at least mimicking a common sports ball. Unless otherwise stated, there is no requirement that a “sports ball” herein must satisfy specific properties required by organizations establishing standards for the balls employed in a particular sport. However, the present invention would be

applicable to creating either type of ball – one generally mimicking a ball of a particular sport or one satisfying the specific properties required of a particular sport. For example, a soccer ball could be created in accordance with this invention to simply appear like a soccer ball and be recognized as such, but such ball does
5 not have to have the size, pressure, etc required of a particular body governing soccer. However, a soccer ball with the necessary size, pressure etc., require of a particular body governing soccer could be created.

[0023] With reference to Figs. 2A and 2B, the general concepts for practicing sports balls in accordance with this invention are shown and disclosed. Fig. 2A
10 shows a sports ball of this invention designated by the numeral 10. Sports ball 10 includes a foam filling 12. The foam filling 12 is produced inside a bladder 14 of the sports ball 10 by the introduction therein of suitable selected foaming reactants. The bladder 14 forms a desired sports ball shape upon expansion under the influence of the foam production and resists expansion beyond the desired
15 shape, as will be appreciated more fully below. In the embodiment of Fig. 2A, the bladder 14 serves as the exterior (or cover) of the sports ball. With reference to Fig. 2B, a sports ball 10a includes a foam filling 12 and bladder 14, but a separate cover 16 is provided over the bladder 14 to provide the exterior. Additional layers could be employed, such as the inclusion of padding layers between a bladder and
20 a cover, but it will be appreciated that one advantageous option according to this invention is to provide a sports ball having only a bladder 14 and foam filling 12, with the bladder 14 providing the exterior surface of the ball (i.e., the bladder serving as the cover), as shown in Fig. 2A. In broadly conceiving this invention, the focus is on the creation of a foam-filled bladder, with the understanding that
25 additional layers and separate covers could be employed, if desired for a particular application.

[0024] The bladder 14 can be selected from any of a variety of flexible materials. By flexible material it is meant that the material can readily bend and flex -- such as common materials for sports balls (leather, artificial leather, rubber,
30 plastic etc). In some embodiments, this flexibility is such that the material can readily bend and flex without such bending and flexing resulting in a new semi-permanent shape that requires an applied force to counter the new semi-permanent shape (i.e., to distinguish the flexible definition in this instance from

malleable and ductile type materials that can bend and flex but take on a new semi-permanent shape in light thereof). In some embodiments, the flexible materials are chosen from materials that are readily deformed under tension or compression or shear. In some embodiments, the flexible material can be elongated by more than 10% before breaking and has a tensile strength less than 50 MPa. In some embodiments, the bladder 14 is formed of materials selected from natural and synthetic fabrics, leather and artificial leather, polymers and plastics. With reference to Figs. 2A and 2B, it is appreciated that a cover 16, if employed can be selected from the some broad range of materials. In embodiments with a cover 16, the bladder 14 can be selected with less concern for the durability necessary if the bladder 14 were also serving as the cover. Thus, the use of a cover 16 or non-use of a cover 16 can influence the choice of materials.

[0025] In some embodiments, the exterior of the sports ball is defined by a bladder 14 (Fig. 2A) or cover 16 (Fig. 2B) that is formed of multiple panels stitched together. Figs. 2A and 2B show the exterior providing the appearance of a soccer ball. A typical embodiment for a soccer ball has a cover constructed from 32 panels: 20 hexagonal and 12 pentagonal. When this cover is expanded it forms a near perfected sphere. In some embodiments, the exterior of the sports ball is oblong and defined by a bladder or cover, and the bladder and/or cover form the proper oblong shape upon expansion.

[0026] The foam filling 12 is produced inside the bladder 14, foaming and expanding to achieve the end result that the bladder 14 is expanded to form the desired sports ball shape. In some embodiments, the foam filling 12 fills the available volume in the bladder 14. In some embodiments, the foam filling 12 fills a portion of the available volume. In some embodiments, the foam filling 12 is supplemented with pneumatic pressure (i.e., the sports ball 10 includes a combination of the foam filling 12 and a pressurized gas). In some embodiments, the foam filling 12 has a consistent symmetrical density throughout the bulk of the foam filling. In other embodiments, the foam filling 12 had an asymmetric density throughout the bulk of the foam filling such that the density can differ substantially at different locations within the bulk of the foam filling.

[0027] With reference to Figs. 3A, B and C, the foam filling 12 is formed by introducing a foam package to the inside of the bladder 14. A foam package will be

one or more reactive components C suitable for creating foam either upon mixing or upon the application of process conditions or both. The one or more reactive components C are introduced to the inside of the bladder 14 through an inlet 20 in the bladder 14 that provides access to the internal volume 22 (Fig. 3A). The one or more reactive components C can be a single component or multiple components depending upon the foam-creating chemistry selected. At Fig. 3B, the one or more reactive components C are activated to produce foam filling 12. This may occur simply upon contact of two or more appropriately chosen reactive components C or by the application of processing conditions such as heat, ultraviolet light or moisture represented at numeral 24. Other embodiments will require contact of two or more components and the application of appropriate processing conditions. As the one or more reactive components C create foam, the amount of foam increases and expands thus beginning to fill the interior volume (or at least a portion thereof) and causing the flexible bladder to begin to attain the desired sports ball shape. At Fig. 3C, the foaming is complete, and the bladder 12 is filled to the desired shape.

[0028] The process of Figs. 3A-C, is readily applicable to the embodiment of Fig. 2B, with the understanding that the cover 16 could be provided either prior to or after the step of forming the general shape of the ball through the expansion of a bladder. Indeed, a separate cover 16 could be stitched or otherwise formed over an expanded bladder 14.

[0029] In some embodiments, the foam package includes methylene diphenyl diisocyanate-based (MDI-based) polyurethane and water reactive components, producing polyurethane foam. In other embodiments, the foam package includes silicone and water reactive components, producing silicone foam.

[0030] In some embodiments, the foam package includes polyol and isocyanate reactive components, producing polyurethane foam. In other embodiments, the foam package includes silicone and catalyst (e.g., tin or platinum) reactive components, producing silicone foam.

[0031] In some embodiments, the foam package includes at least one polymer reactive component together with one or more reactive components selected from fillers, plasticizers, vulcanizing agents and blowing agents. In some embodiments the foam package includes one or more reactive components selected from styrene

butadiene rubber, polyisobutylene rubber, polyisoprene rubber, polyvinyl chloride and polyethylene, with further reactive components being selected from fillers, plasticizers vulcanizing agents and blowing agents, these components being mixed and activated to produce foam through known methods. In many instances these components are heat activated introduction into the ball 10.

[0032] In some embodiments, the foam filling has a density of 0.02 or more to 0.5 or less g/cc. In some embodiments, the foam filling 12 has a density of 0.02 or more to 0.05 or less, in some embodiments, from 0.05 or more to 0.1 or less, and in other embodiments, from 0.1 or more to 0.5 or less g/cc. In addition to considering the foam density selection of the compression deflection properties are considered critical in some embodiments. In some embodiments, the foam filling 12 fills at least a portion of the bladder, and the stress required to compress the ball 20% is from 0.01 or more to 0.25 or less MPa. In other embodiments, the stress required to compress the ball 20% is from 0.01 or more to 0.04 or less MPa, in other embodiments, from 0.04 or more to 0.1 or less MPa, and, in other embodiments, from 0.1 or more to 0.25 or less MPa. In some embodiments, the foam filling 12 fills the available volume of the bladder, and the stress required to compress the ball 20% is from 0.01 or more to 0.25 or less MPa. In other embodiments, the stress required to compress the ball 20% is from 0.01 or more to 0.04 or less MPa, in other embodiments, from 0.04 or more to 0.1 or less MPa, and, in other embodiments, from 0.1 or more to 0.25 or less MPa.

[0033] It should now be better appreciated why the construction of the bladder should be such that it is not deformable beyond its intended size and shape under the force of reactive components employed to expand the bladder to its final ball shape. In some embodiments, the inlet 20 can be made to prohibit the exiting of the contents within the internal volume, while, in other embodiments, the inlet 20 can be made to permit the exiting of contents. In the former, where the inlet prohibits the exit of contents, a separate one-way outlet valve 26 (Fig. 3B) may be provided to allow for the exiting of air generated during the expansion of the foam filling 12. In the later, the inlet 20 could be made to allow air to exit. Also, if a portion of the foam filling 12 exited through the inlet 20, the inlet 20 could be sealed thereby, particularly upon the setting/solidifying of the foam filling.

[0034] The proper amount of each component is injected so that the bladder 14 is filled and takes on its intended shape. The quantity of the components is determined by the volume of the bladder when filled and the resulting density of the foam created from the combination (and appropriate processing conditions) of the one or more reactive components. The density of the foam will impact much of the properties of the sports ball created, and given reactive components will be known to produce foams of particular densities under certain mix ratios for the various components or under certain reaction conditions or both. Thus the amount of each component to be employed can be readily determined from working backward from the desired density of the end product foam. The volume (e.g., units cc) is multiplied by the density of the end product foam to obtain the grams of components necessary. The grams of components necessary are then compared with the mix ratio of each component to obtain a starting amount for each component.

[0035] For example, a 4,000 cc bladder would require 200 g of reactive components that form a 0.5 g/cc foam. If the reactive component package in this example requires two components, component A and component B, and if the mix ratio of component A to component B is 1:1, 100 g of each component A and B will be required. If a different ratio is necessary to produce the desired 0.5 g/cc, the amount of each component would be appropriately calculated as its percentage of the total weight necessary.

[0036] In some embodiments, an advantage of the present invention is that the foam fills the bladder in a single step (without intermediate construction) and produces the desired shape.

[0037] In light of the foregoing, it should be appreciated that the present invention significantly advances the art by providing a sports ball and method of manufacture that is structurally and functionally improved in a number of ways. While particular embodiments of the invention have been disclosed in detail herein, it should be appreciated that the invention is not limited thereto or thereby inasmuch as variations on the invention herein will be readily appreciated by those of ordinary skill in the art. The scope of the invention shall be appreciated from the claims that follow.

CLAIMS

What is claimed is:

- 5 1. A method of forming a sports ball comprising the steps of:
 providing a bladder of a flexible material,
 introducing a foam package including one or more reactive
 components into an interior volume of the bladder, the one or more reactive
 components being capable of activation to produce a foam, and
10 activating the one or more reactive components to produce a foam,
 the foam expanding and filling at least a portion of the bladder and thereby
 causing the bladder to attain the general shape of the sports ball.
2. The method of claim 1, wherein the bladder includes an inlet for the
15 reactive components for practicing said step of introducing.
3. The method of claim 2, wherein the inlet prohibits the exit of contents
 within the internal volume.
- 20 4. The method of claim 3, wherein the bladder includes a one-way outlet
 valve.
5. The method of claim 2, wherein the bladder serves as the exterior of the
25 sports ball.
6. The method of claim 5, wherein, in said step of activating, the foam
 expands and fills the available interior volume of the bladder.
7. The method of claim 1, wherein the foam package is selected from
30 methylene diphenyl diisocyanate-based polyurethane and water reactive
 components; silicone and water reactive components; polyol and isocyanate
 reactive components; silicone and catalyst reactive components; and at least
 one polymer reactive component together with one or more reactive

components selected from fillers, plasticizers, vulcanizing agents and blowing agents.

- 5 8. The method of claim 1, wherein the foam resulting from said step of activating has a density of 0.02 or more to 0.05 or less g/cc.
9. The method of claim 1, wherein the foam resulting from said step of activating has a density of 0.1 or more to 0.5 or less g/cc.
- 10 10. The method of claim 1, wherein, after said step of activating, the foam filling fills at least a portion of the bladder, and the stress required to compress the sports ball 20% is from 0.01 or more to 0.25 or less MPa.
11. The method of claim 1, wherein, after said step of activating, the foam filling fills the available interior volume of the foam, and the stress required to compress the sports ball 20% is from 0.01 or more to 0.25 or less MPa.
- 15 12. The method of claim 1, further comprising adding a cover around the bladder, the cover serving as the exterior of the sports ball.
- 20

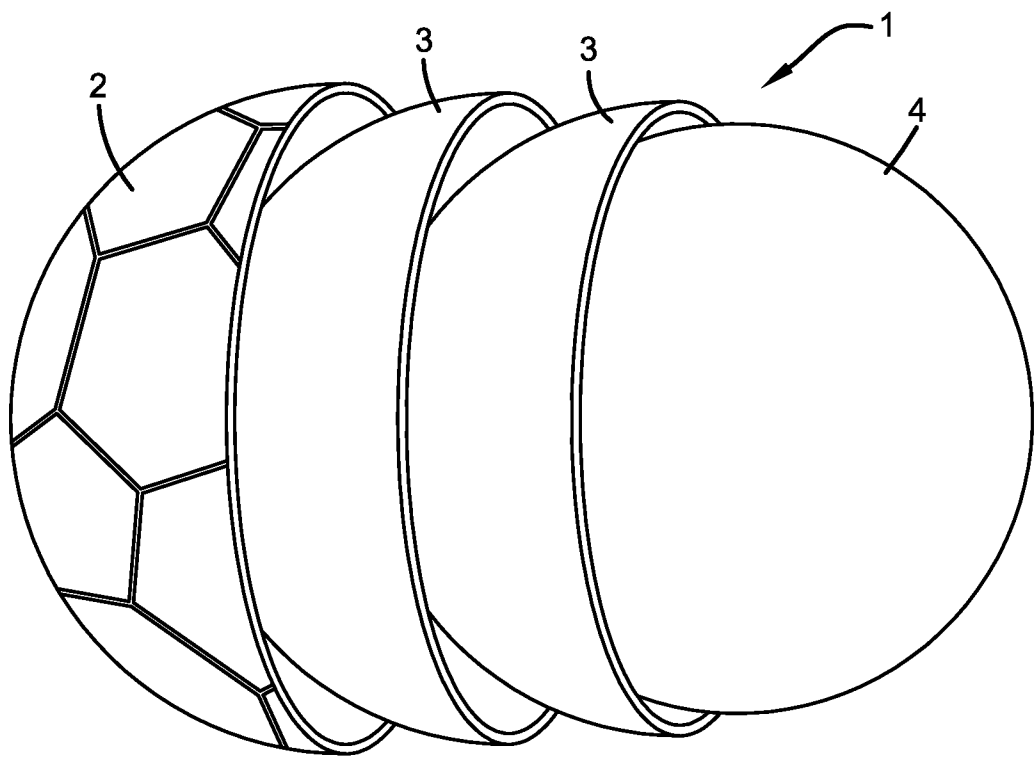


FIG. 1

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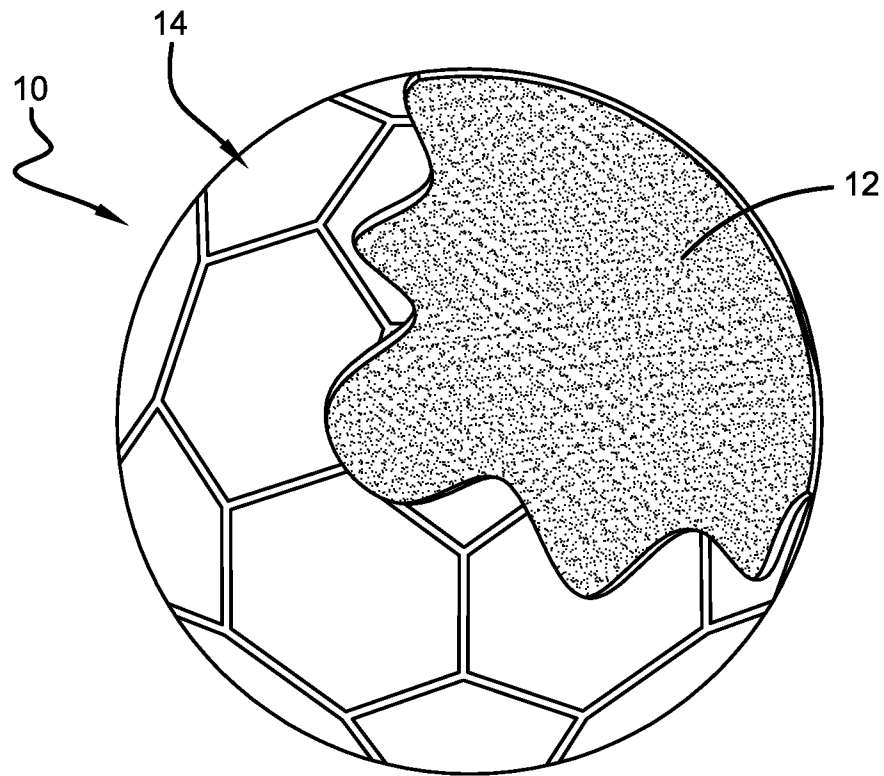


FIG. 2A

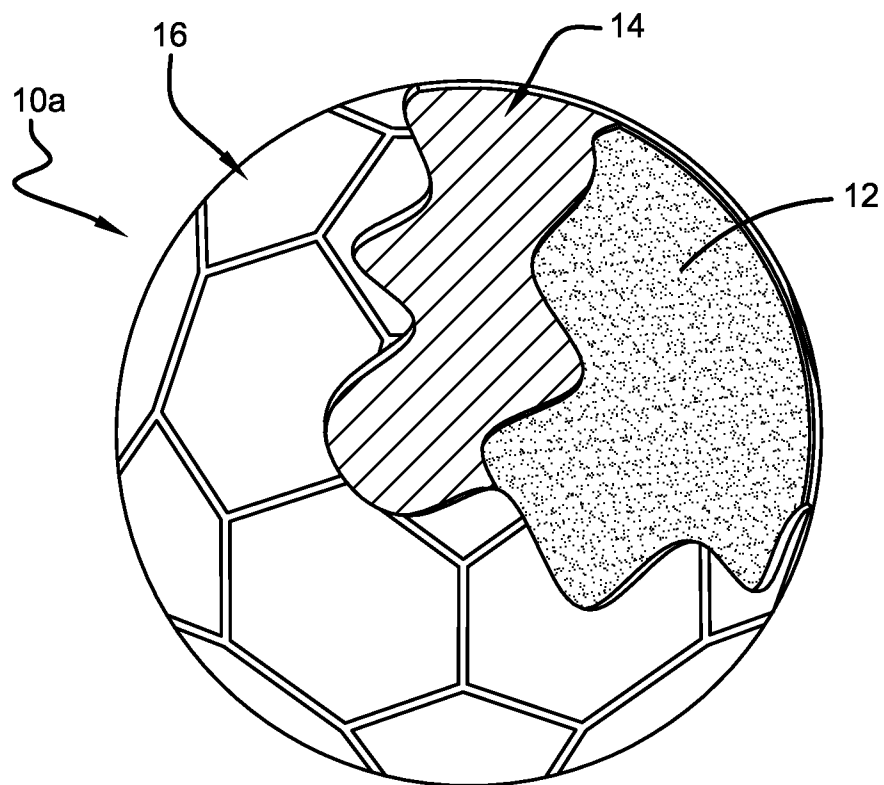


FIG. 2B

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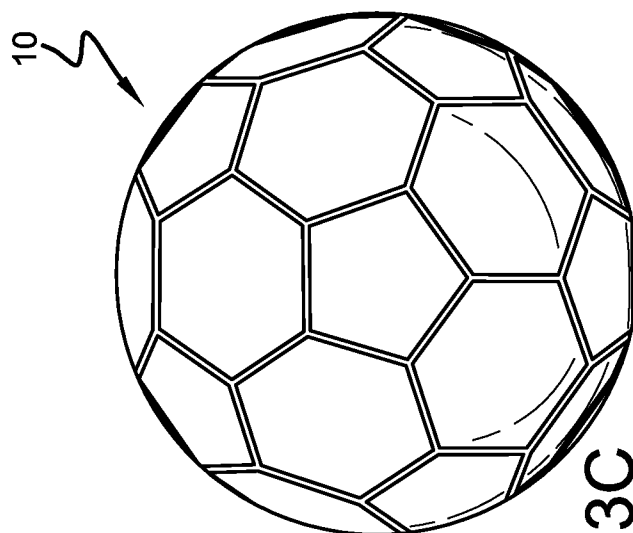


FIG. 3C

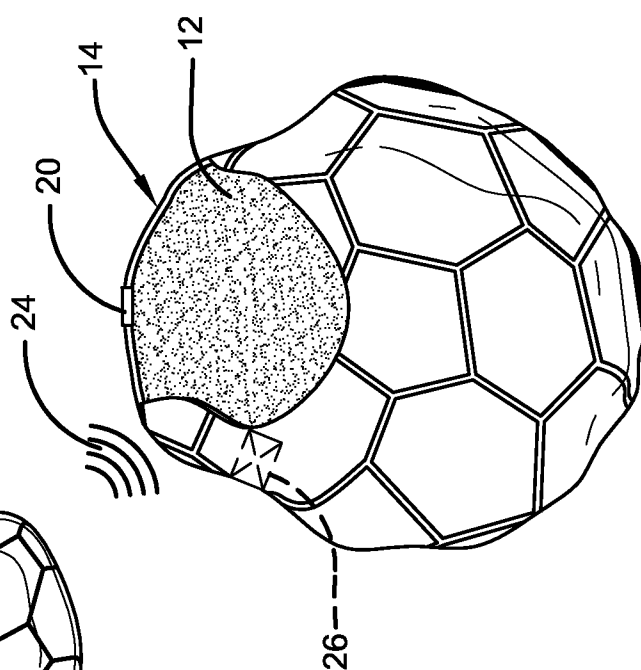


FIG. 3B

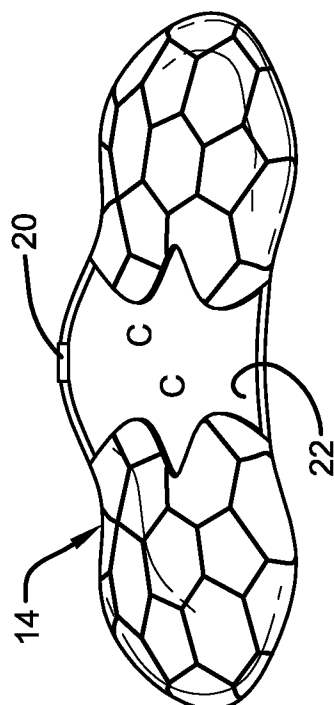


FIG. 3A

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/40446

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A63B 41/00, A63B 41/10, A63B 41/12 (2014.01)

CPC - A63B 41/00, A63B 41/10, A63B 41/12

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)

IPC(8): A63B 41/00, A63B 41/10, A63B 41/12 (2014.01)

CPC: A63B 41/00, A63B 41/10, A63B 41/12

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

IPC(8): A63B 41/* (2014.01)

CPC: A63B 41/*, F16K*; USPC: 473/593; 473/*

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase, Google Patents, Google Web

Keywords: ball, foam, bladder, inflate, inflating, inflation, valve, air, react, activate, game, sport, athletic, density, mPa, stress, compressive, compress, compression, force, outlet, one way, methylene diphenyl diisocyanate, water

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	EP 0985516 A2 (ALTHAUSEN) 15 March 2000 (15.03.2000), entire document	1-3, 5-6, 12 7-11
X — Y	US 5,335,907 A (SPECTOR) 10 January 1995 (10.01.1995), entire document	1-2, 5-6, 12 4
Y	US 2006/0106125 A1 (LEITNER) 18 May 2006 (18.05.2006), entire document	7-11
Y	US 5,098,095 A (WEISS) 24 March 1992 (24.03.1992), entire document	4
A	US 7,193,000 B2 (MAYER) 20 March 2007 (20.03.2007), entire document	1-12
A	US 5,083,961 A (ISHIWA) 28 January 1992 (28.01.1992), entire document	1-12
A	US 1,969,128 A (HARRISON) 07 August 1934 (07.08.1934), entire document	1-12

☐ Further documents are listed in the continuation of Box C.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"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

05 September 2014 (05.09.2014)

Date of mailing of the international search report

01 OCT 2014

Name and mailing address of the ISA/US

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