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GOLF BALL

TECHNICAL FIELD

[0001] The present invention relates generally to a golf ball and a seam line profile for a golf ball.

BACKGROUND

[0002] Golf is a recreational game that involves repeatedly striking a ball with a club that is swung along an arcuate path. When the ball is struck by the club, the ball will typically become airborne to traverse a particular flight path/trajectory, and may have a particular spin rate.

[0003] In conventional golf ball design, a plurality of dimples are included on the outer surface of the golf ball in an effort to create a generally more stable, and longer flight trajectory when properly struck. The interaction between the dimples and the oncoming airstream affect the lift, drag, and flight stability characteristics of the ball; however, the consistency of these effects is dependent on the even distribution and/or symmetry of the dimple pattern around ball.

[0004] Golf balls are formed from polymeric materials that are typically injection molded or compression molded into a spherical shape. In either of these molding processes, two molds (two halves of a mold) may meet at a common interface, and may cooperate to define a void that forms the exact shape of the ball. Using understood injection molding or compression molding techniques the ball may be formed within this void. When the ball is removed from the molds, the ball may have molding flash or other excess material that may have been formed at the interface between the molds. As such, the molding flash may be located at or proximate to the “equator” of the golf ball.

[0005] Molding flash must be removed prior to engaging in a coating process to apply a surface coating to the golf ball. In conventional processes, the flash may be removed from the ball using any combination of cutting, grinding, sanding, tumbling with an abrasive media, and/or cryogenic deflashing. These processes are exceptionally easier and more consistent to perform when the flash extends only from a flat, non-dimpled portion (i.e., a “land area”) of the ball. As such, the common interface between the molds may define a seam line that circumscribes the ball, and

which is devoid of dimples. As noted above, this profile may affect the flight pattern of the ball if not properly designed or accounted for.

SUMMARY

[0006] A golf ball includes an outer spherical surface and a non-planar seam line disposed on the outer spherical surface. The seam line is non-planar and includes an integral number of cycles of a repeating wave that oscillates along the outer surface of the cover. Each cycle of the repeating wave has a 2π radian phase, and a plurality of intermediate sections is interleaved within the repeating wave with an intermediate section inserted at phase angles that are integral multiples of π . Said another way, the plurality of intermediate sections interleaved within the repeating wave at phase angles of the wave equal to $\pi*n$, where n is a positive integer.

[0007] Each intermediate section has a straight surface profile along the outer spherical surface. The golf ball may further include a first pole and a second pole, with the seam line being disposed between the first and second poles. The straight surface profiles may be characterized by a single degree of curvature having a center of curvature disposed along an axis extending between the first pole and the second pole.

[0008] In one configuration, each of the plurality of intermediate sections is coplanar and together they collectively define a seam plane. The repeating wave extends on a first side of the seam plane for phase angles within the range of $(2\pi(m-1), \pi(2m-1))$, where m is a positive integer. Additionally, the repeating wave extends on a second side of the seam plane for phase angles within the range of $(\pi(2m-1), 2\pi m)$. In one particular configuration, the repeating wave is a sinusoid.

[0009] The golf ball may further include a plurality of dimples disposed on the outer spherical surface. The seam line may not intersect any of the dimples. In one configuration, a subset of the plurality of dimples is disposed adjacent the seam line such that the seam plane intersects each dimple within this subset of dimples.

[0010] In one configuration, the golf ball may include a core and a cover surrounding the core. The cover includes a first hemispherical half and a second hemispherical half that define a seam line therebetween and along an outer surface of the cover. In this configuration, the plurality of intermediate sections may be aligned along a common circumference of the cover. A subset of the plurality of

dimples may be disposed adjacent the seam line such that a circumference formed by the plurality of intermediate sections intersects each dimple within the subset.

[0011] In another configuration, the seam line may include an integral number of repeating sections, with each respective section including a first straight portion, a first arcuate portion, a second straight portion and a second arcuate portion. In this configuration, the first arcuate portion is disposed between the first straight portion and the second straight portion for each of the integral number of repeating sections, and the second straight portion is disposed between the first arcuate portion and the second arcuate portion for each of the integral number of repeating sections.

[0012] The first straight portion and the second straight portion of each section may be substantially aligned along a circumference of the cover. The first arcuate portion may be concave relative to the first hemispherical half, and the second arcuate portion may be convex relative to the first hemispherical half.

[0013] The outer surface of the cover includes a plurality of dimples, and the seam line does not intersect any of the dimples. One of the plurality of dimples may be partially disposed within each of the first and second arcuate portions for each of the repeating sections. As such, if the first and second straight portions of each section of the seam line are aligned along a common circumference of the cover, the circumference may intersect each dimple disposed within the arcuate portions of the seam line.

[0014] The above features and advantages and other features and advantages of the present invention are readily apparent from the following detailed description of the best modes for carrying out the invention when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is a schematic cross-sectional view of a golf ball having a core and a cover.

[0016] FIG. 2 is a schematic top view of a golf ball having a repeating dimple pattern.

[0017] FIG. 3 is a schematic side view of a seam line disposed on an outer surface of a golf ball.

[0018] FIG. 2 is a schematic diagram illustrating the composition of a composite seam line.

[0019] FIG. 3 is a schematic side view of a seam line disposed on an outer surface of a golf ball, including a plurality of dimples disposed adjacent to the seam line.

DETAILED DESCRIPTION

[0020] Referring to the drawings, wherein like reference numerals are used to identify like or identical components in the various views, FIG. 1 schematically illustrates a schematic cross-sectional view of a golf ball 10. As shown, the golf ball 10 has an outer spherical surface 12 that is defined by a cover 14. In the embodiment shown, the golf ball 10 has a three-piece construction, with the cover 14 surrounding a core 16 via an intermediate layer 17. In any case, each layer (including the core and cover), may be substantially concentric with every other layer such that every layer shares a common spherical center 18. Additionally, the mass-distribution of each layer may be uniform such that the center of mass for each layer and the ball as a whole is coincident with the common spherical center 18.

[0021] The cover 14 of the golf ball 10 may be formed through compression molding or injection molding, and may include a first hemispherical half 20 and a second hemispherical half 22, which cooperate to surround the core 16. The first and second hemispherical halves 20, 22 may define a seam line 24 that extends along the outer surface 12. In general, the seam line 24 may be a byproduct of the cover fabrication, where excess cover material is slightly expelled from between two molding dies. Said another way, during fabrication, residual mold flash may be formed on the surface 12 of the ball 10 at the interface where two molding dies meet. This mold flash may be removed through subsequent processes, however such processes are easier to perform when the seam line 24/flash resides on a land area (i.e., an undimpled portion) of the ball 10.

[0022] In general, the golf ball 10 may define a first pole 26 disposed within the first hemispherical half 20, and a second pole 28 disposed within the second hemispherical half 22. The first and second poles 26, 28 may respectively be situated at opposing sides of the ball 10, and may define a primary axis 30 of the ball 10. The seam line 24 may be disposed between the first and second poles 26, 28, and may generally circumscribe the primary axis 30.

[0023] A golf ball 10 may have any desired number of dimples 32, including, for example, between 280 and 432 total dimples, and in some examples, between 300 and 392 total dimples, and typically between 298 to 320 total dimples. In one configuration, the dimples 32 may be sized to include at least four different dimple types, and in some configurations, between 4 and 16 different dimple types, or even between 5 and 12 different dimple types. As will be explained in more detail below, a dimple is of a different "type" from another dimple if it differs from the other dimple in any significant manner, such as, for example, dimple depth, dimple radius, dimple diameter, dimple cross sectional shape (e.g., single radius, double radii, polygonal shape, faceted internal surfaces, etc.), dimple volume, dimple surface area, etc.

[0024] In one particular configuration, a golf ball 10 may include: (a) a first dimple type having a first diameter (e.g., within a range of 2 to 3 mm); (b) a second dimple type having a second diameter (e.g., within a range of 3 to 3.6 mm) that is larger than the first diameter; (c) a third dimple type having a third diameter (e.g., within a range of 3.2 to 3.8 mm) that is larger than the second diameter; (d) a fourth dimple type having a fourth diameter (e.g., within a range of 3.4 to 4 mm) that is larger than the third diameter; and (e) a fifth dimple type having a fifth diameter (e.g., within a range of 3.6 to 4.4 mm) that is larger than the fourth diameter. Additionally, more dimple types may be provided in the dimple pattern, including at least a sixth dimple type having a sixth diameter (e.g., within a range of 4 to 6 mm) that is larger than the fifth diameter. In some example balls where five dimple types are present, these example balls may include: at least 36 dimples of the first dimple type; at least 24 dimples of the second dimple type; at least 54 dimples of the third dimple type; at least 30 dimples of the fourth dimple type; and at least 246 dimples of the fifth dimple type. In some example balls where six dimple types are present, the balls may include: at least 18 dimples of the first dimple type; at least 12 dimples of the second dimple type; at least 6 dimples of the third dimple type; at least 36 dimples of the fourth dimple type; at least 270 dimples of the fifth dimple type; and at least 18 dimples of the sixth dimple type.

[0025] As generally illustrated in the top view 50 of a golf ball 10 provided FIG. 2, the dimples 32 disposed on the outer surface 12 of the cover 14 may be arranged in N repeating sectors 52 in each hemispherical half, wherein N is an integer within the range of 2 to 10. In more specific embodiments, the integer N may be between, for example, 2 and 8, or even between 3 and 6. In the specific example

provided in FIG. 2, each half includes 3 sectors 52 that repeat around a pole (e.g., pole 26) (each sector 52 covers 120° of the ball perimeter), for a total of 6 sectors on the overall ball 10 surface 12. Each individual sector 52 in this example dimple arrangement includes a line of symmetry LS (shown as a broken line in FIG. 2), and the individual dimples (and dimple portions) within that sector on one side of the line of symmetry LS are arranged in a mirror image from the individual dimples (and dimple portions) on the other side of the line of symmetry LS within the same sector 52. If desired, one or more sectors 52 may be provided in the dimple pattern half that do not include lines of symmetry, e.g., interspersed with the sectors that include lines of symmetry. In other words, this invention does not require that each identifiable sector of dimples on a ball must include a line of symmetry.

[0026] As shown in FIG. 2, each sector 52 is a spherical triangular region. If desired (although not required), at least some of these sectors 52 may share a common point or even a common side. In the example structure shown in FIG. 2, the sectors 52 meet at a common pole point 54 of that hemisphere. Alternatively, if desired, the sectors 52 need not share a common point (e.g., the spherical triangles may be spaced downward from the pole point 54) and/or they need not share a common edge (e.g., other, different sectors may be located between the sectors 52 having the same dimple patterns).

[0027] While the dimple pattern (i.e., the dimple layout and arrangement) on one hemispherical half 20 may be the same as the dimple pattern on the opposing hemispherical half 22, the dimples 32 are not necessarily arranged in a mirror image across the seam line 24. The dimple patterns on the respective halves may be rotationally offset from one another across the seam line 24 by an offset amount within a range of 2° to 90°, 5° to 60°, 5° to 45°, 10° to 45°, 10° to 30°, and even 15° to 30°.

[0028] Regardless of the fabrication process, the cover 14 may be made from any desired materials, including ionomeric materials (e.g., SURLYN®, available from E.I. DuPont Company of Wilmington, Del.), thermoplastic polyurethane containing materials, and the like, including conventional cover layer materials as known in the art. In a golf ball product, this cover layer 14 may have a surface hardness within a range of 44 to 60 Shore D and a nominal thickness (i.e., at thickness at a location exclusive of the dimples 32) within a range of 0.6 to 2.0 mm. The surface hardness values here are measured "on the ball" (on the exposed outer surface 12 of a cover

layer 14 of a ball), at an area not including a dimple 32, using standard test method ASTM D-2240. This hardness measurement may be made before or after application of finish materials (if any) to the cover layer's 14 outer surface 12.

[0029] FIG. 3 illustrates a side view 60 of a golf ball 10 of the present design. As shown, the golf ball 10 includes a first hemispherical half 20, a second hemispherical half 22, and a seam line 24 disposed between the respective first and second hemispherical halves 20, 22. The first hemispherical half 20 includes a first pole 26, the second hemispherical half includes a second pole 28, and a primary axis 30 extends between the first pole 26 and the second pole 28.

[0030] The seam line 24 illustrated in FIG. 3 is provided on a land area of the ball 10 (i.e., it does not intersect any dimples 32 or other surface features), though is non-planar itself. As shown in FIG. 3, the seam line 24 may resemble a composite wave 62 that has a plurality of straight sections 64 interleaved between sections of a repeating wave 66. The repeating wave 66 may have a periodic nature that oscillates along the outer surface 12 of the golf ball 10.

[0031] FIG. 4 better illustrates the construction of the composite wave 62. As shown, the periodic, repeating wave 66 includes an integral number of complete cycles 68, with each cycle having a 2π radian phase 70. To form the composite wave 62, the repeating wave 66 is divided at integral multiples of π , and interleaved with a straight section 64 at each division. As further shown in FIG. 4, a composite wave 62 formed in this manner may include an integral number of repeating sections/cycles 72, with each section/cycle 72 including, for example, a first arcuate section 74, a first straight section 76, a second arcuate section 78, and a second straight section 80, in an ordered arrangement. While FIG. 4 illustrates the repeating wave 66 as generally resembling a sinusoid, other configurations may include a saw tooth wave, a triangular wave, a trapezoidal wave, a semicircular wave, or other repeating waveforms that are periodic and can be characterized by a 2π phase.

[0032] Around the total circumference of the ball 10, there may be an even number of straight sections 64 and an even number of sections of the repeating wave, such that the entire cycle 72 repeats an integral number of times. As such, the number of straight sections 64 around the circumference may, more specifically, be a multiple of four. Additionally, in one configuration, the wavelength of one cycle 68 of the repeating wave 66 may be approximately equal to the length of a straight section 64.

[0033] Referring again to FIG. 3, in one configuration, each of the plurality of straight sections 64 may be aligned along a latitude 82 of the ball 10 that has a single degree of curvature centered along the primary axis 30. As used herein, a latitude 82 of the ball 10 may be a circular reference disposed on the outer surface 12 of the cover 14, with each point on the circular reference being equidistant from at least one of the two poles 26, 28. In one configuration, each of the plurality of straight sections 64 may be aligned along a latitude 82 that is equidistant between the first pole 26 and the second pole 28, also referred to as the “equator” of the ball 10. As such, each of the plurality of straight sections 64 may be coplanar and may generally define a “seam plane” (i.e., where the seam plane is a plane that includes and/or is defined by the latitude 82).

[0034] In one configuration, the repeating wave 66 may extend on a first side of the seam plane/latitude 82 for phase angles within the range of $(2\pi(m-1), \pi(2m-1))$, where m is a positive integer. Additionally, the repeating wave 66 may extend on a second side of the seam plane/latitude 82 for phase angles within the range of $(\pi(2m-1), 2\pi m)$. In this manner, it may appear that adjacent sections of the repeating wave may oscillate on either side of the seam plane/latitude 82. Said another way, the repeating wave may be concave relative to the first hemispherical half 20 for phase angles within the range of $(2\pi(m-1), \pi(2m-1))$, where m is a positive integer, and may be convex relative to the first hemispherical half 20 for phase angles within the range of $(\pi(2m-1), 2\pi m)$. In a more specific embodiment, the repeating wave 66 may be a sinusoid.

[0035] FIG. 5 illustrates the seam line 24 relative to a subset of dimples 90 that are disposed on the outer surface 12 of the cover 14, directly adjacent to the seam 24. As used herein, “directly adjacent” is intended to mean that there are no intermediate features between the dimples 90 and the seam 24. It should be readily apparent that a substantial number of dimples have been omitted from FIG. 5 for clarity. As further shown, the seam line 24 does not intersect any of the directly adjacent dimples 90, and is entirely disposed on a single, continuous surface 12 of the ball 10. The dimples 32 may be of varying types/sizes, though the dimple pattern of the first hemispherical half 20 may be offset from the dimple pattern of the second hemispherical half 22 by an angle θ . In one configuration, the angle θ may be between approximately 15° and 60° .

[0036] As shown, a dimple 92 may be disposed directly adjacent to each portion of the repeating wave 66, such that the seam line 24 partially circumscribes each of these adjacent dimples 92. Moreover, the seam plane/latitude 82 may intersect each of the dimples 92 that are adjacent the arcuate portions of the repeating wave 66, while the seam line 24, itself, does not.

[0037] By including straight sections in the present seam line profile, the amount of grinding/flash removal that is required post-fabrication may be greatly reduced over a purely sinusoidal seam line, and buffing will be easier because there are straight portions in the parting line. Conversely, the various portions of the repeating wave 64 may still allow for a high degree of interdigitation between the two hemispherical halves 20, 22 of the cover 14. Also, a buffing band width along the parting line can be narrower.

[0038] While the best modes for carrying out the invention have been described in detail, those familiar with the art to which this invention relates will recognize various alternative designs and embodiments for practicing the invention within the scope of the appended claims. It is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative only and not as limiting.

CLAIMS

1. A golf ball having an outer spherical surface, the golf ball comprising:
a non-planar seam line disposed on the outer spherical surface and including:
an integral number of cycles of a repeating wave that oscillates along the outer spherical surface of the golf ball, each cycle of the repeating wave having a 2π radian phase;
a plurality of intermediate sections interleaved within the repeating wave at phase angles of the wave equal to $\pi*n$, where n is a positive integer; and
wherein each intermediate section has a straight surface profile along the outer spherical surface.
2. The golf ball of claim 1, further comprising a first pole and a second pole, with the seam line being disposed between the first pole and the second pole;
wherein the straight surface profile along the outer spherical surface is characterized by a single degree of curvature centered along an axis extending between the first pole and the second pole.
3. The golf ball of any of claims 1-2, wherein each of the plurality of intermediate sections is coplanar, and the plurality of intermediate sections collectively defines a seam plane.
4. The golf ball of claim 3, wherein the repeating wave extends on a first side of the seam plane for phase angles within the range of $(2\pi (m-1), \pi(2m -1))$, where m is a positive integer; and
wherein the repeating wave extends on a second side of the seam plane for phase angles within the range of $(\pi (2m -1), 2\pi m)$.
5. The golf ball of any of claims 1-4, wherein the repeating wave is a sinusoid.
6. The golf ball of any of claims 1-5, further comprising a plurality of dimples disposed on the outer spherical surface; and
wherein the seam line does not intersect any of the dimples.

7. The golf ball of claim 6, wherein each of the plurality of intermediate sections is coplanar, and the plurality of intermediate sections collectively defines a seam plane;

wherein a subset of the plurality of dimples is disposed adjacent the seam line;

and

wherein the seam plane intersects each dimple within the subset.

8. A golf ball comprising:

a core;

a cover including a first hemispherical half and a second hemispherical half that cooperate to surround the core, the first hemispherical half and a second hemispherical defining a seam line therebetween and along an outer spherical surface of the cover; and

wherein the seam line is non-planar and includes:

an integral number of cycles of a repeating wave that oscillates along the outer surface of the cover, each cycle of the repeating wave having a 2π radian phase;

a plurality of intermediate sections interleaved within the repeating wave at phase angles of the wave equal to $\pi \cdot n$, where n is a positive integer; and

wherein each intermediate section has a straight surface profile along the outer spherical surface.

9. The golf ball of claim 8, wherein the repeating wave is a sinusoid.

10. The golf ball of any of claims 8-9, wherein the repeating wave is concave relative to the first hemispherical half for phase angles within the range of $(2\pi(m-1), \pi(2m-1))$, where m is a positive integer; and

wherein the repeating wave is convex relative to the first hemispherical half for phase angles within the range of $(\pi(2m-1), 2\pi m)$.

11. The golf ball of any of claims 8-10, wherein each of the plurality of intermediate sections are aligned along a common circumference of the cover.

12. The golf ball of any of claims 8-11, wherein the outer surface of the cover includes a plurality of dimples, and wherein the seam line does not intersect any of the dimples.

13. The golf ball of claim 12, wherein a subset of the plurality of dimples is disposed adjacent the seam line such that the circumference formed by the plurality of intermediate sections intersects each dimple within the subset.

14. The golf ball of any of claims 8-13, wherein the plurality of intermediate sections is an even number of intermediate sections.

15. The golf ball of any of claims 8-14, wherein each cycle of the repeating wave has a wavelength; and

wherein the length of an intermediate section is approximately equal to the wavelength of one cycle of the repeating wave.

16. A golf ball comprising:

a core;

a cover including a first hemispherical half and a second hemispherical half that cooperate to surround the core, the first hemispherical half and a second hemispherical defining a seam line therebetween and along an outer surface of the cover; and

wherein the seam line includes an integral number of repeating sections, with each respective section including a first straight portion, a first arcuate portion, a second straight portion and a second arcuate portion.

17. The golf ball of claim 16, wherein the first arcuate portion is disposed between the first straight portion and the second straight portion for each of the integral number of repeating sections; and

wherein the second straight portion is disposed between the first arcuate portion and the second arcuate portion for each of the integral number of repeating sections.

18. The golf ball of any of claims 16-17, wherein the first straight portion and the second straight portion of each section are substantially aligned along a circumference of the cover.

19. The golf ball of any of claims 16-18, wherein the first arcuate portion is concave relative to the first hemispherical half; and
wherein the second arcuate portion is convex relative to the first hemispherical half.

20. The golf ball of any of claims 16-19, wherein the outer surface of the cover includes a plurality of dimples, and wherein the seam line does not intersect any of the dimples.

21. The golf ball of claim 20, wherein one of the plurality of dimples is partially disposed within each of the first and second arcuate portions for each of the repeating sections; and
wherein the first and second straight portions of each section of the seam line are aligned along a common circumference of the cover; and
wherein the circumference intersects each dimple disposed within the arcuate portions of the seam line.

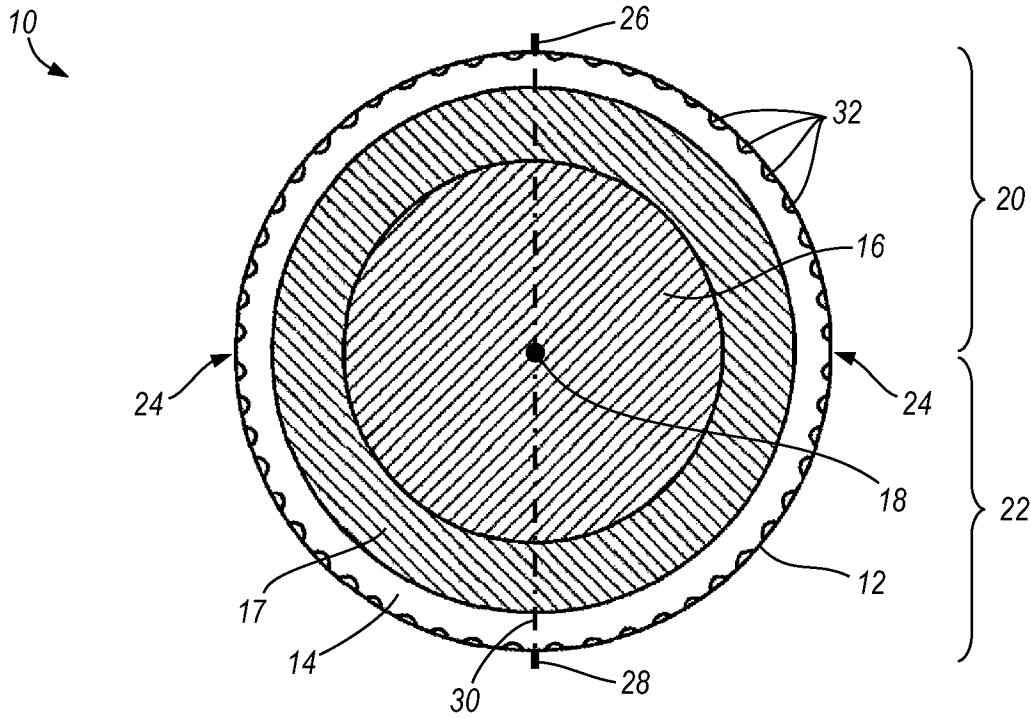
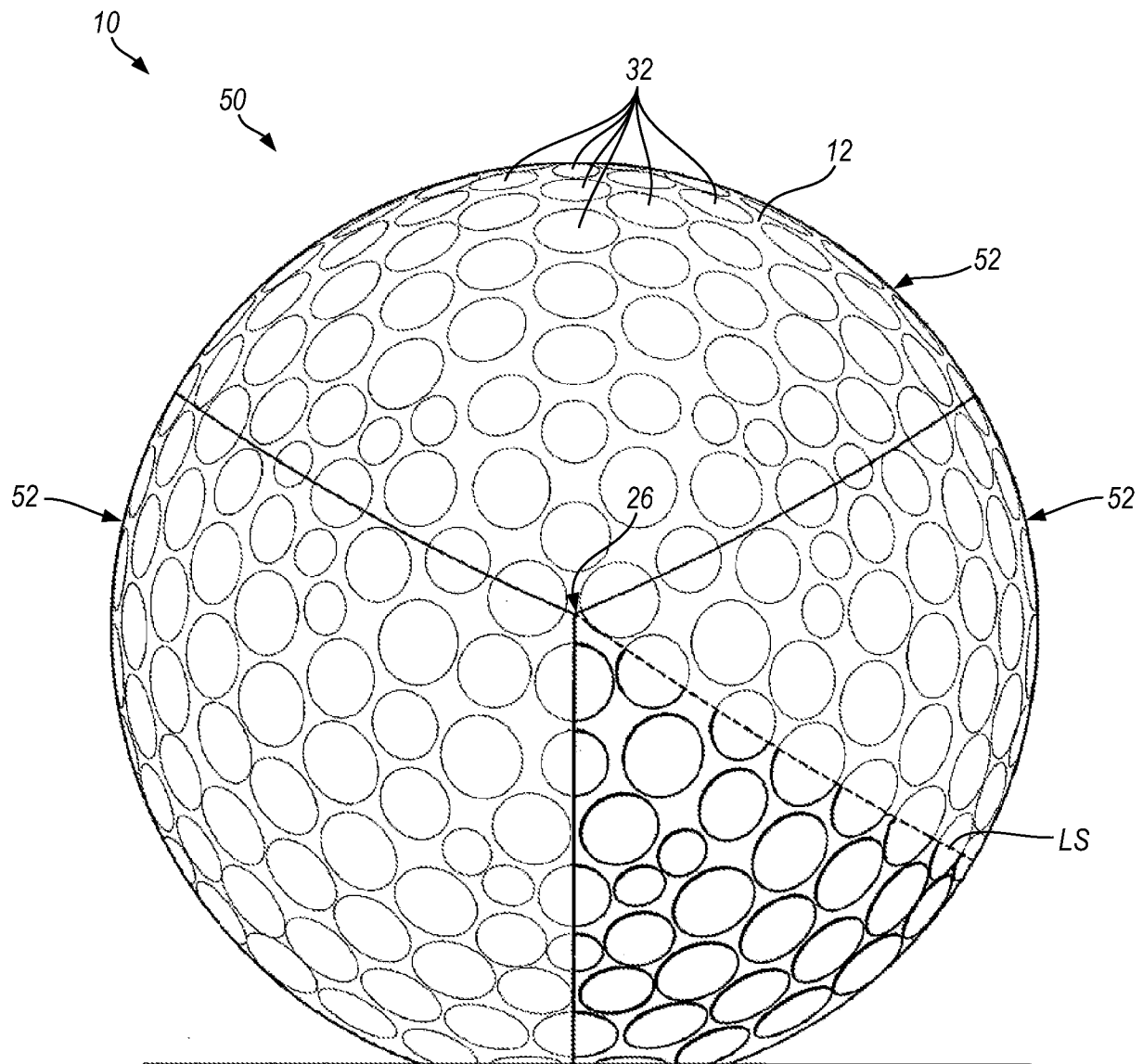


FIG. 1

**FIG. 2**

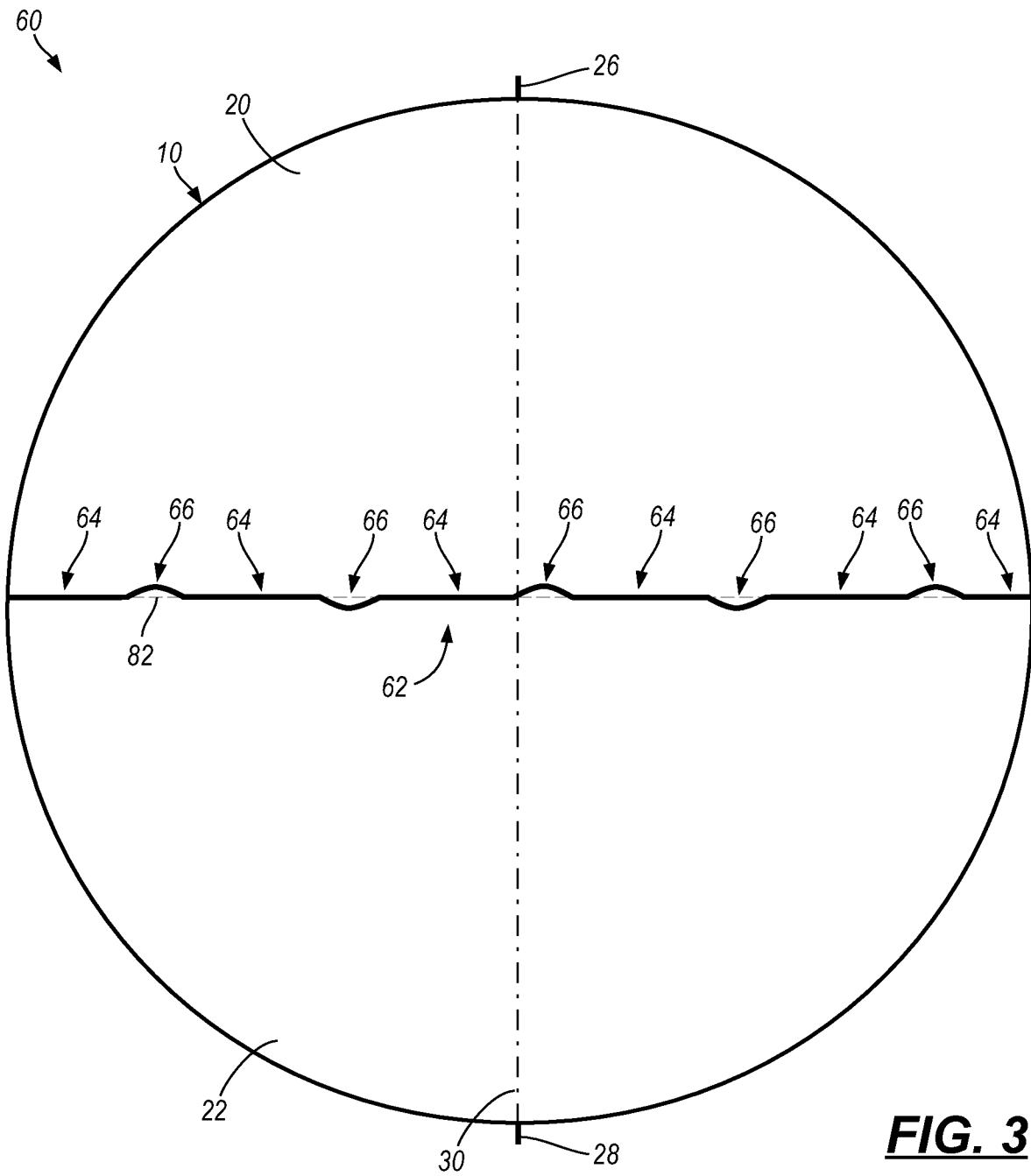


FIG. 3

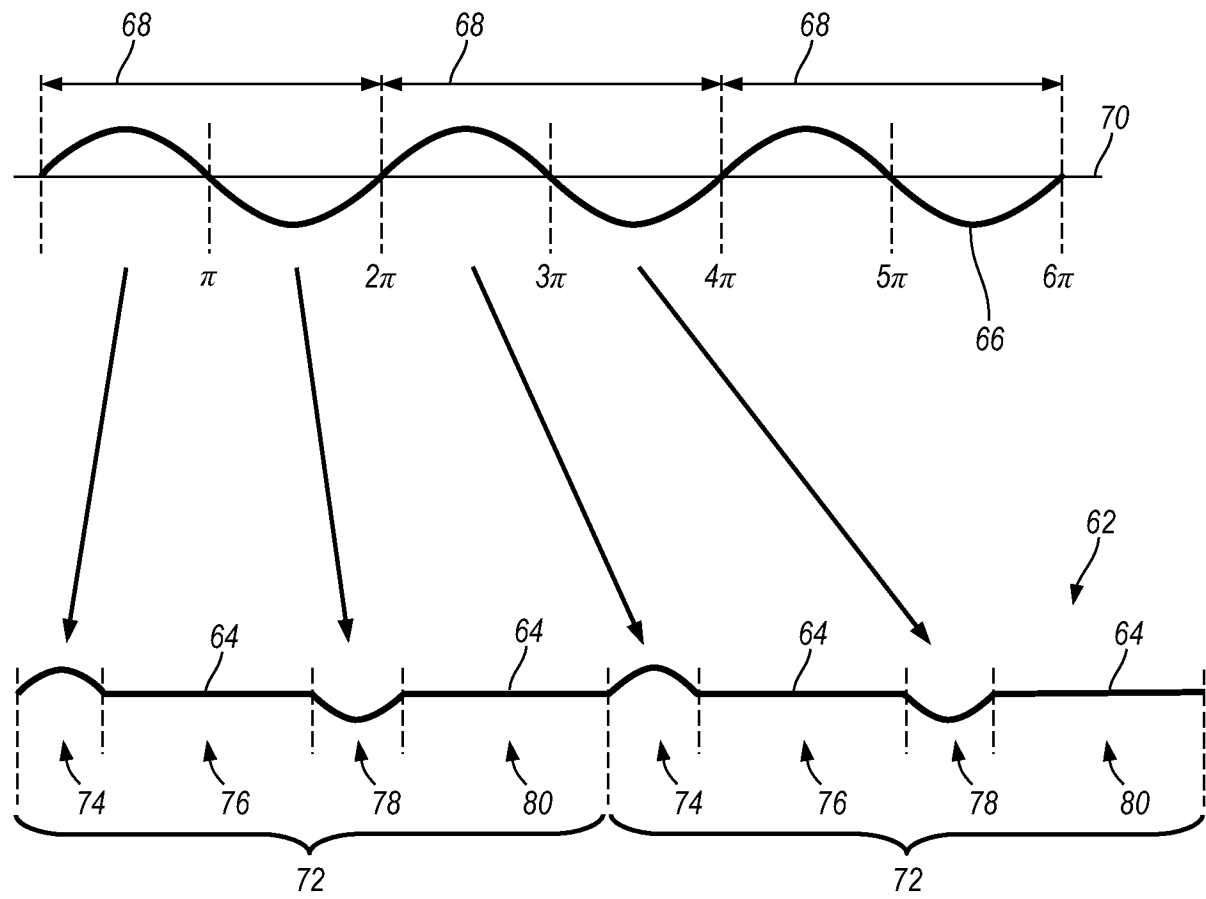


FIG. 4

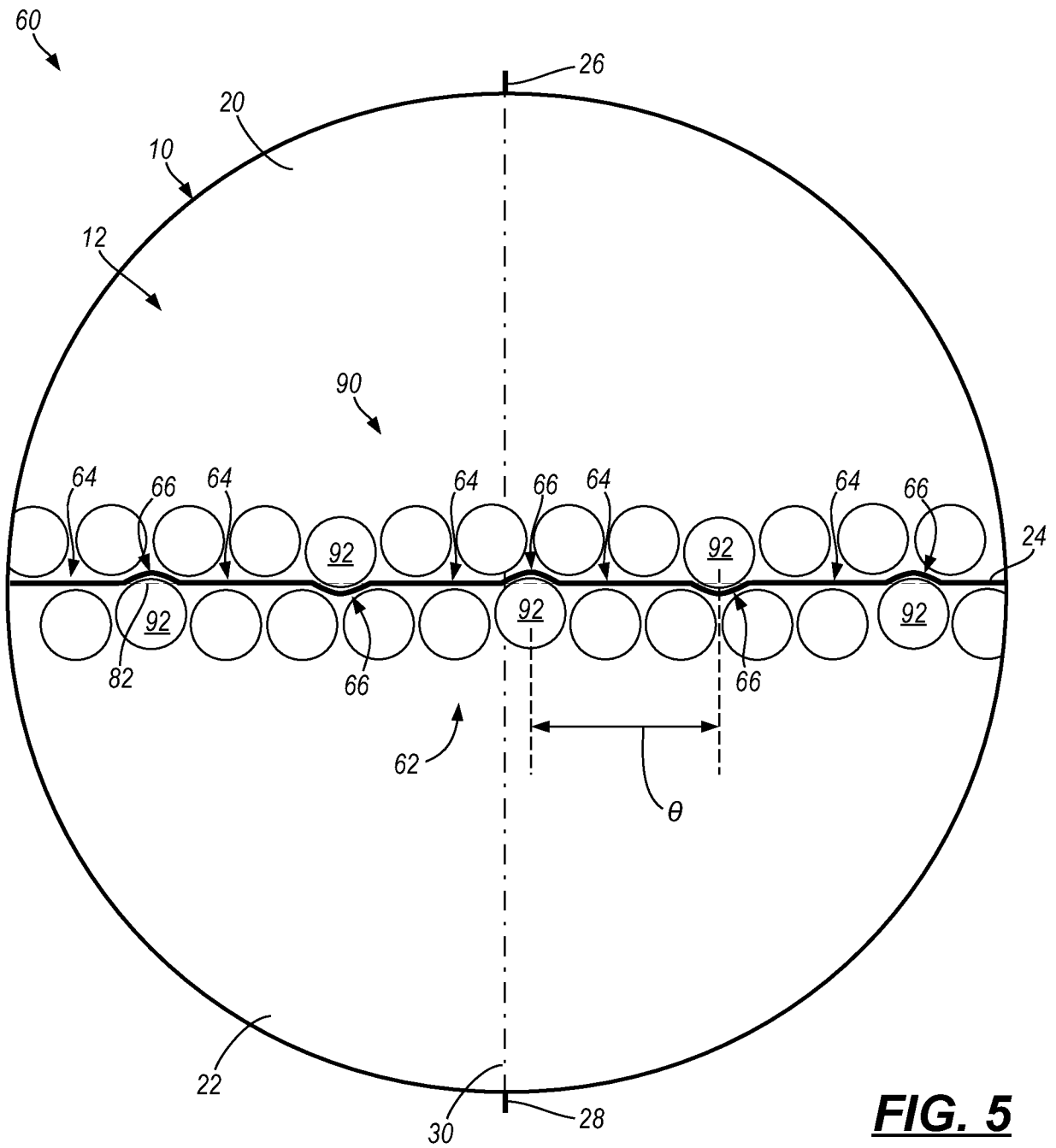


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/039487**A. CLASSIFICATION OF SUBJECT MATTER****A63B 37/14(2006.01)i**

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)

A63B 37/14; B29C 33/42; A63B 37/12; A63B 37/00; B29C 45/16

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: golf ball, non-planar seam line, repeating wave, intermediate section, straight surface

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2012-0157238 A1 (STEFAN) 21 June 2012 See claims 1, 4, 12 and figures 1-2A.	1-4, 8-10, 16-18
A	US 7618333 B2 (NARDACCI et al.) 17 November 2009 See claim 1 and figure 6.	1-4, 8-10, 16-18
A	EP 2420298 A1 (NIKE INTERNATIONAL LTD.) 22 February 2012 See paragraphs [0020], [0025] and figures 3B, 6B.	1-4, 8-10, 16-18
A	US 6632150 B1 (OGG) 14 October 2003 See claim 1; column 5, lines 44-48 and figure 2.	1-4, 8-10, 16-18
A	US 2010-0056300 A1 (COOPER et al.) 04 March 2010 See claims 1, 6-7 and figures 1C, 8B-8D.	1-4, 8-10, 16-18



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 application or patent 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

07 October 2014 (07.10.2014)

Date of mailing of the international search report

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Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US2014/039487**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 7, 13, 21
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 7, 13, 21 are unclear since they are referring to the multiple dependent claims which do not comply with PCT Rule 6.4(a).
3. ☒ Claims Nos.: 5-6, 11-12, 14-15, 19-20
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2014/039487

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