

PATENT SPECIFICATION

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(54) GOLF BALL

(71) We, UNIROYAL, INC., a corporation organised and existing under the laws of the State of New Jersey, one of the United States of America, of 1230 Avenue of the Americas, New York, New York 10020, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention pertains to golf balls.

Most, if not all, of the conventional golf balls in use today, distribute circular or bowl-shaped depressions about the face of the ball in an octahedral (eight sided) pattern, the diameter of the depressions being about 0.130 to 0.140 inch. This type of configuration usually has several circular paths that can be circumscribed about the surface of the ball, such paths not intersecting any depressions.

These paths present a smooth face to the air stream, when the ball is in flight. This is undesirable, since the performance of the ball in flight is dependent upon the air coming in contact with the depressions at it flows over the ball. Furthermore, conventional balls in flight may react in a different manner aerodynamically depending upon the orientation of the ball with respect to the directions of flight.

According to the present invention a golf ball has a substantially spherical surface on which is formed a plurality of bowl-shaped depressions each having a diameter of 0.150 ± 0.015 inch, said ball being divisible about its equatorial plane into two hemispheres and the depressions on each hemisphere being arranged so that notational spatial demarcation lines can be drawn through a number of adjacent depressions to form spherical triangles and parts of spherical triangles which substantially conform to the radial projection of a concentric regular half-icosahedron inscribed on the hemispheric surface.

With such an arrangement no smooth circumferential pathways of appreciable width are created to impair the aerodynamic characteristics of the ball in flight. In other words,

in having an increased number of facets for distribution the depressions about the surface of the ball, there is produced a configuration of depressions which develop a non-laminar air flow over the entire surface of the ball.

In molding the ball, however, a mold line is developed between the two molded halves of the ball that will produce a fine smooth line at the equator of the ball, when the molding flash is removed. Also, the spaces between the rows of depressions immediately adjacent the mold line will also circumscribe what may be referred to as a very fine circular path line about the ball. Preferably, however, these circumferential lines are extremely narrow, being not over .005 inch in width. Thus, they do not appreciably affect the aerodynamic performance of the ball as will thicker path lines.

Preferably each depression has a maximum depth of 0.015 ± 0.003 inch.

As already stated, a plurality of the depressions are bowl-shaped, that is their surface can be generated by revolving planar curves about a radius of the ball with an opening at the surface of the ball which is circular when inspected in an undistorted planar front view. A golf ball according to the invention may have all the surface depressions thereof bowl-shaped. Alternatively, some of the depressions may be in the shape of inverted pyramids with polygonal bases, while the remaining depressions are bowl-shaped. In either case the depressions must be arranged in an icosahedral pattern as described.

For a better understanding of the invention, reference is made to the following description, taken in connection with the accompanying drawings, in which:—

Fig. 1 is a top plan view of a golf ball constructed in accordance with the invention and having spatial pattern lines traced about the surface of the ball;

Fig. 1a is a cross-sectional view of the internal structure of the golf ball of Figs. 1 or 4;

Fig. 2 is a front elevational view of the Fig. 71 golf ball with spatial pattern lines traced about the surface of the ball;

Fig. 3 is a view, to an enlarged scale, of a typical triangular surface section of the Fig. 1 golf ball as developed on a plane surface;

Fig. 4 is a top plan view of a golf ball constructed in accordance with another embodiment of the invention and having spatial pattern lines traced about the surface of the ball;

Fig. 5 is a view to an enlarged scale of a typical triangular surface section of the Fig. 4 golf ball as developed on a plane surface;

Fig. 6 is a view, to an enlarged scale, of a depression having a bowl shape;

Fig. 7 is a sectional view to an enlarged scale, through the cover of the ball and a portion of the interior of the ball to represent a depression having a bowl shape;

Fig. 8 is a view, to an enlarged scale, of a depression having a pentagonal base;

Fig. 9 is a sectional view, to an enlarged scale, through the cover of the ball and a portion of the interior of the ball to represent a depression having a pentagonal base;

Fig. 10 is a top plan view of a gold ball constructed in accordance with the invention, similar to Figure 1, depicting several circumferential path lines circumscribed about the top surface of the ball; and

Fig. 11 is a front elevational view of the Figure 10 golf ball depicting several circumferential path lines circumscribed about the side surface of the ball.

As is well known in the art, the surface of the ball is formed in the final molding operation in a negative mold which is adapted to mold the desired imprint on the surface of the ball. In specifying the surface desired in the ball, it is accepted practice in the art to specify mold dimensions rather than ball dimensions because of the variability inherent in the production of molds and balls. Furthermore, after the ball is molded it is customary to paint the surface of the ball and, therefore, its surface will depart somewhat from the surface imparted in the mold because of the coating of paint applied to the ball. However, any discrepancies which may occur in the ultimate surface of the ball from that provided on the mold are small and the exigencies of ball production make it acceptable and desirable to specify the ball surface in terms of the mold dimensions. Accordingly, it should be understood that throughout this specification and claims the ball surface is to be achieved by providing a mold having the stated dimensions, and that a ball produced in such a mold will have substantially the desired dimensions, a painted ball further differing slightly from these dimensions. The exact mold dimensions will depend on the type of ball being made and the molding conditions. Those skilled in the art know how to select mold dimensions suitable for the materials being used and the types of ball (for example solid or wound) being made.

Referring now more particularly to Fig. 1

of the drawings, a golf ball comprises a spherical surface 10 having a plurality of depressions 11 therein, the majority of the depressions being spherically curved such as to have a bowl-shape with an opening at the surface of the ball which is circular when inspected in an undistorted planar front view, and all such spherically curved depressions having a diameter at the ball surface of 0.150 ± 0.015 inch and a maximum depth of 0.015 ± 0.003 inch. The ball has two poles 12 (only one of which appears in Fig. 1) and an equator 13 and each polar region is divisible into five similar equilateral spherical triangles indicated by broken lines 14 with a common vertex at a given pole 12. Lines 14 do not appear on the ball, but are spatial demarcation lines which are illustrative only. These lines may be inscribed to show how the depressions 11 are arranged on the surface of the ball. It will be realized that these depressions are distributed about the face of the ball to define an icosahedral lattice of equilateral spherical triangles. If the ball is rotated 180° in the direction of the arrow 15, the bottom plan view appears identical with the top plan view. The depressions cover approximately 50% of the surface area of the golf ball.

Referring now more particularly to Figs. 1 and 2 of the drawings, each vertex 16 of equilateral triangles 14, 14, 14 other than the polar vertex 12 serves as a vertex for a similar spherical equilateral triangle 14, 17, 17 having at least one vertex 16 across the equator 13 from another vertex 16 of the triangle 14, 17, 17. Referring to Fig. 2, rotation of the ball by 72° increments in the direction of the arrow 18 (running along the equator of the ball) would present four additional elevational views which appear identical with Fig. 2 as shown.

As mentioned previously, the other polar region of the ball is divisible into five additional equilateral triangles 14, 14, 14 similar to the previously described triangles 14, 14, 14 and having a common vertex at the other pole 12 and having common vertices 16 with the triangles 14, 17, 17 crossing the equator. The arcs 14 and 17 bounding all the equilateral triangles pass through the centers of a plurality of the depressions 11 and each equilateral triangle include within its arcs the same number of depressions and each vertex of the equilateral triangles is in a depression.

Referring to Figs. 1 and 2, all of the depressions 11 including the vertices 12 and 16 of the spherical triangle are spherically curved such as to have a bowl shape and are of substantially the same size.

Referring now more particularly to Fig. 3 of the drawings, there is represented a typical triangular surface portion 14, 14, 14 having its vertex at pole 12 developed as if on a planar surface. Depressions 16 are located at the

other vertices. This triangular surface may be formed by utilizing a hemispherical mold (not shown) in which the bottom of the cavity is a pole. The equator of the mold may then be divided into ten equal parts and five great circles drawn through the pole and the center of the sphere forms a great circle on the surface of that sphere. With a suitable chordal length and the pole as center, ten intersections may be marked, two on each of the great circles. Alternate intersections may be connected by respective great circles to form five spherical triangles corresponding to triangles 14, 14, 14 of the ball.

The ten divisions along the equator may then be bisected and respective great circles drawn from the vertices corresponding to vertices 16 of the five spherical triangles to the adjacent bisecting points just referred to, forming portions corresponding to parts of the triangles 14, 17, 17. An inverted bowl-shaped projection may then be located at each vertex of the mold corresponding to the vertices 12 and 16 shown in Fig. 3. The spherical triangles may be provided with inverted bowl-shaped projections corresponding to the uniformly spaced bowl-shaped regions shown in Fig. 3. All lines interconnecting bowl-shaped regions shown in Fig. 3 are arcs of great circles. The centers of the bowl-shaped regions included within the triangles 14, 14, 14 may be located at the vertices of the small triangles formed by the arcs of these great circles as shown in Fig. 3.

Referring to Fig. 4 all of the depressions 11, except the vertices 12a and 16a of the spherical triangles are spherically curved such as to have a bowl shape and are of substantially the same size. The depressions 12a and 16a which are the vertices of the equilateral triangles have substantially the shape of inverted pyramids with pentagonal bases and are of substantially the same size. The pentagonal bases of such pyramids are substantially pentagonal being on a spherical surface. In particular, referring to Fig. 5, there is represented a typical triangular surface portion 14a, 14a, 14a having its vertex at pole 12a developed as if as on a planar surface. Pentagons 16a are located at the other vertices. This triangular surface may be formed in the same manner as the surface shown in Fig. 3 except that the vertices 12a are pentagonal depressions.

It should be understood that only a top plan view of the golf ball is shown in Fig. 4. Further elevational views, such as a front elevational view corresponding to Fig. 2 can be readily drawn by those skilled in the art, following the construction shown in Fig. 2 and with the assistance of the planar surface developed in Fig. 5. Further elevational views,

therefore, follow the rotation described with respect to Figs. 1 and 2.

The other half of the mold, whether for Fig. 3 or for Fig. 5, is identical with the half just described but is rotated 36° along the equator with respect thereto. The location of the bowl-shaped and pentagonal regions of all the spherical triangles of the mold may be determined in accordance with the typical portion just described. If, however, the bottom mold is rotated less or greater than 36° , or odd multiples thereof, the two mold halves, while being identical, will not form a true icosahedral pattern.

Each hemisphere of the ball will now form only one-half of an icosahedron of equilateral spherical triangles. Although it is preferable to develop the whole icosahedron by phasing the two molds exactly 36° apart, it is nonetheless possible to achieve suitable aerodynamic results if the halves are not exactly aligned. As required by the limitations imposed by mold making equipment, the positions of the bowl-shaped and/or pentagonal depressions, or regions thereof, may deviate slightly from the aforementioned preferred locations.

Referring now more particularly to Figs. 6 and 7, the bowl-shaped depression 11 is shown in plan and in section to an enlarged scale. Referring to Figs. 8 and 9, the pentagonal base preferably has vertices on a circle of the same diameter as the bowl-shaped base and the pentagonal depression preferably has the same depth as the bowl-shaped depression. The sides of the pentagonal pyramids may be curved, and the apices of the pyramids may be slightly rounded.

Figures 10 and 11 correspond to the ball surfaces of Figures 1 and 2, respectively. Arrow lines 20 are inscribed about the face of the ball to demonstrate that any chosen circumferential path line will eventually intersect several depressions. As was aforementioned, the air stream rushing over the surface of the ball in any flight path will intersect the depressions causing the ball to exhibit enhanced aerodynamic characteristics.

However, the equatorial mold line 21 and adjacent lines 22 and 23, respectively will trace a continuous uninterrupted path about the surface of the ball. Lines 21, 22 and 23, however, are extremely narrow being about or less than .005 inch in width, and do not therefore, present a significant path line to the air stream. Thus, there are no closed pathways of substantial width that may be circumscribed about the face of the golf ball.

The following are the mold specifications for a golf ball of approximately 1.680 to 1.690 inches diameter constructed in accordance with a preferred form of the invention which was found to have longer carry in the air, that is, could be driven further in the air, than similar balls with the conventional 336 semi-spherical shaped depressions therein, similarly

made by the same manufacturer especially for comparison with a ball constructed in accordance with the invention. The nominal parameters of the mold for a standard USGA approved ball having the required diameter of not less than 1.680 inches are as follows:

	Number of depression-forming regions	252
5	Number of depression-forming regions with bowl-shaped bases	240 or 252
	Number of depression-forming regions with pentagonal bases	12 (if any)
	Diameter of ball-forming region	1.68—1.70 inches
10	Arc length of equilateral triangle	.93—.94 inch
	Chordal length from vertex to vertex	.883—.896 inch
	Size of pentagonal bases of depression-forming regions	Vertices on circle of $.165 \pm .015$ inch diameter
15	Size of bowl-shaped bases of depression-forming regions	circle of $.150 \pm .015$ inch diameter
	Maximum depth of bowl-shaped and pentagonal depression-forming regions from spherical surface	$.015 \pm .003$ inch

- 20 While the ball has been described above as having a diameter of between 1.680 and 1.690 inches, it is also contemplated that other balls of different diameters can be manufactured without departing from the scope of the present invention. For example, the standard diameter of the golf ball normally used in Great Britain is 1.620—1.630 inches. Other intermediate diameters, such as 1.660—1.670 inches can also be made. The nominal parameters of these balls can readily be modified to lie within or otherwise conform to the invention. By this it is meant to say, that suitable performance will be achieved for balls with these differing diameters and having the depressions designed and arranged according to the invention.

- 35 The exterior surface patterns disclosed herein may, of course, be applied to various golf ball constructions. Thus, the ball may have a fluid, liquid or a solid center or core, and the solid core may be made of metal or of synthetic plastics or of elastomeric material. The entire ball may be a solid, preferably homogeneous composition, with or without a separate cover, and if desired the center or core may be surrounded by windings of elastomeric yarns or filaments or by an elastomeric composition, having a sufficient radial dimension to ensure that the golf ball will have the desired outer diameter. If a cover is provided in any of the foregoing described golf ball constructions, the depression pattern will be provided in the cover itself.

- 50 Figs. 1a, 7 and 9 show the internal cross-section of a golf ball according to a preferred embodiment. The core of the ball comprises a center 26 of cis-polybutadiene or cis-polybutadiene rubber mixture, a rubber thread winding 25 would thereabout and a cover 27. The cover material is preferably that described in U.S. Patent 3,264,272. In particular, the cover material is that which is known in the

trade as "Surlyn A" a trademark of duPont. By way of example, a solid golf ball may be an elastomer cured in the presence of a relatively large amount of a monomer which is capable of acting as a cross-linking agent for the elastomer and under conditions which will additionally result in polymerization of the monomer. In this elastomer a structure is formed which consists of the elastomer cross-linked into a three dimensional network with a high density cross-links. A solid gold ball of this type is described in U.S. Patent 3,313,545.

Another example of a solid golf ball is a composition comprised of a polybutadiene elastomer; an ionomer (such as described in the aforementioned U.S. Patent 3,264,272); a thermoplastic resinous material other than an ionomer; a filler; a poly functional co-curing monomer ester having at least two non-conjugated ethylenic double bonds and a source of free radicals. A solid golf ball of this composition is described in U.S. Patent 3,421,766. A further example of a solid golf ball composition comprises a cured elastomer in conjunction with resin micro-balloons. A golf ball of this composition is described in U.S. Patent 3,238,156.

Although the present invention is operative with any thermoplastic material as noted above, it should be emphasized that certain thermoplastic materials such as polystyrene will not have the properties needed in a top quality golf ball to be used in competition; however, such materials can be used to form range balls, novelty golf balls or display golf balls etc. Particularly effective thermoplastic materials which can be used in the present invention are polyethylene, polypropylene and a copolymer of an alkylene compound such as ethylene, propylene or butylene and acrylic or methacrylic acid. The acid portion of the copolymer may be in free acid form, partially converted to a salt or fully converted to a

5 salt. Any of the monovalent or divalent elements of groups 1 and 2 of the periodic table can be used to form the cation of the salt in the copolymer. However, the monovalent metals such as sodium or potassium are preferred to divalent metals such as zinc because the monovalent metals possess better physical properties. The acid portion of the copolymer is preferably about 5—20% by weight of copolymer. A more complete disclosure of these copolymers is found in U.S. Patent 3,264,272. Also useful are the various nylons presently available, thermoplastic polyurethanes, polycarbonates, polysulfones and
15 balata.

WHAT WE CLAIM IS:—

1. A golf ball having a substantially spherical surface on which is formed a plurality of bowl-shaped depressions each having a diameter of 0.150 ± 0.015 inch, said ball being divisible about its equatorial plane into two hemispheres and the depressions on each hemisphere being arranged so that notional spatial demarcation lines can be drawn through a number of adjacent depressions to form spherical triangles and parts of spherical triangles which substantially conform to the radial projection of a concentric regular half-icosahedron inscribed on the hemispherical surface.
- 20 2. A gold ball according to claim 1 in which each depression has a maximum depth of 0.015 ± 0.003 inch.
3. A golf ball according to claim 1 or claim 2 in which the two hemispheres are angularly aligned so that the spherical triangles conform substantially to the radial projections of a concentric regular icosahedron inscribed on the spherical surface.
4. A golf ball according to any one of the preceding claims in which all the depressions on the ball surface are bowl-shaped.
5. A golf ball according to any one of claims 1 to 3 in which some of the depressions have substantially the shape of inverted pyramids with pentagonal bases.
- 45 6. A golf ball according to claim 5 in which there are 240 bowl-shaped depressions and 12 pentagonal pyramidal depressions.
7. A golf ball according to any one of the

preceding claims in which an axis through the centre of the ball perpendicular to the equatorial plane defines a pair of poles on the spherical surface, and the depression pattern includes a plurality of equilateral spherical triangles, five such triangles having a common vertex at one pole, and five other such triangles having a common vertex at the other pole.

8. A golf ball according to claim 7 in which each vertex of said five such triangles other than said polar vertex serves as a vertex for a similar spherical equilateral triangle crossing the equator and having at least one vertex across the equator therefrom, and said five other such triangles have common vertices with said triangles crossing the equator.

9. A golf ball according to claim 7 or claim 8 in which the depressions at the vertices of the spherical triangles are of pentagonal pyramidal form and all other depressions are bowl-shaped.

10. A golf ball according to any one of the preceding claims wherein any closed pathway having a width of 0.005 inch or greater that may be inscribed on the surface of the ball will intersect at least one depression.

11. A golf ball according to claim 5 in which each pentagonal depression is bounded by a circumcircle on the ball surface having a diameter of 0.165 ± 0.015 inch.

12. A golf ball according to claim 11 in which each pentagonal depression has a depth of 0.015 ± 0.003 inch.

13. A golf ball substantially as herein described and as shown in the accompanying drawings.

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salt. Any of the monovalent or divalent elements of groups 1 and 2 of the periodic table can be used to form the cation of the salt in the copolymer. However, the monovalent metals such as sodium or potassium are preferred to divalent metals such as zinc because the monovalent metals possess better physical properties. The acid portion of the copolymer is preferably about 5—20% by weight of copolymer. A more complete disclosure of these copolymers is found in U.S. Patent 3,264,272. Also useful are the various nylons presently available, thermoplastic polyurethanes, polycarbonates, polysulfones and balata.

WHAT WE CLAIM IS:—

1. A golf ball having a substantially spherical surface on which is formed a plurality of bowl-shaped depressions each having a diameter of 0.150 ± 0.015 inch, said ball being divisible about its equatorial plane into two hemispheres and the depressions on each hemisphere being arranged so that notional spatial demarcation lines can be drawn through a number of adjacent depressions to form spherical triangles and parts of spherical triangles which substantially conform to the radial projection of a concentric regular half-icosahedron inscribed on the hemispherical surface.

2. A gold ball according to claim 1 in which each depression has a maximum depth of 0.015 ± 0.003 inch.

3. A golf ball according to claim 1 or claim 2 in which the two hemispheres are angularly aligned so that the spherical triangles conform substantially to the radial projections of a concentric regular icosahedron inscribed on the spherical surface.

4. A golf ball according to any one of the preceding claims in which all the depressions on the ball surface are bowl-shaped.

5. A golf ball according to any one of claims 1 to 3 in which some of the depressions have substantially the shape of inverted pyramids with pentagonal bases.

6. A golf ball according to claim 5 in which there are 240 bowl-shaped depressions and 12 pentagonal pyramidal depressions.

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preceding claims in which an axis through the centre of the ball perpendicular to the equatorial plane defines a pair of poles on the spherical surface, and the depression pattern includes a plurality of equilateral spherical triangles, five such triangles having a common vertex at one pole, and five other such triangles having a common vertex at the other pole.

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