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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 relates to golf balls.

Heretofore, balls made nominally according to USGA specifications and having wound core diameters less than 1.60 inches were considered to be inferior or low grade. In direct relation to this, covers made from balata (natural or synthetic transpolyisoprene) have been generally molded in thickness ranging between 0.030 and 0.045 inch. The cover thickness and corresponding core diameter are interdependent, since the outer diameter of the standard ball is fixed by USGA rules. It is usually desirable to make the core as large as possible, since the cover material is not as resilient as the core. Yet, the thickness of the cover may have to be greater than a certain desirable thickness for other considerations such as durability, click, feel, mold temperature requirements, cut resistance and other physical or subjective limitations.

With the recent introduction of ionomer

resin "Surlyn" (Registered Trade Mark) as a cover material, we have discovered that when ionomer resin covers are made in the thickness range usually used for balata (0.030—0.045 inch) the ball lacks the desired durability. One common weakness appears to be a tendency for the ball to split at the seam when struck.

Conventional Surlyn-covered balls now on the market having a cover thickness of about 0.075 inch are deficient in resilience.

According to the present invention a golf ball has a core comprising a rubber thread wound onto a center, and a cover, the cover being in two parts joined by a seam and the cover comprising an ionomer resin and having a thickness of from 0.045 to 0.055 inch. The lower limit of 0.045 inch represents the minimum thickness at which we can still maintain good physical integrity in the cover. The upper range figure of 0.055 inch represents the maximum thickness at which we can maintain a sizable performance advantage over high-grade balls having a balata cover.

Standard comparative tests (Table 1) were conducted with a high-quality balata covered ball (ball #1), a commercially available wound ball with a Surlyn cover of 0.075 ± 0.005 inch thickness (ball #2), and a ball of the present invention (ball #3) revealing the following results:

[Price 33p]

TABLE 1

5	Ball No.	Ball Cover	Flight (a) (Yards)	Initial Velocity (b) (fps)	Rebound (c) (inches)	Hardness (d) PGA
	1	Balata	209	252	67.7	87
	2	Surlyn	202	250	67.5	87
10	3	Surlyn (e)	219	255	73.1	89

- (a) Flight tests were made with a mechanical driving machine adjusted to produce the distance and trajectory obtained by an average golf professional using a top quality golf ball.
- 15 (b) Initial velocity tests were made on the standard USGA initial velocity test machine.
- (c) Rebound tests are made by measuring the rebound in inches when the ball is dropped from 100" onto a flat surface of a marble slab 15"×17", 12" thick.
- 20 (d) PGA hardness tester is standard in the golf ball industry and it is manufactured by Atti Engineering Corp., Union City, New Jersey.
- (e) Du Pont Surlyn A, type 1559.

In addition, the commercially available Surlyn-covered ball (ball #2, Table 1) has poor "click" and "feel" as compared to the ball of this invention.

The ionomer resin of the cover may be based on an alkylene compound such as ethylene, propylene or butylene, and acrylic or methacrylic acid. The acid portion of the copolymer may be in the free acid form, partially converted to a salt or fully converted to a 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.

The preferred ionomers that are used are those known in the trade as "Surlyn A". These are ionic copolymers of approximately 96.5 mole-percent of ethylene and 3.5 mole-percent of methacrylic acid, sodium or zinc ions being uniformly distributed throughout the copolymer to an extent representing about 50% neutralization of the methacrylic acid.

The core preferably comprises a center formulated of a cis-polybutadiene or cis-polybutadiene/rubber mixture, and the core has a rubber thread wound thereabout. The center preferably has a rebound from a 100 inch drop of at least 70 inches. The rubber thread for winding is conveniently about 0.020 inch thick and 0.070 inch wide. The center may be nominally 1.06 inches in diameter. If the core has a diameter of from 1.570 to 1.590 inches then the golf ball will

have an overall diameter conforming to the standard USGA specifications. The term "rubber" as used herein, is meant to include either natural rubber or synthetic cis-polyisoprene (sometimes called "synthetic natural rubber"), mixtures thereof, and equivalents of the foregoing rubbers.

Obviously, those skilled in the art can make smaller balls (for example, the 1.62 inch ball currently used outside the U.S.A.) within the scope of this invention. Such balls will have a core diameter between 1.51 and 1.53 inches.

In the preferred method of molding the cover of a ball which is in accordance with our invention, thermoplastic material is heated and formed into first and second hemispherical shaped shells whereupon a core is placed inside the first shell and the second shell is placed thereover so that two shells meet at the equator of said shells. The shells are then molded to form a golf ball.

For a better understanding of the present 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

Fig. 2 is a cross-sectional view of the internal structure of the golf ball of Fig. 1.

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 have substantially the shape of inverted pyramids with hexagonal bases, and reference should be made to our co-pending Applications Nos. 29831/72 and 41047/74 (Serial Nos. 1,402,271 and 1,402,273) for full descriptions of the geometrical configuration

and patterns of the depressions, and for claims directed thereto.

Fig. 2 shows the internal cross-section of the golf ball. The core of the ball comprises a center 26 of cis-polybutadiene or cis-polybutadiene/rubber mixture and a rubber thread winding 25 wound thereabout. For a ball conforming to the USGA specification requirement that the diameter be from 1.68 to 1.69 inches the diameter of the core is approximately between 1.57 and 1.59 inches, and the Surlyn cover 27 is molded about the core and is approximately between 0.045 and 0.055 inch thick (depending on the core diameter).

While the ball has been described above as having a diameter of from 1.68 to 1.69 inches, it is also contemplated that other balls of different diameters can be manufactured. For example, the standard diameter of the golf ball normally used in Great Britain is 1.62—1.63 inches, and in such a ball the core will have a diameter of from 1.51 to 1.53 inches. Other intermediate diameters, such as 1.660—1.670 inches, may alternatively be used.

EXAMPLE

An example of how a ball may be fabricated in accordance with the invention is as follows:

A solid center $1\frac{1}{4}$ inches in diameter was prepared by mixing the composition shown below on a two-roll rubber mill and then molding it in a conventional center mold for 20 minutes at 320°F. in a hydraulic press.

	Parts by Weight
cis-polybutadiene (a)	45
natural rubber (b)	55
barytes (filler)	151
"DiCup" (trademark) (c)	7.5

(a) BRO1 sold commercially by Mitsui
(b) 50 Mooney smoked sheets
(c) "DiCup" is active dicumyl peroxide supported on precipitated calcium carbonate. It is marketed as a rubber curing agent by Hercules, Incorporated.

The center described was frozen in dry ice and while still frozen was wound with natural rubber golf ball thread in a conventional golf ball winding machine to produce a core 1.580 inches in diameter.

The thread used had the following properties:

width	0.070 inch
thickness	0.020 inch
tensile strength	2400 psi
breaking elongation	1000%
modulus at 500% stretch	325 psi

The wound core showed a compression deformation under a 300-lb. load) of 0.115 inch.

An ionomer resin cover made of 5 parts of titanium dioxide pigment blended with 100 parts of Surlyn A type 1559 resin was applied as described below.

To make the cover, the pigmented resin was formed into crude slugs weighing 90 grains each. Half shells were molded in place in the ball molding cavity by placing one of these slugs in each half of a preheated golf ball mold (300°F.) fitted with a removable mating center piece which on closing forms a half shell in each half of the ball mold. The mold was held closed hot, with the center piece in place for 2 minutes to completely form the half shells and to bring the half shells to mold temperature. After 2 minutes, the mold was opened to remove the center piece and replace it with the above-mentioned wound core. With the core in position in the bottom half of the mold, the mold was closed quickly with slower closing at the final stage of closing (last $\frac{1}{4}$ ") to allow the excess cover stock to flow out around the mold parting line. After complete closure, the mold was held under high pressure (about 1500 psi) for 30 seconds, at which time cold (35°F.) water was circulated around the mold for 10 minutes to cool the ball.

After cooling in the mold, the mold was opened to remove the ball. The ball was then buffed to remove the excess material at the mold parting line, i.e. around the seam formed between the two cover parts. Subsequent to buffing, the ball was finished by the usual painting operation. The final ball had a diameter of 1.68 inches and had the following properties:

PGA hardness	— 88
Rebound from 100" drop	— 73 inches

The final ball had unusually good playing qualities (click, feel, distance and durability).

It is within the contemplation of this invention that the exterior features, i.e. the shape and pattern of the depressions, be varied from those shown in Figure 1 without departing from the invention. Thus, some or all of the depressions on the golf ball may be all or in part arcuate in shape rather than polygonal as shown, i.e. they may be curvilinear either in circumference or in depth (when viewed in cross-section) or in both. In particular, all or some of either the disclosed hexagonal or pentagonal depressions may be spherically curved such as to have a generally hemispherical shape with an opening at the surface of the ball which is circular when inspected in an undistorted planar front view. Any arcuate shape depressions

may also have an elliptical curvature in either the circumference or the depth or both. The arrangement of the depressions on the ball surface may also be varied.

- 5 The cover as described may, of course, be applied to various golf ball core constructions. Thus, the ball may have a fluid, liquid or solid center, and the solid center may be made of metal or of synthetic plastics or of elastomeric material. The center is surrounded by windings of elastomeric yarns or filaments, having a sufficient radial dimension to ensure that the golf ball will have the desired outer diameter.

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WHAT WE CLAIM IS:—

1. A golf ball having a core comprising a rubber thread wound on to a center, and a cover, the cover being in two parts joined by a seam and the cover comprising an ionomer resin and having a thickness of from 0.045 to 0.055 inch.

- 20 2. A golf ball according to claim 1 in which the ionomer resin is an ionic copolymer of an alkylene compound and acrylic or methacrylic acid.

- 25 3. A golf ball according to claim 1 in which the ionomer resin includes ions of a monovalent or divalent element of group 1 or 2 of the periodic table uniformly distributed throughout the copolymer.

- 30 4. A golf ball according to any one of claims 1 to 3 in which the ionomer resin is an ionic copolymer of approximately 96.5 mole-percent of ethylene and 3.5 mole-percent of methacrylic acid; sodium or zinc ions being uniformly distributed throughout the copolymer to an extent representing about 50% neutralisation of the methacrylic acid.

5. A golf ball according to any one of the preceding claims in which titanium dioxide is blended with the ionomer resin.

6. A golf ball according to any one of the preceding claims having a nominal diameter of 1.68 inches or more, in which the core comprises a centre and a winding wound about the centre to form a core approximately between 1.57 and 1.59 inches in diameter.

7. A golf ball according to any one of claims 1 to 5 having a nominal diameter of 1.62 inches or more, in which the core comprises a centre and a winding wound about the centre to form a core approximately between 1.51 and 1.53 inches in diameter.

8. A golf ball according to claim 6 or claim 7 in which the centre contains cis-polybutadiene or a cis-polybutadiene/rubber mixture.

9. A golf ball according to any one of claims 6 to 8 in which the centre has a rebound of approximately 70% or better.

10. A golf ball according to any one of claims 6 to 9 in which the winding comprises a rubber thread of approximately 0.020 inch thick and approximately 0.070 inch wide.

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may also have an elliptical curvature in either the circumference or the depth or both. The arrangement of the depressions on the ball surface may also be varied.

- 5 The cover as described may, of course, be applied to various golf ball core constructions. Thus, the ball may have a fluid, liquid or solid center, and the solid center may be made of metal or of synthetic plastics or of elastomeric material. The center is surrounded by windings of elastomeric yarns or filaments, having a sufficient radial dimension to ensure that the golf ball will have the desired outer diameter.

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WHAT WE CLAIM IS:—

1. A golf ball having a core comprising a rubber thread wound on to a center, and a cover, the cover being in two parts joined by a seam and the cover comprising an ionomer resin and having a thickness of from 0.045 to 0.055 inch.

2. A golf ball according to claim 1 in which the ionomer resin is an ionic copolymer of an alkylene compound and acrylic or methacrylic acid.

3. A golf ball according to claim 1 in which the ionomer resin includes ions of a monovalent or divalent element of group 1 or 2 of the periodic table uniformly distributed throughout the copolymer.

4. A golf ball according to any one of claims 1 to 3 in which the ionomer resin is an ionic copolymer of approximately 96.5 mole-percent of ethylene and 3.5 mole-percent of methacrylic acid; sodium or zinc ions being uniformly distributed throughout the copolymer to an extent representing about 50% neutralisation of the methacrylic acid.

5. A golf ball according to any one of the preceding claims in which titanium dioxide is blended with the ionomer resin.

6. A golf ball according to any one of the preceding claims having a nominal diameter of 1.68 inches or more, in which the core comprises a centre and a winding wound about the centre to form a core approximately between 1.57 and 1.59 inches in diameter.

7. A golf ball according to any one of claims 1 to 5 having a nominal diameter of 1.62 inches or more, in which the core comprises a centre and a winding wound about the centre to form a core approximately between 1.51 and 1.53 inches in diameter.

8. A golf ball according to claim 6 or claim 7 in which the centre contains cis-polybutadiene or a cis-polybutadiene/rubber mixture.

9. A golf ball according to any one of claims 6 to 8 in which the centre has a rebound of approximately 70% or better.

10. A golf ball according to any one of claims 6 to 9 in which the winding comprises a rubber thread of approximately 0.020 inch thick and approximately 0.070 inch wide.

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