US 20030032502A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2003/0032502 A1**

Lee et al. (43) **Pub. Date: Feb. 13, 2003**

(54) **GOLF BALL HAVING IMPROVED CORE RUBBER COMPOSITION**

(76) Inventors: **Eui Mun Lee**, Kyeongki (KR); **Gi Jeong Kim**, Qingdao (CN); **Jung Gyu Moon**, Kyeongki (KR); **Lauro C. Cadorniga**, Piedmont, SC (US)

Correspondence Address:
DORITY & MANNING, P.A.
POST OFFICE BOX 1449
GREENVILLE, SC 29602-1449 (US)

(21) Appl. No.: **10/194,116**

(22) Filed: **Jul. 12, 2002**

Related U.S. Application Data

(60) Provisional application No. 60/304,874, filed on Jul. 12, 2001. Provisional application No. 60/304,984, filed on Jul. 12, 2001.

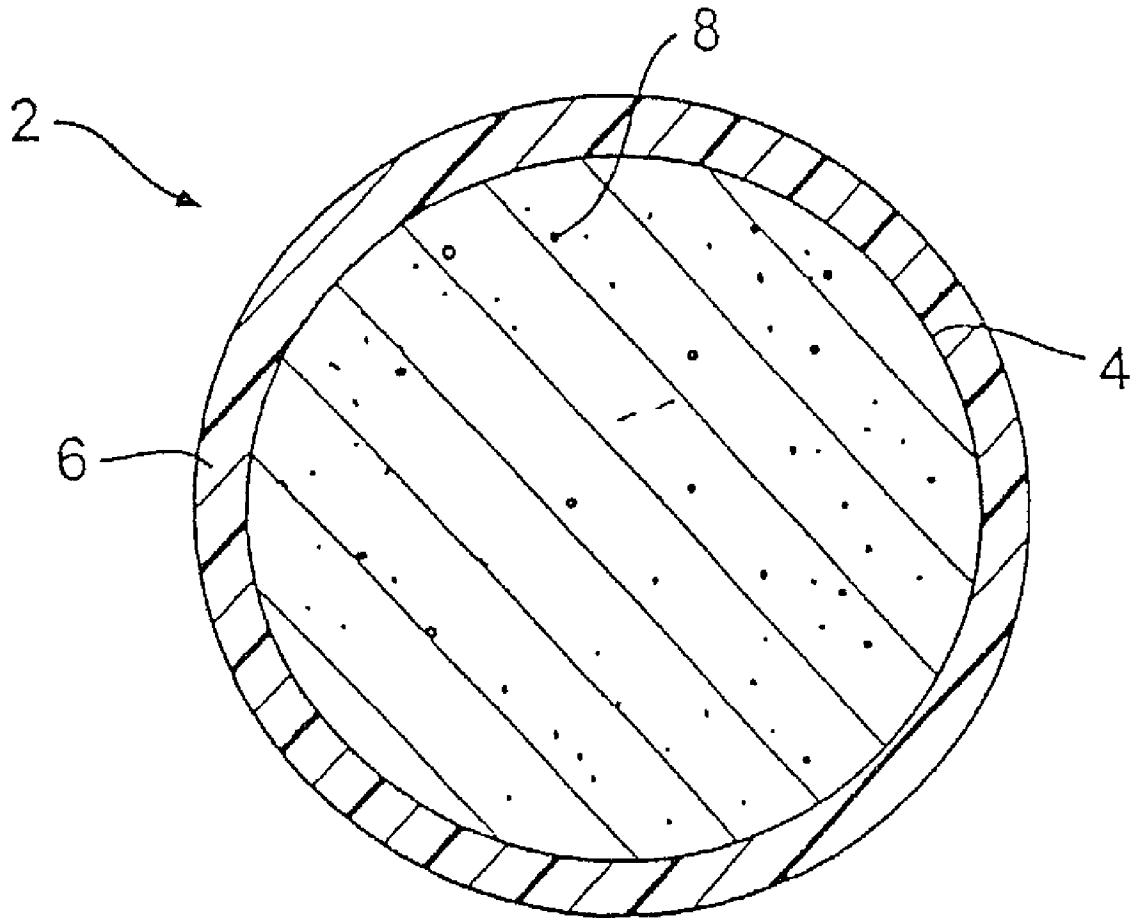
Publication Classification

(51) **Int. Cl.**[7] **A63B 37/04**; A63B 37/06

(52) **U.S. Cl.** **473/377**

(57) **ABSTRACT**

A golf ball construction is provided having a solid core composition comprising a SBR rubber present between about 5 PHR to about 20 PHR. The resulting core has a core center hardness which is between at least 3 to 12 Shore D units less than an exterior of the core.



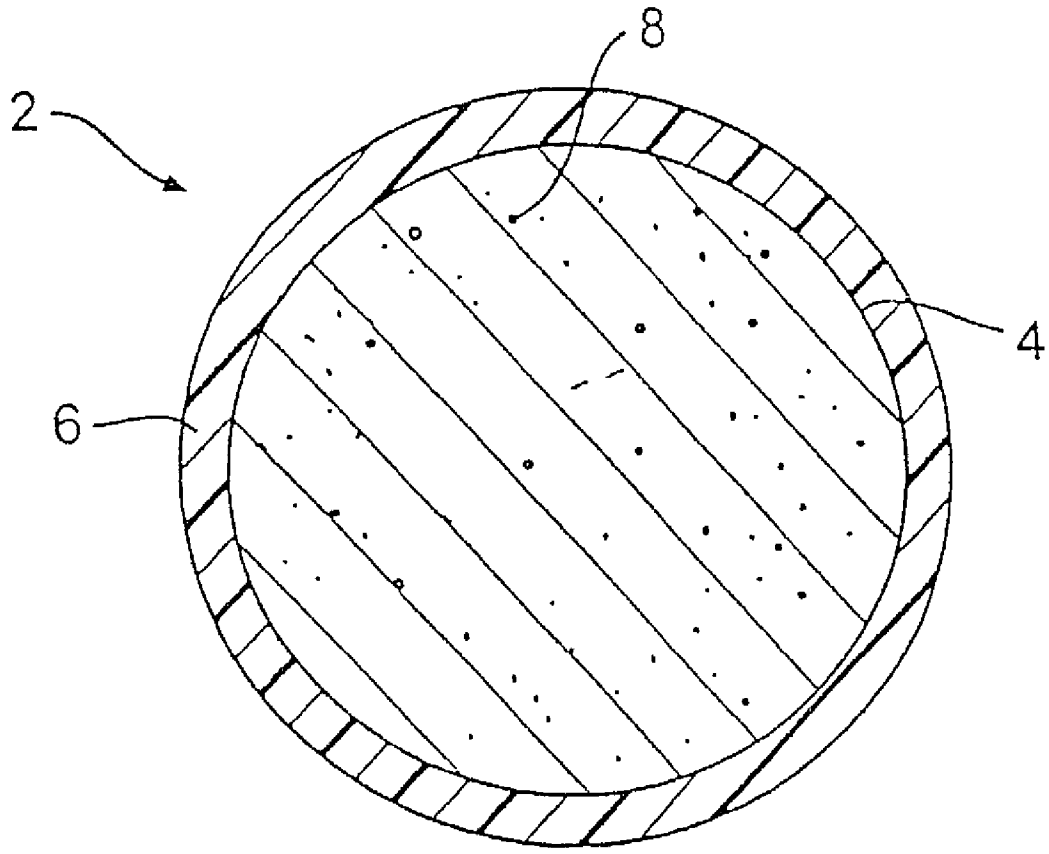


FIG. 1

GOLF BALL HAVING IMPROVED CORE RUBBER COMPOSITION

RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application Nos. 60/304,874 and 60/304/984 each filed on Jul. 12, 2001, and which are both incorporated herein by reference. This application also relates to commonly owned U.S. application Ser. No. xx/xxx,xxx having Attorney Docket No. FNT-3 filed on Jul. 12, 2002, and which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] This invention is directed towards golf balls and is directed more particularly to a two-piece golf ball having a unique core composition and improved performance properties.

BACKGROUND OF THE INVENTION

[0003] A significant number of conventional golf balls are made by molding a cover about a central core, a typical core having a diameter of about 1½ inches. One form of golf ball construction includes balls having a solid core. Solid core golf balls are referred to generally as "two-piece" golf balls.

[0004] The core of a two-piece golf ball is based upon rubber compositions which are formulated to provide a combination of hardness, high compressive strength, durability, and excellent rebound properties. The rubber core provides resiliency to the resulting golf ball that optimizes initial velocity at impact and promotes long flight distance qualities.

[0005] In the construction of golf balls and golf ball cores, it is desirable to provide a finished ball having a high initial velocity. At the same time, it is important to maintain the durability of the golf ball core. Should the integrity of the core be compromised by cracking or other core damage, the ball will suffer a loss of initial velocity. The degradation in ball performance may be gradual and may not be immediately apparent to the user. Accordingly, cores which retain their durability will extend the useful performance life of the golf ball.

[0006] It is known in the art to provide a two-step peroxide cure to provide a core having a single-step change in core hardness values. The process and resulting core is set forth in U.S. Pat. No. 5,782,707 which is incorporated herein by reference.

[0007] Polybutadiene elastomers are commonly used for the rubber component of a core and are cross linked by chemical cross-linking agents to increase the core hardness while maintaining good resiliency. The use of polybutadiene elastomers in manufacturing processes and formulations for conventional two-piece golf ball cores is well known within the art. A representative patent directed to core compositions includes U.S. Pat. No. 5,508,350 which is incorporated herein by reference. Despite advances within the art, such as represented by the above referenced patent, there remains room for improvement and variation in the art directed to core constructions.

SUMMARY OF THE INVENTION

[0008] It is an object of at least one embodiment of the present invention to provide a rubber composition formulation for use as a core in a two-piece golf ball.

[0009] It is yet another object of at least one of the present embodiments to provide a rubber composition formulation for golf ball cores in which a hardness gradient is established across a cross-section of the core.

[0010] It is yet another aspect at least one of the present embodiments to provide a golf ball core which has an improved core durability which is imparted to the core by a core center having softer properties than a surface region of the core.

[0011] It is yet another feature of at least one of the present embodiments to provide a two-piece golf ball having a core hardness differential of greater than about 2 to about 12 or more Shore D units as measured from a center of the core to an exterior of the core.

[0012] It is a further aspect of at least one embodiment of this invention to provide a golf ball having a core, the core having a harder exterior than an interior of the core. A finished ball having the core of the present- invention, exhibits a softer feel for putting and similar soft shots without a loss of initial ball velocity.

[0013] These and other aspects of the invention provided by a golf ball core composition comprising an elastomer having between about 80 to about 85 PHR of a polybutadiene elastomer and about 5 to about 20 PHR of a styrene butadiene elastomer. Optionally, the SBR may be present in an amount of between about 7.5 PHR to about 15 PHR and still more preferably in an amount of between about 5 PHR to about 10 PHR. Additionally, the golf ball core has a core center with a Shore D hardness value which is at least about 2 units less than the Shore D hardness value of an exterior of the core. More preferably, the core has a center Shore D value of between about 33 and about 36 and a core exterior Shore D value of between about 39 and about 49. In another preferred embodiment of the invention, the center of the core has a Shore D value which is at least about 10 Shore D unit values less than the Shore D value of the core exterior.

[0014] These and other features, aspects, and advantages of the present invention will become better understood with reference to the following description and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] A full and enabling disclosure of the present invention, including the best mode thereof, to one of ordinary skill in the art, is set forth more particularly in the remainder of the specification, including reference to the accompanying drawings.

[0016] The FIGURE is a cross section view through a two-piece golf ball illustrating the rubber core construction of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0017] Reference now will be made in detail to the embodiments of the invention, one or more examples of which are set forth below. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or

described as part of one embodiment, can be used on another embodiment to yield a still further embodiment. Thus, it is intended that the present invention cover such modifications and variations as come within the scope of the appended claims and their equivalents. Other objects, features, and aspects of the present invention are disclosed in the following detailed description. It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only and is not intended as limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary constructions.

[0018] In describing the various figures herein, the same reference numbers are used throughout to describe the same material, apparatus or process pathway. To avoid redundancy, detailed descriptions of much of the apparatus once described in relation to a FIGURE is not repeated in the descriptions of subsequent figures, although such apparatus or process is labeled with the same reference numbers.

[0019] The golf ball according to the present invention is produced from a polymer mixture of a high cis-polybutadiene rubber with a styrene butadiene rubber. Useful polybutadiene rubber is produced from using various kinds of catalysts which are well known in the art. In accordance with the present invention, a styrene butadiene rubber (SBR) such as a KHS-68, Kumbo Chemical, Korea, has been found useful to include in the polymer mixture. Additional polymers, such as natural rubber, may be added and other polymers may be added or substituted as is appreciated by one having ordinary skill in the art.

[0020] The resulting polymer mixture which includes a SBR component has, surprisingly, been found to offer a core composition for a two-piece golf ball which exhibits a core hardness gradient and resulting useful properties. By way of example, a solid core can be molded which has a range of hardness values which extend from a center value of about 33 and increases in a gradient-like manner to a hardness of about 42 along the core exterior. By increasing the percentage of the SBR in the rubber mixture, a Shore D value 49 of the core surface has been obtained, with higher Shore D values believed to be readily obtainable by further adjustments of the SBR percentage of the core formulation.

[0021] Additionally, the addition of the SBR as a portion of the elastomer core mixture has been found to increase the compression of the core. As a result of the increased compression, it is possible to reduce the amount of ZDA in the core formulation. As a result, a golf ball core having comparable compression values can be made more economically as a result of the decreased amounts of ZDA needed in the formulation.

[0022] It is believed that the core hardness gradient provided across the two-piece golf ball increases the durability of the core. The improved core durability extends the useful performance life of the golf ball. Additionally, the improved durability is achieved while maintaining a golf ball core which provides excellent initial velocity to a golf ball formed used the core.

[0023] As is well known within the art, the elastomeric polymers used in constructing a golf ball core may utilize metal salts of unsaturated carboxylic acids to cross link the polymers. Suitable carboxylic acids include methacrylic, acrylic, dimethacrylic, and diacrylic acids. Suitable metal ions include sodium, potassium, magnesium, cerium, zinc, and cadmium, with zinc being widely used within the industry.

[0024] In the present invention, a SBR polymer is included in the core polymer composition. In one embodiment of the invention, the percentage of SBR of the total rubber composition of the core formulation may be between about 5% to about 20% by weight. By increasing the percentage of the SBR in the polymer mix, it has been found possible to decrease the amount of ZDA cross-linking agent, thereby lowering the net cost per ball core. In addition to the lower cost, the performance characteristics of the ball, as represented by the core hardness gradient, is also achieved. The inclusion of the SBR in a core formulation for a two-piece golf ball, provides a resulting ball having a desirable high initial velocity, offers improved durability, provides for a softer feel without loss of initial velocity, and maintains a high coefficient of restitution (COR).

[0025] The free radical initiator included in the core composition may be selected from a variety of known polymerization initiators. Preferably, the initiator decomposes during the cure cycle. One useful initiator set forth in Table 1 is dicumyl peroxide and used in amounts from about 0.5 to about 5.0 parts by weight based on 100 parts elastomer.

[0026] In the present invention, zinc oxide is used as an activator as well as a filler. Zinc oxide is present in the formulation in an amount from about 3 to about 5 parts per weight based upon 100 parts elastomer. Metal salts of unsaturated carboxaylic acid such as zinc diacrylate (ZDA) may be present in an amount of about 14% to about 17%, by weight, the lower percentages being correlated with the greater levels of SBR in the core formulations.

[0027] Table 1 sets forth several compositions having a KHS-68 SBR elastomer component along with an appropriate control (A-1). However, it is believed that other conventional polymer compositions used for the core of a two-piece ball may be modified in accordance with this invention by the inclusion or substitution of SBR into the formulation.

[0028] One having ordinary skill in the art would be able, without undue experimentation, to make adjustments to traditional fillers used in core compositions to adjust formulations to accommodate the inclusion of SBR into the core formulation. As a general rule, it is desired to maintain the specific gravity of the core composition between 1.165 to 1.18 for a standard core diameter of 1.510±0.010 inches. As such, adjustments to weight fillers may be used to bring about the reformulation.

TABLE 1

	A-1	A-2	B-1	B-2	C-1	C-2	D-1	D-2
CORE FORMULATION PROPERTY								
BR	100.0	95.0	90.0	90.0	85.0	85.0	80.0	80.0
KHS-68	0.0	5.0	10.0	10.0	15.0	15.0	20.0	20.0
ZDA	26.0	26.0	26.0	23.0	26.0	23.0	26.0	21.5
ZnO	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
BaSO4	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Zn-ST	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
SATITONE	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
LUPEROX	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
TOTAL	156.4	156.4	156.4	153.4	156.4	153.4	156.4	151.9
COMP (kgf)	68.0	65.0	77.0	72.0	96.0	68.0	103.0	73.0
WT (g)	35.20	35.24	35.30	35.00	35.55	35.30	35.60	35.30
HARD (SHORE-D)								
Center	40	33	36	33	40	32	39	31
Midpoint	40	36	40	36	44	36	44	35
Surface	40	39	44	40	48	40	49	40
SIZE								
(inch)	1.514	1.514	1.514	1.514	1.514	1.514	1.514	1.514
(mm)	38.45	38.45	38.45	38.45	38.45	38.45	38.45	38.45
BALL FORMULATION PROPERTY								
COMP (kgf)	104.4	101.0	111.3	106.2	124.6	100.5	129.7	111.6
WT (g)	45.70	45.68	45.81	45.38	46.06	45.76	46.00	45.60
HARD (SHORE-D)	63	63	63	63	63	64	63	65
SIZE								
(inch)	1.683	1.683	1.683	1.683	1.683	1.683	1.683	1.683
(mm)	42.75	42.75	42.75	42.75	42.75	42.75	42.75	42.75
C.O.R.	0.788	0.775	0.775	0.773	0.767	0.762	0.769	0.754
DURABILITY	96	119	159	121	173	121	105	152
	96	133	180	136	180	122	168	162
CARRY DISTANCE (yds)	246.75	247.67	245.83	245.58	245.75	245.08	245.42	243.83
TOTAL DISTANCE (yds)	257.75	261.08	256.33	259.25	258.50	255.67	257.50	257.75
BALL VELOCITY (mph)	156.17	155.92	155.75	156.50	156.00	155.08	155.42	154.42

EXAMPLE I

[0029] As seen in Table 1, the indicated amounts of a polybutadiene rubber BR1 208 (Goodyear) and a SBR (KHS-68, Kumbo Chemical, Korea) are introduced into a Banbury or internal mixer. To this mixture, the zinc oxide and one half of the amount of zinc diacrylate (ZDA) is added, the initial mixture having a temperature of about 100° F. The material is blended for three minutes, during which time the temperature increases to 150° F.

[0030] Following the initial three minute interval, the remaining portion of the zinc diacrylate is added along with the barium sulphate and any optional additives such as titanium oxide or other metallic additives. Additional blending is carried out for two minutes during which time the mix temperature rises to about 170° F. At this point, zinc stearate, aluminum silicate (Satitone) and the dicumyl peroxide (Luperox) are added to the polymer blend along with additional mixing for about 1½ minutes. In place of the aluminum silicate, an equivalent amount of reground ball cores may be used. During this latter step, the temperature rises to about 190° F. and care must be exercised that the temperatures do not exceed 195° F. Following the additional mixing of about 1½ minutes and prior to the elevation of the temperature to 195° F., a dump cycle is carried out in which the composition is placed into a conventional drop mill.

[0031] The drop milling process brings about an immediate reduction in temperature of the polymer composition and generates thin sheets of ¼ to ½ inch thick pre-form slugs of the core polymer mixture.

[0032] The resulting preforms of individual rubber slugs are subsequently cured by heating the compositions on the order of from about 275° F. to about 350° F. with the molding of the composition brought about simultaneously with the curing step. The molding of the composition into a core structure may be used by any conventional molding techniques such as injection, compression, or transfer molding procedures.

[0033] Following molding, the core is removed from the mold and the surface is treated by any of several techniques known in the art such as centerless grinding or surface peeling method and the like so as to facilitate adhesion of a covering composition. As set forth in Table 1, various core composition physical properties and finished golf ball properties were determined. The testing and evaluation procedures are well known to those skilled in the art. Through the use[]of tangential sections through portions of the cured cores, evaluations and measurements of the Shore D hardness gradient were determined. The Shore D hardness values reported in Table 1 are taken from the exterior surface, the core center, and a midpoint region between the core center and the surface. Shore D hardness values determined from the core surface ranged from 39 to 49, with the center of the

core having Shore D values of about 6 to about 10 less than -the surface. Shore D hardness values as seen by the midpoint values, decrease in hardness going from the core surface to the core center in a substantially linear gradient.

[0034] The data set forth in Table 1, indicates that as the percentage of the SBR in the rubber mixture increases, a greater range of core hardness values from the core center to the core surface is obtained. This, in turn, allows lower amounts of ZDA to be included in the mixture while still achieving a ball having excellent core compression values. As a result of the cost savings attributed to lower amounts of ZDA, the golf ball core compositions and resulting golf balls can be provided at a lower cost without sacrificing the quality.

[0035] The compression values set forth in Table 1 are set forth in weight load units. The compression values may be determined by a variety of mechanical apparatuses and commercially available called Compression Units such as that produced by Atti Engineering Corporation of Newark, New Jersey. Conversion factors from a weight load determination are well known in converting a weight load compression value to PGA compression scale values.

[0036] PGA compression is generally set forth on a scale of from 0 to 200 for a golf ball with the lower values equating to a softer feel of a ball. For tournament level quality balls, compression ratings range from about 70 to about 110 and more preferably range from about 80 to 100.

[0037] The term "compression" utilized in the golf ball trade generally defines the overall deflection that a golf ball undergoes when subjected to a compressive load. The compression of the ball can affect the playability of the ball on striking and the "feel" or responsiveness of the ball during chipping and putting. The degree of compression of a ball against the club face and the softness of the cover strongly influences the resultant spin rate. In general, a softer cover will produce a higher spin rate than a harder cover. Additionally, a harder core will produce a higher spin rate than a softer core. A softer core contributes to a cover of the golf ball being under less compressive stress when struck than a harder core. As a result, the club face is not contacted to as great a degree and results in a lower spin rate.

[0038] A suitable cover as used to produce and evaluate the balls as seen in Table 1 uses a mixture of Surlyn® ionomer 8940 and Surlyn® ionomer 9910. (DuPont Corporation, Willington, Del.) The cover formulation uses ionomers 8940 and 9910 at 50 PHR respectively. Additionally, a titanium dioxide pigment is present at 3 PHR along with blue pigment at 0.04 PHR. Additional details related to the composition and construction of a golf ball cover are well known in the art and as seen in reference to U.S. Pat. No. 4,884,814 and U.S. Pat. No. 5,538,794 which are incorporated herein by reference. Additionally, it is believed that any conventional cover formulation for a two-piece ball is compatible with and would benefit from the core composition improvements noted herein.

[0039] The core is provided with at least one layer of a covering composition ranging in thickness from about 0.050 to about 0.250 inches and more preferably from about 0.060 to about 0.090 inches. The process to finish a golf ball with the cover is well known to those having ordinary skill in the art. The resulting cores produced according to the present invention provide a golf ball having a high initial velocity. Further, it has been found that the durability of the core is enhanced by the inclusion of about 5% to about 20% or more of SBR such that the durability of the core is enhanced. As best seen in reference to the FIGURE, one embodiment of the invention provides a golf ball 2 having a cover 6 and a core 4. The golf ball core has the SBR 8 uniformly distributed throughout the core composition.

[0040] Using the above formulation and protocols, golf balls having two-piece cores were manufactured and evaluated. The balls produced were found to have a core weight of about 35.0 to 36.0 grams with a core size of 1.514 inches. The ATTI compression values and Shore D hardness values are set forth in Table 1.

[0041] The core compositions of the present invention may additionally include other conventional modifying ingredients such as fillers, conventional metal oxides, and various cross-linking agents. With respect to the amount of filler, filler amounts are primarily based upon weight restrictions and specific gravity requirements of the total polymer composition in the range from about 15 to about 30 parts by weight on 100 parts elastomer.

[0042] As set forth in Applicant's above identified copending application filed on Jul. 12, 2002, and incorporated herein by reference, additional benefits to a golf ball core may be provided by including titanium, tungsten, or combinations of titanium and tungsten metal to the core compositions. These additives, combined with the core formulations seen here, may offer additional improvements in the construction of a golf ball core and resulting golf ball.

[0043] The coefficient of restitution (COR) of the golf balls are also determined as set forth in Table 1. The COR measurements of the golf ball were made by propelling the ball horizontally at a speed of 125±5 feet per second against a generally vertical flat steel plate. The ball's incoming and outgoing velocity were electrically measured using ballistic screens as are known in the art. The ball speed was measured by timing the pulses from screen 1 to screen 2 on the way into the rebound wall and then the exit speed was timed between screen 2 to screen 1 over the same distance.

[0044] Since the coefficient of restitution of a ball is related to the ball's initial velocity, it is desirable to produce a ball having a sufficiently high coefficient of restitution to closely approach the USGA limit on initial velocity.

[0045] As set forth in the durability data of Table 1, the cores of the present invention in combination with a conventional ionomeric cover results in a golf ball having excellent durability. The durability of the balls was determined by impacting the golf balls at high velocity against a steel plate. The data set forth in Table 1 indicates the number of impacts of two different balls for each evaluated core composition before a failure of the golf ball was noted.

[0046] Additionally, the core maintains desired compression values by incorporating a styrene butadiene rubber which allows the core recipe to reduce the amount of zinc diacrylate (ZDA). The reduction of the ZDA allows for a more economical ball construction without sacrificing performance characteristics of the core or a resulting golf ball using the core. Additionally, it has been found that the core constructed according to the present invention establishes a controlled hardness gradient which provides for a compara-

tively softer core center to a comparatively harder outer surface of the core. These features all contribute to a core construction and resulting ball which has a durable core and excellent initial velocity characteristics. The durability characteristics are believed related to the durability of the gradient core of the present invention.

[0047] Although preferred embodiments of the invention have been described using specific terms, devices, and methods, such description is for illustrative purposes only. The words used are words of description rather than of limitation. It is to be understood that changes and variations may be made by those of ordinary skill in the art without departing from the spirit or the scope of the present invention, which is set forth in the following claims. In addition, it should be understood that aspects of the various embodiments may be interchanged, both in whole or in part. Therefore, the spirit and scope of the appended claims should not be limited to the description of the preferred versions contained therein.

That which is claimed is:

1. A golf ball core composition comprising:

an elastomer having between about 80 to about 95 PHR of a polybutadiene elastomer and about 5 to about 20 PHR of a styrene butadiene elastomer.

2. The core composition according to claim 1 wherein the SBR is present in an amount of between about 5 PHR to about 15 PHR.

3. The core composition according to claim 1 wherein the golf ball core has a core center having a Shore D hardness value of at least 2 units less than an exterior of the core.

4. A golf ball comprising:

an outer cover; and,

a core, the core comprising at least one SBR elastomer and having a core center Shore D value of between about 33 and about 36 and a core exterior having a Shore D value of between about 39 and about 49.

5. The golf ball according to claim 4 wherein the center of the core has a Shore D value which is at least about 10 Shore D unit values less than an exterior of the core.

6. The golf ball according to claim 4 wherein said at least one SBR elastomer is present in an amount of about 5 to about 20 PHR of a core composition.

7. The golf ball according to claim 4 wherein said at least one SBR elastomer is present in an amount of about 5 to about 10 PHR of a core composition.

8. A golf ball core composition comprising:

an elastomer having between about 90 to about 95 PHR of a polybutadiene elastomer and about 5 to about 10 PHR of a styrene butadiene elastomer.

* * * * *