A set of golf balls and package assembly, comprising: a package defining at least one cavity for housing a golf ball set; the golf ball set comprising a series comprising n golf balls, each having an overall color appearance of one of n different colors expressed in the CIE CIECAM color system wherein n>1; the series being ordered in a color progression such that at least one of the a, b, h, J and C values, as defined in the CIE CIECAM color system, is different. The invention is also directed to a method of making the set of golf balls and package assembly.
PACKAGING INCORPORATING COLOR GOLF BALLS IN A COLOR PROGRESSION

CROSS-REFERENCE TO RELATED APPLICATION


FIELD OF THE INVENTION

[0002] The invention relates generally to golf ball packaging incorporating a plurality of differently colored golf balls in a color progression.

BACKGROUND OF THE INVENTION

[0003] Golf balls, whether of solid or wound construction, generally include a core and a cover. It is known in the art to modify the properties of a conventional solid ball by altering the typical single layer core and single cover layer construction to provide a ball having at least one mantle layer disposed between the cover and the core. The core may be solid or liquid-filled, and may be formed of a single layer or one or more layers. Covers, in addition to cores, may also be formed of one or more layers. These multi-layer cores and covers are sometimes known as “dual core” and “dual cover” golf balls, respectively. Additionally, many golf balls contain one or more intermediate layers that can be of solid construction or may be formed of a tensioned elastomeric winding, which are referred to as wound balls. One piece golf balls are even available. The difference in play characteristics resulting from these different types of constructions can be quite significant. The playing characteristics of multi-layer balls, such as spin and compression, can be tailored by varying the properties of one or more of these intermediate and/or cover layers.

[0004] Moreover, color in a golf ball, being a dominant visual feature, also positively contributes to and enhances a golfer’s game by improving the player’s ability to focus on the golf ball when swinging a club and striking the ball. By keeping an eye on the ball, the golfer is able to remain focused on the immediate task at hand of maintaining hand-eye coordination and producing great balance during swing with consistent spine angle in order for the club face to strike the golf ball with just the right force, depending on the chosen club and desired distance.

[0005] Meanwhile, golf balls that are attractive and exude superior quality will also boost a golfer’s confidence and morale, thereby motivating, inspiring and ultimately peaking performance on the green. Accordingly, golf ball manufacturers desire to incorporate color shades in golf balls which will beneficially impact and improve both the physical and emotional/psychological aspects of a golfer’s game. To achieve this end, manufacturers have even sold “rainbow packs” visibly displaying several different solidly colored golf balls in one package.

[0006] But whether on the green or displayed in packaging, it is desirable that a golfer’s eye perceive the same golf ball color shade equally favorably under varied viewing conditions. Yet, sometimes a golfer’s perception of a certain color shade will vary considerably with changed viewing conditions. In this regard, the time of day that a golf game is played may vary the viewing conditions as it is usually much brighter during a game played in the midday sun than one played at dusk. Another factor which may affect viewing conditions is weather—on a sunny day, the human golfer’s eye will perceive some golf ball color shades differently than on an overcast or even rainy day. Meanwhile, the color of the background against which the golf ball lies (e.g., teeing ground versus on fairway, rough or hazard) will change how the golfer’s eye perceives some golf ball color shades. And when contained in packaging, a change in establishment lighting will present the same colored golf ball differently to the human eye. Therefore, golf ball manufacturers desire to choose golf ball color shades which are most likely to produce the least variance in a golfer’s perception of that color with changed viewing conditions and will appear most favorably to the golfer under a wide range of different viewing conditions.

[0007] Manufacturers, in choosing and defining golf ball color, have previously utilized color systems such as the CIE LAB (1976) color space wherein color is defined under only one lighting condition or illuminant, namely D65. Such single lighting condition models present a significant drawback for choosing golf ball color, however, in that they fail to consider, address or account for how changing stimuli on the green will affect a golfer’s visual perception of color and are therefore not practical or reliable systems for choosing appropriate golf ball color shades.

[0008] Accordingly, there is a need for golf ball packaging incorporating a plurality of golf balls in a progression of different colors which golfers will visually perceive most favorably individually and collectively under a wide range of varied viewing conditions based on a color appearance model which takes into account the effect of varying viewing conditions on the human eye’s perception of golf ball colors and color shades.

SUMMARY OF THE INVENTION

[0009] Therefore, the invention is directed to a set of golf balls and package assembly, comprising: a package defining at least one cavity for housing a golf ball set; the golf ball set comprising a series comprising n golf balls, each having an overall color appearance of one of a different colors expressed in the CIE CIECAM color system wherein n>1; the series being ordered in a color progression such that at least one of the a, b, h, j and C values, as defined in the CIE CIECAM color system, is different.

[0010] The invention is also directed to a method of making a set of golf balls and package assembly, comprising: providing a package defining at least one cavity for housing a golf ball set; providing a set of G golf balls wherein G≥2, such that n golf balls of the set are arranged in a series, wherein n>1, the series being ordered in a color progression such that at least one of the a, b, h, j and C values, as defined in the CIE CIECAM color system, is different for each of the n golf balls; providing the set of G golf balls in the at least one cavity, and providing and/or securing a cover for the package to complete the package assembly.

[0011] In one embodiment, n=4 such that a1>a2>a3>a4. In another embodiment, n=4 such that a1<a2<a3<a4. In yet another embodiment, n=4 such that a1>a2>a3>a4. In still another embodiment, n=4 such that a1>a2>a3>a4. In a different embodiment, n=4 such that a1>a2>a3<a4. In an alternative embodiment, n=4 such that a1<a2<a3>a4.

[0012] In one embodiment, n=4 such that b1>b2>b3>b4. In another embodiment, n=4 such that b1>b2>b3<b4. In yet another embodiment, n=4 such that b1>b2>b3>b4. In still
another embodiment, n≥4 such that b₁>b₂>b₃>b₄. In a different embodiment, n≥4 such that b₁>b₂>b₃>b₄. In an alternative embodiment, n≥4 such that b₁>b₂>b₃>b₄. In another embodiment, n≥4 such that b₁>b₂>b₃>b₄. In yet another embodiment, n≥4 such that b₁>b₂>b₃>b₄. In still another embodiment, n≥4 such that b₁>b₂>b₃>b₄. In a different embodiment, n≥4 such that b₁>b₂>b₃>b₄. In an alternative embodiment, n≥4 such that b₁>b₂>b₃>b₄.


In one embodiment, C₁>C₂>C₃>C₄. In another embodiment, C₁>C₂>C₃>C₄. In yet another embodiment, C₁>C₂>C₃>C₄. In still another embodiment, C₁>C₂>C₃>C₄. In a different embodiment, C₁>C₂>C₃>C₄. In an alternative embodiment, C₁>C₂>C₃>C₄.

In one embodiment, 30°<h₁<30°; 0°<h₂<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; 0°<h₂<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; 0°<h₂<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; 0°<h₂<30°; and 360°-h₂>240°.

In yet another embodiment, 30°<h₁<30°; 0°<h₂<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; 0°<h₂<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; 0°<h₂<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; 0°<h₂<30°; and 360°-h₂>240°.

In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In an alternative embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still a different embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.

In yet a different embodiment, 30°<h₁<30°; and 360°-h₂>240°. In another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In yet another embodiment, 30°<h₁<30°; and 360°-h₂>240°. In still another embodiment, 30°<h₁<30°; and 360°-h₂>240°.
The packaging and golf balls of the invention may incorporate many colors and color combinations expressed in the CIECAM color system. For example, a golf ball may have an overall golf ball color of pink or purple comprising a core, a cover and an intermediate layer, wherein at least one of the core, intermediate layer and cover comprises a pigment, dye, or tint which contributes to the color, the color having an a value, a b value and a hue angle value h expressed in the CIE CIECAM color system, wherein: where the a value is from about 5 to about 57, then the b value is from about –1 to about –60 and the hue angle h is from about 271° to about 359°; and where the a value is from about 58 to about 95, then the b value is from about 1 to about 60 and the hue angle h is from about 1° to about 35°.

In another embodiment, a golf ball having an overall golf ball color of pink or purple comprises a core, a cover and an intermediate layer disposed between the core and the cover, wherein the cover is at least partially transparent and at least one of the cover and the intermediate layer comprises a pigment, dye or tint which contributes to the color, said color having an a value, a b value and a hue angle value h expressed in the CIE CIECAM color system, wherein: where the a value is from about 5 to about 57, then the b value is from about –1 to about –60 and the hue angle h is from about 271° to about 359°; and where the a value is from about 58 to about 95, then the b value is from about 1 to about 60 and the hue angle h is from about 1° to about 35°.

In yet another embodiment, a golf ball having an overall golf ball color of pink or purple comprises a core, a cover and an intermediate layer disposed between the core and the cover, wherein the intermediate layer comprises a pigment or dye which contributes to the color, wherein the cover comprises a transparent material and a pigment or dye which contributes to the color, and wherein the surface of said cover is coated with a coating material which is at least partially transparent and comprises a tint which contributes to the color, the color having an a value, a b value and a hue angle value h expressed in the CIE CIECAM color system, wherein: where the a value is from about 5 to about 57, then the b value is from about –1 to about –60 and the hue angle h is from about 271° to about 359°; and where the a value is from about 58 to about 95, then the b value is from about 1 to about 60 and the hue angle h is from about 1° to about 35°.

In still another embodiment, a golf ball having an overall golf ball color of pink or purple comprises a core and a cover, wherein the cover comprises a pigment or dye which contributes to the color, and wherein the surface of said cover is coated with a coating material which is at least partially transparent and comprises a tint which contributes to the color, the color having an a value, a b value and a hue angle value h expressed in the CIE CIECAM color system, wherein: where the a value is from about 5 to about 57, then the b value is from about –1 to about –60 and the hue angle h is from about 271° to about 359°; and where the a value is from about 58 to about 95, then the b value is from about 1 to about 60 and the hue angle h is from about 1° to about 35°.

In a further embodiment, a golf ball having an overall golf ball color of pink or purple comprises a core and a cover wherein at least one of the core and the cover comprises a pigment, dye or tint which contributes to the color such that the color has an a value, a b value and a hue angle value h expressed in the CIE CIECAM color system, wherein: where the a value is from about 5 to about 57, then the b value is from about –1 to about –60 and the hue angle h is from about 271° to about 359°; and where the a value is from about 58 to about 95, then the b value is from about 1 to about 60 and the hue angle h is from about 1° to about 35°.

The invention also pertains to a one piece golf ball having an overall golf ball color of pink or purple comprising a single solid sphere and a coating wherein at least one of the sphere and the coating comprises a pigment, dye or tint which contributes to the color such that the color has an a value, a b value and a hue angle value h expressed in the CIE CIECAM color system, wherein: where the a value is from about 5 to about 57, then the b value is from about –1 to about –60 and the hue angle h is from about 271° to about 359°; and where the a value is from about 58 to about 95, then the b value is from about 1 to about 60 and the hue angle h is from about 1° to about 35°.

In any or all of the embodiments disclosed or claimed herein, the overall golf ball color may also have a J lightness value expressed in the CIE CIECAM color system of from about 15-90 and/or a C chroma value expressed in the CIE CIECAM color system of from about 30 to about 90. Alternatively, the overall golf ball color may have a J lightness value expressed in the CIE CIECAM color system of from about 40-90 and/or a C chroma value expressed in the CIE CIECAM color system of from about 50 to about 90.

Other embodiments for each of the ball constructions described above are envisioned wherein the CIECAM color values for the overall golf ball are as follows. The color may alternatively have an a value, a b value and a hue angle value h expressed in the CIE CIECAM color system, wherein: where the a value is from about 52 to about 58, the b value is from about –30 to about 30 and the hue angle h is either from about 330° to about 359° or from about 1° to about 30°.

The cover may comprise thermoset and/or thermoplastic materials. The cover may comprise materials selected, for example from the group comprising polyurethane, polyurea, and ionomer resins. The cover may comprise a material, which is at least partially translucent, transparent, or pearlescent. In one embodiment, both the cover and intermediate layer comprise a material which is at least partially translucent, transparent, or pearlescent. The cover may further comprise particulate material selected from the group comprising metal flake, iridescent glitter, metalized film and colored polyester foil. The cover may also incorporate traditional effect pigments.

In one embodiment, the pigment, dye or tint may be fluorescent. The pigment, dye or tint may also be inorganic or organic.

Herein, the term “pigment” refers to any vehicle or means for contributing color and/or color effects to the golf ball.

Herein, the term color or “overall golf ball color” refers to the color of a finished golf ball as perceived by the golfer according to the CIECAM color appearance model parameters disclosed herein. Color may also include a color shade within a color. For example, golf balls in a series may all be red but each golf ball in the series is a different shade of red as expressed in the CIECAM color appearance model.

The term “pink” includes/references to any color which satisfies the CIECAM system parameter values described or set forth herein and may be used interchangeably with other common similar color terms which may also satisfy these parameters, including for example without limitation light crimson or pale reddish purple.
The term “purple” includes/refers to any color which satisfies the CIECAM system values/parameters described or set forth herein and may be used interchangeably with other common similar color terms which may also satisfy these parameters including, for example, without limitation, violet, lilac, indigo, reddish violet, or blue violet. In fact, the packaging and golf ball of the invention may incorporate numerous other/additional colors and color shades such as but not limited to blue, yellow, orange, red, green as expressed in the CIECAM system—as such colors are perceived by humans most favorably under a wide range of varied viewing conditions—whether viewed singly or in combination by the human eye.

A golf ball of the invention incorporates color using the CIE CIECAM color appearance model which was developed based on human perception and permits the golf ball manufacturer to accurately predict how the average golfer will perceive a specific overall golf ball color shade under different viewing conditions. In this way, it becomes possible for a golf ball manufacturer to identify and incorporate into a golf ball only those color shades which are most likely to produce the least variance in a golfer’s perception of color in response to the expected changes to stimuli on the golf course and therefore be most appealing to the golfer’s eye under a variety of viewing circumstances.

The overall golf ball may have a compression of from about 25 to about 110. In another embodiment, the overall golf ball has a compression of from about 25 to about 110. In another embodiment, the overall golf ball has a compression of from about 35 to about 100. In yet another embodiment, the overall golf ball has a compression of from about 45 to about 95. In still another embodiment, the compression may be from about 55 to about 85, or from about 65 to about 75. Meanwhile, the compression may also be from about 50 to about 110, or from about 60 to about 100, or from about 70 to about 90, or even from about 80 to about 110.

Generally, the overall golf ball coefficient of restitution (COR) is at least about 0.780. In another embodiment, the overall golf ball COR is at least about 0.788. In yet another embodiment, the overall golf ball COR is at least about 0.791. In another embodiment, the overall golf ball COR is at least about 0.794. Also, the overall golf ball COR may be at least about 0.797. The overall golf ball COR may even be at least about 0.800, or at least about 0.803, or at least about 0.812.

The moment of inertia for a golf ball of the invention may be from about 0.410 oz-in² to about 0.470 oz-in². The moment of inertia for a one piece ball that is 1.62 ounces and 1.68 inches in diameter may be approximately 0.4572 oz-in², which is the baseline moment of inertia value.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts a CIECAM hue circle as described herein.

DETAILED DESCRIPTION

The present invention is directed to a golf ball comprising at least a core or a multi-piece core and a cover. The cover may comprise a translucent or transparent material that can be cast, injection molded, compression molded or reaction injection molded over a golf ball precursor or subassembly. Additionally, the cover comprises a plurality of dimples on its surface. The golf ball may also comprise an intermediate layer between the core and the cover. As taught in parent U.S. patent application Ser. No. 11/707,493 (published as US 2007/0149323), which has been incorporated by reference in its entirety, the cover may comprise a substantially optically transparent or translucent material, so that the intermediate layer or core contributes to the color characteristics of the ball. The intermediate layer or core may be white, transparent or translucent, colored, or may have a multi-colored pattern. The intermediate layer may be opaque, transparent or translucent, or be white or comprise one or more colors. The cover may be translucent and may comprise an amount of pigment or dye, creating a colored but translucent cover under which the intermediate or outer core layer is visible. In this embodiment, the intermediate layer, which can be an outer core layer, may be colored or may comprise a pattern that is visible through the translucent outer cover. The intermediate or outer core layer may also be printed with indicia or other markings that may be viewed through the clear or translucent cover. The cover may also comprise an amount of reflective particulates to create a pearl-like or pearlescent effect.

The colored core, intermediate layer, cover or coating of any embodiment herein embodiment may be pink, light crimson, pale reddish purple, lilac, purple, indigo, violet, for example. Additionally, golf balls of the present invention having partially translucent covers and an amount of dye or pigment would incorporate the same colors in accordance with the CIECAM color model parameters disclosed herein.

Under the CIECAM model, 3 represents the lightness of a color and varies from 0 (black) to 100 (white). C or Chroma represents the intensity of the color, which may range from 0 (neutral) to 100. Meanwhile, either

The colored core, intermediate layer, cover or coating of any embodiment herein embodiment may be pink, light crimson, pale reddish purple, lilac, purple, indigo, violet, for example. Additionally, golf balls of the present invention having partially translucent covers and an amount of dye or pigment would incorporate the same colors in accordance with the CIECAM color model parameters disclosed herein.

The colored core, intermediate layer, cover or coating of any embodiment herein embodiment may be pink, light crimson, pale reddish purple, lilac, purple, indigo, violet, for example. Additionally, golf balls of the present invention having partially translucent covers and an amount of dye or pigment would incorporate the same colors in accordance with the CIECAM color model parameters disclosed herein.

The colored core, intermediate layer, cover or coating of any embodiment herein embodiment may be pink, light crimson, pale reddish purple, lilac, purple, indigo, violet, for example. Additionally, golf balls of the present invention having partially translucent covers and an amount of dye or pigment would incorporate the same colors in accordance with the CIECAM color model parameters disclosed herein.

The colored core, intermediate layer, cover or coating of any embodiment herein embodiment may be pink, light crimson, pale reddish purple, lilac, purple, indigo, violet, for example. Additionally, golf balls of the present invention having partially translucent covers and an amount of dye or pigment would incorporate the same colors in accordance with the CIECAM color model parameters disclosed herein.

The colored core, intermediate layer, cover or coating of any embodiment herein embodiment may be pink, light crimson, pale reddish purple, lilac, purple, indigo, violet, for example. Additionally, golf balls of the present invention having partially translucent covers and an amount of dye or pigment would incorporate the same colors in accordance with the CIECAM color model parameters disclosed herein.

The colored core, intermediate layer, cover or coating of any embodiment herein embodiment may be pink, light crimson, pale reddish purple, lilac, purple, indigo, violet, for example. Additionally, golf balls of the present invention having partially translucent covers and an amount of dye or pigment would incorporate the same colors in accordance with the CIECAM color model parameters disclosed herein.

The colored core, intermediate layer, cover or coating of any embodiment herein embodiment may be pink, light crimson, pale reddish purple, lilac, purple, indigo, violet, for example. Additionally, golf balls of the present invention having partially translucent covers and an amount of dye or pigment would incorporate the same colors in accordance with the CIECAM color model parameters disclosed herein.

The colored core, intermediate layer, cover or coating of any embodiment herein embodiment may be pink, light crimson, pale reddish purple, lilac, purple, indigo, violet, for example. Additionally, golf balls of the present invention having partially translucent covers and an amount of dye or pigment would incorporate the same colors in accordance with the CIECAM color model parameters disclosed herein.
the intermediate layer or cover layer may solely contribute a violet color or pink color to the final overall golf ball color appearance.

[0092] The present invention is directed to a golf ball comprising color shades which the player will perceive most favorably irrespective of changed viewing conditions. The golf ball of the invention incorporates color shades into a golf ball according to a color model which accounts for/considers a human’s varied perception of color shades according to certain expected changes to the stimuli, such as the weather changing from sunny to cloudy, or from golfer playing at different times of day, or the golf ball being struck on different colored playing surfaces.

[0093] A golf ball of the invention incorporates color using the CIECAM color appearance model which was developed based on human perception and permits the golf ball manufacturer to accurately predict how the average golfer will perceive a specific golf ball color shade under different conditions. In this way, it becomes possible for the golf ball manufacturer to identify and incorporate into a golf ball only those color shades which remain most visually desirable to the golfer under a wide range of changing viewing conditions as well as are most likely to produce the least variance in a golfer’s perception of color in response to the expected changes to stimuli on the golf course.

[0094] The golf ball of the invention incorporates colors taking into account the tristimulus values (X, Y, and Z) of the stimulus, its background, its surround, the adapting stimulus, the luminance level, and other factors such as cognitive discounting of the luminant. The model includes correlations for perceptual attributes including brightness, lightness, colorfulness, chroma, saturation and hue.

[0095] The core may be a wound core, which is visible through the clear or translucent cover. The uneven surface of the wound core creates a unique visual effect, as the crevices and ledges created by the wound elastomeric material create shadows visible through the clear or translucent cover. An intermediate layer may be disposed around the wound core. In this instance, the intermediate layer is visible through the clear or translucent cover and may be white, colored, or comprise multiple colors as disclosed herein in various patterns.

[0096] A cover of the golf ball of the present invention may comprise surface off-sets, or depressions or projections, on its surface. Surface off-sets include dimples and marking other than dimples. For instance, the surface of the translucent cover may comprise depressed logos, text, lines, arcs, circles or polygons. The surface may also comprise raised projections in the form of logos, text, lines, arcs, circles or polygons. The inclusion of such surface off-sets on the translucent cover creates a unique visual effect, as the juxtaposition of thick and thin portions of the translucent cover material creates a “shadow” effect on the opaque surface below the translucent cover.

[0097] The cover of the golf ball of the present invention may have a thickness between 0.02 and 0.1 inch. More preferably, the cover has a thickness between 0.02 and 0.08 inches. Most preferably, the cover has a thickness between 0.025 and 0.07 inches. Additionally, the golf ball preferably has a coefficient of restitution of at least 0.700 and an Atti compression between 50 and 120. The thickness of the intermediate layer may be between 0.01 and 0.06 inches. More preferably, the intermediate layer has a thickness between 0.02 and 0.025 inches. Most preferably, the intermediate layer has a thickness between 0.03 and 0.05 inches. The core of the golf ball of the present invention may have a diameter between 0.5 and 1.62 inches. More preferably, the core has a thickness between 0.8 and 1.61 inches. Most preferably, the core has a thickness between 1.0 and 1.6 inches.

[0098] Preferably, a cover of the present invention is made from thermoplastic and thermoset materials, preferably polyurethane, polyurea, and ionomer resins.

[0099] Polyurethane that is useful in the present invention includes the reaction product of polyisocyanate, at least one polyl, and at least one curing agent. Any polyisocyanate available to one of ordinary skill in the art is suitable for use according to the invention. Exemplary polyisocyanates include, but are not limited to, 4,4’-diphenylmethane disiocyanate (“MDI”), polymeric MDI, carbodiimide-modified liquid MDI, 4,4’-dicyclopentylmethane disiocyanate (“H1,6MDI”), p-phenylene disiocyanate (“PPDI”), m-phenylene disiocyanate (“MPDI”), toluene disiocyanate (“TDI”), 3,3’-dimethyl-4,4’-biphenylene disiocyanate (“TODI”), isophoronedisocyanate (“IPDI”), hexamethylene disiocyanate (“HDI”), naphthalene disiocyanate (“NDI”), xylene disiocyanate (“XDI”); p-tetramethylxylene disiocyanate (“p-TMXDI’’); m-tetramethylxylene disiocyanate (“m-TMXDI’’); ethylene disiocyanate; propylene-1,2-disiocyanate; tetramethyle-1,4-disiocyanate; cyclolhexyl disiocyanate; 1,6-hexamethylene disiocyanate (“HDI’’); dodecan-1,12-disiocyanate; cyclobutane-1,3-disiocyanate; cyclohexane-1,3-disiocyanate; cyclohexane-1,4-disiocyanate; 1-isocyanato-3,3,5-trimethyl-5-isocyanatomethylcyclohexane; methyl cyclohexyl disiocyanate; isocyanurate of HDI; trisocyanate of 2,4,4-trimethyl-1,6-hexane disiocyanate (“TMDI’’), tetracene disiocyanate, naphthalene disiocyanate, anthracene disiocyanate, and mixtures thereof. Polysiocyanates are known to those of ordinary skill in the art as having more than one isocyanate group, e.g., di-, tri-, and tetra-isocyanate. The polyisocyanate may include H1,6MDI, MDI, PPDI, TDI, or a mixture thereof. It should be understood that, as used herein, the term “MDI” includes 4,4’-diphenylmethane disiocyanate, polymeric MDI, carbodiimide-modified liquid MDI, and mixtures thereof and, additionally, that the disiocyanate employed may be “low free monomer,” understood by one of ordinary skill in the art to have lower levels of “free” isocyanate monomer, typically less than about 0.1 percent to about 0.5 percent free monomer. Examples of “low free monomer” disiocyanates include, but are not limited to Low Free Monomer MDI, Low Free Monomer TDI, Low Free MPDI, and Low Free Monomer MPDI.

[0100] The at least one polyisocyanate should have less than about 14 percent unreacted NCO groups. Preferably, the at least one polyisocyanate has less than about 7.9 percent NCO, more preferably, between about 2.5 percent and about 7.8 percent, and most preferably, between about 4 percent to about 6.5 percent. In an alternative embodiment, the at least one polyisocyanate could have more than about 14 percent unreacted NCO groups, which would be suitable if the golf balls are made by means of reaction injection molding (RIM).

[0101] As used herein, the term “percent NCO” or “% NCO” refers to the percent by weight of free, reactive, and unreacted isocyanate functional groups in an isocyanate-functional molecule or material. The total formula weight of all the NCO groups in the molecule or material, divided by its total molecular weight, and multiplied by 100, equals the percent NCO.
Any polyol available to one of ordinary skill in the art is suitable for use according to the invention. Exemplary polyols include, but are not limited to, polyether polyols, hydroxy-terminated polybutadiene and partially/fully hydrogenated derivatives, polyester polyols, polycaprolactone polyols, and polycarbonate polyols. In one preferred embodiment, the polyol includes polyether polyol, more preferably those polyols that have the generic structure:

where $R_1$ and $R_2$ are straight or branched hydrocarbon chains, each containing from 1 to about 20 carbon atoms, and $n$ ranges from 1 to about 45. Examples include, but are not limited to, polytetramethylene ether glycol, polyethylene propylene glycol, polyoxypropylene glycol, and mixtures thereof. The hydrocarbon chain can have saturated or unsaturated bonds and substituted or unsubstituted aromatic and cyclic groups. Preferably, the polyol of the present invention includes PTMEG.

In another embodiment, polyester polyols are included in the polyurethane material of the invention. Preferred polyester polyols have the generic structure:

where $R_1$ and $R_2$ are straight or branched hydrocarbon chains, each containing from 1 to about 20 carbon atoms, and $n$ ranges from 1 to about 25. Suitable polyester polyols include, but are not limited to, polyethylene adipate glycol, polybutylene adipate glycol, polyethylene propylene adipate glycol, ortho-phthalate-1,6-hexanediol, and mixtures thereof. The hydrocarbon chain can have saturated or unsaturated bonds, or substituted or unsubstituted aromatic and cyclic groups.

In another embodiment, polycaprolactone polyols are included in the materials of the invention. Preferably, any polycaprolactone polyols have the generic structure:

where $R_1$ is a straight chain or branched hydrocarbon chain containing from 1 to about 20 carbon atoms, and $n$ is the chain length and ranges from 1 to about 20. Suitable polycaprolactone polyols include, but are not limited to, 1,6-hexanediol-initiated polycaprolactone, diethylene glycol initiated polycaprolactone, trimethyl propane initiated polycaprolactone, neopentyl glycol initiated polycaprolactone, 1,4-butanediol-initiated polycaprolactone, and mixtures thereof. The hydrocarbon chain can have saturated or unsaturated bonds, or substituted or unsubstituted aromatic and cyclic groups.

In yet another embodiment, the polycarbonate polyols are included in the polyurethane material of the invention. Preferably, any polycarbonate polyols have the generic structure:

where $R_1$ is predominantly bisphenol A units -(p-C$_6$H$_4$)$_n$—C (CH$_2$)$_2$-(p-C$_6$H$_4$)$_m$— or derivatives thereof, and $n$ is the chain length and ranges from 1 to about 20. Suitable polycarbonates include, but are not limited to, polyphthalate carbonate. The hydrocarbon chain can have saturated or unsaturated bonds, or substituted or unsubstituted aromatic and cyclic groups. In one embodiment, the molecular weight of the polycarbonate is from about 200 to about 4000.

Polyamine curatives are also suitable for use in the polyurethane composition of the invention and have been found to improve cut, shear, and impact resistance of the resultant balls. Preferred polyamine curatives have the general formula:

where $n$ and $m$ each separately have values of 0, 1, 2, or 3, and where $Y$ is ortho-cyclohexyl, meta-cyclohexyl, para-cyclohexyl, ortho-phenylene, meta-phenylene, or para-phenylene, or a combination thereof. Preferred polyamine curatives include, but are not limited to, 3,5-dimethylthio-2,4-toluenediamine and isomers thereof (trade name ETHACURE 100 and/or ETHACURE 100 LC), 3,5-diethyltoluene-2,4-diisocyanate and isomers thereof, such as 3,5-diethyltoluene-2,6-diisocyanate; 4,4'-bis(sec-butylamino)-diphenylmethane; 1,4-bis(sec-butylamino)-benzene; 4,4'-methylene-bis(2-chloroanilnine); 4,4'-methylene-bis(3-chloro-2,6-diethylanilnine); trimethylene glycol-di-p-aminobenzoate; polytetramethylenoxide-di-p-aminobenzoate; NN'-dialkyldiamino diphenyl methane; para, para'-methylene dianiline (MDA), m-phenylenediamine (MPDA), 4,4'-methylene-bis(2-chloroanilnine) (MOCA), 4,4'-methylene-bis(2,6-diethylanilnine), 4,4'-diamino-3,3'-diethyl-5,5'-dimethyl diphenylmethane, 2,2',3,3'-tetrachloro diamino diphenylmethane, 4,4'-methylene-bis(3-chloro-2,6-diethylanilnine), (LONZACURE M-CDEA), trimethylene glycol di-p-aminobenzoate (VERSALINK 740M), and mixtures thereof. Preferably, the curing agent of the present invention includes 3,5-dimethylthio-2,4-toluenediamine and isomers thereof, such as ETHACURE 300, commercially available from Albermarle Corporation of Baton Rouge, La. Suitable polyamine curatives, which include both primary and secondary amines, preferably have molecular weights ranging from about 64 to about 2000. Preferably, $n$ and $m$, each separately, have values of 1, 2, or 3, and preferably, 1 or 2.

At least one of a diol, triol, tetraol, hydroxy-terminated, may be added to the aforementioned polyurethane composition. Suitable hydroxy-terminated curatives have the following general chemical structure:
where \( n \) and \( m \) each separately have values of 0, 1, 2, or 3, and where \( X \) is ortho-phenylene, meta-phenylene, para-phenylene, ortho-cyclohexyl, meta-cyclohexyl, or para-cyclohexyl, or mixtures thereof. Preferably, \( n \) and \( m \), each separately, have values of 1, 2, or 3, and more preferably, 1 or 2.

Preferred hydroxy-terminated curatives for use in the present invention include at least one of 1,3-bis(2-hydroxyethoxy)benzene and 1,3-bis-[2-(2-hydroxyethoxy)ethoxy] benzene, and 1,3-bis-[2-(2-hydroxyethoxy)ethoxy] benzene, 1,4-butanediol, resorcinol-di-(β-hydroxyethyl)ether, and hydroquinone-di-(β-hydroxyethyl) ether, and mixtures thereof. Preferably, the hydroxy-terminated curatives have molecular weights ranging from about 48 to 2000. It should be understood that molecular weight, as used herein, is the absolute weight average molecular weight and would be understood as such by one of ordinary skill in the art. Both the hydroxy-terminated and amine curatives can include one or more saturated, unsaturated, aromatic, and cyclic groups. Additionally, the hydroxy-terminated and amine curatives can include one or more halogen groups. Suitable diol, triol, and tetrol groups include ethylene glycol, diethylene glycol, polyethylene glycol, propylene glycol, polypropylene glycol, lower molecular weight polytetramethylene ether glycol, and mixtures thereof. The polyurethane composition can be formed with a blend or mixture of curing agents. If desired, however, the polyurethane composition can be formed with a single curing agent.

The cover may alternatively comprise polyurea. In one embodiment, the polyurea prepolymer includes at least one diisocyanate and at least one polyether amine.

In this aspect of the invention the diisocyanate is preferably saturated, and can be selected from the group consisting of ethylene diisocyanate, propylene-1,2-diisocyanate; tetramethylene diisocyanate; tetramethyle-1,4-diisocyanate; 1,6-hexamethylene diisocyanate; octamethylene diisocyanate; decamethylene diisocyanate; 2,2,4-trimethylhexamethylene diisocyanate; 2,4,4-trimethylhexamethylene diisocyanate; dodecane-1,12-diisocyanate; dicyclohexylmethane diisocyanate; cyclobutane-1,3-diisocyanate; cyclohexane-1,2-diisocyanate; cyclohexane-1,3-diisocyanate; and mixtures thereof. The saturated diisocyanate is preferably selected from the group consisting of isophoronediisocyanate, 4,4'-dicyclohexylmethane diisocyanate, 1,6-hexamethylene diisocyanate, or a combination thereof.

In another embodiment, the diisocyanate is an aromatic aliphatic isocyanate selected from the group consisting of meta-tetramethylene diisocyanate; para-tetramethylene diisocyanate; trimerized isocyanurate of polyisocyanate; dimerized urea of polyisocyanate; modified polyisocyanate; and mixtures thereof.

[0112] The polyether amine may be selected from the group consisting of polytetramethylene ether diamines, polyoxypropylene diamines, polyethylene oxide capped oxypropylene ether diamines, triethyleneglycol diamines, polyethylene oxide-based triamines, trimethylolpropane-based triamines, glycerin-based triamines, and mixtures thereof. In one embodiment, the polyether amine has a molecular weight of about 1000 to about 3000.

[0113] The curing agent may be selected from the group consisting of hydroxy-terminated curing agents, amine-terminated curing agents, and mixtures thereof, and preferably has a molecular weight from about 250 to about 4000.

[0114] In one embodiment, the hydroxy-terminated curing agents are selected from the group consisting of ethylene glycol; diethylene glycol; polyethylene glycol; propylene glycol; 2-ethyl-1,3-propanediol; 2-ethyl-1,4-butanediol; dipropylene glycol; polypropylene glycol; 1,2-butanediol; 1,3-butanediol; 1,4-butanediol; 2,3-butanediol; 2,3-dimethyl-2,3-butanediol; trimethylolpropane; cyclohexyldimethyol; triisopropanolamine; tetra-(2-hydroxypropyl)-ethylene diamine; diethylene glycol di-(aminopropyl)ether; 1,5-pentanediol; 1,6-hexanediol; 1,3-bis-(2-hydroxyethoxy) cyclohexane; 1,4-cyclohexyldimethyol; 1,3-bis-[2-(2-hydroxyethoxy)ethyl]cyclohexane; 1,3-bis-[2-(2-hydroxyethoxyethoxy)ethyl]cyclohexane; or trimethylolpropane; polytetramethylene ether glycol, preferably having a molecular weight from about 250 to about 3900; and mixtures thereof.

[0115] The amine-terminated curing agents may be selected from the group consisting of ethylene diamine; hexamethylene diamine; 1-methyl-2,6-cyclohexyl diamine; tetrahydroxypropylene ethylene diamine; 2,2,4- and 2,4,4-trimethyl-1,6-hexanediame; 4,4'-bis-(sec-butylamino)-dicyclohexylmethane; 1,4-bis-(sec-butylamino)-cyclohexane; 1,2-bis-(sec-butylamino)-cyclohexane; derivatives of 4,4'-bis-(sec-butylamino)-dicyclohexylmethane; 4,4'-dicyclohexylmethane diamine; 1,4-cyclohexane-1,3-bis-(methylamine); 1,3-cyclohexane-1,3-bis-(methylamine); diethylene glycol di-(aminopropyl)ether; 2-methylpentamethylene diamine; diaminoxycyclohexane; diethylene triamine; triethylene tetramine; tetraethylene pentamine; propylene diamine; 1,3-diaminopropane; dimethylaminopropylamine; diethyldiamine propylamine; imido-bis-propylamine; monoethanolamine, diethanolamine; triethanolamine; monoiso propanolamine, diisopropanolamine; isophoronediamine; and mixtures thereof.

[0116] In one embodiment, the composition further includes a catalyst that can be selected from the group consisting of a bismuth catalyst, zinc octoate, di-butyltin dilaurate, di-butyltin diacetate, tin (II) chloride, tin (IV) chloride, di-butyltin dimethoxide, dimethyl-3-[1-oxoenedecyl]oxy stannate, di-n-octyltin bis-isooctyl mercaptoproacetate, triethylendiamine, triethylene diamine, tributylamine, oleic acid, acetic acid; delayed catalysts, and mixtures thereof. The catalyst may be present from about 0.005 percent to about 1 percent by weight of the composition.

[0117] Any method available to one of ordinary skill in the art may be used to combine the polyisocyanate, polyol or polyamine, and curing agent of the present invention. One commonly employed method, known in the art as a one-shot
method, involves concurrent mixing of the polyisocyanate, polyol or polyether amine, and curing agent. This method results in a mixture that is inhomogeneous (more random) and affords the manufacturer less control over the molecular structure of the resultant composition. A preferred method of mixing is known as the prepolymer method. In this method, the polyisocyanate and the polyol or polyether amine are mixed separately prior to addition of the curing agent. This method seems to afford a more homogeneous mixture resulting in a more consistent polymer composition.

As mentioned above, the cover layer may also comprise ionomeric materials, such as ionic copolymers of ethylene and an unsaturated monocarboxylic acid, which are available under the trademark SURLYN® of E.I. DuPont de Nemours & Co., or Wilmington, Del., or IOTEK® or ESCOR® of Exxon. These are copolymers or terpolymers of ethylene and methacrylic acid or acrylic acid totally or partially neutralized, i.e., from about 1 to about 100 percent, with salts of zinc, sodium, lithium, magnesium, potassium, calcium, manganese, nickel or the like. In one embodiment, the carboxylic acid groups are neutralized from about 10 percent to about 100 percent. The carboxylic acid groups may also include methacrylic, crotonic, maleic, fumaric or itaconic acid. The salts are the reaction product of an olefin having from 2 to 10 carbon atoms and an unsaturated monocarboxylic acid having 3 to 8 carbon atoms.

The cover layer may also include at least one ionicomer, such as acid-containing ethylene copolymer ionomers, including E/XY terpolymers where E is ethylene, X is an acrylate or methacrylate-based softening comonomer present in about 0 to 50 weight percent and Y is acrylic or methacrylic acid present in about 5 to 35 weight percent. The ionomer may include so-called “low acid” and “high acid” ionomers, as well as blends thereof. In general, ionic copolymers including up to about 15 percent acid are considered “low acid” ionomers, while those including greater than about 15 percent acid are considered “high acid” ionomers. “Low acid” ionomers may be combined with a softening comonomer such as vinyl esters of aliphatic carboxylic acids wherein the acids have 2 to 10 carbon atoms, vinyl ethers wherein the alkyl groups contain 1 to 10 carbon atoms, and alkyl acrylates or methacrylates wherein the alkyl group contains 1 to 10 carbon atoms. Suitable softening comonomers include vinyl acetate, methyl acrylate, methyl methacrylate, ethyl acrylate, ethyl methacrylate, butyl acrylate, and butyl methacrylate, and are believed to impart high spin to golf balls.

Covers comprising “high acid” ionomers are believed to impart low spin and longer distance to golf balls. A cover of the present invention may comprise about 15 to about 35 weight percent acrylic or methacrylic acid, making the ionomer a high modulus ionomer. An additional ionomer such as an acrylate ester (i.e., iso- or n-butylacrylate, etc.) can also be included to produce a softer terpolymer. The additional ionomer may be selected from the group consisting of vinyl esters of aliphatic carboxylic acids wherein the acids have 2 to 10 carbon atoms, vinyl ethers wherein the alkyl groups contain 1 to 10 carbon atoms, and alkyl acrylates or methacrylates wherein the alkyl group contains 1 to 10 carbon atoms. Suitable softening comonomers include vinyl acetate, methyl acrylate, methyl methacrylate, ethyl acrylate, ethyl methacrylate, butyl acrylate, butyl methacrylate, or the like.

The core of the present invention may comprise a polymer such as ionomeric copolymers and terpolymers, thermoset materials, ionomer precursors, thermoplastics, thermoplastic elastomers, polybutadiene rubber, balata, graft copolymerized non-catalyzed polymers, single-site polymers, high-crystalline acid polymers, cationic ionomers, and mixtures thereof. The core may be colored or may be transparent or translucent. As used herein, and as discussed in commonly-owned U.S. Patent Publication No. 2007/0149323, previously incorporated by reference, the term “core” refers to any portion of the golf ball surrounded by the cover.
the parting line resulting from compression molding may be
maintained on the clear or translucent cover to create unique
visual effects, such as the enhancement of shadows on the
core of the ball.
[0128] In other embodiments, these artifacts from the
manufacturing process may be removed by post-mold finish-
ing processes such as vibration tumbling.
Other non-limiting examples of surface off-sets include a
molded stripe, which can be co-molded to provide the stripe
with a color different than the core or the intermediate layer,
so that the ball may identified as a practice ball; a molded line
to aid in putting alignment; logos or indicia; raised text or
indicia; great circles; lines or line segments; polygons or other
shapes; arcs or curves; or text. The molded elements
described above may be depressed into the cover or may rise
as projections away from the surface of the cover.
[0129] The surface of the golf ball may also include opti-
cally active sites detectable by a ball-launching mechanism to
allow for launch monitor testing. The sites may be reflective
in the visible or invisible range.
[0130] In another embodiment of the current invention, the
cover may be cast or compression molded. This process
involves the joining of two cover hemispheres at an equator.
Additionally, other inventive aspects of the present invention,
such as a cover comprising a transparent or translucent mate-
rial and having an amount of pigment or dye or an amount of
reflective particulates, may be incorporated into only one
hemisphere of the golf ball cover.
[0131] Dye or pigment may be added to the cover material
to create a golf ball having a translucent colored cover. In the
case of a golf ball with depressions molded into the cover, the
addition of dye to the cover material can help to enhance
the shadow effect of the depressions incorporated on the
surface of the cover. The dye may be a fluorescent dye.
[0132] In one aspect of the present invention, dyes or pig-
ments may be added to any or all layers of the golf ball
including, but not limited to, the cover and the core, the
intermediate layer and any coating as well. The dyes or pig-
ments may be inorganic or organic. In one embodiment, the
pigments include effect pigments.
[0133] According to another embodiment, the cover may
comprise reflective particulates to create the effect of sparkle,
glitter, pearlescence or iridescence. The cover may contain
reflective or optically active particulates such as described by
Murphy in U.S. Pat. No. 5,427,378 which is incorporated
herein by reference. Pearlescent pigments sold by the Mearle
Corporation can also be used in this way. The reflective mate-
rial may comprise at least one member selected from the
group consisting of metal flake, iridescent glitter, metalized
film and colored polyester foil.
[0134] In one embodiment of the present invention, the core
may comprise a swirled color pattern achieved by mixing
materials of different colors or different color shades during
the manufacture of the core. The swirled pattern of the core
can be created using the method described in U.S. Pat. No.
2,283,845, which is incorporated herein by reference in its
entirety.
[0135] In a variation of the above embodiment, the core
may be a multi-piece core having a center and an outer core
layer visible through the transparent or translucent cover.
Preferably, the outer core layer has a swirled appearance. The
outer swirled core layer may comprise molded rubber or
thermoplastic halves having a swirled pattern. The center of
the multi-piece core may comprise rubber or a blend thereof,
rubber regrind, filler, foam, liquid, or other suitable materials.
[0136] In another embodiment of the present invention, the
core may be formed from a slug or prep or perforin made from
multiple segments of differently color shaded material. The
slug may comprise at least three differently color shaded
segments, and each color shade segment accounts for at least
five percent of the total color coverage of the golf ball. The
multi-color shaded slug is molded to form a multi-colored
core.
[0137] The core may include a plurality of surface off-sets
including ridges, raised edges, points or other projections on
its outer surface. The clear or translucent cover is molded
around the core by casting, injection molding, compression
molding or other methods. The projections on the outer sur-
face of the core provide more surface area for the adherence
of the cover, decreasing the possibility of the separation or
delamination of the cover from the core. The surface of the
core may also include a plurality of depressions or valleys,
also increasing surface area and so providing for better adhe-
sion of the cover. The resulting ball is more durable than golf
balls comprising smooth cores.
[0138] A golf ball of the present invention may alternati-
vely comprise a clear or translucent cover, a core and an
intermediate layer including a plurality of surface off-sets
including ridges, raised edges, points or other projections on
its outer surface. The clear or translucent cover is molded
around the intermediate layer by casting, injection molding,
compression molding or other methods. As in the above
embodiment, the projections on the outer surface of the inter-
mediate layer provide more surface area for the adherence
of the cover, decreasing the possibility of the separation or
delamination of the cover and core.
[0139] The transparent or translucent cover of the present
invention may additionally act as a lens, magnifying the
appearance of the core or intermediate layer below. Any text,
logo or design printed on the core or intermediate layer will
then also be magnified. More particularly, the transparent or
translucent cover comprises a polymeric material having a
magnification factor from about 2x to about 5x to make text or
other markings printed on the surface of the layer immedi-
ately beneath the cover appear larger than its actual size. The
actual size of any text or markings is typically small given the
limited amount of space on the surface of the golf ball layer.
Because a player may not be able to easily discern the fine text
or marking, it is advantageous to magnify the physical appear-
cance of the indicia. The magnified appearance of the
core or intermediate layer or any marking on the surface of the
core or intermediate layer may also enhance a player’s ability
to visualize the ball, and hence may improve a player’s ability
to strike the ball in the desired location.
[0140] The golf balls of the present invention may be
painted, coated, or surface treated for further benefits. For
example, trademarks or other indicia may be printed, i.e.,
pad-printed, transfer printed, decal or ink jet printed, on the
inner layer such that they are visible through the translucent
cover. Protective and decorative coating materials, as well as
methods of applying such materials to the surface of a golf
ball cover, are well known in the golf ball art. Generally, such
cover materials comprise urethanes, urethane hybrids,
epoxies, polyesters and acrylics. If desired, more than one
coating layer can be used. Further discussion of finishing
treatments may be found in parent application Ser. No. 11/707,493, which was previously incorporated by reference in its entirety.

Table I below illustrates several non-limiting embodiments of the invention. Specifically, Table I displays the construction and overall golf ball CIECAM color appearance model color characteristics for five prophetic golf balls GB I-GB V. GB I is a 1 piece golf ball wherein the core contributes a pink pigment to the overall golf ball color and the coating contributes a pink tint to the overall golf ball. Fainting a golf ball having an overall golf ball pink color defined by the CIECAM Color Model characteristics $a=72, b=13, h=10^\circ, J=44$ and $C=73$. GB II is a coated 2 piece golf ball wherein the core contributes a pink pigment to the overall golf ball color, the cover contributes a pink dye to the overall golf ball color, and the coating contributes a pink tint to the overall golf ball forming a golf ball having an overall golf ball pink color defined by the CIECAM Color Model characteristics $a=74, b=16, h=12^\circ, J=35$, and $C=76$. GB III is a 2 piece golf ball wherein the core contributes a purple pigment to the overall golf ball color and the cover is translucent, forming a golf ball having an overall golf ball purple color defined by the CIECAM Color Model characteristics $a=33, b=32, h=316^\circ, J=46$, and $C=47$. GB IV is a 3 piece golf ball wherein the core is opaque, the intermediate layer contributes a purple pigment to the overall golf ball color and the cover is transparent to form a golf ball having an overall purple golf ball color defined by the CIECAM Color Model characteristics $a=39, b=-21, h=331^\circ, J=31$, and $C=44$. Finally, GB V is a 3 piece golf ball wherein the core is opaque, the intermediate layer contributes a purple pigment to the overall golf ball color and the cover is pearlescent with a purple tinted coating to form a golf ball having an overall purple golf ball color defined by the CIECAM Color Model characteristics $a=52, b=-26, h=334^\circ, J=50$, and $C=58$.

Example

In a prophetic embodiment representing only one possible embodiment of the invention, a set of 12 golf balls are housed in a package assembly comprising a package defining one cavity and housing the 12 golf balls. A series of the golf balls within the set comprises 4 golf balls, each having an overall color appearance expressed in the CIE CIECAM color system for one of the 4 different colors of the set. The series of golf balls in this example is ordered in a color progression such that at least one of the $a$, $b$, $h$, $J$, and $C$ values, as defined in the CIE CIECAM color system, is different:

Golf ball $n_1$ of the series has a CIE CIECAM red appearance wherein:
\[a_1 = 72,\]
\[b_1 = 13,\]
\[h_1 = 10^\circ,\]
\[J_1 = 44,\]
\[C_1 = 73.\]

Golf ball $n_2$ of the series has a CIE CIECAM orange appearance wherein:
\[a_2 = 59,\]
\[b_2 = 58,\]
\[h_2 = 44^\circ,\]
\[J_2 = 10,\]
\[C_2 = 82.\]

Golf ball $n_3$ of the series has a CIE CIECAM yellow appearance wherein:
\[a_3 = -2,\]
\[b_3 = 80,\]
\[h_3 = 91^\circ,\]
\[J_3 = 85,\]
\[C_3 = 80.\]

Golf ball $n_4$ of the series has a CIE CIECAM blue appearance wherein:
\[a_4 = -28,\]
\[b_4 = -60,\]
\[h_4 = 245^\circ,\]
\[J_4 = 34,\]
\[C_4 = 66.\]
Thus, for the golf balls in the series of this example, the relationships are as follows:

- $a_i \geq a_j \Rightarrow a_3 < a_4$
- $b_i \geq b_j \Rightarrow b_3 < b_4$
- $h_i \geq h_j \Rightarrow h_3 < h_4$

Therefore, in the golf ball series of this example, all five CIECAM color variables are different in golf balls $n_i$. Further, in this example, for series $n_i - n_a$, the following is also satisfied: $30^\circ < h_1 < 0^\circ$; $90^\circ < h_2 < 30^\circ$; $240^\circ < h_3 < 90^\circ$; and $360^\circ < h_4 < 240^\circ$. This example is intended as but one illustration of the golf balls and packaging of the invention.

While it is apparent that the illustrative embodiments of the invention disclosed herein fulfill the objectives of the present invention, it is appreciated that numerous modifications and other embodiments may be devised by those skilled in the art. Additionally, features and/or elements from any embodiment may be used singly or in combination with other embodiments and steps or elements from methods in accordance with the present invention can be executed or performed in any suitable order. Therefore, it will be understood that the appended claims are intended to cover all such modifications and embodiments, which would come within the spirit and scope of the present invention.

What is claimed is:

1. A set of golf balls and package assembly, comprising:
   - a package defining at least one cavity for housing a golf ball set;
   - the golf ball set comprising a series comprising $n$ golf balls, each having an overall color appearance of one of $n$ different colors expressed in the CIE CIECAM color system wherein $n > 1$;
   - the series being ordered in a color progression such that at least one of the $a$, $b$, $h$, $J$, and $C$ values, as defined in the CIE CIECAM color system, is different.

2. The set of golf balls and package assembly of claim 1, wherein $n \geq 4$ such that $a_i > a_j \Rightarrow a_3 < a_4$.

3. The set of golf balls and package assembly of claim 1, wherein $n \geq 24$ such that $a_i > a_j \Rightarrow a_3 < a_4$.

4. The set of golf balls and package assembly of claim 1, wherein $n \geq 24$ such that $a_i > a_j \Rightarrow a_3 < a_4$.

5. The set of golf balls and package assembly of claim 1, wherein $n \geq 4$ such that $a_i < a_j \Rightarrow a_3 > a_4$.

6. The set of golf balls and package assembly of claim 1, wherein $n \geq 4$ such that $a_i < a_j \Rightarrow a_3 > a_4$.

7. The set of golf balls and package assembly of claim 1, wherein $n \geq 4$ such that $a_i < a_j \Rightarrow a_3 > a_4$.

8. The set of golf balls and package assembly of claim 1, wherein $n \geq 4$ such that $b_i > b_j \Rightarrow b_3 > b_4$.

9. The set of golf balls and package assembly of claim 1, wherein $n \geq 4$ such that $b_i > b_j \Rightarrow b_3 > b_4$.

10. The set of golf balls and package assembly of claim 1, wherein $n \geq 4$ such that $b_i < b_j \Rightarrow b_3 > b_4$.

11. The set of golf balls and package assembly of claim 1, wherein $n \geq 4$ such that $b_i < b_j < b_3 < b_4$.

12. The set of golf balls and package assembly of claim 1, wherein $n \geq 4$ such that $b_1 > b_2 > b_3 < b_4$.

13. The set of golf balls and package assembly of claim 1, wherein $n \geq 4$ such that $b_1 > b_2 > b_3 < b_4$.

14. A set of golf balls and package assembly comprising:
   - a golf ball set comprising a series comprising $n$ golf balls, each having an overall color appearance of one of $n$ different colors expressed in the CIE CIECAM color system wherein $n > 3$;
   - the series being ordered in a color progression such that for $h$ values $h_1$, $h_2$, $h_3$, as defined in the CIE CIECAM color system, $h_1 \neq h_2 \neq h_3$ and $h_1$, $h_2$, and $h_3$ are selected from $h_0$, $h_5$, $h_6$, $h_7$, $h_8$, and $h_9$, wherein $42^\circ < h_1 < 20^\circ$; $80^\circ < h_2 < 42^\circ$; $103^\circ < h_3 < 80^\circ$; $190^\circ < h_4 < 103^\circ$; $270^\circ < h_5 < 190^\circ$; and $340^\circ < h_6 < 270^\circ$.

15. The set of golf balls and package assembly of claim 14, wherein at least one golf ball of the series comprises a cover comprising a material selected from the group comprising polyurethane, polyurea, and ionomer resins.

16. The set of golf balls and package assembly of claim 14, wherein at least one golf ball in the series comprises a pigment, dye or tint that is fluorescent.

17. The set of golf balls and package assembly of claim 14, wherein at least one golf ball in the series comprises a pigment, dye or tint that is inorganic or organic.

18. The set of golf balls and package assembly of claim 14, wherein at least one golf ball in the series comprises a metallic material selected from the group comprising metal flake, iridescent glitter, metallicized film, and colored polyester foil.

19. The set of golf balls and package assembly of claim 14, wherein at least one golf ball in the series comprises a cover comprising a material which is at least partially transparent, translucent, or pearlescent.

20. The set of golf balls and package assembly of claim 14, wherein at least one golf ball in the series comprises a cover and intermediate layer comprising a material which is at least partially transparent, translucent, or pearlescent.

21. A method of making package assembly including a set of golf balls, comprising:
   - providing a package defining at least one cavity for housing a golf ball set;
   - providing a set of $G$ golf balls wherein $G \geq 2$, such that $n$ golf balls of the set are arranged in a series, wherein $n > 1$, the series being ordered in a color progression such that at least one of the $a$, $b$, $h$, $J$, and $C$ values, as defined in the CIE CIECAM color system, is different for each of the $n$ golf balls;
   - placing the set of $G$ golf balls in the at least one cavity; and
   - providing and/or securing a cover for the package to complete the package assembly.

* * * * *