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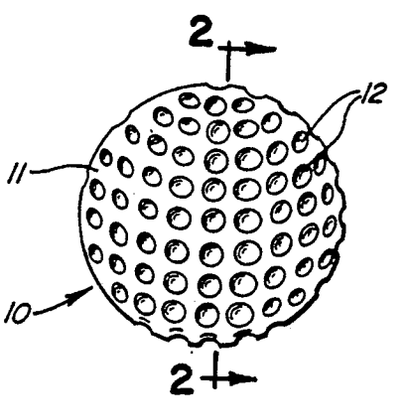
(54) Golf ball with variable density center.

(57) A golf ball includes a spherical center having a plurality of grooves in its outer surface. The grooves extend along great circles of the center which lie in planes which extend through an axis of the center. An intermediate layer of elastomeric material or rubber windings covers the center, and a molded cover forms the outside of the ball.



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GOLF BALL WITH VARIABLE DENSITY CENTER

Background and Summary

This invention relates to golf balls, and, more particularly, to a golf ball which includes a variable density center for controlling the spin of the ball.

Balata covered golf balls usually possess greater backspin off the club-head as compared to Surlyn covered two-piece and three-piece golf balls. The increased spin provides better bite on the green, and this is one of the reasons why balata balls are usually preferred by more accomplished players even though Surlyn balls are more durable.

Traditional three-piece golf balls have centers which are homogeneous spheres of uniform density across all diameters of the ball. Two-piece ball cores are also homogeneous across all diameters. Such center and cores do not provide any means for adjusting the radius of gyration or spin of the ball.

The invention provides a golf ball center which has a variable density or density gradient. The surface of the center is provided with recesses

or grooves which allow more of the weight of the center to be concentrated at its center. Concentrating more of the weight of the ball at its geometric center reduces the energy required to produce spin and increases the spin under normal playing conditions. A Surlyn ball can thereby be provided with as much spin and bite as a balata ball.

Description of the Drawing

This invention will be explained in conjunction with an illustrative embodiment shown in the accompanying drawing, in which --

Fig. 1 illustrates a golf ball formed in accordance with the invention;
Fig. 2 is an enlarged fragmentary sectional view taken along the line 2-2 of Fig. 1;
Fig. 3 is a sectional view of the center of the ball of Fig. 1;
Fig. 4 is a top view of the center of Fig. 3;
Fig. 5 is a side view of the center taken along the line of Fig. 5-5 of Fig. 4;
Fig. 6 is a bottom view of the center taken along the line 6-6 of Fig. 5;
Fig. 7 is a perspective view of the top of the center; and
Fig. 8 is a perspective view of the bottom of the center.

Description of Specific Embodiment

Referring first to Figs. 1 and 2, the numeral 10 designates a golf ball which includes a conventional cover 11 having dimples 12. The cover surrounds an intermediate layer 13 and a center 14. The intermediate layer 12 can be either a molded mantle of elastomeric material or can be formed by windings of rubber thread. The cover 11 can be molded from ionomer resin material sold under the trademark Surlyn by DuPont or balata. The cover 11 is conventional but the intermediate layer may be a conventionally wound layer or it could be a non-conventional solid elastomeric material of the appropriate physical properties.

Referring now to Figs. 3-8, the center 14 has a spherical outer surface 16 which is provided with a plurality of elongated recesses or grooves 17. Each of the grooves extends along a portion of a great

circle of spherical center, i.e. a circle defined by the intersection of the spherical surface and a plane which extends through the center of the core. Each groove lies in a plane which extends parallel to and through a central axis y of the center.

A pair of grooves 17a and 17b intersect at the top of the center, and the angle between the great circles of the grooves 17a and 17b is 90°. The bottom of each of the grooves 17a and 17b terminates short of the bottom of the y axis (Fig. 6).

A pair of grooves 17c and 17d intersect at the bottom of the core, and the top of each groove 17c and 17d terminates short of the top of the y axis (Fig. 4). The angle between the great circles of the grooves 17c and 17d is 90°.

Each of the grooves 17a-17d extends around substantially the entire circumference of the center, and short grooves 17e through 17l extend between adjacent long grooves 17a-17d. Each of the short grooves extends along an arc of less than 180°, and in the embodiment illustrated, extends along an arc of about 90°.

The diameter of the center 14 can range between 1.00 inch and 1.30 inch for the American size ball. The outside diameter of the intermediate layer 13 is advantageously 1.505 inch, but can be within the range of 1.490 and 1.570 inch. The outside diameter of the cover of the American ball is 1.680 inch. The center can be molded from natural or synthetic rubber or plastic which is compounded with fillers, curatives, extenders, and processing aids. The center is integrally molded by either compression molding or injection molding from homogeneous material, either thermoplastic or thermosetting. The grooves can be formed by the mold or can be machined into the core after molding.

In one specific embodiment the core was molded from a polybutadiene compound having the following composition:

	Parts by Weight
Polybutadiene Rubber	100.0
Chemlink WT Resin (supplied by Arco Chemical Co.)	20.0
Zinc Oxide	10.0
Barytes	98.0
Antioxidant, A02246	0.5
Dicup 4OKE	5.0
Total	233.5

This provided a cross-linked center having high density and low compressibility.

The spherical surface of the center had a diameter of 1.220 inch. The grooves 17a through 17l were spaced equally around the central axis y so that the angle A between adjacent grooves in Fig. 6 was 22-1/2°. The width W (Fig. 6) of each groove was 0.110 inch, and the depth D of the long grooves 17a-17d was 0.135 inch throughout the groove. The bottom surface of each of the short grooves 17e-17l was planar, and the maximum depth of the short grooves was 0.135 inch. The weight of the center was 19.5 $\pm$ 0.1 grams.

The grooves reduce the density of the center at the outside surface of the center and permit more of the weight of the center to be concentrated at its center compared to a conventional spherical core having uniform density. The radius of gyration and polar movement of inertia of both the core and the golf ball are thereby reduced, and less energy is required to spin the ball. The greater spin causes the ball to fly higher, land softer, and have more bite on the green even when the cover is Surlyn material.

The increased spin and bite is exemplified by the following table, which compares three commercial balls with a Surlyn covered ball formed in accordance with the invention. All balls were hit with an 8 iron.

Table 1

Ball Type	Mean Spin (rpm)
Two-piece Surlyn ball (Wilson Aviator)	6916
Three-piece Surlyn ball (Wilson ProStaff)	7570
Three-piece Balata ball (Wilson ProStaff T)	8195
Three-piece Surlyn ball (inventive ball)	8198

The increased spin of the inventive ball does not seem to affect the accuracy of the ball. However, the increased spin will result in slightly shorter distance compared to conventional Surlyn covered balls.

The invention permits the distribution of the weight of the center and therefore the radius of gyration and polar movement of inertia to be easily adjusted as desired in order to vary the spin of the ball. For example, more of the weight of the core can be concentrated at its center by increasing the amount of the filler, e.g., barytes, and by making grooves 17 deeper and/or wider. The total weight of the core and the resultant ball would remain the same because the deeper grooves would compensate for the increased filler. However, less energy would be required to spin the ball.

Although the specific embodiment illustrated in the drawing is a three-piece ball having a center 14, an intermediate mantle or layer of windings 13, and a cover 11, the core can also be used in a two-piece ball comprised of a center and a cover. Further, the shape and size of the recesses in the center can be varied. However, it is desirable that the recesses be aligned with planes which extend parallel to and through an axis of rotation of the center.

While in the foregoing specification a detailed description of a specific embodiment of the invention was set forth for the purpose of illustration, it will be understood that many of the details herein given may be

varied considerably by those skilled in the art without departing from the spirit and scope of the invention.

CLAIMS:

1. A golf ball comprising a center and a cover, the center having a generally spherical outer surface having a plurality of recesses therein, each of the recesses being aligned with a plane which extends parallel to and through an axis of the center.

2. The golf ball of claim 1 in which each of said planes extends parallel to and through the same axis.

3. The golf ball of claim 1 in which each of said recesses comprises an elongated groove which extends along at least a portion of a great circle of the spherical outer surface of the center.

4. The golf ball of claim 3 in which the angle between adjacent pairs of said great circles is 22-1/2°.

5. The golf ball of claim 3 in which the width of each of said grooves is 0.110 inch.

6. The golf ball of claim 5 in which the depth of each of said grooves is 0.135 inch.

7. The golf ball of claim 3 in which the depth of each of said grooves is 0.135 inch.

8. The golf ball of claim 1 including an intermediate layer between said center and said cover.

9. The golf ball of claim 8 in which said intermediate layer comprises a mantle of elastomeric material.

10. The golf ball of claim 8 in which said intermediate layer comprises windings of rubber thread.

11. The golf ball of claim 1 in which the cover is Surlyn material.

12. The golf ball of claim 1 in which the cover is balata.

13. The golf ball of claim 1 in which the core is integrally molded from homogeneous material.

14. A golf ball comprising a center having a generally spherical outer surface, an intermediate layer surrounding the center, and a Surlyn cover, the center having a central axis and a plurality of elongated grooves in the outer surface thereof, each of the grooves extending along at least a portion of a great circle of the spherical outer surface of the center, each of said great circles lying in a plane which extends parallel to and through said central axis.

15. The golf ball of claim 14 in which the angle between adjacent pairs of said great circles is 22-1/2°.

16. The golf ball of claim 14 in which the width of each of said grooves is 0.110 inch.

17. The golf ball of claim 16 in which the depth of each of said grooves is 0.135 inch.

18. The golf ball of claim 14 in which the depth of each of said grooves is 0.135 inch.

19. The golf ball of claim 14 in which the diameter of the outer spherical surface of the center is within the range of 1.00 to 1.30 inch.

20. The golf ball of claim 14 in which the outside diameter of the intermediate layer is within the range of 1.490 to 1.570 inch.

21. The golf ball of claim 14 in which said intermediate layer comprises a mantle of elastomeric material.

22. The golf ball of claim 14 in which said intermediate layer comprises windings of rubber thread.

23. The golf ball of claim 14 in which the core is integrally molded from homogeneous material.

FIG. 1

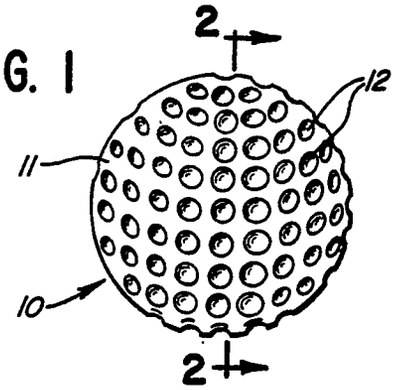
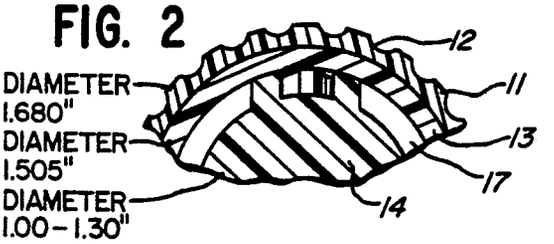


FIG. 2



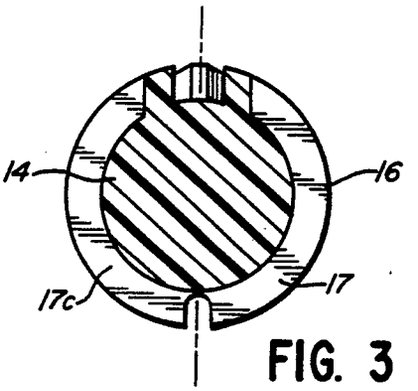


FIG. 3

FIG. 4

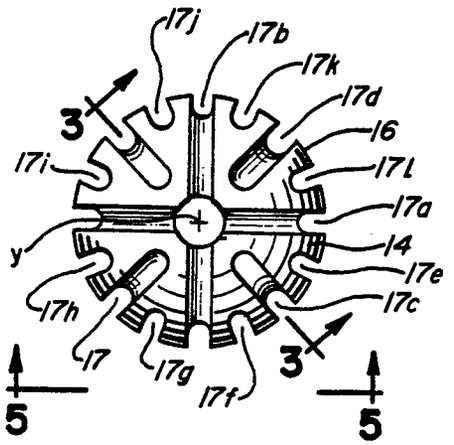


FIG. 5

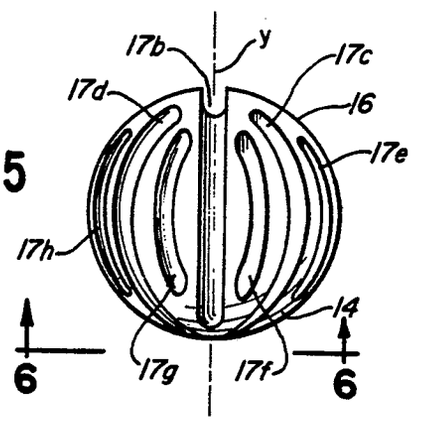


FIG. 6

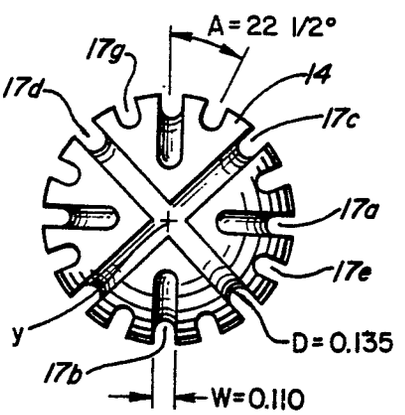
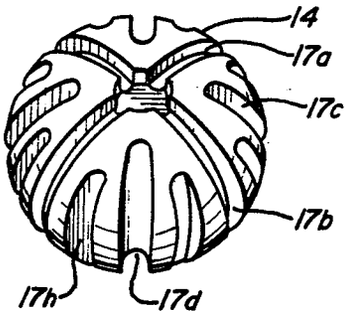


FIG. 7



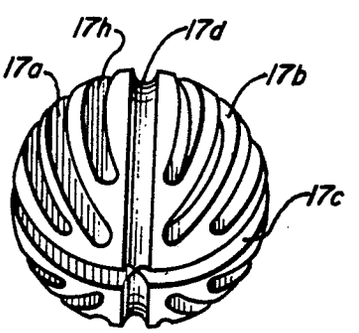


FIG. 8