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(54) **Short distance golf ball.**

(57) A one-piece short distance golf ball which is a moulded mixture of a foamed thermoplastic polymer and a filler material, the ball having an increasing density gradient from the centre to the surface and the surface having a bramble configuration.

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Short distance golf ball

This invention is concerned with a short distance golf ball, that is a golf ball which has performance characteristics comparable to that of a conventional golf ball except that it plays from 30%-70% shorter in distance than a conventional golf ball.

In our European Application 84303514.8 we have described a one-piece short distance golf ball which is a moulded mixture of a foamed thermoplastic polymer and a filler material, the ball having an increasing density gradient from the centre to the surface. The ball preferably has a cellular core structure and a dense outer skin which preferably has a thickness of from 3.175 mm to 15.88 mm. The filler material is preferably microscopic glass bubbles which are distributed uniformly throughout the thermoplastic polymer.

In a preferred embodiment of the golf ball described in our said application, it comprises from 0.5 to 15% of filler material, based on the weight of the thermoplastic polymer and the ball has a diameter of approximately 1.68 inch (42.67 mm) and weighs from 15 to 30 grams. The surface of the golf ball is preferably provided with dimples in any suitable dimple pattern such as is conventionally used on standard golf balls.

In conventional, full weight, golf balls, the

provision of dimples on the surface of the ball improves the flight characteristics of the ball and, in particular, the resistance of the ball to the effects of wind, particularly side wind, while in flight. We have now unexpectedly found that in the case of a short distance golf ball as described in our said application, a bramble surface finish, that is a surface provided with rounded bumps, provides much better resistance to the effects of wind while in flight.

According to the present invention, therefore, there is provided a one-piece short distance golf ball which is a moulded mixture of a foamed thermoplastic polymer and a filler material, the ball having an increasing density gradient from the centre to the surface and the surface having a bramble configuration.

The golf ball preferably has a cellular core structure and a dense outer skin, the latter preferably having a thickness of from 0.125 inch (3.175 mm) to 0.625 inch (15.88 mm). The thickness of the dense outer skin determines the moment of inertia of the ball which, in turn, determines how much spin can be imparted to the ball when struck by a golf club. The range of thicknesses mentioned corresponds to the preferred range of moments of inertia for the ball to have desirable playing characteristics.

The preferred filler material is microscopic glass bubbles and it is preferred to use from 0.5 to 15% of filler material, based on the weight of the thermoplastic polymer.

The golf ball is preferably approximately 1.68 inch (42.67 mm) in diameter, the same size as a conventional golf ball, and weighs from 17 to 35 grams as compared to approximately 45 grams for a conventional golf ball (the golf ball according to this invention, is preferably about 15% heavier at 17 to 35 grams than that

described in our said European application which preferably weighs 15 to 30 grams). It is made by injection moulding a mixture of thermoplastic material and a filler material together with a chemical blowing agent, as described in greater detail below. A cross section of the golf ball shows that the density of the ball material increases along the radius of the ball from the centre to the surface. The ball has an outer dense skin which is preferably from 0.125 inch to 0.625 inch (3.175 to 15.88 mm) thickness. The skin thickness, which is inversely related to the amount of blowing agent used in making the golf ball, is most preferably approximately 0.250 inch (6.35 mm). The core of the ball has a blown cellular structure. The boundary between the cellular core and the skin, while not sharply delineated, is observable from an inspection of a cross sectioned sample of a golf ball made in accordance with the present invention.

The weight and density distribution of the material of the ball ensures that the golf ball will perform in most respects in the same way as a conventional golf ball except that its playing distance will be shorter. The short distance golf ball of the present invention has a rebound of from 50% to 80%, and preferably 67%, and it has a compression of from 0 to 100, preferably 10, as measured on the Atti compression tester.

The preferred material from which the ball is made comprises a thermoplastic polymer and microscopic glass bubbles distributed uniformly throughout the polymer. The thermoplastic polymer is preferably the product of the reaction of an olefin and metallic salt of an unsaturated monocarboxylic acid. Suitable ionomer resins for producing such thermoplastic polymers are sold by the Dupont Company, Polymer Products Department,

Ethylene Polymers Division, Wilmington, Delaware 19898, under the trademark SURLYN. The Surlyn resin is available both as a zinc ionic copolymer and as a sodium ionic copolymer. It has been found that each copolymer is useful in carrying out the present invention and that mixtures of the two copolymers are also useful in carrying out the present invention.

The thermoplastic material, as previously stated, includes microscopic glass bubbles which serve as filler or extender. In the finished product the glass bubbles are distributed uniformly throughout the thermoplastic polymer. Preferred glass bubbles for carrying out the present invention are manufactured by the 3M Company, St. Paul, Minnesota 55101 and range in density from 0.12 to 0.18 g/cc. Other inorganic fillers, such as titanium dioxide or calcium carbonate, can also be used. Glass bubbles are, however, preferred because they improve impact resistance by functioning as microscopic shock absorbers to dissipate energy and thus help to reduce the distance the ball travels when struck.

Suitable blowing agents for use in the process according to the invention are volatile liquids or gases, such as Freon, nitrogen gas, and carbon dioxides, or chemical blowing agents which are thermally decomposed to release a gas; these may, in particular, be used with Surlyn. The chemical blowing agent used should preferably have a decomposition temperature of from 230° to 435°F (110° to 224°C). Two preferred chemical blowing agents are sold under the trade designation Celogen TSH and Celogen RA by Uniroyal Chemical, Naugatuck, Connecticut 06770. Norteck brand foam concentrate sold by Northern Petro Chemical Company, Clinton, Massachusetts 01510 also works well.

While the process can be operated over a wide range of blowing agent decomposition temperatures, higher

decomposition temperatures are preferable because the risk of premature expansion can be minimized. Thus decomposition temperatures of from 350° to 450°F (177° to 232°C) are preferred.

The following formulations have been found to produce acceptable golf balls which have approximately 0.250 inch (6.35 mm) thick skin and which have the physical and performance characteristics desired for short distance golf balls.

Example 1

Material	Parts (by weight)
Surlyn Ionomer Resin 1605	50
Surlyn Ionomer Resin 1706	50
Glass Bubbles (C15/250-by 3M)	6.25
Celogen TSH	1.06

Example 2

Material	Parts (by weight)
Surlyn Ionomer Resin 1855	100
Glass Bubbles (C15/250-by 3M)	6.25
Celogen TSH	1.06

Example 3

Material	Parts (by weight)
Surlyn Ionomer Resin 1856	100
Glass Bubbles (C15/250-by 3M)	6.25
Celogen TSH	1.06

Example 4

Material	Parts (by weight)
Surlyn Ionomer Resin 1855	50
Surlyn Ionomer Resin 1856	50
Glass Bubbles (C15/250-by 3M)	6.25
Celogen TSH	1.06

Example 5

Material	Parts (by weight)
Surlyn Ionomer Resin 1855	50
Surlyn Ionomer Resin 1856	50
Glass Bubbles (SSX-by 3M)	3.0
Celogen RA	1.5

Example 6

Material	Parts (by weight)
Surlyn Ionomer Resin 1855	50
Surlyn Ionomer Resin 1856	50
Glass Bubbles (SSX-by 3M)	3.0
Titanium Dioxide	0.5
Celogen RA	0.5

Example 7

Material	Parts (by weight)
Surlyn Ionomer Resin 1855	50
Surlyn Ionomer Resin 1856	50
Glass Bubbles (SSX-by 3M)	3.0
Titanium Dioxide	0.5
Norteck 1039	0.5

The thickness of the skin of the finished golf ball is inversely proportional to the amount of blowing agent. For example, reducing the amount of Celogen TSH to 0.50 parts will produce a skin thickness of approximately 0.5 inch (12.7 mm) in the finished golf ball. Therefore a range of 0.50 to 2.00 parts of blowing agents should produce skin thickness of from 0.5 to 0.125 inch (12.7 to 3.88 mm) respectively.

In order to form the short distance golf ball of the present invention, the ingredients specified are first mixed together prior to injection moulding.

A conventional screw injection machine as used to manufacture conventional two-piece moulded golf balls is suitably modified for foam moulding as follows. The injection nozzle is provided with a shut-off valve to

ensure that only a predetermined amount of the mixture is injected into each mould cavity. In particular, it is preferred that only about 17 to 35 grams of the mixture per golf ball be injected. The injection machine must generate sufficient injection pressure to be able to inject the material into the mould cavity in one second or less to minimize premature gas expansion. Also flow channels must be kept short and provide equi-distance flow to the extremities of the cavity to achieve uniform skin thickness for each ball moulded.

In order to ensure that the resulting short distance golf ball has the proper skin thickness, it is important that the process parameters be controlled. The initial temperature of the mixture is room temperature. The mould cavity is chilled by 40°F (4.4°C) water to approximately 40° to 70°F (4.4 to 21.1°C). The injection cylinder is provided with a temperature gradient along its length to the nozzle. The rear part of the cylinder is kept at a lower temperature (preferably about 325°F; 163°C) to reduce premature gas expansion, and the nozzle is maintained at a higher temperature (preferably about 400°F; 204°C) to make rapid injection easier by reducing viscosity of the mixture. The mould is then held closed (elapsed time) for from 60 to 240 seconds (depending on the skin thickness) while maintaining the mould temperature at approximately 40° to 70°F (4.4 to 21.1°C). The process requires about 60 seconds per 0.125 inch (3.18 mm) of skin thickness to ensure that the skin is fully moulded before the mould is opened. After the specified time has elapsed, the mould is opened, the ball is removed and immediately quenched in cold water to curtain any further blowing.

By mixing the requisite amount of blowing agent and regulating the process within the parameters specified above, the density of the thermoplastic

material which forms the short distance golf ball will have the desired skin thickness to provide the performance characteristics required.

We have achieved best results with the following process parameters for golf balls having a skin thickness of approximately 0.250 inch (6.35 mm) and manufactured from the mixtures specified in Examples 1 to 7:

Process Parameter	Value
Initial mould temperature	40°F-70°F (4.4°-21.1°C)
Cylinder temperature	
rear	325°F (163°C)
centre	350°F (177°C)
front	375°F (191°C)
nozzle	400°F (204°C)
Screw back pressure	250 psi (17.5 kg/cm^2)
cure cycle (elapsed time)	109 sec.
Fill rate	1 sec. or less.

A preferred embodiment of golf ball according to the present invention is shown, by way of example, in the single Figure of the accompanying drawing, which is a plan view of the golf ball (with only part of the surface configuration shown).

Referring to the Figure, the surface of the golf ball 110 is provided with a plurality of rounded bumps 128; there are in all 398 bumps 128 constituting the "bramble" (blackberry) pattern. The golf ball also comprises a raised band 130 round the "seam" of the ball.

The 398 bumps of the bramble pattern are approximately 0.010 inch (0.254 mm) high in the first row adjacent the raised band, 0.018 inch (0.457 mm) high in the second row adjacent the raised band, and 0.030 inch (0.762 mm) over the rest of the ball. The bumps are arranged in a tetraicosahedron pattern (a delta hedron

with 24 sides) which geometric pattern is the same geometric pattern used for dimples on some conventional golf balls, for example, the Muirfield brand golf ball manufactured by MacGregor Golf Company. The raised band 130 is not crucial to the improved flight characteristics of the brambled ball but is merely provided so that the seam line left by the moulding process can be buffed smooth.

The inclusion of the bramble configuration in the golf ball 110 leads to the latter having a relatively higher drag than a corresponding dimpled ball as described in our said European application. As a result, the velocity of the brambled ball 110 is rapidly reduced after it leaves the club face. Because of the reduced velocity resulting from the drag, the weight of the brambled ball can be increased. We have found that by increasing the weight of the brambled ball about 15% over the weight of a corresponding dimpled ball 10, the distance flown by the brambled ball is approximately the same as that of the lighter, lower drag, dimpled ball. As previously stated, the weight of the brambled ball is preferably from 17 to 35 grams.

Because the brambled ball 110 is about 15% heavier than a corresponding dimpled golf ball, its trajectory is not affected by wind as much as the lighter dimpled golf ball. Surprisingly, the bramble configuration with its surface roughness, its relatively high drag, and its turbulent air flow on the surface of the ball even at low velocities, is affected in flight even less by the wind than the smoother dimpled ball.

The bramble pattern also appears to eliminate the abrupt transition from turbulent air flow at high velocities to laminar air flow at low velocities across the ball and thus makes the brambled ball more stable

in flight, especially under windy conditions, so that the bramble ball does not dart or flutter like a dimpled ball.

The bramble configuration on the golf ball 110 is produced by using moulds which have the requisite complementary surface configuration.

Claims:

1. A one-piece short distance golf ball which is a moulded mixture of a foamed thermoplastic polymer and a filler material, the ball having an increasing density gradient from the centre to the surface and the surface having a bramble configuration.

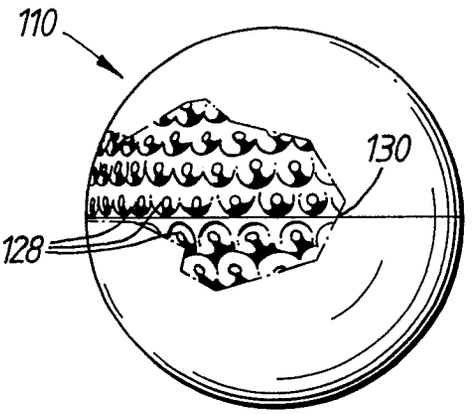
2. A golf ball according to claim 1, in which the ball has a cellular core structure and a dense outer skin.

3. A golf ball according to claim 2, in which the skin has a thickness of from 0.125 inch (3.175 mm) to 0.625 inch (15.88 mm).

4. A golf ball according to any of claims 1 to 3, in which the filler material is microscopic glass bubbles which are distributed uniformly throughout the thermoplastic polymer.

5. A golf ball according to any of claims 1 to 4, which comprises from 0.5 to 15% of filler material, based on the weight of the thermoplastic polymer, and the ball has a diameter of approximately 1.68 inch (42.67 mm) and weighs from 17 to 35 grams.

6. A golf ball according to any of claims 1 to 5, in which the bramble surface configuration comprises 398 rounded bumps arranged in a tetraicosahedron pattern.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