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(54) **GOLF BALL**

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(57) **ABSTRACT**

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A golf ball (G) has incorporated therein an IC chip (3) which can input and/or output data relating to at least one item selected from among manufacture history, shot history and flight properties. The ball's own possession of inherent information facilitates operations including ball quality control, ball recycling, and evaluation of flight performance.

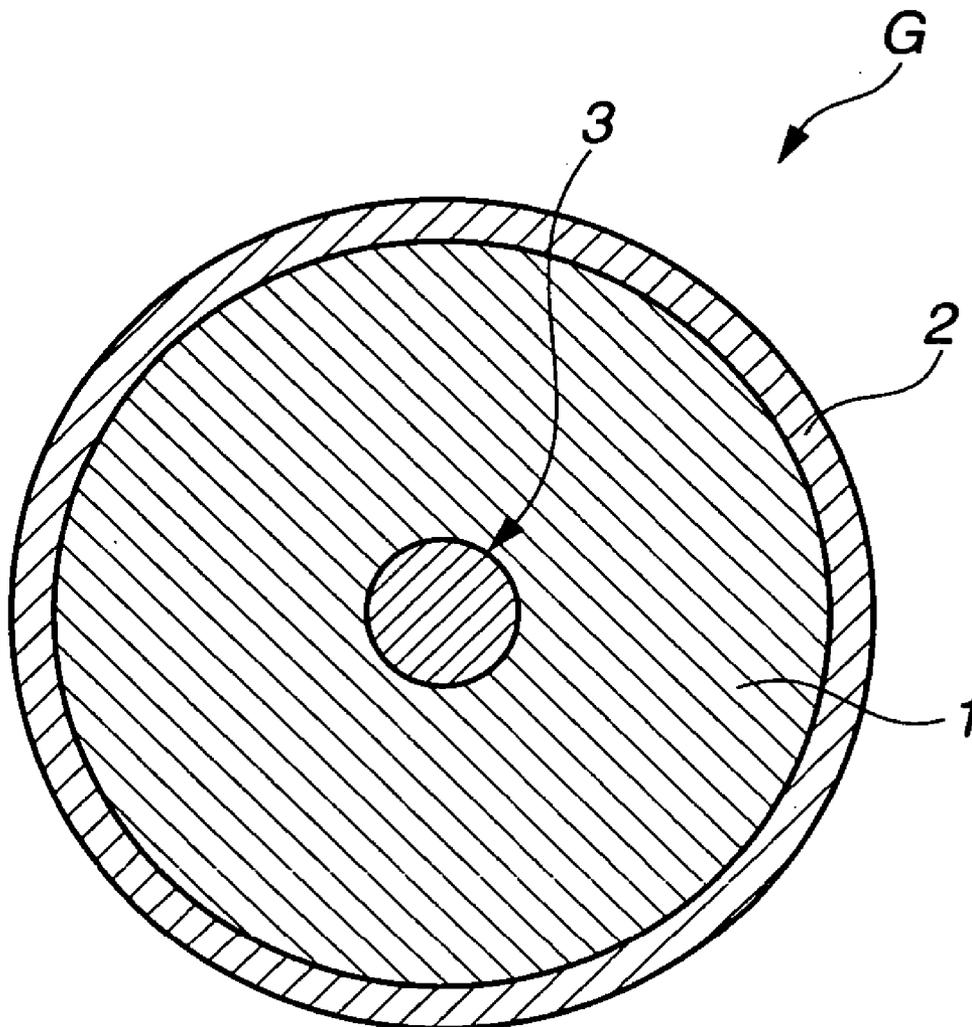


FIG.1

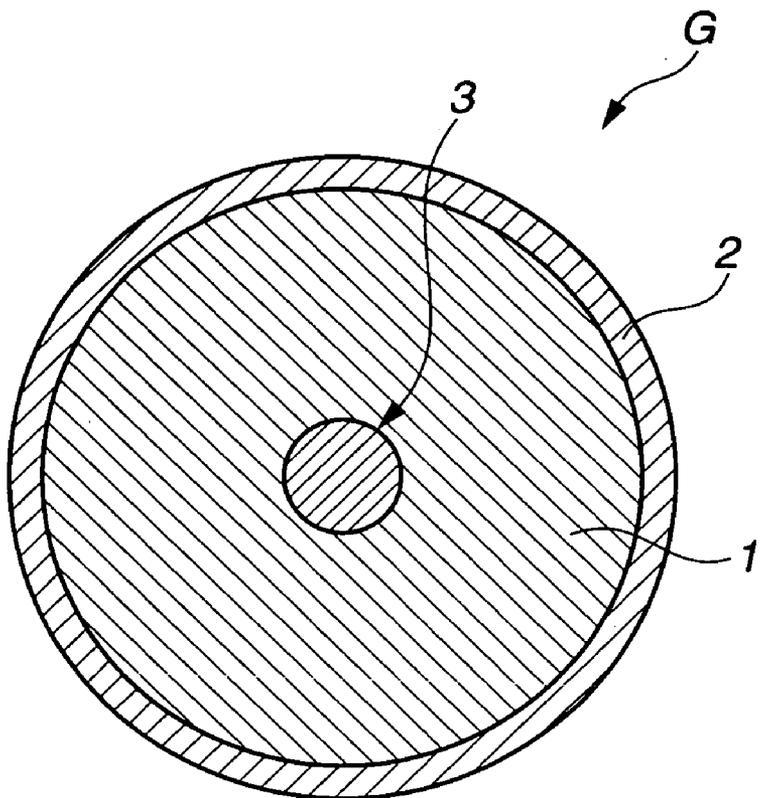


FIG.2

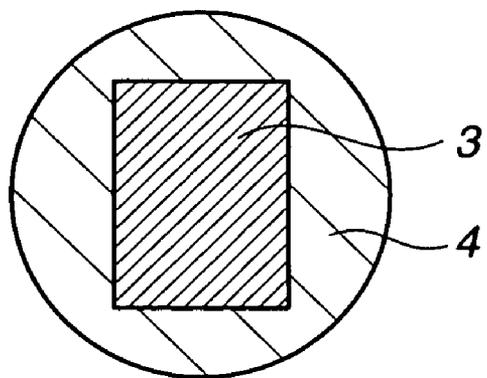


FIG.3

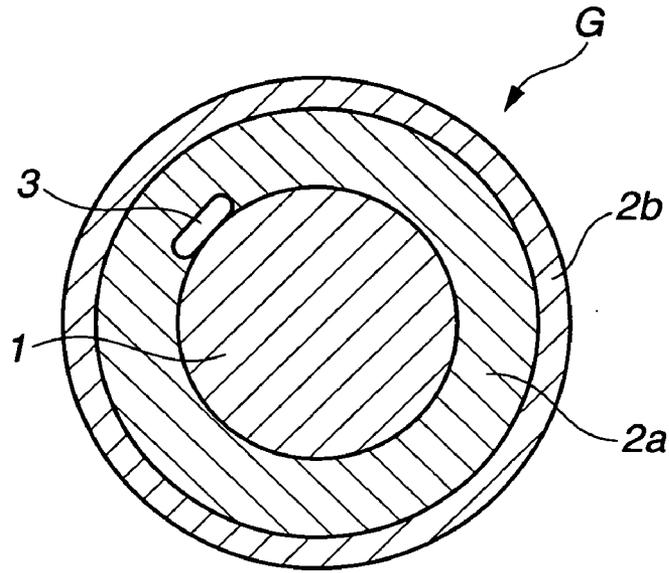
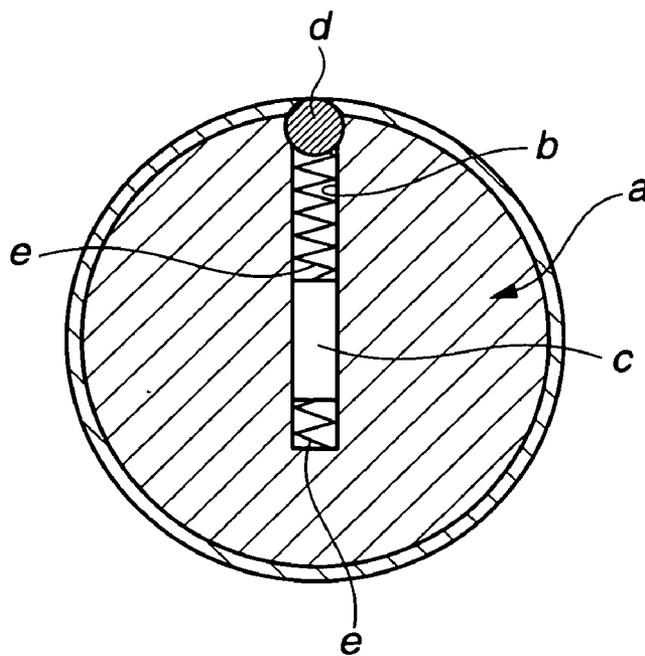


FIG.4



GOLF BALL

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This non-provisional application claims priority under 35 U.S.C. §119(a) on Patent Application No. 2004-017386 filed in Japan on Jan. 26, 2004, the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD

[0002] This invention relates to a golf ball which bears data relating to its own manufacture history, shot history and flight properties so that such data may be read out and used for ball quality control, flight performance measurement or the like.

BACKGROUND ART

[0003] From the past, information data relating to golf ball materials, manufacture conditions and the date of manufacture and necessary for quality control of respective golf balls, are managed within a ball manufacturing factory on the basis of a manufacture number or mark engraved or printed on the ball surface.

[0004] However, once golf balls are shipped from the factory, it is difficult to seize the detail of manufacture history directly. For example, in golf practice ranges where balls are used at very high frequencies, it is difficult to time the replacement of overused balls.

[0005] If information data inherent to each golf ball are seized, such data can be used in determining whether the quality of that ball is still acceptable or not. This is effective for the recycling of golf balls. As a golf ball is used more times, the ball surface is gradually scraped off. Such a worn ball can be recycled by overlaying filler build-ups on scraped areas. However, it is unknown how many times the ball has been recycled. If the number of recycles is known, it is useful for quality control.

[0006] With respect to initial parameters of a golf ball including initial velocity, launch angle and spin rate, a measuring instrument such as a hitting robot is installed in the factory for actually hitting the ball in order to measure various parameters. Although the parameters of a golf ball are measured and recorded by the manufacturer at the time of manufacture, it is difficult for a golf player to learn on a non-personal basis the flight properties of the ball with which the player actually plays.

[0007] It would be desirable for a golf ball to bear data relating to its own manufacture history, shot history, flight performance and the like so that the quality control and flight performance measurement of the ball are enabled on the basis of such data.

[0008] JP-A 2003-24473 discloses a golf ball having an IC chip built therein. Referring to FIG. 4, a ball body 11 is bored with an insert hole 13 that extends radially from the spherical surface toward the center. An IC chip 14 is inserted into the hole 13 and positioned at the center of the ball body 11. The opening of the hole 13 is closed with a generally spherical plug member 17. The IC chip 14 is located in position by buffer members 15 and 16.

[0009] The IC chip built-in golf ball, however, has the problem that the flight performance and properties of the ball are largely affected by the elongated insert hole 12 that extends from the spherical surface toward the center. For example, when the ball is hit at one side, the impact energy created by that shot is converted to kinetic energy, during which process the inclusion of the elongated insert hole 12 prevents the energy from transferring through the entirety of the ball interior, degrading ball performance such as flight properties. With the final target of increased flight distance borne in mind, most golf balls have recently been developed as comprising at least a core and a cover, wherein the core is made of a rubber composition and the cover consists of one or two layers of thermoplastic resin. Typically the hardnesses of respective layers are adjusted to optimum ranges so that the impact energy created when the ball is hit is conducted to the respective layers where it is converted to repulsion and kinetic energy of the ball.

[0010] It is then strongly desired from the practical aspect that the embedment of an IC chip within the golf ball do not change the ball interior structure substantially or affect the properties of the golf ball detrimentally.

SUMMARY OF THE INVENTION

[0011] An object of the invention is to provide a golf ball which bears data relating to its own manufacture history, shot history and flight properties so that such data are read out and used for ball quality control, flight performance measurement or the like while the properties (such as flight performance) of the ball are maintained.

[0012] According to the invention, there is provided a golf ball having incorporated therein an IC chip which can input and/or output data relating to at least one item selected from the group consisting of manufacture history, shot history and flight properties.

[0013] In the golf ball having a surface, the IC chip is preferably embedded at least 1 mm inside the ball surface. More preferably, the IC chip is embedded at the center of the ball.

[0014] In a preferred embodiment, the golf ball has a solid core which is formed of a rubber base composition, and the IC chip is encapsulated with a protective layer of a special rubber member and embedded in the solid core.

[0015] The golf ball is typically a practice golf ball.

[0016] The golf ball of the invention bears on itself data relating to its own manufacture history, shot history and flight properties, which ensures facile and smooth operation taken for ball quality control, ball recycling, and evaluation of ball properties such as flight performance. In particular, a knowledge about the manufacture history of each ball is useful in determining the time of replacement of used balls in a golf practice range or in resurfacing used balls for recycling. The data relating to the shot history of a ball enable to learn the initial velocity, launch angle, spin rate and other properties of the ball when actually hit, which is very useful in the development of new golf balls.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. 1 is a cross-sectional view of a golf ball in one embodiment of the invention.

[0018] FIG. 2 is a cross-sectional view of an IC chip encapsulated with a protective layer.

[0019] FIG. 3 is a cross-sectional view of a golf ball in another embodiment of the invention.

[0020] FIG. 4 is a cross-sectional view of a prior art IC chip built-in golf ball.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Referring to FIGS. 1 to 3, some embodiments of the invention are illustrated.

[0022] FIG. 1 illustrates a golf ball G in one embodiment of the invention. The golf ball G has incorporated therein an IC chip 3 which can input and/or output data relating to at least one item selected from among manufacture history, shot history and flight properties. The golf ball G is illustrated in FIG. 1 as comprising a solid core 1, a cover 2, and the IC chip 3 encapsulated with a protective layer 4 (see FIG. 2).

[0023] In the illustrated golf ball, the IC chip 3 encapsulated with the protective layer 4 is disposed at the center of the ball. The IC chip 3 is enclosed with the solid core 1, which is, in turn, enclosed with the single layer cover 2.

[0024] The material of which the solid core 1 is made is typically a rubber base composition which is obtained by an ordinary process including compounding in a selected proportion and vulcanizing under controlled conditions. The core-forming composition generally comprises a base rubber, a crosslinking agent, a co-crosslinking agent, an inert filler and the like. The base rubber used may be natural rubber and/or synthetic rubber which is used in the manufacture of conventional solid golf balls. Use may be made of 1,4-polybutadiene containing at least 40% cis-configuration, for example. If desired, the polybutadiene may be compounded with an appropriate amount of natural rubber, polyisoprene rubber, styrene-butadiene rubber or the like. Exemplary crosslinking agents used herein are organic peroxides such as dicumyl peroxide and di-t-butyl peroxide. The co-crosslinking agent may be selected from, for example, metal salts of unsaturated fatty acids, especially zinc and magnesium salts of unsaturated fatty acids having 3 to 8 carbon atoms (e.g., acrylic acid, methacrylic acid), but is not limited thereto. Exemplary inert fillers include zinc oxide, barium sulfate, silica, calcium carbonate, zinc carbonate, etc. For the solid core material, thermoplastic resins and elastomers such as ionomer resins and polyester elastomers may also be used in lieu of the rubber composition.

[0025] While the material of which the cover 2 is made is not particularly limited, it is preferably selected from thermoplastic resins and elastomers which are well known in the art. Examples include thermoplastic urethane elastomers, ionomer resins, polyester elastomers, polyamide elastomers, propylene-butadiene copolymers, 1,2-polybutadiene, and styrene-butadiene copolymers, alone or in admixture of any. For example, one or more ionomer resins may be used as the base to form the cover. Titanium dioxide, barium sulfate, magnesium stearate or the like may be added to the ionomer resin(s) for adjusting specific gravity and hardness. If necessary, UV absorbers, antioxidants, dispersing aids (e.g., metal soaps) and the like may be further added. The method of enclosing the solid core with the cover is not particularly

limited. Typically employed are a method of molding a pair of hemispherical cover preforms, encasing the core in the cover preforms, and heat compression molding and a method of injection molding a cover-forming composition around the core.

[0026] The IC chip 3 encapsulated with the protective layer 4, shown in FIG. 2, is a generally spherical component which is prepared by enclosing an IC chip 3 with a protective layer 4 of a special rubber member such as silicone rubber or butyl rubber. The IC chip 3 is typically a tiny thin piece of about 0.4 mm square. The IC chip 3 is protected by encapsulating it with the special rubber which does not interfere with the internal function of the IC chip. The special rubber used herein is not particularly limited as long as it has elastic and vibration-damping functions. For example, silicone rubber and butyl rubber are used.

[0027] The IC chip 3 encapsulated with the protective layer 4 is incorporated in the golf ball, typically by embedding the encapsulated IC chip at the center of the solid core during its manufacture prior to rubber vulcanization, then vulcanizing the rubber so that the encapsulated IC chip becomes integral with the solid core. More specifically, the encapsulated IC chip is forcedly inserted into an unvulcanized rod-shaped rubber composition, known as "slug" in the art, at the center, followed by vulcanization. In this way, the vulcanized rubber and IC chip are integrally combined.

[0028] The IC chip is designed to input and/or output data relating to at least one item selected from among manufacture history, shot history and flight properties.

[0029] As used herein, the term "manufacture history" refers to a collection of data about a golf ball of interest including the date of manufacture, manufacture number, manufacture lot, manufacture factory or the like, and manufacturing conditions such as vulcanizing temperature, vulcanizing time, mold, injection molding temperature and injection molding time, and golf ball materials such as core formulation (rubber composition, etc.) and cover formulation. These data of "manufacture history" as information bits can be input to and/or output from the IC chip, offering the following advantages:

[0030] (i) when defective golf balls are found, quick remedies can be taken,

[0031] (ii) the timing of replacement of used balls in a golf practice range can be readily determined, and

[0032] (iii) the number of golf ball resurfacing cycles is seized and used for quality control.

[0033] The term "shot history" refers to the number of shots a golf ball has experienced. Counting the number of shots is useful for the management of golf balls used repeatedly and frequently in a golf practice range. For example, when a golf ball comes out of an automatic tee-up machine or automatic vending machine in a golf practice range, a bit of shot information is transferred to or from the IC chip whereby the number of shots is learnt. If the number of shots a golf ball has experienced is known, a worker of the golf practice range estimates the degree of degradation of the ball on a non-personal basis, and thus readily determines the timing of replacement of practice golf balls.

[0034] The "flight properties" include the initial parameters of a golf ball such as initial velocity, launch angle, and

spin rate. Specifically, radio wave is transmitted from an internal unit of the golf ball and then the radio wave is measured by the receiver set in the field. The manner is similar to a global positioning system (GPS). By delivering such initial parameters to or from the IC chip, various properties of each golf ball can be directly measured. Exemplary data relating to flight properties include an initial velocity, ramp, height, spin rate, fall speed, spin rate during fall, etc. Heretofore, these data had to be measured in a factory or laboratory using a measuring instrument such as a hitting robot or swing robot. Now that the data are transferred to or from the IC chip, the data can be obtained directly from each ball. The data indicative of flight properties are useful in the development efforts of new golf balls intending to upgrade the flight performance.

[0035] The IC chip has incorporated therein a data storage element capable of writing and reading the information about the above items. For example, the data storage element described in JP-A 9-135925 may be used. The data storage element is described as comprising a storage section, a processor section, and a transmitter section, wherein information bits relating to manufacture history, rubber composition, shot history and flight properties are previously programmed or written in the storage section. In response to a retrieval command from an external unit, the processor section reads out the information data in the storage section, and the transmitter section transmits them to the external unit. On receipt of such information data, the external unit displays the information relating to manufacture history, rubber composition, shot history and flight properties.

[0036] The IC chip may be any of well-known IC chips, for example, available under the trade name of "μ-Chip" from Hitachi, Ltd.

[0037] Now, the golf ball G shown in FIG. 3 is described as a second embodiment of the invention. The golf ball G is a three-piece solid golf ball comprising a solid core 1 and a cover of two layers 2a and 2b. An IC chip 3 is embedded directly in the cover inner layer 2a that directly encloses the solid core 1, and disposed adjacent to the solid core 1.

[0038] The cover layers 2a and 2b are prepared, as described in conjunction with the first embodiment, by furnishing cover materials based on thermoplastic resins or elastomers and injection molding the cover materials around the core in a mold. The IC chip 3 directly embedded in the cover inner layer 2a is obtained by placing the IC chip in position within a mold and then injection molding a cover material therein. For example, a core is placed in a mold cavity, an IC chip is attached to the surface of the core at a selected position, and a cover material is then injected into the mold cavity. In this way, there is obtained a ball structure as shown in FIG. 3 wherein the IC chip 3 and the cover inner layer 2a are combined in an integral fashion.

[0039] The materials of which the solid core 1 and two cover layers 2a, 2b are made are the same as described in conjunction with the first embodiment. The solid core 1 may be prepared by well-known methods. For example, the solid core is prepared by kneading a core-forming composition on a well-known milling machine such as a Banbury mixer or roll mill, compression or injection molding the composition

in a core mold, and heating the core form at a temperature sufficient for the crosslinking and co-crosslinking agents to act for curing.

[0040] As described above, the golf ball G in an embodiment of the invention has an IC chip embedded in the ball interior so that the ball itself bears the information relating to its own manufacture history, shot history and flight properties. The ball's own possession of inherent information facilitates operations including ball quality control, ball recycling, evaluation of flight performance and the like.

[0041] While specific embodiments of the golf ball of the invention have been described, it will be apparent to those skilled in the art that various modifications thereto can be made without departing from the spirit and scope of the present invention as defined in the appended claims. For example, with respect to the type of golf ball, the illustrated embodiments relate to two and three-piece solid golf balls comprising a solid core enclosed with a cover of one or two layers. The invention is applicable to all types of golf balls, that is, may be embodied as solid golf balls including one-piece golf balls and multi-piece golf balls of three or more layer structures, or wound golf balls.

[0042] The position where the IC chip is embedded in the golf ball is not limited to those of the illustrated embodiments. Preferably, the IC chip is positioned at a depth of at least 1 mm radially inward from the ball surface and especially at the center of the ball because it is desired to minimize the influence of the IC chip on the durability, flight properties and structure of the golf ball.

[0043] While the diameter of the inventive golf ball is not particularly limited, it is preferred from the practical aspect that the ball have a diameter according to the golf ball regulation. For the small size, the ball has a diameter of at least 41.15 mm. For the large size, the ball has a diameter of at least 42.67 mm. Practice golf balls may have the same diameter as the large size or a diameter of at least 44.00 mm.

[0044] Japanese Patent Application No. 2004-017386 is incorporated herein by reference.

[0045] Although some preferred embodiments have been described, many modifications and variations may be made thereto in light of the above teachings. It is therefore to be understood that the invention may be practiced otherwise than as specifically described without departing from the scope of the appended claims.

1. A golf ball having incorporated therein an IC chip which can input and/or output data relating to at least one item selected from the group consisting of manufacture history, shot history and flight properties.

2. The golf ball of claim 1, having a surface wherein the IC chip is embedded at least 1 mm inside the ball surface.

3. The golf ball of claim 1, wherein the IC chip is embedded at the center of the ball.

4. The golf ball of claim 1, wherein said golf ball has a solid core which is formed of a rubber base composition, and said IC chip is encapsulated with a protective layer of a special rubber member and embedded in said solid core.

5. The golf ball of claim 1, which is a practice golf ball.