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GOLF BALL

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(56) Related Art

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Abstract

The present invention provides a golf ball which is good in shot feel and controllability, and also has high rebound performance and good flight performance. The golf ball of the present invention comprises a core and a cover with one or more layers covering on the core, wherein at least one layer of the cover contains 5-100% by weight, based on the total weight of the whole resin components contained the cover layer, of an ionomer resin neutralized with plural metal ions, which is obtained by neutralizing at least two base polymers selected from the group consisting of ethylene-acrylic acid copolymer, ethylene-methacrylic acid copolymer, ethylene-acrylic acid-acrylate terpolymer and ethylene-methacrylic acid-acrylate terpolymer with two or more sorts of metal ions, the base polymers essentially including at least one of the terpolymers.

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COMPLETE SPECIFICATION

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INVENTION TITLE:

Golf ball

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

1a

FIELD OF THE INVENTION

The present invention relates to a golf ball, and in particular to a
5 golf ball which has good shot feel, good controllability, high rebound
performance and good flight performance.

BACKGROUND OF THE INVENTION

Recently, ionomer resin has been widely employed as a base resin
10 for a cover of a golf ball. Especially, in two-piece solid golf balls using solid
core, the ionomer resin has been exclusively used as the base resin of the
cover, because the ionomer resin has high rebound performance, and is good
in durability and cut-resistance, and also it is easy to be processed.

However, since the ionomer resin has high hardness and high
15 rigidity, the resulting golf balls are poor in shot feel and in controllability,
namely, ease to apply spin to a golf ball, in comparison with balata
(transpolyisoprene) covered golf balls. The balata is softer than the ionomer
and therefore has been used as a base resin for a cover of a golf ball having a
multi-layer structure including a thread rubber layer.

20 Under these circumstances, it has been attempted to improve shot
feel and controllability by softening the ionomer resin by way of various
means.

For example, Japanese Patent Unexamined Publication Nos. Hei
1-308577 and Hei 5-3931 propose to blend (mix) a soft ionomer with the
25 above mentioned rigid ionomer resin, in order to soften the rigid ionomer and
to improve the shot feel and controllability of the resulting golf balls. The soft

ionomer is obtained by neutralizing a terpolymer formed from α -olefin, an unsaturated carboxylic acid (such as, acrylic acid and methacrylic acid) and an ester of acrylic acid, with sodium ion or zinc ion. However, the above-mentioned blend of the soft ionomer has not given satisfactory results
 5 because it adversely affects on rebound performance and flight performance.

The present invention advantageously alleviates the problems of the aforementioned conventional techniques, and provides a golf ball which has good shot feel and good controllability, and also has high rebound performance and
 10 good flight performance.

SUMMARY OF THE INVENTION

Under the above circumstances, the present inventors have
 15 intensively studied about a resin to be used for a cover of a golf ball in order to satisfy good shot feel and good controllability, and also satisfactory flight performance. As a result, they have found that there can be provided a golf ball which has good shot feel and good controllability, and also has high rebound performance and good flight performance, by employing a cover
 20 comprising, as a main component, a plural metal ion-neutralized ionomer, which is obtained by neutralizing at least two base polymers selected from the group consisting of ethylene-acrylic acid copolymer, ethylene-methacrylic acid copolymer, ethylene-acrylic acid-acrylate terpolymer and ethylene-methacrylic acid-acrylate terpolymer with two or more sorts of metal ions
 25 wherein the base polymers essentially include at least one of the above terpolymers.



Accordingly, the present invention provides a golf ball which comprises a core and a cover with one or more layers covering on the core, wherein at least one layer of the cover contains 5-100% by weight, based on the total weight of the whole resin components contained the cover layer, of

5 an ionomer resin neutralized with plural metal ions, which is obtained by neutralizing at least two base polymers selected from the group consisting of ethylene-acrylic acid copolymer, ethylene-methacrylic acid copolymer, ethylene-acrylic acid-acrylate terpolymer and ethylene-methacrylic acid-

10 acrylate terpolymer with two or more sorts of metal ions, the base polymers essentially including at least one of the terpolymers.

DETAILED DESCRIPTION OF THE INVENTION

The plural metal ion-neutralized ionomer employed in the present invention is obtained by neutralizing at least two base polymers selected from

15 the group consisting of ethylene-acrylic acid copolymer, ethylene-methacrylic acid copolymer, ethylene-acrylic acid-acrylate terpolymer and ethylene-methacrylic acid-acrylate terpolymer with two or more sorts of metal ions wherein the base polymers essentially include at least one of the above terpolymers. The plural metal ion-neutralized ionomer is extremely superior

20 in rebound performance to conventional ionomers having medium rigidity, e.g., Hi-Milan 1855 (Zn) and Hi-Milan 1856 (Na), both available from Mitsui Du Pont Polychemical Co., Ltd., although its hardness is almost equal to that of the conventional ionomers. Therefore, a cover layer containing the specific ionomer as a main component can provide a golf ball which has good shot

25 feel and controllability, and also has high rebound performance and good flight performance. The symbols given in the parentheses after the names of

the ionomers, e.g., Zn and Na, respectively indicate sorts of metals used for neutralization.

In the present invention, the plural metal ion-neutralized ionomer may be contained in at least one cover layer, but an amount of it may be
5 within the range of 5-100% by weight, preferably 10-100% by weight, more preferably 30-100 % by weight, based on the total weight of the whole resin components contained the cover layer. Where the cover layer contains the plural metal ion-neutralized ionomer in an amount less than 5% by weight based on the total weight of the whole resin components, it is difficult to
10 exhibit the technical effects of giving good shot feel and good controllability to a golf ball, and also giving high rebound performance and good flight performance to the golf ball.

The reason why, in the present invention, at least one terpolymer of ethylene-acrylic acid-acrylate terpolymer and ethylene-methacrylic acid-acrylate
15 terpolymer is employed as at least one of the base polymers of the plural metal ion-neutralized ionomer is that it is necessary to use at least one terpolymer of the above listed terpolymers in order to make both shot feel and controllability good with maintaining good flight performance.

The reason why two or more base polymers selected from the group
20 consisting of ethylene-acrylic acid copolymer, ethylene-methacrylic acid copolymer, ethylene-acrylic acid-acrylate terpolymer and ethylene-methacrylic acid-acrylate terpolymer essentially including at least one of the above terpolymers is employed as the base polymers is that it is necessary to use at least two polymers of the above listed four polymers in order to satisfy
25 good shot feel and good controllability, and also good flight performance.

Examples of the metal ions for neutralizing the base polymers are

monovalent metal ion, such as sodium ion, lithium ion or potassium ion;
divalent metal ion, such as zinc ion, magnesium ion, calcium ion or nickel ion;
and trivalent metal ion, such as aluminum ion.

The reason why the present invention requires the use of two or
6 more metal ions for neutralizing the base polymers is that it is necessary to
use two or more metal ions in order to make shot feel and controllability good,
and also to make flight performance good. When using two or more metal
ions, it is preferable to use a combination of the monovalent metal ion and the
divalent metal ion, particularly a combination of sodium ion and magnesium
10 ion.

The cover layer may contain another resin other in addition to the
above mentioned plural metal ion-neutralized ionomer as the resin
component of the cover layer. The other resin may include materials such
as an ionomer other than the plural metal ion-neutralized ionomer of the
15 present invention, a thermoplastic elastomer and a thermoplastic elastomer
modified with a polar group, which have been generally employed as a cover
resin for a golf ball.

Examples of the other ionomer resins are ionomers available from
Mitsui Du Pont Polychemical Co., such as Hi-Milan 1605 (Na), Hi-Milan 1707
20 (Na), Hi-Milan AM7318 (Na), Hi-Milan 1706 (Zn), Hi-Milan AM7315 (Zn), Hi-
Milan AM7317 (Zn), Hi-Milan AM7311 (Mg) and Hi-Milan MK7320 (K);
ionomers available from Du Pont Co., such as Surlyn 8920 (Na), Surlyn 8940
(Na), Surlyn AD8512 (Na), Surlyn 9910 (Zn), Surlyn AD8511 (Zn), Surlyn
AD7930 (Li), Surlyn AD7940 (Li) and terpolymeric ionomers, e.g., Surlyn 8320
25 (Na) and Surlyn AD8542 (Mg); and ionomers available from Exxon Co., such
as IOTEC 8000 (Na) and IOTEC 7010 (Zn). The symbols given in the

parentheses after the names of the ionomers, e.g., Na, Zn, K, Li and Mg, respectively indicate a sort of metal used for neutralization. These ionomers may be respectively used alone. Alternatively, two or more of them may be mixed. Two or more kinds of ionomers including at least one ionomer
5 neutralized with monovalent metal ion and at least one ionomer neutralized with divalent metal ion may be mixed.

The thermoplastic elastomer can be any thermoplastic elastomer, which has been used for golf balls, for example polyolefins, polyesters, polyamides, polyurethanes, polystyrene base polymers having styrene-
10 butadiene-styrene structure or styrene-isoprene-styrene structure. It may be possible to mix the thermoplastic elastomer with the above mentioned ionomer. The thermoplastic elastomer may be modified with a polar group, such as a maleic anhydride, an epoxy group (typically a glycidyl group), or a sulfonic acid group, to increase compatibility with the ionomer resin. As
15 mixture of the ionomer, the thermoplastic elastomer and the thermoplastic elastomer modified with polar group may also be employed for the same purpose.

In order to make shot feel and controllability good and also make flight performance good, it is preferred that the plural metal ion-neutralized
20 ionomer itself has a Shore D-scale hardness of 30 to 60, preferably 35 to 60 and a flexural modulus of 30 to 200 MPa, preferably 50 to 200 MPa. In addition, the cover layer containing the plural metal ion-neutralized ionomer preferably has a Shore D-scale hardness of 35 to 70, more preferably 40 to 65. When the plural metal ion-neutralized ionomer has a Shore D-scale hardness
25 of lower than 30, it may be difficult to adjust a Shore D-scale hardness of the resulting cover layer to a desirable hardness, namely, Shore D-scale

hardness of 35-70. Rebound performance and cut- resistance may also be poor. When the Shore D-scale hardness of the plural metal ion-neutralized ionomer is higher than 60, rebound performance is deteriorated and it may be difficult to provide the cover layer having a desirable hardness, that is Shore

5 D-scale hardness of 35-70.

When the plural metal ion-neutralized ionomer has a flexural modulus of lower than 30 MPa, it may be difficult to adjust the cover layer to a desirable hardness, that is, Shore D-scale of 35-70. On the other hand,

10 when a flexural modulus of the plural metal ion-neutralized ionomer is higher than 200 MPa, rebound performance may be deteriorated and it may be difficult to adjust the cover layer to a desirable hardness, that is, Shore D-scale hardness of 35-70. When the cover layer containing the plural metal ion-neutralized ionomer has a Shore D-scale hardness of lower than 35, the cover layer may be too soft, and rebound performance, flight performance
15 and cut-resistance may be deteriorated. When the cover layer containing the plural metal ion-neutralized ionomer has a Shore D-scale hardness of higher than 70, the cover layer may be too hard, and shot feel and controllability may be deteriorated.

In the present invention, the cover may have a single layer
20 structure composed of one cover layer and may have a multi-layer structure composed of two or more cover layers. When the cover has the single layer structure and when the cover is formed from only one cover layer, the plural metal ion-neutralized ionomer should be contained in the cover layer. When the cover has the multi-layer structure and when the cover is composed of two
25 or more cover layers, the plural metal ion-neutralized ionomer may be contained in at least one of the cover layers. In the cover having the multi-

layer structure, the cover layer containing the plural metal ion-neutralized ionomer can be provided as an outermost layer, or as an intermediate layer, or as an inner layer of a cover of two-layer structure. However, the cover layer containing the plural metal ion-neutralized ionomer may be provided at
5 any positions without being limited to the above examples.

In the preparation of a cover composition containing the plural metal ion-neutralized ionomer, mixing the ingredients including the plural metal ion-neutralized ionomer is preferably conducted at 150-200 °C for 0.5-15 minutes, using an internal mixer such as a twin-screw kneading type
10 extruder, a Banbury mixer and a kneader. If necessary, various additives, such as pigment (e.g., titanium oxide (TiO₂) and barium sulfate), dispersant, antioxidant, ultraviolet absorber and light stabilizer, may be added to the cover composition containing the plural metal ion-neutralized ionomer. When the cover is composed of plural layers including the cover layer
15 containing the plural metal ion-neutralized ionomer and a cover layer not containing the plural metal ion-neutralized ionomer, the preparation of a cover composition which does not contain the plural metal ion-neutralized ionomer can be conducted according to the same manner for the preparation of the cover composition containing the ionomer neutralized with multi-sorts metals,
20 except for using another resin in place of the plural metal ion-neutralized ionomer. A golf ball can be produced by covering a core with cover layers including the cover layer containing the plural metal ion-neutralized ionomer. The core may be either a core for solid golf balls, that is, a solid core, or a core for golf balls having a multi-layer structure with a thread rubber layer, that is, a
25 thread wound core.

The solid core may be a core having a single layer structure or a

core having a multi-layer structure including two or more layers. For example, the solid core for tow piece solid golf balls can be obtained by press-vulcanizing (crosslinking) a rubber composition obtained by mixing 100 parts by weight of polybutadiene; 10 to 60 parts by weight of a vulcanizing agent (a crosslinking agent) such as α, β -monoethylenically unsaturated carboxylic acids (e.g. acrylic acid and methacrylic acid) or a metal salt thereof, a functional monomer (e.g. trimethylolpropane trimethacrylate) or a combination of α, β -monoethylenically unsaturated carboxylic acids or a metal salt thereof and a functional monomer; 10-30 parts by weight of a filler such as zinc oxide or barium sulfate; 0.5-5 parts by weight of a peroxide such as dicumyl peroxide; and if necessary, 0.1-1 parts by weight of an antioxidant, into a spherical vulcanized article. The press-vulcanization can be conducted by, for example, heat-compressing the rubber composition at 140-170 °C for 10-40 minutes.

The thread wound core comprises a center and a thread rubber layer wound on the center. The center may be either a liquid type or a rubber type. For example, the rubber type center may be obtained by vulcanizing the same rubber composition as used for preparing the aforementioned solid core. The liquid type center may be prepared by forming a rubber bag into which liquid is poured.

Thread rubber can be any one which has been conventionally used for thread wound golf balls. For example, thread rubber may be obtained by vulcanizing a rubber composition obtained by mixing a natural rubber or a mixture of a natural rubber and a synthetic polyisoprene with an antioxidant, a vulcanization accelerator and sulfur. Since both aforementioned solid core and thread wound core are mere examples, the solid core and the thread

wound core should not be limited to the examples.

A method for covering the core with the cover layers is not particularly limited and may be any conventional methods, for example, a method in which a cover composition is molded into a semi-spherical half-shell, then a core is covered with two semi-spherical half-shells, followed by molding under pressure at 130-170°C for 1-15 minutes, or a method in which the cover composition is directly injection-molded onto the core. When the cover is composed of two or more cover layers, the above-mentioned cover forming operation may be repeated. For example, when a first cover layer is formed according to the above-mentioned method and then a second cover layer is formed on the first cover layer, the second cover layer may be formed on the first cover layer according to either the method using the semi-spherical half-shells or injection molding, as described above. The cover is preferably approximately 1-5 mm in thickness. In case the cover is composed of two or more cover layers, the cover layer containing the aforementioned plural metal ion-neutralized ionomer preferably has a thickness of about 1-4 mm. In the formation of the cover, dimples may be formed on a surface of the golf ball, if necessary. After forming the cover, paint and stamp may be provided on the golf ball, if necessary.

Referring to the drawings, a representative example of the golf ball of the present invention will be illustrated. Fig. 1 is a cross-sectional view which schematically illustrates an example of the golf ball of the present invention. The golf ball illustrated in Fig. 1 is a solid golf ball comprising a core 1 which is a vulcanized molded article from a rubber composition, namely, a so-called solid core, and a cover 2 covered on the core 1. The core 1 is not restricted to any particular core and may be a vulcanized molded

article from the aforementioned rubber composition containing polybutadiene as a main ingredient. The cover 2 formed on the core 1 contains the plural metal ion-neutralized ionomer which is obtained by neutralizing at least two base polymers selected from the group consisting of ethylene-acrylic acid copolymer, ethylene-methacrylic acid copolymer, ethylene-acrylic acid-acrylate terpolymer and ethylene-methacrylic acid-acrylate terpolymer with two or more sorts of metal ions wherein the base polymers essentially include at least one of the above terpolymers, in a content of 5-100 % by weight based on the total weight of the whole resin components contained in the cover 2. The numeral 2a indicates dimples provided on the cover 2.

In the golf ball illustrated in Fig. 1, the core 1 is a vulcanized molded article having the mono-layer structure made from a rubber composition. Alternatively, the core 1 may be a core having two or more layers which comprises an inner core, which is a vulcanized molded article made from a rubber composition containing polybutadiene as a main ingredient, and an outer core which is another vulcanized molded article made from another rubber composition containing polybutadiene as a main ingredient wherein the outer core surrounds the inner core. Still alternatively, the core 1 may be a thread wound core instead of the solid core. The cover 2 may have not only the single layer structure composed of only one cover layer but also the multi-layer structure composed of two or more cover layers wherein at least one of the cover layers contains the plural metal ion-neutralized ionomer. The dimple 2a is recesses which are formed on the surface of the golf ball, if necessary. Paint and marking may be provided on the surface of the golf ball, if necessary.

BRIEF EXPLANATION OF DRAWING

Fig. 1 is a cross-sectional view which schematically illustrates an example of the golf ball of the present invention.

5 EXAMPLES

The present invention will be illustrated by the following Examples which, however, are not to be construed as limiting the present invention to their details.

Examples 1-4 and Comparative Examples 1-3

10 Golf balls of Examples 1-4 and Comparative Examples 1-3 were prepared via following steps ①-③.

① Preparation of core

15 A rubber composition was prepared by mixing 100 parts by weight of polybutadiene (commercial name "BR-11", manufactured by JSR Co., Ltd.), 34 parts by weight of zinc acrylate, 20 parts by weight of zinc oxide, 1.5 parts by weight of dicumyl peroxide and 0.5 parts by weight of an antioxidant (commercial name "Yoshinox 425", manufactured by Yoshitomi Seiyaku Co., Ltd.). The rubber composition was vulcanization-molded by heating at 160°C for 15 minutes to produce a solid core. An average diameter of the core
20 obtained was 38.9 mm. Hardnesses at any portion of the core, which were measured by a JIS-C type hardness meter, all fell within the range of 75-81.

② Preparation of a resin composition for forming cover layer

25 A pellet-like composition for forming a cover layer was prepared by mixing the formulation shown in Tables 1 and 2 by using a twin-screw kneading type extruder. In the Tables, an amount of each ingredient is expressed in a unit of parts by weight. Details of the ingredients represented

by their commercial name in the Tables are summarized below Table 2.

Extrusion conditions were as follows: screw diameter, 45 mm; screw speed, 200 r.p.m.; screw L/D, 35. The mixtures were heated to 220-260°C at the die position of the extruder.

- 5 Flexural modulus and Shore D-scale hardness of the obtained composition for forming the cover layer were measured. The results are summarized in Tables 1 and 2 with formulation of the composition for forming the cover layer. Methods of measuring the flexural modulus and Shore D-scale hardness are as follows.

10 Flexural modulus

A flexural modulus of a molded sheet prepared from each resin composition for forming the cover layer was measured according to ASTM D-747 after storing the sheet at 23°C for 2 weeks.

Shore D-scale hardness

- 15 Shore D-scale hardness of a molded sheet prepared from each composition for forming the cover layer was measured according to ASTM D-2240 after storing the molded sheet at 23°C for 2 weeks.

Table 1

	Example			
	1	2	3	4
Resin composition for cover layer				
Hi-Milan M7031-1 (Note 1)	50	80	100	80
Hi-Milan 1605 (Note 2)	25	20	0	0
Hi-Milan 1706 (Note 3)	25	0	0	0
Hi-Milan AM7316 (Note 4)	0	0	0	20
Titanium oxide	2	2	2	2
Barium sulfate	2	2	2	2
Antioxidant	0.2	0.2	0.2	0.2
Flexural modulus (MPa)	250	200	150	110
Shore D-scale hardness	59	57	56	52

Table 2

	Comparative Example		
	1	2	3
Resin composition for cover layer			
Hi-Milan 1605 (Note 2)	50	25	50
Hi-Milan 1706 (Note 3)	50	25	0
Hi-Milan AM7316 (Note 4)	0	0	50
Hi-Milan 1855 (Note 5)	0	50	0
Titanium oxide	2	2	2
Barium sulfate	2	2	2
Antioxidant	0.2	0.2	0.2
Flexural modulus (MPa)	340	240	130
Shore D-scale hardness	62	59	53

(Note 1): Hi-Milan M7031-1 (commercial name); a plural metal ion-

5 neutralized ionomer which is produced by neutralizing a mixture of ethylene-

methacrylic acid copolymer and ethylene-methacrylic acid-acrylate terpolymer with sodium ion and magnesium ion, manufactured by Mitsui Du Pont Polychemical Co., Ltd.; flexural modulus: 150 MPa; Shore D-scale hardness: 56.

- 5 (Note 2): Hi-Milan 1605 (commercial name); an ionomer which is produced by neutralizing ethylene-methacrylic acid copolymer with sodium ion, manufactured by Mitsui Du Pont Polychemical Co., Ltd.; flexural modulus: 295 MPa; Shore D-scale hardness: 61.

- (Note 3): Hi-Milan 1706 (commercial name); an ionomer which is
10 produced by neutralizing ethylene-methacrylic acid copolymer with zinc ion, manufactured by Mitsui Du Pont Polychemical Co., Ltd.; flexural modulus: 270 MPa; Shore D-scale hardness: 60.

- (Note 4): Hi-Milan AM7316 (commercial name); an ionomer
15 produced by neutralizing ethylene-methacrylic acid-acrylate terpolymer with zinc ion, manufactured by Mitsui Du Pont Polychemical Co., Ltd.; flexural modulus: 24 MPa; Shore D-scale hardness: 34.

- (Note 5): an ionomer produced by neutralizing ethylene-
methacrylic acid-acrylate with zinc ion, manufactured by Mitsui Du Pont
Polychemical Co., Ltd.; flexural modulus: 87 MPa; Shore D-scale hardness:
20 54.

③ Preparation of golf ball

- The resin composition for forming the cover layer obtained in the
operation ② was directly injection-molded on the solid core obtained in the
operation ① to obtain a ball. The ball was painted to produce a golf ball
25 having an outer diameter of 42.7 mm and a weight of 45.3 g.

Ball compression (PGA), flight distance and shot feel when hitting

by a driver and controllability in an approach shot were tested. The results are summarized in Tables 3 and 4. Methods of measurement and evaluation of the properties are as follows.

Flight distance by a driver (No. 1 wood club)

- 5 A driver (No.1 wood club) was attached to a swing robot manufactured by True Temper Co. and a golf ball was hit at a head speed of 45 m/second. A distance from the hitting point to a point firstly reaching on the ground, that is, a carry distance, was measured.

Shot feel and controllability in approach shot

- 10 Shot feel and controllability in an approach shot were evaluated by way of an actual hitting test by ten top-professional golfers. Evaluation criteria are as follows. Evaluation results expressed with symbols in Table 3 are in accord with those evaluation criteria. A symbol in the Table indicates that eight out of ten golfers gave a common evaluation corresponding to the symbol. The shot feel was evaluated by the actual hitting test using a driver (No. 1 wood). The controllability in the approach shot was evaluated by the actual hitting test using a sand wedge.

Evaluation criteria

Shot feel

- 20 ○: soft and good
△: a little hard
×: hard and poor

Controllability

- 25 ○: easy to apply spin and good
△: possible to apply spin but insufficient
×: hard to apply spin and poor

Table 3

	Example			
	1	2	3	4
Ball compression	90	88	87	85
Flight distance by driver (yard)	230	228	227	225
Shot feel	○	○	○	○
Controllability in approach shot	○	○	○	○

Table 4

	Comparative Example		
	1	2	3
Ball compression	98	90	86
Flight distance by driver (yard)	227	221	218
Shot feel	x	x	△
Controllability in approach shot	x	△	△

- As is apparent from the comparison of the ball characteristics of
- 5 Examples 1-4 shown in Table 3 to those of Comparative Examples 1-3 shown in Table 4, the golf balls of Examples 1-4 had better shot feel and better controllability, and also had longer flight distance and better flight performance than the golf balls of Comparative Examples 1-3.

- 10 A golf ball of Comparative Example 1, which was obtained by using a highly rigid ionomer for the cover, had been evaluated to have good flight performance. The golf balls of Examples 1-4 were equal to the golf ball of Comparative Example 1 in rebound performance and flight performance, and were superior to the golf ball of Comparative Example 1 in shot feel and controllability.

Although the golf ball of Comparative Example 1 attained a long flight distance to be excellent in flight performance, it was inferior in both shot feel and controllability. The balls of Comparative Examples 2 and 3 were poor in flight distance, and additionally insufficient in shot feel and
5 controllability.

Although it was described that the cover had the single layer structure composed of only one cover layer in the above Examples, the cover may have the multi-layer structure composed of two or more cover layers essentially including at least one cover layer which contains 5-100% by
10 weight, based on the whole resin components included therein, of the plural metal ion-neutralized ionomer.

As is described above, the present invention can provide a golf ball which is excellent in shot feel and controllability, and also has high rebound performance and excellent flight performance.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that that prior art forms part of the common general knowledge in Australia.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A golf ball comprising a core and a cover with one or more layers covering on said core, wherein at least one layer of the cover contains 5-100% by weight, based on the total weight of the whole resin components
5 contained in the cover layer, of an ionomer resin neutralized with plural metal ions, which is obtained by neutralizing at least two base polymers selected from the group consisting of ethylene-acrylic acid copolymer, ethylene-methacrylic acid copolymer, ethylene-acrylic acid-acrylate terpolymer and ethylene-methacrylic acid-acrylate terpolymer with two or more sorts of metal
10 ions, the base polymers essentially including at least one of the terpolymers.
2. A golf ball according to Claim 1, wherein the plural metal ion-neutralized ionomer is obtained by neutralizing the base polymers with at least one monovalent metal ion and at least one divalent metal ion.
3. A golf ball according to Claim 1 or 2, wherein the plural metal
15 ion-neutralized ionomer is obtained by neutralizing the base polymers with sodium ion and magnesium ion.
4. A golf ball according to any one of Claims 1-3, wherein the plural metal ion-neutralized ionomer has a Shore D-scale hardness of 30 to 60 and a flexural modulus of 30-200 MPa.
- 20 5. A golf ball according to any one of Claims 1-3, wherein the cover layer containing the plural metal ion-neutralized ionomer has a Shore D-scale hardness of 35-70.



- 20 -

6. A golf ball substantially as hereinbefore described with reference to the drawings and/or Examples, but excluding the Comparative Examples.

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DATED this 15th day of March, 2001

SUMITOMO RUBBER INDUSTRIES, LTD.

By its Patent Attorneys:

DAVIES COLLISON CAVE

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Fig. 1

