

PATENT SPECIFICATION

(11) 1 265 596

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NO DRAWINGS

- (21) Application No. 25710/70 (22) Filed 28 May 1970
 (31) Convention Application No. 41501 (32) Filed 28 May 1969 in
 (33) Japan (JA)
 (45) Complete Specification published 1 March 1972
 (51) International Classification A 63 b 37/00
 (52) Index at acceptance
 C3P 2A 2C13A 2C17 2C18 2C19 2C20C 2C20D1 2C7
 2C8C 2H4 2HY 2K8 2R2
 A6D 1B 1C5



(54) SOLID GOLF BALL

- 71) We, DUNLOP HOLDINGS LIMITED (formerly The Dunlop Company Limited), a British Company of Dunlop House, Ryder Street, St. James's, London, S.W.1., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—
- 10 This invention relates to a solid golf ball, that is a golf ball which can be formed from a moulding composition and does not require a complicated, thread-wound core. Such a solid golf ball may therefore be in the form of a unitary, i.e. one-piece, substantially spherical moulding or it may be a composite ball consisting of a core and a cover.
- 15 A conventional golf ball consists of an expensive thread-wound core encased in a cover. The core usually consists of a spherical centre, which may be of rubber, glass or metal or a paste-filled sac, and around this spherical centre are wound many yards of a special elastic thread. The ball is then finished by the formation of a cover encasing the thread-wound core. The cover protects the core from impact damage and the core provides the vital properties of resilience, flight characteristics and speed off the club head.
- 20 A ball of this conventional type is clearly expensive and laborious to manufacture and so the desirability of providing a single moulding composition from which the ball could be formed has long been apparent. However no single moulding composition has yet been formulated which can give to a golf ball moulded therefrom all the special characteristics and requirements demanded by golfers. One of the most successful attempts to solve this problem was an invention in which a solid golf ball was moulded from a composition comprising filler, a cross-linkable rubber and a polyfunctional monomer which reacts to cross-link the rubber into a three dimensional network with long flexible cross-links. Golf balls of this type will hereafter, for convenience, be referred to as solid golf balls

[Price 25p]

of the "conventional cross-linked" type in order to distinguish them from golf balls of the present invention. The monomer which is used in the "conventional cross-linked" golf balls not only cross-links the rubber component but may also polymerise to a certain extent. Thus a cross-linked rubber-resin system may be obtained, the resin being polymerised monomer. Solid golf balls of the "conventional cross-linked" type have better cut-resistance than thread-wound balls, are cheaper to make and approach a thread-wound ball in many other of the desired properties. For example, "conventional cross-linked" golf balls are considered to have, in many cases, a high rebound elasticity approaching, or equivalent to, that of a thread-wound golf ball.

Now the present inventors studied various experiments based on the "conventional cross-linked" type of solid golf ball. The results showed that the rebound coefficient of this golf ball may be equal to or greater than that of a thread-wound golf ball at low impact velocity (20 m/sec. or less), but as the impact velocity increases the rebound coefficient decreases considerably. For example, it has been found that it decreases by about 10 per cent at an impact velocity of about 40 m/sec. Since shots played by a No. 1 wood club afford an average impact velocity of greater than 40 m/sec., this is clearly disadvantageous. Thus, the flight distances of golf balls of the "conventional cross-linked" type are found on average to be several yards shorter than those of thread-wound golf balls.

Although it is not wished to limit the present invention to any particular theory, the cause of this decrease of rebound coefficient, from the results of observations with an electron microscope and chemical experiments, may be deduced from the facts that the polyfunctional monomer is dispersed in the rubber after curing in the form of spherical resin particles of about 100 Å diameter, and is combined linearly with the rubber by graft polymerisation, i.e. by primary bonds. However, the filler is bound to the

rubber-resin system by secondary bonding only and this secondary bonding breaks down on impact with a golf club, thereby resulting in great hysteresis loss.

- 5 In order to overcome this problem, we have manufactured solid golf balls incorporating a silane coupling agent in order to convert the secondary bonding between the rubber-resin system and the filler to linear bonding.
- 10 By this means, the manufacture of an economical golf ball having high rebound elasticity more comparable to that of a first class thread-wound golf ball not only at low impact velocity but also at high impact velocity and
- 15 superior in respect to the resistance to cutting (which is one of the main defects of a thread-wound ball) is now possible.

- Accordingly, the present invention provides a solid golf ball which is moulded from a composition comprising a rubber having a glass transition temperature of -50°C. or less, or a rubber prepared by blending the aforesaid rubber with a rubber having a glass transition temperature of from -50°C. to -30°C. , the latter being present in an amount of up to 30 percent by weight based on the former; a polyfunctional monomer which can act as a cross-linking agent for the above-mentioned rubber; a polymerisation initiator, e.g. an organic peroxide, a silane coupling agent in an amount of up to 40 percent by weight based on the total rubber; and a filler which reinforces the cross-linked rubber system and which can bond to the silane coupling agent.

- The silane coupling agent used in the present invention is a compound having one or more groups which can react, usually by hydrolysis, to bond to the filler, and one or more groups which can by organic reaction bond with the rubber-resin system in the moulding composition.

- An example of a suitable rubber having a glass transition temperature of -50°C. , or less, is high *cis* polybutadiene with a *cis* content of at least 30 percent, preferably at least 90 percent and especially at least 95 percent.

- Other suitable rubbers include natural rubber, synthetic polyisoprene rubber, silicone rubber, and block-polymerised S.B.R.

- As indicated above, a rubber with a glass transition temperature of -50°C. , or less, must be used in the present invention, but rubbers with a glass transition temperature of from -50°C. to -30°C. , e.g. chloroprene, S.B.R. of a low styrene content, chlorinated or chlorosulphonated polyethylene and ethylene-propylene rubber, may be incorporated by blending in an amount of up to 30 percent by weight based on the rubber with a glass transition temperature of -50°C. or less.

- The polyfunctional cross-linking monomer may be bifunctional, trifunctional, tetrafunctional or higher. Suitable examples of

these polyfunctional reactants include unsaturated acid esters; polyamine amides and imides of unsaturated acids; polyol esters and anhydrides of unsaturated acids, and other polyfunctional compounds such as divinyl benzene and di- and triallyl cyanurates. Partial polymers capable of further polymerisation may also be used, e.g. low molecular weight liquid polymers such as liquid polybutadiene, polyester and epoxy resins. Particularly preferred examples are trimethylol propane trimethacrylate and butylene glycol dimethacrylate.

The filler which is to be added to the moulding composition must, in addition to having the desired reinforcing action, be capable of undergoing a bonding reaction with the hydrolysed silane coupling agent. It is preferred to use anhydrous or hydrous silicic acid and silicates, melamine-formaldehyde resins or urea-formaldehyde resins. Melamine-formaldehyde and urea-formaldehyde resins are hereafter referred to, for convenience, as M.F. and U.F. resins respectively.

The amount of filler required varies from formulation to formulation, but the determination of the optimum amount for any particular ball is a well known technique in the art. Thus compositions to give golf balls having the desired weight and "click" can be readily formulated. Amounts of up to 70 parts by weight of filler per 100 of rubber have been found particularly effective. Moreover, in the present invention, it has been found particularly useful, but not essential, to incorporate filler to an amount by weight at least twice that of the silane coupling agent. A polymerisation initiator, e.g. one capable of producing free radicals, such as an organic peroxide, should be added to the moulding composition in order to cause polymerisation of the monomer and cross-linking of the rubber.

The silane coupling agents used usually contain one, two or three hydrolysable groups attached to the silicon atom and at least one reactive organic group which can react with the system in which it is used. The hydrolysible groups become hydrolysed on the filler surface and condense with the hydroxyl groups attached to the filler whilst the reactive organic group undergoes either radical copolymerisation or condensation with the rubber-resin system, i.e. the cross-linked elastomer and/or the polymerised monomer in the present invention. In this manner the rubber-resin system and the filler are joined by primary covalent bonds via a silane coupling agent instead of by secondary bonds as in previous solid golf balls.

Silane coupling agents which may be used to make the solid golf balls of this invention include those which may be described by the general formula:—



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At least one, and usually two or all three of R^1 , R^2 and R^3 are hydrolysable to give hydroxy groups which have an affinity for the filler used. Typical hydrolysable groups include alkoxy, halogen and metal and non-metal salts. Any non-hydrolysable group in R^1 , R^2 or R^3 is usually alkyl.

x may be 0, 1, 2 or 3.

R^4 is an organic functional group capable of entering into organic reactions to form a bond with the rubber and/or the resin in the composition. This group may therefore contain one or more reactive groups, e.g. vinyl, amino, epoxy, hydroxy, carboxy, mercapto, ether or ester groups.

A list of silane coupling agents of the types usable in the present invention was published as Section 14—A in the reprints of the 17th Annual Technical and Management Conference of the Reinforced Plastics Division of the Society of the Plastics Industry Inc. held in Chicago in February 1962.

Particularly preferred silane coupling agents are vinyl tris-(betamethoxyethoxy) silane, gamma - methacryloxypropyltrimethoxysilane, and mercaptopropyltrimethoxysilane. These are available under the code numbers A172, A174 and A189 respectively from the Union Carbide Corporation. Another particularly preferred silane coupling agent is N-beta (aminoethyl) - gamma - aminopropyltrimethoxysilane which is available under the code number Z6020 from Dow Corning International Limited.

By the incorporation of small amounts of silane coupling agent in the manner of the present invention an improved solid golf ball can be made which has a high rebound elasticity comparable to that of a first class thread-wound ball, and which has better durability than a thread-wound ball. More-

over the decrease in rebound resilience which is obtained on increasing the club-head impact velocity is less marked with balls of the invention than with solid golf balls moulded without the incorporation of a silane coupling agent.

It is preferred to use the silane in amounts of from 1 to 30 parts per hundred of rubber, and especially up to 20 parts per hundred.

As indicated above the ball of the invention may be a one-piece moulding or may be a composite ball consisting of a core encased in a cover, the core being formed from the silane-containing moulding composition set out above. In the latter case, the core may be a one-piece moulding or may itself be of two or more portions. In a multi-portion core at least one of the core portions must be formed from the aforesaid moulding composition.

Where a separate cover is provided it can be, for example, of one or more of the following:—

balata; *trans*-polymers of a conjugated diolefine, e.g. *trans*-polyisoprene, *trans*-polybutadiene (preferably having a *trans*-polymer content of at least 90 percent); polyurethanes; polyamides; high-styrene content butadiene-styrene copolymers; polymers and copolymers of ethylene; polymers and copolymers of propylene; olefine-unsaturated carboxylic acid copolymers, particularly metal terpolymers thereof; copolymers of unsaturated olefines with esters of unsaturated acids, e.g. methyl methacrylate-butadiene copolymers (especially those of high methyl methacrylate content); and neoprene (especially in crystalline form). These cover materials may be blended with natural or synthetic elastomers.

The dimensions of the components of a composite golf ball according to the present invention may suitably be as follows:—

Ball Diameter	1.62 inches	1.68 inches
Two Component Ball:		
Core Diameter:—	0.75 —1.6 inches	0.75 —1.64 inches
Preferred Range	1.00 — 1.54 inches	1.00 —1.60 inches
Cover Thickness:—	0.020—0.435 inch	0.020—0.465inch
Preferred Range	0.040—0.310 inch	0.040—0.340 inch
Three Component Ball:		
Inner Core Diameter	0.25 —1.00 inch	0.25 —1.00 inch
Overall Core Diameter	0.75 —1.60 inches	0.75 —1.64 inches
Cover Thickness	As for the two component ball	

The invention is further illustrated by the following Examples, in which all parts are by weight and in which "p.p.h.r." means "parts per hundred of rubber".

- 5 Examples 1 to 13 describe the manufacture and testing of one-piece solid golf balls of the invention and Examples 14 to 23 describe the manufacture and testing of two component balls of the invention. These two component balls each consisted of a one-piece moulded core encased in a cover.

EXAMPLES 1 TO 13

- 15 Compounding of the various moulding compositions was carried out on a 2-roll laboratory mill at 80—100°C. The rubber (*cis*-polybutadiene) was first banded onto the mill and then an antioxidant (1p.p.h.r.) added.

Filler, silane and monomer were added in the form of a paste and finally the peroxide cross-linking agent was incorporated.

Solid golf balls 1.68 inches in diameter were prepared from each composition by moulding the composition for 30 minutes at 160°C. The golf balls were tested for rebound coefficients and compression and some of the balls were also tested for flight and impact-resistance.

The results obtained, together with the formulations used, are given in Tables 1, 2, 3 and 4 below.

The epoxy silane used in Example 1 was gamma - Glycidoxypyltrimethoxysilane (available from the Union Carbide Corporation under code number A-187.)

TABLE 1

Example	Silane Coupling Agent	Formulation				
		Rubber	Monomer	Filler Silica	Peroxide	Silane
1	Epoxy Silane	100	40	40	3.15	20
2 (a)	Metha-	100	40	40	3.15	2
(b)	crylate	100	40	40	3.15	8
(c)	Silane	100	40	40	3.15	20
(d)	A174	100	40	30	3.15	30
3 (a)	Vinyl	100	40	40	3.15	2
(b)	Silane	100	40	40	3.50	8
(c)	A172	100	40	40	3.15	80
4	Amino Silane Z6020	100	40	40	3.15	2
5	Mercapto Silane A189	100	40	40	3.15	2
	1st Class Thread-wound Ball	—	—	—	—	—
	Solid Ball from above formulations omitting silane	100	40	40	3.15	—
	*solid ball commercially available	Not Known				

*This ball was of the "conventional cross-linked" type discussed above.

TABLE 1 Continued — Results

Example	Silane Coupling Agent	Compression (thousandths of an inch)	Rebound Coefficient			
			25m/s	30 m/s	40m/s	45m/s
1	Epoxy Silane	69	0.801	0.776	0.718	0.691
2 (a)	Metha-	60	0.806	0.783	0.734	0.709
(b)	crylate	50	0.805	0.787	0.739	0.715
(c)	Silane	46	0.798	0.784	0.740	0.719
(d)	A174	62	0.801	0.778	0.732	0.706
3 (a)	Vinyl	53	—	—	0.748	0.738
(b)	Silane	60	—	—	0.748	0.730
(c)	A172	44	0.813	0.793	0.748	0.724
4	Amino Silane Z6020	47	—	—	0.766	0.739
5	Mercapto Silane A189	58	—	—	0.775	0.744
	1st Class Thread-wound Ball	55	0.795	0.787	0.763	0.748
	Solid Ball from above formulations omitting Silane	60	0.780	0.757	0.705	0.678
	Solid ball commercially available	65	0.750	0.728	0.678	0.668

Silane

20

2

8

20

30

2

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80

2

2

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TABLE 2

Example	Silane Coupling Agent	Formulation				
		Rubber	Monomer	*MF Resin	Peroxide	Silane
6 (a)	Vinyl	100	40	40	3.15	2
(b)	Silane	100	40	40	3.15	8
(c)	A172	100	40	40	3.15	14
(d)		100	40	40	3.15	20
7 (a)	Methacry-	100	40	40	3.15	2
(b)	late Silane	100	40	40	3.15	8
(c)	A174	100	40	40	3.15	14
8	Amino Silane Z6020	100	40	40	3.15	2
9	Mercapto Silane A189	100	40	40	3.15	2
	1st Class Thread-wound ball	—	—	—	—	—
	Solid Ball from above formulations omitting silane	100	40	40	3.15	—

*The MF resin filler used was "MF particulate resin" supplied by Cabot Carbon Limited of Ellesmere Port, England.

TABLE 2 Continued — Results

Example	Silane Coupling Agent	Compression (thousandths of an inch)	Rebound Coefficient	
			40m/sec.	45m/sec.
6 (a)	Vinyl Silane A172	67	0.760	0.740
(b)		61	0.751	0.724
(c)		66	0.734	0.710
(d)		67	0.742	0.720
(7) (a)	Methacrylate	60	0.759	0.740
(b)	Silane A174	63	0.761	0.736
(c)		60	0.752	0.733
8	Amino Silane Z6020	51	0.770	0.753
9	Mercapto Silane A189	59	0.782	0.751
	First Class Thread-wound Ball	56	0.764	0.760
	Solid Ball from above formulations omitting silane	62	0.752	0.730

Silane

2

8

14

20

2

8

14

2

2

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measure

TABLE 3

Example	Silane Coupling Agent	Formulation				
		Rubber	Monomer	*UF Resin	Peroxide	Silane
10 (a)	Vinyl	100	40	40	3.15	0.9
(b)	Silane	100	40	40	3.15	3.6
(c)	A172	100	40	40	3.15	6.3
(d)		100	40	40	3.15	9.0
11 (a)	Metha-	100	40	40	3.15	0.9
(b)	crylate	100	40	40	3.15	3.6
(c)	Silane	100	40	40	3.15	6.3
(d)	A174	100	40	40	3.15	9.0
12	Amino Silane Z6020	100	40	40	3.15	2.0
13	Mercapto Silane A189	100	40	40	3.15	2.0
	1st Class thread-wound ball	—	—	—	—	—
	Solid ball from above formulations omitting silane	100	40	40	3.15	—

*The UF filler used was "UF particulate resin" supplied by Cabot Carbon Limited of Ellesmere Port, England.

TABLE 3 Continued — Results

Example	Silane Coupling Agent	Compression (thousandths of an inch)	Rebound Coefficient	
			40m/sec.	45m/sec.
10 (a)	Vinyl Silane A172	46	0.774	0.760
(b)		47	0.775	0.763
(c)		54	0.766	0.753
(d)		62	0.757	0.740
11 (a)	Methacrylate Silane A174	52	0.771	0.751
(b)		51	0.778	0.752
(c)		48	0.770	0.744
(d)		52	0.750	0.735
12	Amino Silane Z6020	52	0.783	0.759
13	Mercapto Silane A189	52	0.783	0.765
	First Class Thread-wound Ball	56	0.764	0.760
	Solid ball from above formulations omitting silane	50	0.773	0.758

Silane

0.9

3.6

6.3

9.0

0.9

3.6

6.3

9.0

2.0

2.0

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TABLE 4

Flight and Impact Results on Various Balls
From Examples 1 to 13

Ball (Example No.) or Control)	Compression (thousandths of an inch)	Carry in Metres (45m/sec)	Impact* (No. of hits at 45m/sec.)
1st Class Thread-wound ball	56	198	>20
Solid ball (1st control from Table 1)	60	191	>20
3 (b)	60	193	>20
2 (a)	60	196	>20
4	47	196	>20
Solid ball (control from Table 2)	62	187	>20
6 (a)	67	189	>20
7 (a)	60	201	>20
7 (b)	63	206	>20
8	51	198	>20
Solid ball (control from Table 3)	50	191	>20
10 (b)	47	196	>20
11 (a)	52	192	>20
11 (b)	51	192	>20
12	52	199	>20

*With regard to the impact test it should be noted that a figure of 20 impacts is considered to be a satisfactory standard for a golf ball. All the balls tested passed this standard.

- It will be seen from Tables 1, 2 and 3 that the effect of the silane coupling agent varies according to the particular agent used. For any particular coupling agent, the effect varies with the amount used, but determination of the optimum amount in any particular system is a relatively simple matter for a man of the art. Above the optimum amount the extra silane appears to act merely as a plasticizer.

EXAMPLES 14 TO 23

- 1.58 inch diameter cores were prepared by moulding the various compositions described below in smooth spherical moulds 1.61 inches in diameter and curing for 30 minutes at 160°C.

The cores were painted with an adhesive comprising a blend of two adhesives commercially available from Hughson Chemicals of Erie, Pennsylvania, a division of Lord Manufacturing Corporation, described as Chemlok 234 and EXB 576—6 respectively. The painted cores were allowed to stand until free from solvent.

Half shells moulded from one of the two cover compounds A and B described below were placed around the cores and the final golf balls moulded as specified below in dimpled moulds 1.694 inch diameter to produce final golf balls 1.68 inch diameter.

The core formulations were as follows:—

	Parts		
Cis-polybutadiene	100	100	100
Monomer	40	40	40
Silica	40	—	—
MF Filler	—	40	—
UF Filler	—	—	40
Peroxide	3.15	3.15	3.15
Silane	type and amount as specified in table		

Two types of cover materials were used. These were:—

35 A Ionomer—EVA Blend

- Ninety five parts of a copolymer of ethylene and a methacrylic acid, containing 9.5% of methacrylic acid by weight of the copolymers and in which 55% of the acid was present as the sodium salt, were blended with five parts of a copolymer of ethylene and vinyl acetate, containing 28% by weight of the copolymer of vinyl acetate. The blending was carried out in an internal mixer at 200°C., and four parts by weight of titanium dioxide were added based on the weight of polymer.

- The compound was granulated, dried and injection moulded to produce half shells 1.68 inch external diameter with wall-thickness 50 thousandths of an inch. Golf balls were moulded from these covers and the above cores in a hot mould for 2—5 minutes at 160°C.

55 B TPI—Balata Blend

- The following cover compound was mixed using a warm mill at 65—75°C.

	Parts
Synthetic transpolyisoprene	40.5
Natural Balata	40.25
Pale Crepe	5.0
Titanium Dioxide	9.5
Zinc Oxide	3.0
Sulphur	1.0
Dibenzylamine	0.75

Half shells were compression moulded at 100°C., and final balls were moulded from these covers and the above cores by moulding in dimpled moulds 1.694 inches in diameter to produce golf balls 1.68 inches in diameter, using a temperature of 80°C. for 20 minutes.

The golf balls with the covers of type B were cured by exposure to carbon disulphide vapour for 24 hours at 40°C. followed by heating for a further 1 to 2 days at 40°C.

The balls so obtained were tested for compression, rebound coefficient and flight and were compared with control balls containing no silane coupling agent. The results are listed in Table 5 from which it will be seen that the balls of the invention have improved properties over the control balls.

TABLE 5

Example	Silane Coupling Agent	Amount of Silane in Core (pphr)	Cover Type	Ball Compression (thousandths of an inch)
	(a) <u>Silica</u>			
14	Vinyl (A172)	2	A	59
15	Methacryl (A174)	2	A	60
	Control	—	A	63
16	Vinyl (A172)	2	B	44
17	Methacryl (A174)	2	B	54
	Control	—	B	56
	(b) <u>MF Filler</u>			
18	Vinyl (A172)	2	A	61
19	Methacryl (A174)	2	A	50
	Control	—	A	58
20	Vinyl (A172)	2	B	67
21	Methacryl (A174)	2	B	58
	Control	—	B	60
	(c) <u>UF Filler</u>			
22	Methacryl (A174)	2	A	74
	Control	—	A	58
23	Methacryl (A174)	2	B	53
	Control	—	B	57
	Conventional Thread-wound ball	—	—	—

TABLE 5 Continued

Example	Silane Coupling Agent	Rebound Coefficient		Flight (metres)	
		40m/sec.	45m/sec.	Carry at 45m/sec.	Carry at 48m/sec.
	(a) <u>Silica</u>				
14	Vinyl (A172)	0.758	0.740	201	215
15	Methacryl (A174)	0.755	0.730	198	212
	Control	0.747	0.726	194	210
16	Vinyl (A172)	0.767	0.744	201	215
17	Methacryl (A174)	0.760	0.738	198	212
	Control	0.741	0.715	186	191
	(b) <u>MF Filler</u>				
18	Vinyl (A172)	0.764	0.740	201	215
19	Methacryl (A174)	0.766	0.744	198	212
	Control	0.756	0.738	196	210
20	Vinyl (A172)	0.751	0.733	196	210
21	Methacryl (A174)	0.753	0.726	198	212
	Control	0.745	0.723	194	210
	(c) <u>UF Filler</u>				
22	Methacryl (A174)	0.768	0.755	201	215
	Control	0.764	0.753	196	208
23	Methacryl (A174)	0.756	0.714	196	210
	Control	0.747	0.726	172	192
Conventional threadwound ball		0.764	0.760	198	218

WHAT WE CLAIM IS:—

1. A solid golf ball moulded from a composition containing a rubber having a glass transition temperature of not more than $-50^{\circ}\text{C}.$, a polyfunctional monomer which can act as a cross-linking agent for the rubber, a polymerisation initiator, a silane coupling agent, as herein defined, which is present in an amount of up to 40% by weight of the rubber, and a filler which can bond to the silane coupling agent.
2. A golf ball according to Claim 1, in which the rubber is a *cis*-polybutadiene having a *cis* content of at least 30%.
3. A golf ball according to Claim 2, in which the *cis*-polybutadiene has a *cis* content of at least 95%.
4. A golf ball according to Claim 1, 2 or 3, in which the rubber is blended with up to 30% of its weight of a rubber having a glass transition temperature of from $-50^{\circ}\text{C}.$ to $-30^{\circ}\text{C}.$
5. A golf ball according to Claim 4, in which the rubber having a glass transition temperature of from $-50^{\circ}\text{C}.$ to $-30^{\circ}\text{C}.$ is chloroprene, low-styrene-content S.B.R., chlorinated or chlorosulphonated polyethylene, or ethylene-propylene rubber.
6. A golf ball according to any one of the preceding claims, in which the polyfunctional monomer is trimethylolpropane tri-methacrylate.
7. A golf ball according to any one of Claims 1 to 5, in which the polyfunctional monomer is butylene glycol dimethacrylate.
8. A golf ball according to any one of the preceding claims, in which the filler is a silicic acid or silicate.
9. A golf ball according to any one of Claims 1 to 7, in which the filler is a melamine-formaldehyde resin.
10. A golf ball according to any one of Claims 1 to 7, in which the filler is a urea-formaldehyde resin.
11. A golf ball according to any one of the preceding claims, in which the polymerisation initiator is an organic peroxide.
12. A golf ball according to any one of the preceding claims, in which the silane coupling agent has the formula:



wherein at least one of R^1 , R^2 and R^3 is a group hydrolysable to a hydroxy group, R^4 is an organic functional group and x is 0, 1, 2 or 3.

13. A golf ball according to Claim 12, in which the group hydrolysable to a hydroxy group is an alkoxy, halogen, metal- or non-metal-salt.

14. A golf ball according to Claim 12, or 13, in which R^4 is a vinyl, amino, epoxy or hydroxy group.

15. A golf ball according to Claim 12 or 13, in which R^4 is a carboxy, mercapto, ether or ester group.

16. A golf ball according to any one of the preceding claims, in which the silane coupling agent is vinyl tris(betamethoxyethoxy) silane.

17. A golf ball according to any one of Claims 1 to 15, in which the silane coupling agent is gamma-methacryloxypropyltrimethoxysilane.

18. A golf ball according to any one of Claims 1 to 15, in which the silane coupling agent is mercaptopropyl trimethoxysilane.

19. A golf ball according to any one of Claims 1 to 15, in which the silane coupling agent is N-beta(aminoethyl)-gamma-amino-propyltrimethoxysilane.

20. A golf ball according to any one of the preceding claims, in which the silane coupling agent is present in an amount of from 1 to 30 parts by weight per hundred of rubber.

21. A golf ball according to any one of the preceding claims, in which the silane coupling agent is present in an amount of up to 20 parts by weight per hundred of rubber.

22. A golf ball according to any one of the preceding claims, in which the filler is present in an amount by weight at least twice that of the silane coupling agent.

23. A golf ball according to any one of the preceding claims, in the form of a one-piece moulded ball.

24. A golf ball according to any one of Claims 1 to 22, which comprises a core encased in a cover, the core being moulded from the composition of Claim 1.

25. A golf ball according to Claim 24, in which the core consists of two or more portions, at least one of which is moulded from the composition of Claim 1.

26. A solid golf ball substantially as hereinbefore described with reference to Examples 1 to 13 (not being a "control").

27. A solid golf ball substantially as hereinbefore described with reference to Examples 14 to 23 (not being a "control").

28. A solid golf ball according to Claim 1, substantially as hereinbefore described.

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