

(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 199659481 B2**
(10) Patent No. **701944**

(54) Title

solid golf ball

(51)⁶ International Patent Classification(s)

A63B 037/06 A63B 037/12

(21) Application No: **199659481**

(22) Application Date: **1996 .07 .12**

(30) Priority Data

(31) Number (32) Date
7-201756 1995 .07 .13

(33) Country
JP

(43) Publication Date : **1997 .01 .23**

(43) Publication Journal Date : **1997 .01 .23**

(44) Accepted Journal Date : **1999 .02 .11**

(71) Applicant(s)

Sumitomo Rubber Industries, Ltd.

(72) Inventor(s)

Takeshi Asakura; Keiji Moriyama

(74) Agent/Attorney

DAVIES COLLISON CAVE

(56) Related Art

US 5490673



AU9659481

(12) PATENT ABSTRACT (11) Document No. AU-A-59481/96
(19) AUSTRALIAN PATENT OFFICE

- (54) Title
SOLID GOLF BALL
- International Patent Classification(s)
(51)^b **A63B 037/06 A63B 037/12**
- (21) Application No. : **59481/96** (22) Application Date : **12.07.96**
- (30) Priority Data
- | | | |
|-----------------|-----------------|-----------------|
| (31) Number | (32) Date | (33) Country |
| 7-201756 | 13.07.95 | JP JAPAN |
- (43) Publication Date : **23.01.97**
- (71) Applicant(s)
SUMITOMO RUBBER INDUSTRIES, LTD.
- (72) Inventor(s)
TAKESHI ASAKURA; KEIJI MORIYAMA
- (74) Attorney or Agent
DAVIES COLLISON CAVE , 1 Little Collins Street, MELBOURNE VIC 3000
- (57)

Disclosed is a solid golf ball having good shot feel and controllability as well as excellent flight performance and durability. The golf ball comprises a core and a cover covering the core, wherein the core has a diameter of not more than 36.7 mm, a hardness (JIS-C hardness) of 50 to 80 and the cover has a thickness of 3 to 5 mm and a hardness (Shore-D scale hardness) of 50 to 60.

ABSTRACT OF THE DISCLOSURE

Disclosed is a solid golf ball having good shot feel and controllability as well as excellent flight performance and durability. The golf ball comprises a core and a cover covering the core, wherein the core has a diameter of not more than 36.7 mm, a hardness (JIS-C hardness) of 50 to 80 and the cover has a thickness of 3 to 5 mm and a hardness (Shore-D scale hardness) of 50 to 60.

5
P
A
T
E
N
T

AUSTRALIA
PATENTS ACT 1990
COMPLETE SPECIFICATION

NAME OF APPLICANT(S):

Sumitomo Rubber Industries, Ltd.

ADDRESS FOR SERVICE:

DAVIES COLLISON CAVE
Patent Attorneys
1 Little Collins Street, Melbourne, 3000.

INVENTION TITLE:

Solid golf ball

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



FIELD OF THE INVENTION

The present invention relates to a solid golf ball comprising a core and a cover covering the core. More particularly, it relates to a solid golf ball having good feeling at the time of hitting and controllability as well as excellent flight performance and durability.

BACKGROUND OF THE INVENTION

A two-piece solid golf ball is used by a lot of golfers, particularly amateur golfers, because of long flight distance and excellent durability.

However, the two-piece solid golf ball has problems that a feeling at the time of hitting (shot feel) is hard and inferior to that of a thread wound golf ball and that controllability is inferior because a contact time between club head and golf ball is short (i.e. fast ball separation from club head). Therefore, the two-piece solid gold ball is liable to be kept at a distance by professional golfers and upper grade golfers who think shot feel and controllability important.

Therefore, a soft type two-piece solid golf ball has been suggested, in order to obtain shot feel similar to that of the thread wound golf ball.

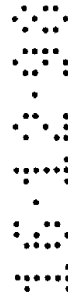
However, it is necessary to use a soft core to obtain a soft type two-piece solid golf ball, and the use of the soft core causes a problem that a rebound performance of the golf ball is deteriorated and, therefore, the

flight distance and durability are also lowered, which results in the deterioration of flight performance and durability which are peculiar to the two-piece solid golf ball.

Regarding the controllability of a golf ball, it can be said to be ideal that the golf ball
5 is easily controlled at a driver (No. 1 wood club) shot because of a long contact time between the golf ball and a club head and that spin is easily put on the golf ball at an approach shot. When the core is softened, the spin amount is decreased and, therefore, the controllability is sometimes deteriorated.



10 The present inventors have intensively studied to overcome the above problems. As a result, it has been found that shot feel, controllability and durability can be improved by controlling a diameter and hardness of the core as well as by controlling a thickness and hardness of the cover within a specific range without deteriorating flight performance, even
15 if a comparatively soft core and cover are formed in order to improve shot feel and controllability.



Advantageously, the present invention alleviates the above problems of a conventional
20 solid golf ball, thereby providing a solid golf ball wherein shot feel and controllability are improved without deteriorating excellent flight performance and durability as a feature of the solid golf ball.



This as well as other advantages of the present invention will become apparent to those skilled in the art from the following description with reference to the accompanying drawings.



BRIEF EXPLANATION OF DRAWINGS

Fig. 1 is a schematic cross section illustrating one embodiment of the solid golf ball of the present invention.

SUMMARY OF THE INVENTION

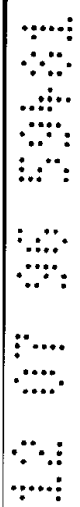
5 The present invention provides a solid golf ball comprising a core and a cover covering the core, wherein the core has a diameter of not more than 36.7 mm, a hardness (JIS-C hardness) of 50 to 80 and the cover has a thickness of 3 to 5 mm and a hardness (Shore-D scale hardness) of 50 to 60.

10 In order to carry out the present invention, more preferably, it is preferred that a difference between the hardness (JIS-C hardness) at the center of the core and that at any part from the center to surface of the core is within ± 5 .

DETAILED DESCRIPTION OF THE INVENTION

15 Hereinafter, the present invention will be explained in detail. In the present invention, a diameter of the core is adjusted to not more than 36.7 mm, which is smaller than that of a conventional golf ball. When the diameter of the core is larger than 36.7 mm, the thickness of the cover is small and it is difficult to obtain a difference in performance between the golf ball of the present invention and the conventional two-piece solid golf ball. On the other hand, when the diameter of the core is too small, the thickness of the cover is large and, therefore, shot feel is hard. Therefore, it

20



is particularly preferred that the diameter of the core is from 34.7 to 36.7 mm.

In the present invention, a hardness of the core is preferably from 50 to 80, particularly from 60 to 75. When the hardness (JIS-C
5 hardness) of the core is lower than 50, the core is too soft and the rebound performance of the golf ball is deteriorated, which results in decrease in flight distance of the golf ball. On the other hand, when the hardness (JIS-C hardness) of the core is higher than 80, shot feel is hard and inferior. It is preferred that a difference between the hardness (JIS-C hardness) at the
10 center of the core and that at any part from the center to surface of the core is within ± 5 . That is, when using such a core having a small difference in hardness, a golf ball having high rebound performance can be easily obtained. The JIS-C hardness is a hardness measured by a JIS-C type hardness tester, which equals to Shore C hardness.

15 The above core is composed of a vulcanized (crosslinked) molded material of a rubber composition. The rubber composition generally comprises a base rubber (e.g. high-cis polybutadiene rubber, etc.), a metal salt of α, β -unsaturated carboxylic acid (e.g. zinc acrylate, zinc methacrylate, etc.), an organic peroxide, an organosulfur compound
20 and/or metal-containing organosulfur compound and a filler.

The base rubber of the rubber composition for core preferably is the above-described high-cis polybutadiene. In addition, it may be those obtained by blending (mixing) natural rubber, polyisoprene rubber, styrene-butadiene rubber, etc. with the above high-cis polybutadiene
25 rubber.

The metal salt of α, β -unsaturated carboxylic acid serves to crosslink the rubber. The metal salt of α, β -unsaturated carboxylic acid includes zinc and magnesium salts of α, β -unsaturated carboxylic acid such as acrylic acid, methacrylic acid, etc. An amount of the metal salt of α, β -unsaturated carboxylic acid formulated is not specifically limited, but is preferably from 15 to 30 parts by weight, based on 100 parts by weight of the base rubber.

The organic peroxide serves as an initiator when crosslinking the rubber. The organic peroxide, for example, includes dicumyl peroxide, 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane, 2,5-dimethyl-2,5-di(t-butylperoxy)hexane), di-t-butyl peroxide, etc. An amount of the organic peroxide formulated is not specifically limited, but is preferably from 0.5 to 3 parts by weight, based on 100 parts by weight of the base rubber.

The organosulfur compound and metal-containing organosulfur compound serve to accelerate mastication of the rubber, thereby enhancing the rebound performance of the soft part of the core. The organosulfur compound, for example, includes diphenyl disulfide, dixylyl disulfide, pentachlorothiophenol, thiobenzoic acid, morpholine disulfide, etc. The metal-containing organosulfur compound, for example, includes zinc salts of thiophenols and thiocarboxylic acids. These organosulfur and metal-containing organosulfur compounds can be used alone or in combination thereof. An amount of these organosulfur and metal-containing organosulfur compound formulated is not specifically limited. When each compound is used alone, an amount of the organosulfur compound formulated is preferably from 0.3 to 2.3 parts by

weight based on 100 parts by weight of the base rubber and that of the metal-containing organosulfur compound formulated is preferably from 0.3 to 2.3 parts by weight based on 100 parts by weight of the base rubber. When using them in combination, the total amount of them is preferably
5 from 0.3 to 2.3 parts by weight based on 100 parts by weight of the base rubber.

The filler includes zinc oxide, barium sulfate, calcium carbonate, etc. An amount of the filler formulated is not specifically limited, but is preferably from 20 to 40 parts by weight based on 100 parts by
10 weight of the base rubber.

The core can be obtained by subjecting the above rubber composition for core to vulcanization (crosslinking) molding to form a spherical material. In the vulcanization molding, for example, a press molding is used. The press molding is conducted by charging the above
15 rubber composition for core in a mold, followed by heating under pressure at 140 to 180°C for 10 to 60 minutes. The heating during vulcanization molding may also be conducted in two or more stages.

In the present invention, a thickness of the cover is from 3 to 5 mm, which is larger than that of a conventional golf ball, preferably from 3
20 to 4 mm. When the thickness of the cover is larger than 5 mm, shot feel is harder and inferior. On the other hand, when the thickness of the cover is smaller than 3 mm, a difference in feature between the golf ball of the present invention and conventional golf ball disappeared.

The hardness (Shore-D scale hardness) of the cover is from
25 50 to 60, preferably from 53 to 57. When the hardness (Shore-D scale

A method of coating the cover is not specifically limited, but may be a general method. For example, there can be used a method comprising molding a cover composition into a semi-spherical half-shell in advance, covering a core with two half-shells and then subjecting to a pressure molding at 130 to 170°C for 1 to 10 minutes, or a method comprising injection molding the cover composition directly on the core to cover the core. At the time of molding the cover, dimples may be optionally formed on the ball surface. After molding the cover, paint finishing and stamping may be optionally conducted.

Next, one embodiment of the solid golf ball of the present invention will be explained with reference to the accompanying drawing. Fig. 1 is a schematic cross section illustrating one embodiment of the solid golf ball of the present invention. The solid golf ball shown in Fig. 1 is a two-piece solid golf ball comprising a core 1 of the vulcanized molded material of the rubber composition and a cover 2 for covering the core. The core 1 is referred to as a solid core and, as described above, the core 1 has a diameter of not more than 36.7 mm and a hardness (JIS-C hardness) of 50 to 80. The cover 2 has a thickness of 3 to 5 mm and a hardness (Shore D-scale hardness) of 50 to 60. 2a in Fig. 1 indicates dimples and the suitable number/embodiment of dimples 2a may be optionally provided on the cover 2 so as to obtain the desired characteristics. Furthermore, painting, marking, etc. may be optionally provided on the surface of the golf ball.

As described above, the present invention provides a solid golf ball having good shot feel and controllability as well as excellent

flight performance and durability.

EXAMPLES

The following Examples and Comparative Examples further illustrate the present invention in detail but are not to be construed to limit the scope thereof.

Examples 1 to 4 and Comparative Examples 1 to 6

Composition for core A to F were prepared according to the formulation shown in Table 1. The unit of the amount of the respective components to be formulated is "parts by weight".

10 Table 1

		A	B	C	D	E	F
BR-18	*1	100	100	100	100	100	100
Zinc acrylate		26	25	13	22	20	28
Zinc oxide		29.9	31.7	35.6	31.2	36.9	24.6
Antioxidant	*2	0.5	0.5	0.5	0.5	0.5	0.5
Dicumyl peroxide		2.0	1.3	1.0	1.6	1.3	2.0
Balnok R	*3	0.76	0	0	0	0	0.76
Diphenyl disulfide		0	0	0	0.5	0	0

*1: Trade name, high-cis polybutadiene manufactured by Japan Synthetic Rubber Co., Ltd.

*2: Yoshinox 425 (trade name), manufactured by Yoshitomi Seiyaku Co., Ltd.

15 *3: Trade name, morpholine disulfide manufactured by Ohuchi Shinko

Kagaku Kogyo Co., Ltd.

Then, cover compositions I to V were prepared according to the formulation shown in Fig. 2.

Table 2

		I	II	III	IV	V
Hi-milan 1605	*4	0	0	0	50	0
Hi-milan 1652	*5	0	0	70	0	0
Hi-milan 1705	*6	20	0	0	0	0
Hi-milan 1706	*7	60	0	0	50	0
Hi-milan 1855	*8	20	50	0	0	30
Hi-milan 1856	*9	0	50	30	0	30
EVA	*10	0	0	0	0	40
Titanium dioxide		2	2	2	2	2



5

*4: Hi-milan 1605 (trade name):
ethylene-methacrylic acid copolymer ionomer resin obtained by neutralizing with a sodium ion, manufactured by Mitsui Du Pont Polychemical Co., MI (melt index): 2.8, stiffness: 310 MPa, Shore D-scale hardness: 62



10

*5: Hi-milan 1652 (trade name):
ethylene-methacrylic acid copolymer ionomer resin obtained by neutralizing with a zinc ion, manufactured by Mitsui Du Pont Polychemical Co., MI: 5.0, stiffness: 160 MPa, Shore D-scale hardness: 57



- 5

*6: Hi-milan 1705 (trade name):
ethylene-methacrylic acid copolymer ionomer resin obtained
by neutralizing with a zinc ion, manufactured by Mitsui Du
Pont Polychemical Co., MI: 5.5, stiffness: 250 MPa, Shore D-
scale hardness: 62
- 10

*7: Hi-milan 1706 (trade name):
ethylene-methacrylic acid copolymer ionomer resin obtained
by neutralizing with a zinc ion, manufactured by Mitsui Du
Pont Polychemical Co., MI: 0.8, stiffness: 260 MPa, Shore D-
scale hardness: 61
- 15

*8: Hi-milan 1855 (trade name):
ethylene-butyl acrylate-methacrylic acid terpolymer ionomer
resin obtained by neutralizing with a zinc ion, manufactured
by Mitsui Du Pont Polychemical Co., MI: 1.0, stiffness: 90
MPa, Shore D-scale hardness: 55
- 20

*9: Hi-milan 1856 (trade name):
ethylene-butyl acrylate-methacrylic acid terpolymer ionomer
resin obtained by neutralizing with a sodium ion,
manufactured by Mitsui Du Pont Polychemical Co., MI: 1.0,
stiffness: 70 MPa, Shore D-scale hardness: 58
- *10: EVA:
VR (trade name), ethylene-vinyl acetate copolymer,
manufactured by Mitsui Du Pont Polychemical Co.

Then, the rubber compositions described in Table 1 were

vulcanized under the vulcanization conditions shown in Tables 3 to 5 to produce a core and its hardness was measured by a JIS-C type hardness tester, respectively. The results are shown in Tables 3 to 5, respectively. Since the rubber composition for core was vulcanized in two stages by changing the temperature in Examples 1 to 3 and Comparative Examples 1 to 6, two kinds of the temperature/time are described separately in Tables 3 to 5. The hardness of the interior of the core was determined by cutting the core into halves, followed by measuring at the predetermined position, respectively.

10 The cores produced as described above were covered with cover compositions I to V described in Table 2 according to the combination shown in Tables 3 to 5 to prepare a two-piece solid golf ball having an outer diameter of 42.7 mm, respectively. The covering of the cover was conducted by injection molding.

15 The specific gravity, thickness and Shore D-scale hardness of the cover are shown in Tables 3 to 5, respectively. The Shore D-scale hardness of the cover was measured according to ASTM D-2240. A sample was made by subjecting the above resin cover composition to heat press molding to form a sheet having a thickness of about 2 mm, followed by standing at 23°C for 2 weeks.



Table 3

	Example 1	Example 2	Example 3	Example 4
Rubber composition for core	A	D	A	A
Diameter of core (mm)	35.5	35.5	35.5	35.5
Vulcanization condition (°C x minute)	140X30 165x8	140X30 165x8	140X30 165x8	155x30
Hardness of core (JIS-C hardness)				
Center	66.0	70.0	66.0	72.0
Position which is 5 mm away from the center	65.5	70.5	65.5	68.5
Position which is 10 mm away from the center	65.5	70.5	65.5	68.5
Position which is 15 mm away from the center	68.0	70.0	68.0	68.0
Surface	65.5	68.0	65.5	67.0
Cover composition	I	II	III	I
Thickness of cover (mm)	3.6	3.6	3.6	3.6
Hardness of cover (Shore-D scale hardness)	57	55	53	57



Table 4

	Comparative Example 1	Comparative Example 2	Comparative Example 3
Rubber composition for core	A	A	B
Diameter of core (mm)	35.5	35.5	35.5
Vulcanization condition (°C x minute)	140X30 165x8	140X30 165x8	140X30 165x8
Hardness of core (JIS-C hardness)			
Center	66.0	66.0	82.0
Position which is 5 mm away from the center	65.5	65.5	81.0
Position which is 10 mm away from the center	66.5	66.5	80.5
Position which is 15 mm away from the center	68.0	68.0	82.5
Surface	65.5	65.5	81.0
Cover composition	IV	V	I
Thickness of cover (mm)	3.6	3.6	3.6
Hardness of cover (Shore-D scale hardness)	65	48	58



Table 5

	Comparative Example 4	Comparative Example 5	Comparative Example 6
Rubber composition for core	C	E	F
Diameter of core (mm)	35.5	31.7	37.1
Vulcanization condition (°C x minute)	140X30 165x8	140X30 165x8	140X30 165x8
Hardness of core (JIS-C hardness)			
Center	48.0	68.0	65.0
Position which is 5 mm away from the center	47.0	67.5	64.0
Position which is 10 mm away from the center	46.5	68.5	64.5
Position which is 15 mm away from the center	47.0	69.0	67.0
Surface	47.0	67.0	65.0
Cover composition	I	I	I
Thickness of cover (mm)	3.6	5.5	2.8
Hardness of cover (Shore-D scale hardness)	58	58	58

The spin amount and flight distance due to a No.1 wood club, spin amount due to a sand wedge, shot feel and durability of the resulting golf ball were examined. The measuring method or evaluation method of them is as follows.

Spin amount due to No.1 wood club:

A No. 1 wood club is mounted to a Swing robot manufactured by True Temper Co., and then a golf ball is hit at a head speed of 45 m/second. The spin amount is determined by continuously taking the photograph of the hit golf ball.

Flight performance due to No. 1 wood club:

A No. 1 wood club is mounted to a Swing robot manufactured by True Temper Co., and then a golf ball is hit at a head speed of 45 m/second to measure the distance to the dropping point (carry).

Spin amount due to sand wedge:

A sand wedge is mounted to a Swing robot manufactured by True Temper Co., and then a golf ball is hit at a head speed of 19.2 m/second. The spin amount is determined by continuously taking the photograph of the hit golf ball.

Shot feel:

It is evaluated by hitting a golf ball with a No. 1 wood club due to 10 top professional golfers. The evaluation criteria are as follows. The results shown in the Tables below are based on the fact that not less than 8 out of 10 professional golfers evaluated with the same criterion about each test item.

Evaluation criteria:

◎: Very good

○: Good

△: Ordinary

×H: Hard and inferior

×S: Too soft and inferior

Durability:

5 A No. 1 wood club is mounted to a Swing robot manufactured by True Temper Co., and then a golf ball is hit at a head speed of 45 m/second. The durability is evaluated by the number of times until breakage arose.

Evaluation criteria:

- 10
- ◎: Very good
 - : Good
 - △: Ordinary
 - ×: Inferior

The above evaluation results are shown in Tables 6 to 8, respectively.

Table 6

	Example 1	Example 2	Example 3	Example 4
Due to No. 1 wood club				
Spin amount (rpm)	2730	2800	2870	2780
Flight distance (yard)	234.1	233.6	233.3	232.5
Due to sand wedge				
Spin amount (rpm)	5500	5780	5900	5480
Shot feel	○	◎	◎	○
Durability	◎	◎	◎	○

Table 7

	Comparative Example 1	Comparative Example 2	Comparative Example 3
Due to No. 1 wood club			
Spin amount (rpm)	2630	3010	2780
Flight distance (yard)	234.8	229.0	233.3
Due to sand wedge			
Spin amount (rpm)	4760	6040	5600
Shot feel	○	◎	×H
Durability	△	◎	△

Table 8

	Comparative Example 4	Comparative Example 5	Comparative Example 6
Due to No. 1 wood club			
Spin amount (rpm)	2830	2810	2720
Flight distance (yard)	229.5	230.6	231.1
Due to sand wedge			
Spin amount (rpm)	5430	5670	5060
Shot feel	×S	×H	△
Durability	◎	○	○



As is apparent from a comparison between physical properties of the golf balls of Examples 1 to 4 shown in Table 6 and those of Comparative Examples 1 to 6 shown in Tables 7 and 8, the golf balls of Examples 1 to 4 had good shot feel and controllability as well as excellent flight performance and durability. That is, regarding the golf balls of Examples 1 to 4 attained a long flight distance such as 232.5 to 234.1 yards and had excellent durability and good shot feel. Also, the spin amount due to the sand wedge and No. 1 wood club was large and controllability was good.

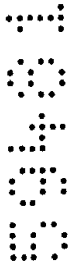
Like this, regarding the golf balls of Examples 1 to 4 of the present invention, the core is soften and the hardness of the cover is decreased as shown in Table 3 so as to improve the shot feel and controllability. However, a decrease in flight distance was not recognized and the shot feel and controllability were good. Furthermore, the flight performance and durability were excellent.

To the contrary, regarding the golf ball of Comparative Example 1, the spin amount was small because the hardness of the cover is high and, therefore, the controllability was inferior. Regarding the golf ball of the Comparative Example 2, the flight distance is small because the hardness of the cover was too small.

Regarding the golf ball of Comparative Example 3, the flight distance was long because the core is hard but the shot feel was hard and inferior. Regarding the golf ball of Comparative Example 4, the flight distance was small because the core is too soft. Also, the shot feel was too soft and inferior.

Regarding the golf ball of Comparative Example 5, the shot feel was hard and inferior because the core was small and the cover was too thick and the durability was also inferior. Regarding the golf ball of Comparative Example 6, the spin amount became not so large because the core was large and the cover was too thin. Therefore, the controllability was not sufficiently improved.

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 group of integers or steps but not the exclusion of any other integer or group of integers or steps.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A solid golf ball comprising a core and a cover covering said core, wherein the core has a diameter of not more than 36.7 mm, a hardness (JIS-C hardness) of 50 to 80 and the cover has a thickness of 3 to 5 mm and a hardness (Shore-D scale hardness) of 50 to 60.
2. The solid golf ball according to claim 1, wherein the core comprises a vulcanized molded material of a rubber composition which comprises a base rubber, a metal salt of an unsaturated carboxylic acid, an organic peroxide, an organosulfur compound and/or metal-containing organosulfur compound and a filler.
3. The solid golf ball according to claim 2, wherein a difference between the hardness (JIS-C hardness) at the center of the core and that at any part from the center to surface of the core is within ± 5 .



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

DATED this 14TH day of DECEMBER 1998

5

by DAVIES COLLISON CAVE
Patent Attorneys for the Applicants

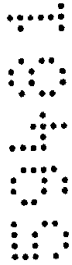


Fig. 1

