Title: GOLF PUTTER WITH DUAL-FRICTION CURVED-FACE

(57) Abstract: A golf putter with a dual-friction curved face including a shaft having a grip provided at its upper end, and a putter head connected to the lower end of the shaft and having a putter face convexly curved so as to substantially correct directional error in putting, the golf putter wherein the putter face has a radius of curvature of approximately 400 mm to approximately 900 mm so as to maximize a direction error correcting effect, the shaft which is the rotation center of the putter head is positioned approximately 5 mm to approximately 20 mm in rear of the foremost part of the putter face so as to substantially correct the directional error, and the putter face has a dual-friction structure in which friction resistance differs in a heel-to-toe direction and in a vertical direction to decrease directional error due to inaccurate putting strokes and to increase top spin to a golf ball. In the golf putter with a dual-friction curved face, directional error can be corrected so as to put in an intended target direction, by employing a low friction material as a putter face material and making the putter face convexly curved, even when a putting stroke direction does not coincide with the target direction or the putter face of a putter head is not perpendicular to the target direction due to a golfer’s inaccurate putting posture, habits, or strain.
GOLF PUTTER WITH DUAL-FRICTION CURVED-FACE

Technical Field

The present invention relates to a golf putter with a dual-friction curved-face, and more particularly, to a golf putter having an improved putter face with a dual-friction curved-face by improving the material and shape of a putter face of a putter head and the rotation center of the putter head, so that a golf ball moves to be closer to an intended direction even when the direction of the putter head movement is not coincident with a target direction or the putter face of the putter head is not perpendicular to the target direction.

Background Art

Although golfers, like many other sport players, show differences among individuals in accuracy and skill according to their natural talents and experience, the differences can be considerably reduced by using more scientifically designed devices (golf clubs), leading to improved athletic performance. In the game of golf, since putting strokes account for substantially half of a golfer’s total strokes, it is necessary to reduce the number of putting strokes to achieve a good score.

According to the general principles of putting, in order for a golfer to put accurately in a desired direction, as shown in FIG. 1, the golfer must strike a golf ball 1 with a putter face 11 of a putter head 10 perpendicular to a target direction while moving the putter head 10 so as to coincide with the target direction. Then, the golf ball 1 comes into contact with the center (P) of the putter face 11, and the struck golf ball 1 travels in a desired direction with an accurate trajectory.

However, it is not possible for one to keep one’s putting accurate based on the putting principles alone. Thus, in practice, it is often the case that the putter head 10 is pulled in toward the golfer (“pulled” swing), as shown in FIG. 2, or pushed out from the golfer (“pushed” swing), as shown in FIG. 3. In this case, a striking spot (P’) contacting the golf ball 1 does not coincide with a center P of the putter face 11 and the struck golf ball 1 tends to travel to the left or right with respect to its intended direction, leading to erroneous putting.

FIG. 4 shows the distribution of contact points shown on a putter face through a field putting experiment, showing the deviation of contact points from the
center of the putter due to erroneous putting.

As described above, accurate putting can be achieved by satisfying two conditions: the stroke of the putter head 10 coincides with the target direction; and the front surface of the putter head 11 is maintained perpendicular to the target direction at the time of putting.

The dynamics of the above-noted two factors determining the direction of a golf ball will now be described in more detail with reference to the accompanying drawings.

FIG. 5 shows that the putting stroke direction P, that is, the movement direction of the putter head 10, is at an angle of θ with respect to the normal N of the putter face 11. Here, a force \( \overrightarrow{F_p} \) of the same direction as the putting stroke direction P is applied to the contact point P'. The force \( \overrightarrow{F_p} \) applied to the golf ball 1 can be divided into two components: one is a normal force \( \overrightarrow{F_N} \) perpendicular to the putter face 11 and the other is a shear force \( \overrightarrow{F_s} \) parallel to the putter face 11. Here, while the normal force \( \overrightarrow{F_N} \) is always transferred to the golf ball 1 irrespective of the friction coefficient between the putter face 11 and the golf ball 1, the shear force \( \overrightarrow{F_s} \) varies according to the friction coefficient between the putter face 11 and the golf ball 1. In general, the force \( \overrightarrow{F_s} \) actually transferred to the golf ball 1 is smaller than \( \overrightarrow{F_s} \) which is applied to the golf ball 1.

Thus, the total force \( \overrightarrow{F_B} \), which is the sum of the normal force \( \overrightarrow{F_N} \) and the actual shear force \( \overrightarrow{F_{s'}} \), is actually transferred to the golf ball 1, and the golf ball 1 travels in a direction of the force \( \overrightarrow{F_B} \), that is, in a 'B' direction, giving the struck golf ball 1 a side spin S by the action of the actual shear force \( \overrightarrow{F_{s'}} \). If the friction coefficient between the putter face 11 and the golf ball 1 is sufficiently high, that is, if the shear force \( \overrightarrow{F_s} \) is completely transferred to the golf ball 1, the struck golf ball 1 would necessarily travel in a direction of the force \( \overrightarrow{F_p} \) applied to the golf ball 1, that is, in a 'P' direction. If there is no friction effect on the putter face 11, the actual shear force \( \overrightarrow{F_{s'}} \) would be zero so that the struck golf ball 1 would
travel in a direction the normal force (\(\overrightarrow{F_N}\)), that is, in an 'N' direction perpendicular to the putter face 11, without side spin S.

In the case where \(\theta=0\), that is, in the case where the direction of the putting stroke force (\(\overrightarrow{F_p}\)) coincides with the target direction, that is, \(\overrightarrow{F_p} = \overrightarrow{F_N}\) and \(\overrightarrow{F_s} = 0\), the golf ball 1 travels accurately in the intended direction without a side spin S, and the force is completely transferred to the golf ball 1, increasing the moving distance of the golf ball 1. Conversely, in the case where \(\theta=90^\circ\), that is, \(\overrightarrow{F_p} = \overrightarrow{F_s}\) and \(\overrightarrow{F_N} = 0\), the golf ball 1 does not travel forward, only resulting in the side spin S. Here, if there is no friction effect at all, even the side spin S does not occur to the golf ball 1. This is based on empirical facts and can be easily confirmed experimentally by reducing the friction coefficient by coating lubricating oil on the putter face 11.

Curved-face golf putters have already been proposed in many patents, including U.S. Patent Nos. 3,989,257, 4,121,833, 4,162,074, 5,213,332, 5,382,019, 5,782,705 and 5,792,003, disclosing putters of various types and configuration such as a vertically parabolic faced putter, a horizontally elliptic surface putter, a concave surface putter, a curved surface having a curvature of approximately 6.35-8.89 cm to approximately 213 cm. Also, a curved surface putter having a curvature of 40 to 60 cm is disclosed in Korean Utility Model No. 133263. However, in the proposed putters disclosed in the above-noted patents, the friction effect, which is a major factor determining the direction of the golf ball in putting, has not been taken into consideration. Further, research into the rotation center of a putter head related to generation of the effect of substantially correcting erroneous putting, and putters having top spin increasing function and structure, has never been made, and corresponding putters are not being put into common use in reality.

Disclosure of the Invention

It is an objective of the present invention to provide a golf putter with a dual-friction curved-face, which can correct directional error so as to put in an intended target direction, even when the putting stroke direction does not coincide
with the target direction or the putter face of a putter head is not perpendicular to the target direction due to golfer’s inaccurate putting.

To accomplish the above object of the present invention, there is provided a golf putter with a dual-friction curved-face, having reduced directional error due to a putting stroke direction inconsistent with a target direction by using a material having a small friction effect with respect to a golf ball, and having reduced errors due to rotation of a putter head by making a putter face convexly curved. Here, in order to substantially correct putting errors due to rotation of a putter head, the rotation center of the putter head, that is, an extension of a shaft, is preferably positioned in rear of the putter face. Also, in order to impart a higher top spin to a golf ball in putting, the putter face is preferably constructed so as to increase the friction effect in a vertical direction.

The golf putter with a dual-friction curved-face according to the present invention includes a shaft provided with a grip at its upper end, and a head coupled to a lower end of the shaft and actually used to hit the golf ball. The putter head has a putter face which is convexly curved in a heel-to-toe direction. Also, the extension of the shaft, that is a rotation center of the putter head, is positioned in rear of the putter face. Here, the term "putter head" is used to encompass a hosel corresponding to a neck portion thereof. Thus, the rotation center of the putter head means an intersection between the extension of the shaft and the putter head. Alternatively, a bent shaft can be directly used without a hosel. In order to reduce directional error, occurring in the case where the putting stroke direction does not coincide with the target direction, and to increase the top spin, the putter face has a dual-friction structure in which friction resistance differs in a horizontal (heel-to-toe) direction and in a vertical direction. The dual-friction effect is realized by forming micro-grooves on a low-friction putter face in a heel-to-toe direction or by other similar methods.

**Brief Description of the Drawings**

FIG. 1 is a conceptual diagram showing the putting stroke in accurate putting in an intended target direction using a conventional golf putter;

FIG. 2 is a conceptual diagram showing the putting stroke in pulled-swing, that is, when a putter head is pulled in toward a golfer, using a conventional golf
putter;

FIG. 3 is a conceptual diagram showing the putting stroke in pulled-swing, that is, when a putter head is pushed out from a golfer, using a conventional golf putter;

FIG. 4 is a schematic diagram showing a change in contact point depending on golfer's skill in actual putting;

FIG. 5 is a conceptual diagram showing the putting stroke and component forces depending on the angle between a putting stroke direction and a putter face;

FIG. 6 is a conceptual diagram showing the putting stroke in accurate putting in an intended target direction using a golf putter with a dual-friction curved face according to the present invention;

FIG. 7 is a conceptual diagram showing the putting stroke in pulled-swing, that is, when a putter head is pulled in toward a golfer, using a golf putter with a dual-friction curved face according to the present invention;

FIG. 8 is a conceptual diagram showing the putting stroke in pulled-swing, that is, when a putter head is pushed out from a golfer, using a golf putter with a dual-friction curved face according to the present invention;

FIG. 9 is a conceptual diagram showing the putting stroke in pulled-swing as shown in FIG. 7, in the case where the rotation center of a putter head, corresponding to extension of a shaft, is positioned in front of the putter face;

FIG. 10 is a conceptual diagram showing the putting stroke in pulled-swing as shown in FIG. 7, in the case where the rotation center of a putter head, corresponding to extension of a shaft, is positioned in rear of the putter face;

FIG. 11 is a conceptual diagram showing the necessity of an anisotropic friction material for increasing top spin on a struck ball in putting;

FIGS. 12 and 13 are perspective views of preferred embodiments of a putter head and a shaft employed to a golf putter with a dual-friction curved face according to the present invention; and

FIGS. 14 through 16 illustrate a golf putter according to the present invention.

Best mode for carrying out the Invention
Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the attached drawings. Two factors determining the directivity of a struck golf ball are a putting stroke direction and an angle between a putter face and the target direction. At the above we showed that the smaller a heel-to-toe friction effect between a putter face and a golf ball, the closer to a direction perpendicular to the putter face the struck golf ball gets. This is totally different from the well-known fact that the direction of a golf ball is warped while traveling due to a hooking or slicing.

This theory suggests that the directional error, which is one of factors determining the direction of a golf ball can be reduced by using a material having a low friction coefficient with respect to the golf ball. Also, in the present invention, in order to compensate the error in the other factor determining the direction of a golf ball, that is, rotation of a putter head, it is proposed that the putter face be made convex, so that the normal direction is closer to the target direction at a contact point, even if the contact point is moved by rotation of the putter head.

When the surface of the putter head is convexly curved, in the case of accurate putting, as shown in FIG. 6, since the normal direction at the actual contact point P coincides with the target direction, like in the conventional flat-face putter head, the golf ball travels in the target direction. Also, even in the case of erroneous putting, such as a pulled swing or pushed swing, as shown in FIGS. 7 and 8, the normal direction at the actual contact point P', which is a point moved from the center P, gets closer to the target direction, unlike in the conventional flat-face putter head, thereby reducing an error due to rotation of a putter head.

Rotation on a putter face due to erroneous putting occurs around the intersection between an extension of the shaft and the putter head. Thus, in order to ensure a substantial putting correcting effect in a golf putter having a curved putter face, the rotation center of the putter head must also be taken into consideration.

In the conventional flat-face putter, since a putter face is flat, even if a putter head rotates, the slope of the putter face is kept constant irrespective of the position of a contact point. Thus, in the flat-face golf putter, there is no relevance between the rotation center of a putter head and the angle of the putter face. However, in the curved-face golf putter, the rotation center of a putter head has an
influence on correction of directional error. Referring back to FIGS. 7 and 8, directional error correcting effects are exerted in a desired manner when the actual contact point P' is upwards with respect to the center P of the putter face in the case of the putter head being closed, and the actual contact point P' is downwards with respect to the center P of the putter in the case of the putter head being open.

As shown in FIG. 9, if the center R of rotation of the putter head is positioned forward with respect to a tangent F of the putter face, the actual contact point P' is positioned downwards with respect to the center P, so that a desired correcting effect cannot be attained. As shown in FIG. 10, if the center R of rotation of the putter head is positioned in rear of a tangent F of the putter face, the actual contact point P' is positioned upwards with respect to the center P, so that a desired correcting effect can be attained. Therefore, in order to attain substantial directional error correcting effects using a curved putter face, the rotation center of a putter head must be positioned in rear of the putter face, unlike in most flat-face putters, in which the extension of a shaft is positioned in front of the putter face.

Although only the case in which the putter head is closed has been described with reference to FIGS. 9 and 10, the same principle can also be applied to the case in which the putter head is open.

As described above, directional error due to erroneous putting can be reduced by using a material having a small friction effect in a heel-to-toe direction with respect to a putter head. However, the more the struck golf ball rotates forwards at an initial putting stage, that is, the higher the top spin effect is, the less the golf ball is affected by factors of the environment, such as geographical features, slopes of the greens, or grass conditions, thereby improving the directionality of the golf ball. In order to impart a higher top spin to the struck ball, as shown in FIG. 11, a friction effect must be high in a vertical direction of a putter face. Thus, a material for use in the putter face is preferably a dual friction material having a difference in friction effect between in a heel-to-toe direction and a vertical direction.

FIGS. 14 through 16 illustrate a golf putter according to the present invention. A head 30 has a size of 10 to 14 cm in width (W), 2 to 3 cm in height (H) and 2 to 4 cm in depth (D), which is similar to that of a conventional putter head, and can also be employed to a conventional D-type (mallet type) putter. A
putter face 31 is a convexly curved in a heel-to-toe direction so as to have a radius of curvature of approximately 400 mm to approximately 900 mm and has a loft angle (α) of approximately 2° to approximately 5° in a direction along the height of the putter face 31. In order to make the rotation center of the head 30 be positioned in rear of the putter face 31, the connection position of a shaft 32 (or a hosel 33) and the head 30 is preferably positioned approximately 5 mm to approximately 20 mm in rear of the foremost part of the putter face 31.

A material having a small friction coefficient with a golf ball is used as a material of the putter face 31. The friction coefficient greatly differs according to the surface processing method, the kind of a contact material or experimental conditions. Thus, it is substantially impossible to define the value of the friction coefficient. However, in the present invention, a relatively low friction material is used as the putter face material. In other words, a highly polished iron (Fe) based material having an arithmetic average roughness of 5 μm or less so as to have a reduced friction effect, a material plated with gold, silver, platinum, nickel or chrome to have the same friction effect, or a low friction material having a friction coefficient of 0.3 or less, which is generally used as a solid lubricant, may be used.

Examples of the solid lubricant include molybdenum disulfide (MoS₂), diamond, graphite, Teflon (PTFE: polytetrafluoroethylene), acrylic polymer, silicon-based materials such as silicone, silicone dioxide, silicates, wax or other petroleum derivatives, plastic and water based lubricants and the like. Such a low friction material and a composite material thereof may be coated or directly applied as the material of the putter face 31. Alternatively, as shown in FIG. 13, a separate member 35 may be inserted into a preform of the putter face 31 in the form of an insert. Otherwise, the friction effect of the putter face 31 can be reduced by high-temperature penetrating carbon, nitrogen or boron into a preform of the putter face 31, while increasing the hardness of the putter face 31. In order to gain a dual-friction effect, micro-grooves 34 and 36 are formed on the putter face 31 made of the above-described low friction material in a heel-to-toe direction, or the low friction material is inserted into the micro-grooves 34 and 36 formed on the putter face 31. An appropriate size of each of the micro-grooves 34 and 36 is 0.2 to 0.8 mm in pitch (p), 2 to 6 mm in radius of curvature (r) and 0.01 to 0.1 mm in depth (d), as shown in FIG. 14, in consideration of a smaller contact point.
between the ball and the putter face compared to other golf clubs. However, modifications and changes can be easily implemented within the scope of the invention.

Industrial Applicability

As described above, in the golf putter with a dual-friction curved face according to the present invention, directional error can be corrected so as to putt in an intended target direction, by employing a low friction material as a putter face material and making the putter face curved, even when the putting stroke direction does not coincide with the target direction or the putter face of a putter head is not perpendicular to the target direction due to a golfer's inaccurate putting posture, habits, or strain.

Also, according to the present invention, the putting performance of the golf putter can be improved by differing frictional resistance of the putter face in a heel-to-toe direction of and in a vertical direction thereof to decrease directional error and to increase a top spin effect acting on a golf ball.

Various embodiments of the present invention have been described in detail herein. It should be understood, however, that the foregoing description of the present invention is exemplary only. It is intended that the scope of the invention be defined by the claims appended hereto and their equivalents.
What is claimed is:

1. A golf putter with a dual-friction curved face including a shaft having a grip provided at its upper end, and a putter head connected to the lower end of the shaft and having a putter face convexly curved so as to substantially correct directional error in putting, the golf putter wherein the putter face has a radius of curvature so as to maximize a direction error correcting effect, the shaft which is the rotation center of the putter head is positioned in rear of the foremost part of the putter face so as to substantially correct the directional error, and the putter face has a dual-friction structure in which friction resistance differs in a heel-to-toe direction and in a vertical direction to decrease directional error due to inaccurate putting strokes and to increase top spin to a golf ball.

2. The golf putter according to claim 1, wherein the putter face is made of a low friction material having a friction coefficient of 0.3 or less with respect to a golf ball, and has a plurality of micro-grooves extending in a heel-to-toe direction along the putter face so as to increase friction resistance in a vertical direction.

3. The golf putter according to claim 2, wherein the putter face is made of an iron (Fe) based material, and is surface-processed to have an arithmetic average roughness of 5 μm or less.

4. The golf putter according to claim 2, wherein the putter face is plated with at least one material selected from the group consisting of gold, silver, platinum, nickel and chrome to have an arithmetic average roughness of 5 μm or less.

5. The golf putter according to claim 2, wherein the low friction material includes molybdenum disulfide (MoS₂), diamond, graphite, Teflon, acrylic polymer, silicon-based materials, wax or other petroleum derivatives, plastic and water based lubricants and composite materials thereof.

6. The golf putter according to claim 2, wherein the low friction material
is carbon, nitrogen or boron which is high-temperature penetrated into the putter face.

7. The golf putter according to claim 2, wherein the putter face is formed by directly coating the low friction material on the entire front surface of the putter head or inserting the low friction material in the form of an insert into a portion of the front surface of the putter head.
FIG. 4

Tour Pro  Handicap 0  Handicap 8  Handicap 16
Handicap 24  Handicap 32  Handicap 40

FIG. 5
FIG. 16
A. **CLASSIFICATION OF SUBJECT MATTER**

IPC7 A63B 53/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. **FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC7 A63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KR, JP : IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. **DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>US 5,213,332 A (William J. Faby, et al.) May. 25, 1993 see abstract; Fig. 3</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>US 4,964,641 A (Gary D. Miesch, et al.) Oct. 23, 1990 see Fig. 1; Fig. 2; column 3, line 22-58, column 3, line 61 - column 4, line 8</td>
<td>1, 2</td>
</tr>
<tr>
<td>A</td>
<td>US 5,718,644 A (Matt Donofrio) Feb. 17, 1998 see abstract; Fig. 2</td>
<td>5</td>
</tr>
</tbody>
</table>

☐ Further documents are listed in the continuation of Box C.  ☐ See patent family annex.

* Special categories of cited documents:
  *A* document defining the general state of the art which is not considered to be of particular relevance
  *E* earlier application or patent but published on or after the international filing date
  *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
  *O* document referring to an oral disclosure, use, exhibition or other means
  *P* document published prior to the international filing date but later than the priority date claimed
  *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  *&* document member of the same patent family

**Date of the actual completion of the international search**
25 FEBRUARY 2002 (25.02.2002)

**Date of mailing of the international search report**
25 FEBRUARY 2002 (25.02.2002)

**Name and mailing address of the ISA/KR**
Korean Intellectual Property Office
Government Complex-Uijeonb, 920 Dunsan-dong, Seo-gu, Daejeon Metropolitan City 302-701, Republic of Korea
Facsimile No. 82-42-472-7140

**Authorized officer**
KIM, Eun Rae
Telephone No. 82-42-481-5458

Form PCT/ISA/210 (second sheet) (July 1998)