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(71) Applicant(s):
Dave Hicks Golf Ltd
(Incorporated in the United Kingdom)
Unit 1 Hamilton Business Park, Gore Road,
NEW MILTON, Hants, BH25 6TH,
United Kingdom

(72) Inventor(s):
David Raymond Hicks

(74) Agent and/or Address for Service:
Fry Heath & Spence LLP
The Gables, Massetts Road, HORLEY,
Surrey, RH6 7DQ, United Kingdom

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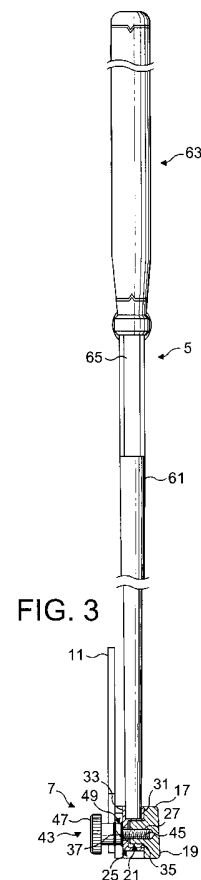
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GB 2175510 A **US 6623372 B1**
US 5782005 A **US 4885847 A**
US 4815740 A

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INT CL⁷ **A63B**
Other: **WPI, EPODOC**

(54) Abstract Title: **Golf putter fitting device**

(57) A golf putter fitting device comprises a head assembly 7 and a shaft assembly 5 which are mounted to allow relative movement between the two assemblies. The head assembly 7 should be moveable relative to the shaft in at least one plane, but preferably two planes. Preferably, an attachment member 25 is used to connect the head member 17 of the head assembly 7 to the shaft assembly 5. The attachment member 25 may allow for adjustment of the lie angle and the loft angle of the head assembly 7. Angular scales 11 may be used to help the measurement of these angles. A locking member 43 may be used to hold the head assembly 7 in position. The shaft assembly may also allow for adjustment of the shaft length. A grip unit 63 engages either one of axial slots 65 (67, Fig 4, also) by means of a locking member (75, Fig 8) to allow for length adjustment. At a certain point on the shaft 61, a circumferential slot (69, Fig 8) that connects slots 65 and (67) is provided that allows the grip 63 to be rotated through 180 degrees and so the fitting device may be used with both left- and right-handed golfers.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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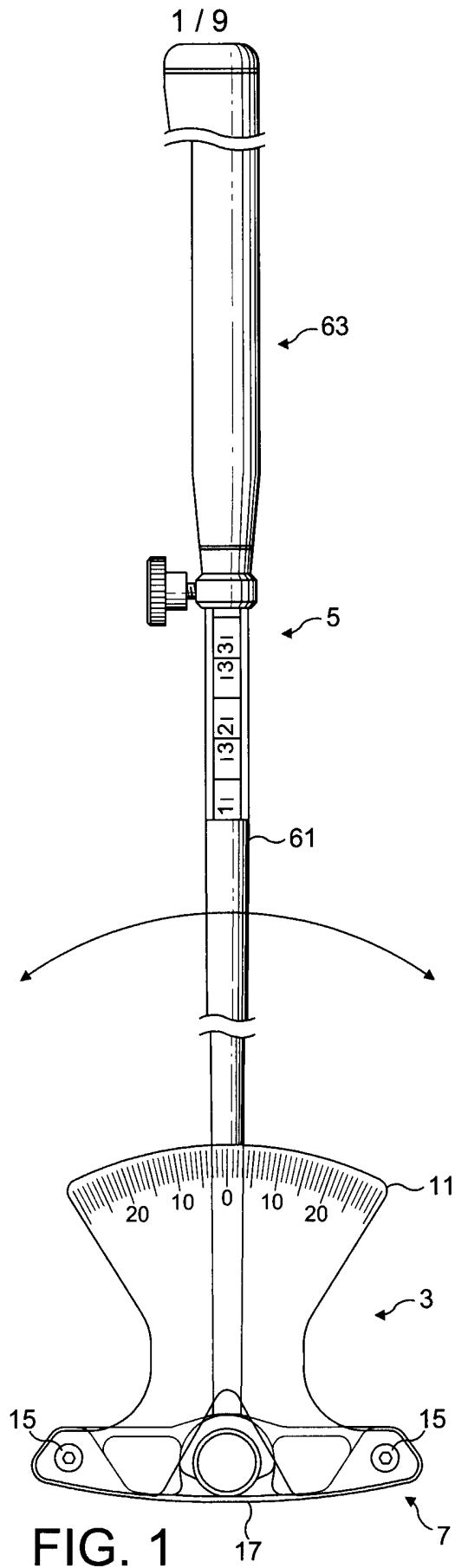
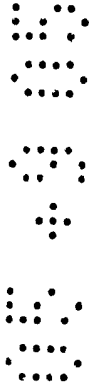


FIG. 1



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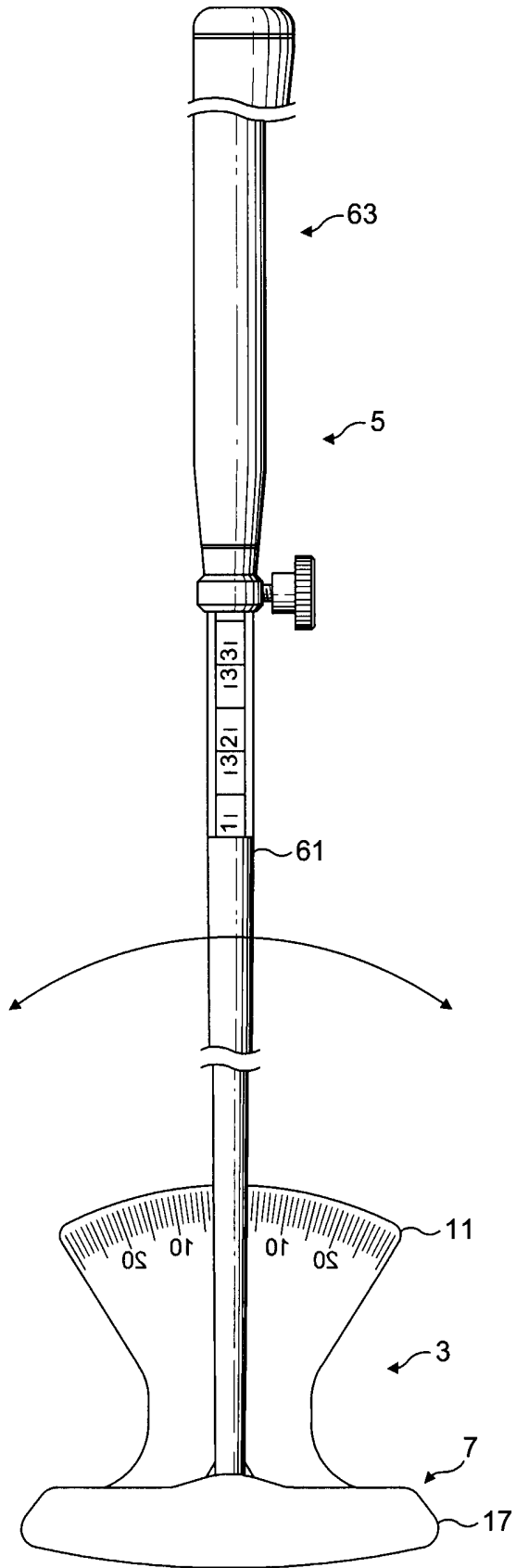


FIG. 2

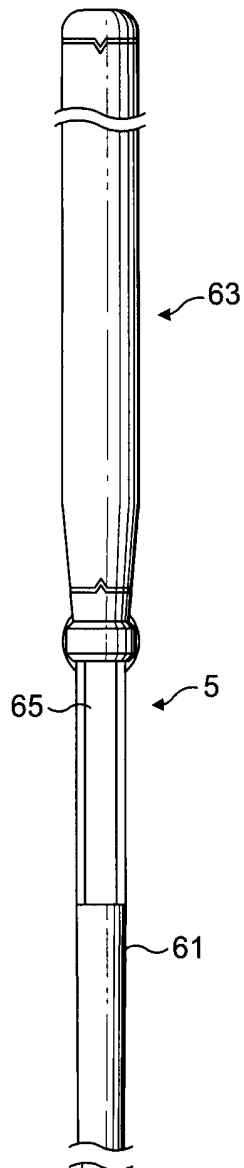


FIG. 3

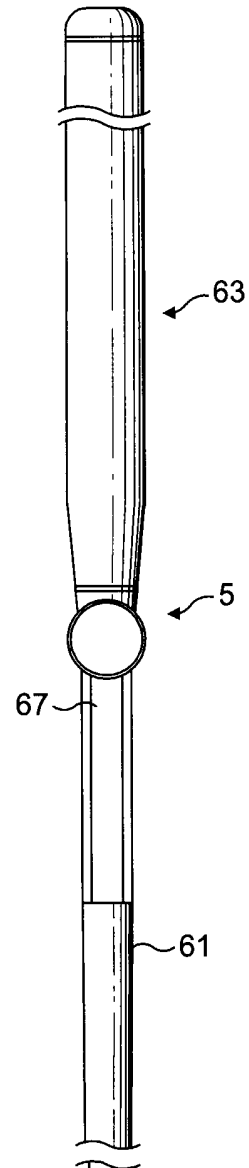
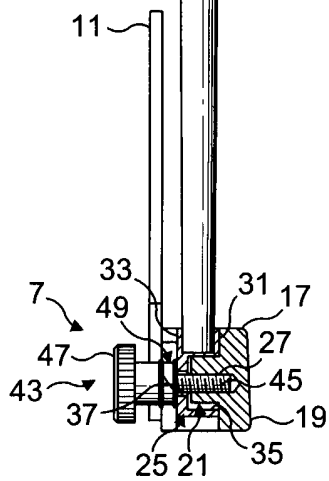
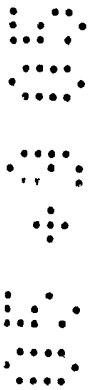
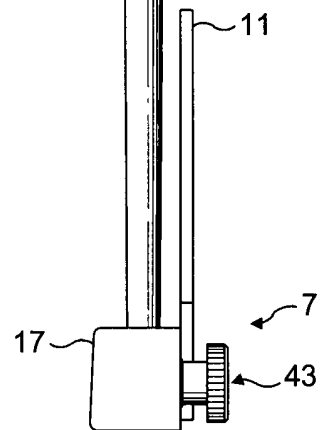


FIG. 4



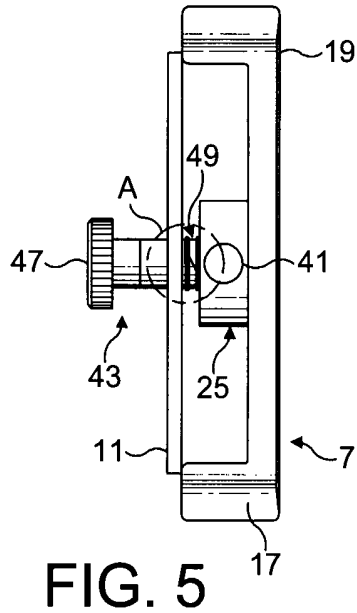


FIG. 5

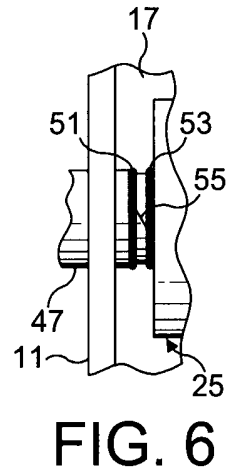
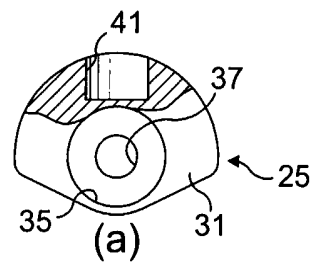
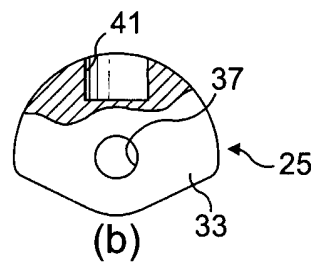


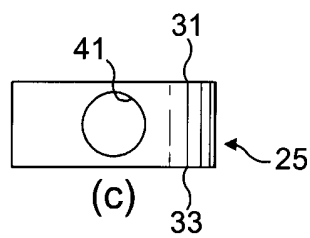
FIG. 6



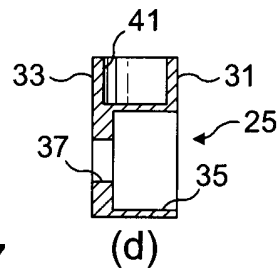
(a)



(b)

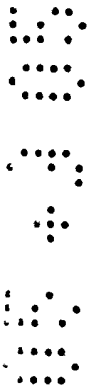


(c)



(d)

FIG. 7



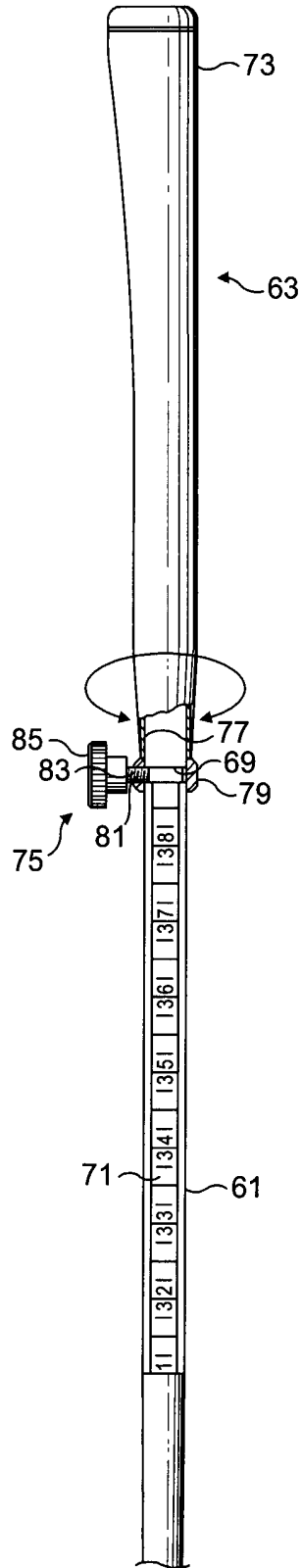


FIG. 8



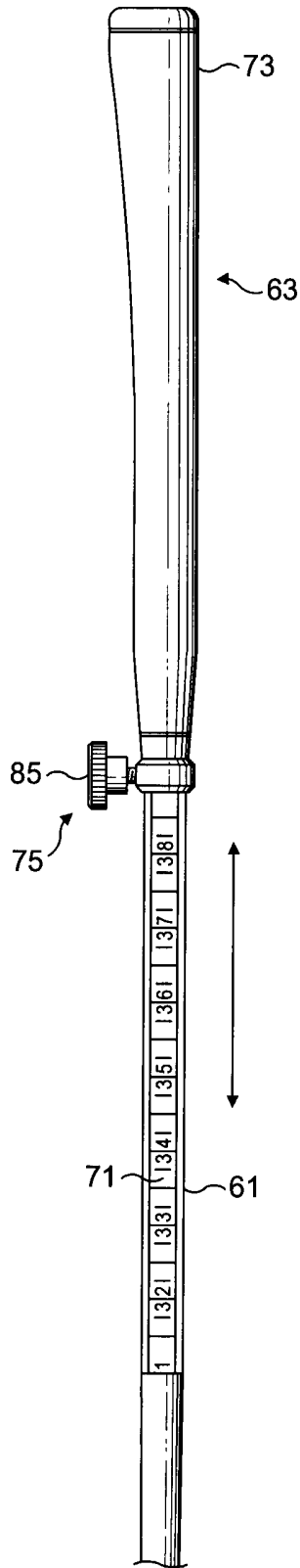


FIG. 9(a)

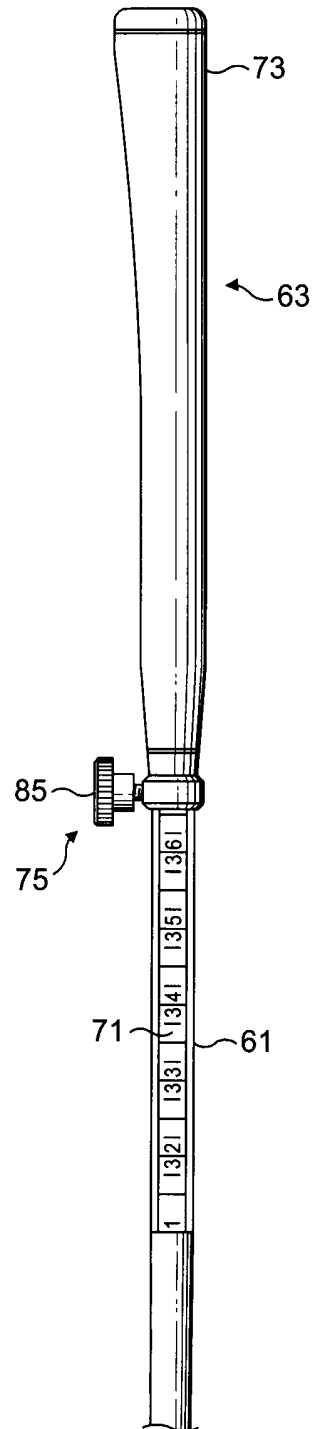


FIG. 9(b)



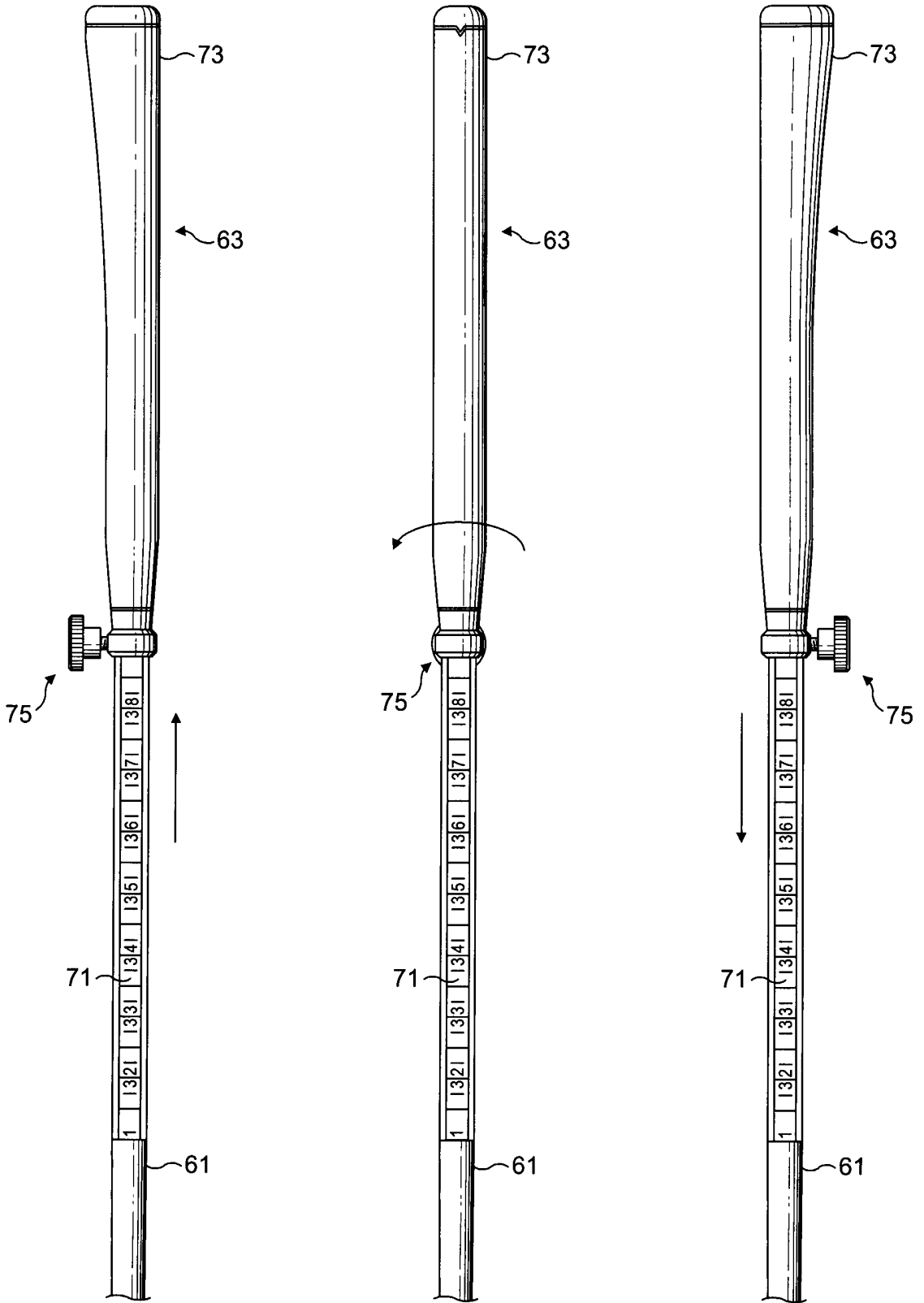


FIG. 10(a)

FIG. 10(b)

FIG. 10(c)



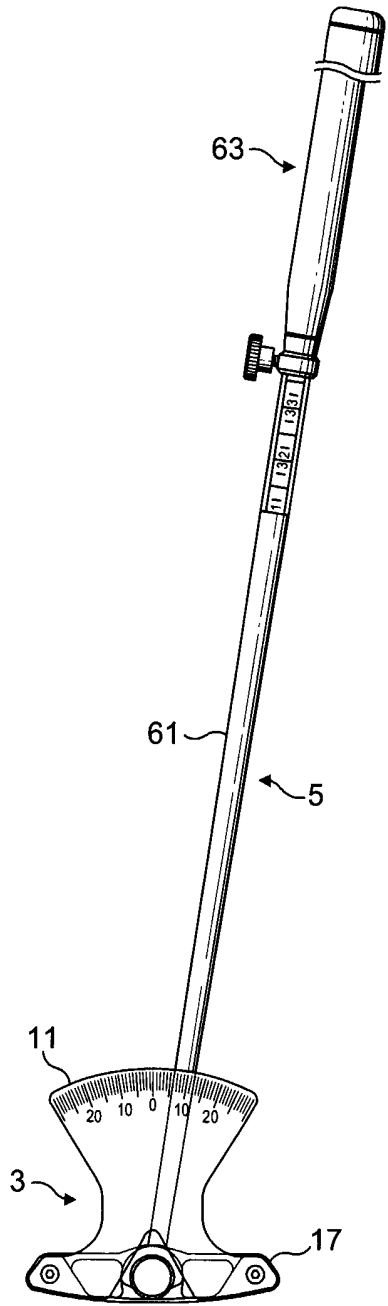


FIG. 11

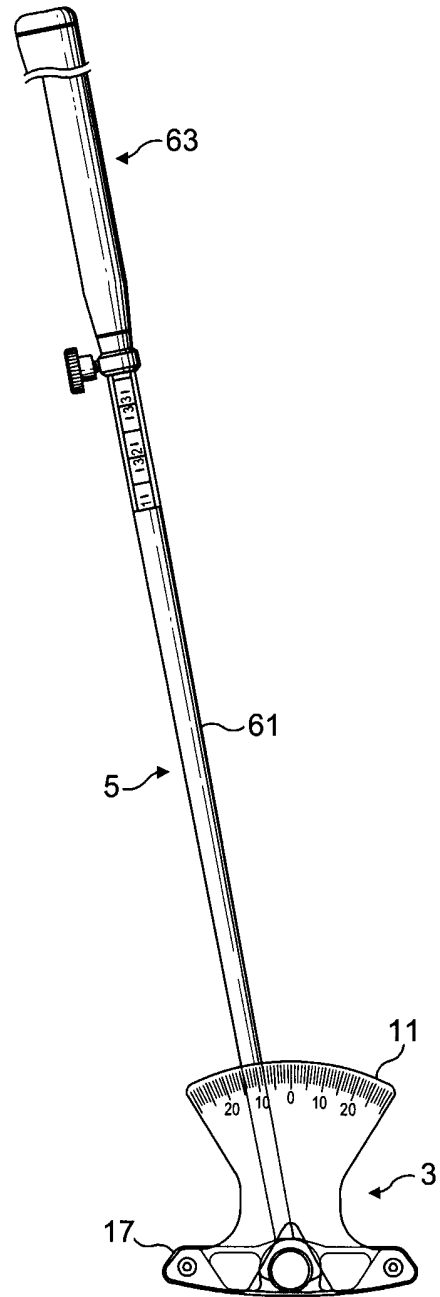


FIG. 12



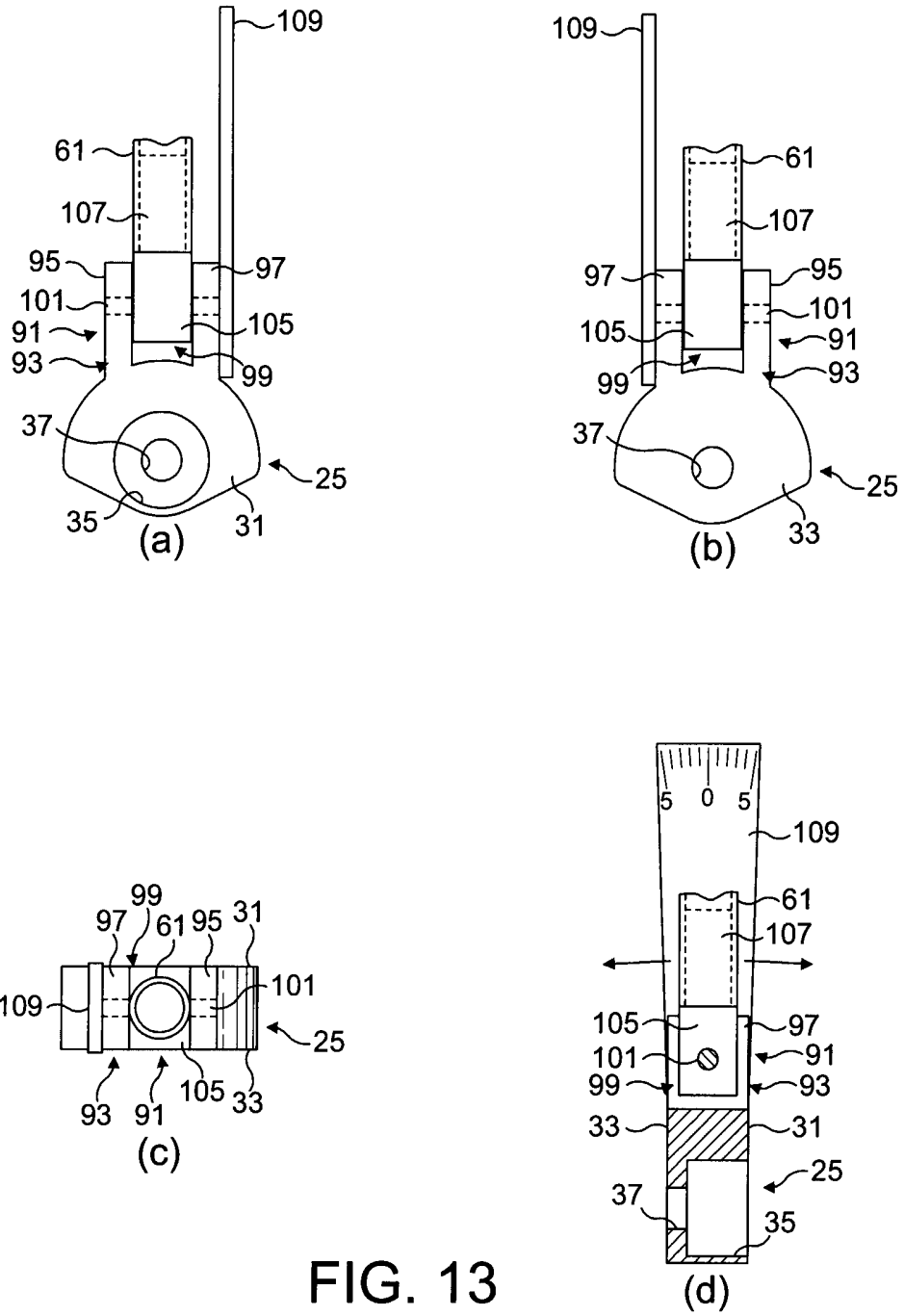


FIG. 13

FITTING DEVICE FOR GOLF PUTTERS

The present invention relates to a fitting device for golf putters, which provides for custom fitting of golf putters to the requirements of individual users, where either left or right handed.

It is important that a golf putter, whose purpose is to propel a golf ball along the ground of a prepared surface, referred to as a green, provides a consistent strike and thus imparts consistent momentum to the golf ball.

This momentum is transferred from the golf putter to the golf ball by the movement of the putter head when swung by the golfer. It is a requirement that this momentum be transferred consistently to the golf ball for a given force of impact, as otherwise a variable amount of momentum will be transferred, causing the golf ball to be propelled a variable distance.

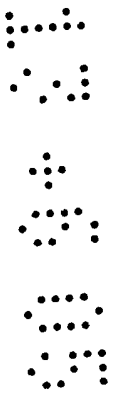
Certain other characteristics are also desirable, particularly that the golf putter should not twist in the hands as the golf ball is struck. If the point of contact is away from the "sweet spot" of the golf putter, the putter head, which is disposed at right angles to the intended line of the golf ball, will twist away from the intended line of the golf ball and the golf ball will not be propelled in the correct direction. The "sweet spot" is normally found by tapping the face of the putter head when the golf putter is held in the finger tips at the end of the grip and the golf putter hangs vertically downwards. If the putting face is tapped near the toe or heel on conventionally-balanced golf putters, then the putting face will twist in one of the respective directions. If the putting face does not deflect off axis when so tapped, then the "sweet spot" has been found.

It is also desirable to provide that the "sweet spot" of the golf putter is in line with the shaft of the golf putter, as this configuration minimizes the possibility of twisting.

Good putting is possible only if the golfer has a good putting technique based on good putting mechanics. In order to have a solid, repetitive putting stroke, the golfer's eyes should be over the golf ball and the golfer's hands need to be below the shoulders, and, in order to meet these requirements, the golf putter should be made such as to fit the physical characteristics of the golfer precisely.

Complying with these principles allows a golfer to move his/her hands and the putter head along the intended line of the golf ball towards and past the hole, thereby allowing the putter head to stay at right angles to that line for as long as possible.

The fitting device of the present invention has been developed to enable golf putters to be custom fitted to golfers, in particular to be made to the correct length and to have the correct lie. The lie is defined as the angle between the putter head and the shaft. If the lie angle is too small, the golfer will find it difficult to position the putter head under his/her eyes without the toe of the golf putter being raised from the ground. Conversely, if the lie angle is too great, then the heel of the putter will be raised from the ground. In both instances, hitting the ground with either the heel or the toe of the golf putter before hitting the golf ball, would result in the golf putter being twisted off the intended line of the golf ball and the golf ball being propelled dramatically off line.



Furthermore, in order to ensure that the shaft of a golf putter is of the correct length, it is necessary to have an adjustable shaft which allows the eyes of the golfer to be positioned over the golf ball and the hands of the golfer to be positioned below his/her shoulders. The lie angle can then be adjusted to ensure that the head of the golf putter is flat to the ground.

It is an aim of the present invention to allow for custom fitting of golf putters to golfers, in which both the length of the golf putters and the lie angle of the golf putters can be configured to suit the golfers.

In one aspect the present invention provides a fitting device for use in fitting golf putters to users, the fitting device comprising: a head assembly which comprises a head unit which comprises a head member which represents a putting head of a golf putter; and a shaft assembly which comprises a shaft which is connected to the head assembly and a grip unit by which a user grips the fitting device, wherein the shaft assembly is movably connected to the head assembly, such as to allow for configuration of the shaft assembly relative to the head member in fitting a golf putter to a user.

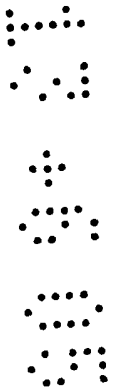
Preferably, the head assembly and the shaft assembly are configured to provide for angular movement of the head member relative to the shaft assembly in at least one plane.

In one embodiment the head member includes a coupling element, and the head unit comprises an attachment member which is connected to the shaft of the shaft assembly and movably coupled to the coupling element of the head member, such as to provide for angular movement of the head member relative to the shaft assembly in at least one plane.

Preferably, the head member includes a face representative of a putting face, and the head assembly and the shaft assembly are configured to provide for angular movement of the head member relative to the shaft assembly in at least one plane relative to the putting face.

In one embodiment the head assembly and the shaft assembly are configured to provide for angular movement of the head member relative to the shaft assembly in a plane substantially parallel to the putting face, which represents a lie angle of the head member relative to the shaft assembly.

Preferably, the coupling element comprises a coupling projection which extends rearwardly from the head member and the attachment member includes a recess which receives the coupling projection, such that the



attachment member is pivotally coupled to the coupling projection in the plane substantially parallel to the putting face.

Preferably, the head assembly comprises a lie angle indicator for measuring the lie angle of the head member relative to the shaft assembly.

More preferably, the lie angle indicator comprises an angular scale which is attached to the head member.

In one embodiment the head assembly and the shaft assembly are configured to provide for angular movement of the head member relative to the shaft assembly in a plane substantially perpendicular to the putting face, which represents a loft angle of the head member relative to the shaft assembly.

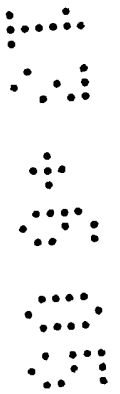
Preferably, the attachment member includes a pivotable support coupling to which the shaft is coupled, such as to provide for angular movement of the head member relative to the shaft assembly in the plane substantially perpendicular to the putting face.

Preferably, the head assembly comprises a loft angle indicator for measuring the loft angle of the head member relative to the shaft assembly.

More preferably, the loft angle indicator comprises an angular scale which is attached to the attachment member.

In one embodiment the head assembly comprises a head locking member for locking the head member in a required position relative to the shaft assembly.

In one embodiment the grip unit is movable axially on the shaft, such as to provide for adjustment of a length of the shaft assembly.

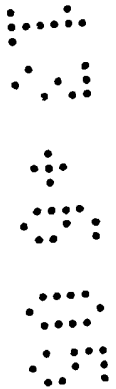


In one embodiment the shaft includes an axial slot section which extends axially along a length of the shaft, and the grip unit includes a guide element which, when located in the axial slot section, acts to guide the grip unit when moved along the shaft.

In another embodiment the grip unit is configurable in one of a left-handed or right-handed configuration.

In one embodiment the shaft includes first and second oppositely-directed axial slot sections which extend axially along a length of the shaft, and the grip unit includes a guide element which, when located in a respective one of the axial slot sections, acts to guide the grip unit when moved along the shaft in one of the left-handed or right-handed configurations.

Preferably, the shaft includes a circumferential slot section which interconnects the first and second axial slot sections, such as to allow the guide element to be moved selectively between the first and second axial slot sections and thereby enable the grip unit to be moved between the left-handed and right-handed configurations.



In one embodiment the grip unit includes a grip locking member which is operative to lock the grip unit in a desired position to the shaft.

In another embodiment the grip unit includes a grip locking member which is operative to lock the grip unit in a desired position to the shaft, and the guide element is a locking element of the grip locking member.

In another aspect the present invention provides a method of fitting a golf putter to a user where using the above-described fitting device.

Preferred embodiments of the present invention will now be described hereinbelow by way of example only with reference to the accompanying drawings, in which:

Figure 1 illustrates a rear view of a golf fitting putter in accordance with a preferred embodiment of the present invention;

Figure 2 illustrates a front view of the golf fitting putter of Figure 1;

Figure 3 illustrates one side view, in part section, of the golf fitting putter of Figure 1;

Figure 4 illustrates the other side view of the golf fitting putter of Figure 1;

Figure 5 illustrates a plan view of the head assembly of the golf fitting putter of Figure 1;

Figure 6 illustrates an enlarged view of detail A in Figure 5;

Figures 7(a) to (d) illustrate, in enlarged scale, front, rear, plan and vertical sectional views of the boss member of the golf fitting putter of Figure 1;

Figure 8 illustrates a part-sectional rear view of the shaft assembly of the golf fitting putter of Figure 1;

Figures 9(a) and (b) illustrate the steps in adjusting the length of the golf fitting putter of Figure 1;

Figures 10(a) to (c) illustrate the steps in re-configuring the golf fitting putter of Figure 1 between the left-handed and right-handed configurations;

Figure 11 illustrates a rear view of the golf fitting putter of Figure 1 in a left-handed configuration;

Figure 12 illustrates a rear view of the golf fitting putter of Figure 1 in a right-handed configuration;



Figures 13(a) to (d) illustrate, in enlarged scale, front, rear, plan and vertical sectional views of one modified boss member for the golf fitting putter of Figure 1.

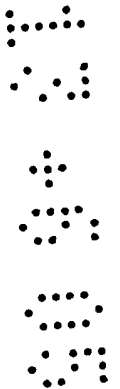
The golf fitting putter comprises a head assembly 3, and a shaft assembly 5 which is connected to the head assembly 3 and by which a user grips the golf fitting putter.

The head assembly 3 comprises a head unit 7 to which the shaft assembly 5 is connected, and a lie angle indicator 11, in this embodiment an angular scale, which is attached to the head unit 7, in this embodiment by screws 15, such as to enable measurement of the lie angle of the head unit 7 relative to the shaft assembly 5.

Referring to Figures 3 to 7, the head unit 7 comprises a head member 17, which includes a striking face 19 which is used to strike a golf ball, and a coupling element 21, in this embodiment a cylindrical projection, which extends rearwardly from the head member 17, in this embodiment at a central position along the length thereof, and a boss member 25 which is connected to the shaft assembly 5 and movably coupled to the head member 17, such as to allow for adjustment of the lie angle of the head member 17 relative to the shaft assembly 5.

In this embodiment the coupling element 21 includes a screw-threaded bore 27 for receiving a screw-threaded shaft 45 of a locking member 43, as will be described in more detail hereinbelow.

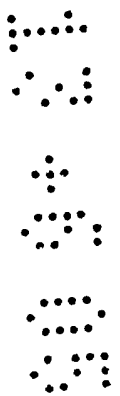
In this embodiment the boss member 25 includes front and rear faces 31, 33, where the front face 31 is configured such as to abut a rear surface of the head member 17, a recess 35, in this embodiment a cylindrical recess, which is disposed in one, the front face 31 thereof and is of complementary shape to the coupling element 21 at the rear of the head member 17, such



that the boss member 25 is rotatable relative to the head member 17 in a first vertical plane, which is substantially parallel to the striking face 19 of the head member 17, thereby enabling adjustment of the lie angle of the head member 17 relative to the shaft assembly 5, and a clearance aperture 37 which extends through the rear face 33 in correspondence with the screw-threaded bore 27 in the coupling element 21, such as to allow the screw-threaded shaft 45 of the locking member 43 to extend therethrough.

In this embodiment the boss member 25 further includes a bore 41, in this embodiment a cylindrical bore, which is disposed in the upper end thereof for fixedly receiving the lower, distal end of the shaft assembly 5.

The head unit 7 further comprises a locking member 43 for locking the boss member 25 in a desired angular position relative to the head member 17. In this embodiment the locking member 43 comprises a screw-threaded shaft 45 which extends through the clearance aperture 37 in the rear face 33 of the boss member 25 and is threadedly engaged with the screw-threaded bore 27 in the coupling element 21, a knob 47 which is attached to one, the rear, end of the screw-threaded shaft 45, such as to provide for rotation of the screw-threaded shaft 45, and a biasing element 49 which is located about the screw-threaded shaft 45 at the forward end of the knob 47, such as to bias the boss member 25 against the rear surface of the head member 17.



In this embodiment, referring particularly to Figure 6, the biasing element 49 comprises first and second washers 51, 53 and a spring 55, in this embodiment a spring washer, which is disposed between the washers 51, 53, such as to bias apart the washers 51, 53 and thereby promote the frictional engagement between the rear surface of the head member 17 and the front face 31 of the boss member 25.

In another embodiment the biasing element 49 could be formed from a resilient material, such as a rubber material.

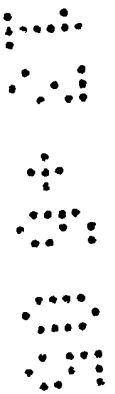
In an alternative embodiment the biasing element 49 could be replaced by a spacer element which acts frictionally to engage the forward end of the knob 47 and the rear face 33 of the boss member 25.

With this configuration, through operation of the knob 47, the locking member 43 can be loosened to allow the lie of the shaft assembly 5 to be set relative to the head member 17 and subsequently tightened to lock the boss member 25, and hence the shaft assembly 5 as connected thereto, to the head member 17, such as to fix the lie angle of the shaft assembly 5 relative to the head member 17.

Referring particularly to Figures 3 and 4, the shaft assembly 5 comprises a shaft 61, one, the lower, end of which is connected, in this embodiment fixedly connected, to the bore 41 in the boss member 25, and a grip unit 63 which is disposed to the other, upper end of the shaft 61 by which a user grips the golf fitting putter.

The shaft 61 includes first and second oppositely-directed axial slot sections 65, 67 which extend axially along a length of the shaft 61 at one, the upper, end thereof, and are configured captively to receive a locking element 83 of a grip locking member 75 when the grip unit 63 is in a respective one of a left-handed or right-handed configuration, as will be described in more detail hereinbelow.

Referring to Figure 8, the shaft 61 further includes a circumferential slot section 69, in this embodiment semi-circular, which interconnects the first and second axial slot sections 65, 67, in this embodiment at the upper ends thereof, such as to allow the locking element 85 of the grip locking member 75 to be moved selectively between the first and second axial slot sections 65, 67, and thereby enable the grip unit 63 to be moved between the left-handed and right-handed configurations.



In this embodiment the shaft 61 further includes a graduated scale 71, here marked in the imperial scale of inches which is still the measurement of choice in the golf industry, though it will be understood that any measurement unit could be employed. In this embodiment the graduated scale 71 enables the required length of the shaft 61 to be determined without recourse to the use of any other measuring device.

The grip unit 63 comprises a grip member 73, which is slideably mounted to the shaft 61 such as to be movable axially therealong, and a grip locking member 75, which is operable to allow for locking of the grip unit 63 in a desired position relative to the shaft 61.

The grip member 73 includes a bore 77 which receives the shaft 61 and a collar 79, which is disposed to one, the lower, end of the grip member 73 and includes a screw-threaded through bore 81, which receives a locking element of the grip locking member 75, as will be described in more detail hereinbelow.

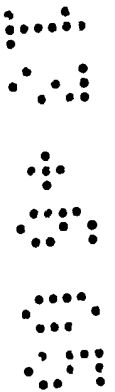
In this embodiment the grip locking member 75 comprises a screw-threaded, locking element 83 which is threadedly engaged with the screw-threaded bore 81 in the grip member 73, and a knob 85 which is attached to one, the outer end of the locking element 83, such as to provide for rotation of the locking element 83 and frictional engagement between the distal end of the locking element 83 and the shaft 61, such as to lock the grip unit 63 in a desired position axially relative to the shaft 61. In this embodiment the distal end of the locking element 83 can be formed of a material having a low coefficient of friction, such as a plastics material, so as to facilitate, when desired, the free movement of the locking element 83 within the axial and circumferential slot sections 65, 67, 69.

With this configuration, as illustrated in Figures 9(a) and (b), through operation of the knob 85, the grip locking member 75 can be loosened to allow the position of the grip unit 63 on the shaft 61 to be set to a desired



height, and subsequently tightened to lock the grip unit 63 to the shaft 61, such as to fix the effective length of the shaft 61, in terms of the separation of the head member 17 from the grip member 73.

Also, as illustrated in Figures 10(a) to (c), this configuration allows the grip unit 63 to be set to either one of a left-handed or right-handed configuration. This is achieved by first loosening the grip locking member 75, through operation of the knob 85, and raising the grip unit 63 to the uppermost position on the shaft 61, such that the grip locking member 75 is drawn to the upper end of the one of the axial slot sections 65, 67, in which position the locking element 83 of the grip locking member 75 is located at the circumferential slot section 69 in the shaft 61. The grip unit 63 is then rotated through 180 degrees about the shaft 61, such that the grip locking member 75 is in a position corresponding to the upper end of the other one of the axial slot sections 65, 67. The grip unit 63 is then lowered, such that the locking element 83 of the grip locking member 75 passes down the other one of the axial slot sections 65, 67. The position of the grip unit 63 can then be adjusted on the shaft 61, and the grip locking member 75 subsequently tightened to lock the grip unit 63 to the shaft 61, such as to fix the effective length of the shaft 61, in terms of the separation of the head member 17 from the grip member 73. Figures 11 and 12 illustrate the configuration of the golf fitting putter for left-handed and right-handed fitting, respectively.



Finally, it will be understood that the present invention has been described in its preferred embodiments and can be modified in many different ways without departing from the scope of the invention as defined by the appended claims.

In one modification, as illustrated in Figures 13(a) to (d), the golf fitting putter can be modified to allow for adjustment of the loft angle of the shaft 61 relative to the putting face 19 of the head member 17.

In this embodiment the boss member 25, instead of including a bore 41 in which the distal end of the shaft 61 is fixedly connected, further comprises a pivotable support coupling 91 to which the distal end of the shaft 61 is connected, such as to allow for adjustment of the loft angle of the shaft 61 relative to the putting face 19 of the head member 17.

In this embodiment the support coupling 91 comprises a support element 93, here a pair of parallel, opposed supporting arms 95, 97 which extend from the upper end of the boss member 25, and a connector element 99 which is pivotally coupled between the supporting arms 95, 97 about a pivot 101, where the ends of the pivot 101 are located in respective ones of the supporting arms 95, 97.

In this embodiment the connector element 99 comprises a first, lower section 105 which is of a square section and configured to be a tight interference fit between the supporting arms 95, 97, such as to require the application of a predetermined force to cause the pivoting of the connector element 99 relative to the supporting arms 95, 97, and a second, upper section 107, here of a cylindrical section, over which the distal end of the shaft 61 is fitted.

In this embodiment the boss member 25 further includes a loft angle indicator 109, here an angular measurement scale, for measuring the loft angle of the shaft 61 relative to the putting face 19 of the head member 17. In this embodiment the loft angle indicator 109 is attached to the support element 93.

In another modification the bore 77 of the grip member 73 can be formed of a material of a low coefficient of friction, such as a plastics material, so as to facilitate the free movement of the grip unit 63 over the shaft 61. Alternatively, the bore 77 of the grip member 73 could include one or more annular elements of such a material.

CLAIMS

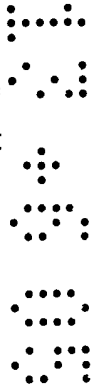
1. A fitting device for use in fitting golf putters to users, the fitting device comprising:
a head assembly which comprises a head unit which comprises a head member which represents a putting head of a golf putter; and
a shaft assembly which comprises a shaft which is connected to the head assembly and a grip unit by which a user grips the fitting device, wherein the shaft assembly is movably connected to the head assembly, such as to allow for configuration of the shaft assembly relative to the head member in fitting a golf putter to a user.

2. The fitting device of claim 1, wherein the head assembly and the shaft assembly are configured to provide for angular movement of the head member relative to the shaft assembly in at least one plane.

3. The fitting device of claim 2, wherein the head member includes a coupling element, and the head unit comprises an attachment member which is connected to the shaft of the shaft assembly and movably coupled to the coupling element of the head member, such as to provide for angular movement of the head member relative to the shaft assembly in at least one plane.

4. The fitting device of claim 3, wherein the head member includes a face representative of a putting face, and the head assembly and the shaft assembly are configured to provide for angular movement of the head member relative to the shaft assembly in at least one plane relative to the putting face.

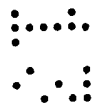

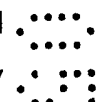
5. The fitting device of claim 4, wherein the head assembly and the shaft assembly are configured to provide for angular movement of the head member relative to the shaft assembly in a plane substantially parallel

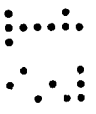
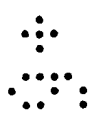
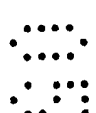


to the putting face, which represents a lie angle of the head member relative to the shaft assembly.

6. The fitting device of claim 5, wherein the coupling element comprises a coupling projection which extends rearwardly from the head member and the attachment member includes a recess which receives the coupling projection, such that the attachment member is pivotally coupled to the coupling projection in the plane substantially parallel to the putting face.
7. The fitting device of claim 5 or 6, wherein the head assembly comprises a lie angle indicator for measuring the lie angle of the head member relative to the shaft assembly.
8. The fitting device of claim 7, wherein the lie angle indicator comprises an angular scale which is attached to the head member.
9. The fitting device of any of claims 4 to 8, wherein the head assembly and the shaft assembly are configured to provide for angular movement of the head member relative to the shaft assembly in a plane substantially perpendicular to the putting face, which represents a loft angle of the head member relative to the shaft assembly.
10. The fitting device of claim 9, wherein the attachment member includes a pivotable support coupling to which the shaft is coupled, such as to provide for angular movement of the head member relative to the shaft assembly in the plane substantially perpendicular to the putting face.
11. The fitting device of claim 9 or 10, wherein the head assembly comprises a loft angle indicator for measuring the loft angle of the head member relative to the shaft assembly.



12. The fitting device of claim 11, wherein the loft angle indicator comprises an angular scale which is attached to the attachment member.
13. The fitting device of any of claims 1 to 12, wherein the head assembly comprises a head locking member for locking the head member in a required position relative to the shaft assembly.
14. The fitting device of any of claims 1 to 13, wherein the grip unit is movable axially on the shaft, such as to provide for adjustment of a length of the shaft assembly.
15. The fitting device of claim 14, wherein the shaft includes an axial slot section which extends axially along a length of the shaft, and the grip unit includes a guide element which, when located in the axial slot section, acts to guide the grip unit when moved along the shaft. 
16. The fitting device of claim 14, wherein the grip unit is configurable in one of a left-handed or right-handed configuration. 
17. The fitting device of claim 16, wherein the shaft includes first and second oppositely-directed axial slot sections which extend axially along a length of the shaft, and the grip unit includes a guide element which, when located in a respective one of the axial slot sections, acts to guide the grip unit when moved along the shaft in one of the left-handed or right-handed configurations. 
18. The fitting device of claim 17, wherein the shaft includes a circumferential slot section which interconnects the first and second axial slot sections, such as to allow the guide element to be moved selectively between the first and second axial slot sections and thereby enable the grip unit to be moved between the left-handed and right-handed configurations.

19. The fitting device of any of claims 14 to 18, wherein the grip unit includes a grip locking member which is operative to lock the grip unit in a desired position to the shaft.
20. The fitting device of any of claims 15 to 18, wherein the grip unit includes a grip locking member which is operative to lock the grip unit in a desired position to the shaft, and the guide element is a locking element of the grip locking member.
21. A fitting device for use in fitting golf putters to users, the fitting device comprising a head member and a shaft which is movably connected to the head member, such as to allow for configuration of the shaft relative to the head member in fitting a golf putter to a user.
22. A method of fitting a golf putter to a user where using the fitting device of any of claims 1 to 21. 
23. A fitting device for use in fitting golf putters to users substantially as hereinbefore described with reference to the accompanying drawings. 
24. A method of fitting a golf putter to a user substantially as hereinbefore described with reference to the accompanying drawings. 



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Application No: GB0511471.5 17 Examiner: Andrew Hole
 Claims searched: 1 to 24 Date of search: 28 July 2005

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1 to 14, 19, 21 & 22.	GB 2175510 A (Grant) See Figs 1 to 3 and page 1, line 116 to page 2, line 37 in particular.
X	1 to 5, 7, 8, 13, 21 & 22.	US 5782005 A (Reilly III) See Fig 1 and column 2, line 34 to column 3, line 42.
X	1, 2, 13, 14, 19, 21 & 22.	US 4885847 A (Korfanta) See Figs and column 3, line 30 to column 5, line 7.
X	1 to 5, 7, 8, 13, 14, 19, 21 & 22.	US 6623372 B1 (Beebe et al.) See Figs and description of the preferred embodiment.
X	1 to 6, 13, 21 & 22.	US 4815740 A (Williams et al.) See Figs 1 to 3 and column 2, lines 30 to 66 in particular.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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Worldwide search of patent documents classified in the following areas of the IPC⁰⁷

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The following online and other databases have been used in the preparation of this search report

WPI, EPODOC