Title: PUTTING TRAINING DEVICE

Abstract: A putting training device. The device comprises a surface over which a golfer executes a putting stroke, an electric field generator, an electric field detector, a plurality of electrodes responsive to the electric field generator each for producing an electric field and wherein as the golfer executes the putting stroke one or more of the electric fields is perturbed, and wherein the electric field detector detects the perturbed electric field to determine parameters related to putter head movement.
PUTTING TRAINING DEVICE

[001] The present application claims the benefit of the Provisional Patent Applications No. 60/829,715 filed on October 17, 2006 and No. 60/787,575 filed on March 30, 2006, and also of the U.S. Application No. 11/693,788 filed on March 30, 2007.

BACKGROUND OF THE INVENTION

[002] Some golfers believe that the art of putting is a subjective skill based primarily on the golfer's confidence and "the right feel" during the address and putting stroke. Other golfers believe that good putting results from the development and execution of proper putting mechanics. In fact, both "the right feel" and good putting fundamentals are requisite skills that lead to consistently good putting. The golfer's failure to execute proper putting mechanics inevitably leads to poor putting and causes extra strokes during a golf match.

[003] The following are common putting errors: misalignment of a clubface relative to break and speed of the ball, inconsistent clubhead path during the putting stroke, inability to properly read the break in the green, excessive opening/closing of the clubface during the stroke, inconsistent ball speed control, failure to accelerate the putter through impact, incorrect putter position relative to ball's lie on the green, failure to maintain the hands ahead of the clubhead during the stroke, improper approach angle of the putter through impact, failure to maintain the clubface square to the intended stroke line, lack of confidence in making the putt, failure to solidly strike the ball with the putter, poor grip and improper posture at address.

[004] In his book, Putt Like the Pros, Dave Pelz suggests, "Putting is 43% of the game of golf. The average golfer shoots 95 and will average thirty-eight putts per round." To put this in perspective, if Tiger Woods averaged 38 putts per round his stroke average would climb to 78. These numbers illustrate the importance of good putting, even for the best player in the world today. Pelz also offers, "Golfers misalign their intended line as much as 75% and therefore make compensating putting stroke errors in an effort to
redirect their misalignment at address. Nick Faldo recently remarked, "The name of the game is turning three shots into two!" Improved putting is key to achieving that objective.

[005] Thus it is apparent that millions of golfers cannot putt well because they cannot align their putters, read the greens or control the distance the ball travels after impact. Generally, the problem is not a lack of natural ability. The available putting aids are limited by the approach they take to teaching the art of putting. These products typically train mechanics or alignment, but do not comprehensively and simultaneously teach alignment, speed control and proper mechanics. But good putting requires consistent and proper clubface alignment at address (relevant to break), proper and repeatable mechanics and the learned skill of touch for speed. Teaching putting without teaching the simultaneous execution of these skills is not really teaching putting at all.

BRIEF SUMMARY OF THE INVENTION

[006] One embodiment of the invention comprises a putting training device further comprising: a surface over which a golfer executes a putting stroke, an electric field generator, an electric field detector, a plurality of electrodes responsive to the electric field generator each for producing an electric field, and wherein as the golfer executes the putting stroke one or more of the electric fields is perturbed, and wherein the electric field detector detects the perturbed electric field to determine parameters related to putter head movement.

[007] Another embodiment comprises a method for conducting putting training for a golfer executing a putting stroke. The method comprises generating electric fields through which the golfer executes the putting stroke; detecting perturbations in the electric fields caused by a putter moving through the electric fields during the putting stroke; and responsive to detected perturbations, determining a relationship between the putting stroke and a desired putting stroke for various putting stroke parameters.

BRIEF DESCRIPTION OF THE DRAWINGS
The present invention can be more easily understood and the advantages and uses thereof more readily apparent when the following detailed description of the present invention is read in conjunction with the figures wherein:

Figure 1 is a perspective view of one embodiment of a putting training device of the present invention.

Figure 2 is a block diagram depicting components of the putting training device of Figure 1.

Figure 3 is an underside view of one embodiment of the putting training device of the present invention.

Figure 4 is a perspective view of a putting training device according to another embodiment of the invention.

Figures 5 and 6 illustrate a shroud for use with the embodiment of Figure 4.

Figures 7 and 8 illustrate placement of the shroud of Figures 5 and 6.

Figures 9A and 9B illustrate an alternative electrode configuration for the present invention.

In accordance with common practice, the various described features are not drawn to scale, but are drawn to emphasize specific features relevant to the invention. Like reference characters denote like elements throughout the figures and text.

DETAILED DESCRIPTION OF THE INVENTION

Before describing the invention in detail it should be observed that the present invention resides primarily in a novel and non-obvious combination of elements and process steps. So as not to obscure the disclosure with details that will be readily apparent to those skilled in the art, certain conventional elements and steps have been presented with lesser detail, while the drawings and the specification describe in greater detail other elements and steps pertinent to understanding the invention.

The following embodiments are not intended to define limits as to the structure or method of the invention, but only to provide exemplary constructions. The embodiments are permissive rather than mandatory and illustrative rather than exhaustive.
The putting training device of the present invention teaches and reinforces techniques to improve a golfer's putting game, especially putting under about ten feet. Practicing with the training device will develop the golfer's putting skills, increasing the number of successful short putts during a match. The golfer uses his/her personal putter with the putting training device of the invention. The invention does not require use of a special putter, awkward training aid attachments, putter attachments or restrictive rails for controlling the clubhead during the training session. All such putting training aids are undesirable as they restrict the golfer's putting "feel." The device of the present invention teaches putting to maximize a player's feel using the player's personal putter and without attachments or restrictive devices surrounding the putter at address. There is no contact between the training device and the putter during the stroke, but the stroke mechanics are accurately monitored regardless of putter size.

The device enhances a player's feel for ball speed around the hole. As is known, as the ball slows down the effects of gravity increase. Therefore if the ball speed is not correct around the hole/cup the putt will be either high or low, unless there is no break in the green to the hole/cup. While monitoring clubface motion and enhancing "feel" the device also teaches a player the necessary mechanical skills for consistent putting, regardless of the player's skill level. These two putting skills are inseparable. The device further verifies the putter's alignment with a guideline within 1/8 inch (in one embodiment) over a twenty feet length. The combination of these multiple features improves a player's alignment, stroke mechanics and ball speed around the hole/cup.

In one embodiment the device provides four skill levels (also referred to as error levels) to address the needs of all golfers from novice to professional. The trainer can be used outside in full sunlight, on the course or on any indoor or outdoor putting surface, including the golfer's home or office. The golfer learns to putt with feel and to hit putts to impart the proper ball speed for any degree of putt break. He can practice firm putts with little break and softer putts with considerable break. The device helps the golfer identify the putting style that best suits his game. By using the putting trainer
of the present invention the golfer gains trust in his stroke mechanics and the ability to make small adjustments, improving putting consistency and confidence.

[022] The training device of the present invention, in its various embodiments, improves the golfer's putting game by increasing the number of successful putts within 10, 15 and even 20 feet from the pin, minimizing any confusing technical (mechanical) thoughts during balls address and/or during the putting stroke, improving the golfer's ability to read greens more accurately, enhancing the ability to correctly align the putter face, developing repeatability of the putter's path without restricting the stroke, controlling the clubhead speed and inertia at impact, improving ball speed control around the hole, reducing clubface rotation through impact, enhancing a player's putting confidence, visually improving a player's ability to "see the line," decreasing the backspin/rebound effect at impact, validating a putter's aim within about 1/8" at twenty feet, teaching green reading at any ball speed and for any green break, guaranteeing a putter's path within 1/4", 1/2", 3/8" or 1" of a guideline (responsive to a user-selected error level, each level corresponding to one of the four deviations from the guideline), improving the putter's pitch angle to ensure solid hits, verifying clubface alignment before every putt, developing a natural cadence during the stroke and teaching a touch for speed, alignment and mechanics.

[023] According to one embodiment, the trainer of the present invention employs a control device (e.g., a microprocessor or microcontroller) that can be upgraded to include additional beneficial features. These upgrades include an interface to Bluetooth or other wireless (or wired) networks, camera add-ons and software upgrades to more precisely track putting habits.

[024] The device can interface with a computer, via a network link for example. A software application executing on the computer receives and manipulates the data collected during the putting stroke to provide additional information for improving the golfer's putting game, such as graphs and charts that depict various parameters of the golfer's putting stroke. The putting training device can also communicate with a removable storage device (for example, a jump drive) for downloading the collected
information to the storage device for more detailed analysis on a separate processing platform.

[025] The device includes the capability to teach and monitor the putter head during the putting stroke, including putting strokes taught by various golf instructors and professionals. In one embodiment, the device teaches the newest stroke methodology, popularized by Stan Utley, that involves an inside to square, to back inside stroke theory as the clubface stays perpendicular to the stroke radius. According to Utley's theory the clubhead moves in a gently curving path that is about 2 degrees from the centerline that intersects the ball. The clubface should stay square (perpendicular) to this arcuate path during the backstroke and the forward stroke.

[026] In another embodiment, the device teaches a putting theory made popular by Dave Pelz, where the putting stroke moves straight back on the backstroke and straight through on the forward swing while the clubface stays perpendicular to the path during the entire stroke.

[027] Thus the device offers the golfer a choice of putting theories and implements monitoring techniques pertinent to either popular putting theory. The device also monitors two putting stroke fundamentals that are common to any putting stroke: return of the clubface to impact the ball at the same angle as the angle at address, and regardless of the stroke path (linear or arcuate), the perpendicular orientation of the clubface to the path at every point along the path. The present invention simultaneously monitors both clubface angle and path for accuracy relative to a desired position/orientation. Audio and video indicators, operative responsive to the monitored results, provide instantaneous feedback to the golfer.

[028] Golfers continue to buy new technology to improve their handicap. Preliminary studies with the training device of the present invention indicate a handicap reduction of about 15% to 20% for an average player. This calculates to a handicap reduction of about 5 to 7 strokes. The average player taking 95 strokes for a round can break 90 by improving his putting game with the training device of the present invention. With a lower average score and the player's ability to score more consistently, the game is more enjoyable encouraging him or her to play golf more frequently.
[029] The device also improves a golfer's putting form and consistency by sensing the putter's alignment to and deviation from a designated path and by monitoring a descending arc circumscribed by the clubhead during the down stroke. The angle of descent is adjustable and related to the putters loft at address. All putters vary in loft and therefore to properly and consistently roll the ball for speed, the angle of descent must be carefully controlled during the stroke. When the angle of descent properly matches the putter head loft, both ball skip/bouncing (caused by an angle of descent that is too low) and drag/excessive loft (causing backspin) are reduced and the ball rolls its intended distance. Loss of ball speed inevitably causes the putt to be missed as the ball does not reach the desired target on the green at the desired speed.  

[030] Excessive lifting of the putter head from a surface of the putting training device activates an alarm or other warning indicator. The angle of descent is monitored by the device with real time audible/visual feedback to the golfer before the ball is hit. In one embodiment the angle between the surface of the device and the ground or surface on which the device rests is adjustable to monitor any angle of descent and detect deviations from the desired angle of descent.  

[031] In addition to sensing the motion of the clubhead, the device includes an alignment mechanism for aligning the device with either the hole or an imaginary point near the hole to allow for breaks on the green. The device verifies alignment at address and assists the golfer in applying the correct ball roll arc for optimal accuracy.  

[032] The training device senses putter head alignment and motion by using sensors that detect putter deviation from a prescribed line or arc visibly inscribed on an upper surface of the device. The sensors are monitored by an apparatus that compares the relative position of the putter head with a prescribed reference position at multiple points during the stroke. Responsive to the relative position, the controlling apparatus provides stroke feedback information to the user via visible and/or audible indicators.  

[033] Figure 1 illustrates a putting training device 10 of the present invention for use with a golf ball 1 placed proximate an inclined putting trainer surface 2 (having a guideline 3 defined therein, in one embodiment the guideline comprises a centerline). A golfer controls a putter 4 (further comprising a heel 5 and a toe 6) through a backswing
along the guideline 3 and a forward swing through impact with the ball 1. The ball travels in a direction indicated by an arrowhead 12.

[034] In a preferred embodiment, the device 10 generates an electric field and analyzes field perturbations caused by the putter 4, in particular perturbations caused by motion of the putter 4. The putter path is monitored from a time when the putter 4 moves backward on the backswing and continues through the downswing until immediately prior to impact of the putter 4 with the ball 1. The monitoring ends when the putter crosses a start electrode (described further below) on the downswing.

[035] An electric field emanates from electrodes on a lower surface of the trainer surface 2. The electrodes also monitor the electric field and detect putter-induced field perturbations. Each electrode preferably comprises a conductive elongated strip, with the plurality of electrodes oriented such that when excited by an electric field generator the electrodes create electric fields along the putting stroke path, including especially certain strategic points along the path.

[036] An electric field generator 30 (see Figure 2) produces a sine wave signal with a nominal frequency of 120 KHz and a voltage of about 5 V peak-to-peak. The signal is sequentially and individually supplied to electrodes 34-40, under control of a microprocessor 50, for generating an electric field in a region of the currently active electrode (i.e., the electrode to which the signal is supplied). The inactive electrodes (i.e., not supplied with a signal from the field generator 30) are grounded.

[037] In one embodiment the electric field generator 30 comprises an electric field imaging device part number MC33794 available from Motorola, Inc. of Schaumberg, IL. and the microprocessor (or microcontroller) comprises a microprocessor part number MSP4301232 available from Texas Instruments, Inc. of Dallas, TX.

[038] The electric field generator 30 further comprises a receiver/detector connected to the currently-active electrode for monitoring the generated field as disturbed by any objects within or proximate the field and for producing a signal representative thereof. The signal is converted to a DC value that therefore represents the current from the active electrode to the grounded electrodes and other grounded objects that affect the field distribution. Field perturbations caused by an object entering, exiting or stationary
within the field, such as the putter, are detected by the receiver/detector as a change in this DC value. Specifically, an object within the field modifies the field between the active electrode and the surrounding grounded objects, modifying an effective capacitance between the active electrode and the grounded objects. The effective capacitance increases as the object approaches the active electrode and the measured DC value is inversely related to the effective capacitance.

[039] The shape and size of the object can be determined by using multiple electrodes in the region where the object is expected and observing the capacitance change for each electrode. The electrodes that experience a capacitance change have a portion of the object proximate thereto. The object is not proximate any electrodes that experience no capacitance change.

[040] The physical location of the electrodes illustrated schematically in Figure 2 is depicted in the underside view of Figure 3, which also depicts the guideline 3 in phantom. Figure 3 also illustrates a ball placement cutout or notch 44 to ensure that the ball 1 is placed in the same starting position for each practice stroke.

[041] In one embodiment (not illustrated) one or more of the electrodes 34-38 is replaced with a plurality of spaced apart electrodes each independently generating a field responsive to the electric field generator 30. Putter velocity and acceleration can be determined from the field perturbations as described above. Thus in one embodiment the putter velocity, acceleration and position can be determined at any point during the putting stroke and the golfer visually or aurally advised of these parameters during the putting stroke. It is generally desired for the putter to be accelerating during the forward stroke; the putting training device of the present invention can confirm that acceleration. The velocity, acceleration and position data can also be stored and provided to the golfer in the form of a graphical or numerical display.

[042] The golfer begins using the training device 10 by placing a ball in the cutout 44. As he moves the putter to the start electrode 38 at address, the field at each electrode (as perturbed by the putter) is determined and a reference DC voltage for each electrode is generated responsive to the measured field. These DC reference voltages are used for determining putter position during the putting stroke. The training device
can accommodate any size putter.

[043] In effect, the start electrode 38 operates as a switch that initiates the monitoring process (including determining the reference DC voltage values) when the putter is first placed proximate the start electrode 38 and terminates the process when the putter crosses the start electrode 38 during the down stroke, immediately prior to ball impact.

[044] As the golfer continues his backstroke, the receiver/detector monitors the field at each electrode and generates a DC voltage responsive thereto. Putter motion is thereby determined relative to the toe electrode 34, the toe height electrode 35, the heel height electrode 36 and the heel electrode 37. In particular movement of the toe 6 and the heel 5 relative to the two toe electrodes and the two heel electrodes is determined.

[045] An analog-to-digital converter 45 interposed between the electric field generator 30 and the microprocessor 50 converts the measured DC voltage values to a binary value. The microprocessor 50 compares the digitized voltages representing the monitored fields at the electrodes with the reference voltages. In one embodiment, the voltage decreases as the putter 4 moves toward an electrode. The specific electrode experiencing the decreased voltage indicates the direction in which the putter has varied from the guideline 3 and/or identifies an increase in putter height above the surface 2.

[046] In one embodiment of the invention, the electric field generator 30 and the microprocessor/microcontroller 50 cooperate to sequentially supply the field-generating current to a single electrode 34-38 and monitor a single electrode at any given time during a cycle interval. The process cycles through multiple iterations of the cycle during the putting stroke to activate each electrode 34-38 multiple times during the putting stroke.

[047] In one embodiment, the microprocessor/microcontroller 50 selects one electrode at the beginning of an 8 msec window and the electric field generator supplies a current to the selected electrode to create the field. The microprocessor remains idle until the window expires. During the next 8 msec window the microprocessor 50 reads the data supplied from the A/D converter 45, i.e., a digitized version of the field-representing voltage detected by the receiver/detector in the electric field generator 30. This value is
compared with the reference value for the selected electrode to determine if a deviation in excess of a selected error value has occurred, activating the alarm 70 responsive thereto. The microprocessor 50 then activates a different electrode, cycling through all electrodes multiple times during both the backstroke and the forward stroke of the putting stroke.

[048] The microprocessor 50 determines putter movement relative to a decreased voltage at the specific electrodes as described below.

[049] Start electrode 38: The device 10 waits for an indication that the putter 4 has been placed over the start electrode 38 and has moved beyond the start electrode before determining a reference voltage for all electrodes. The device 10 continues to monitor the putter path until the putter 4 crosses the start electrode 38 immediately before the ball is struck.

[050] Toe electrode 34: The putter 4 has moved away from the guideline toward the toe side if at anytime during the putting stroke (including both the backswing and the downswing) the voltage decreases from the reference value for this electrode. The voltage difference is compared with the value for a selected error level (1-4) and an alarm (visual or aural) triggered if the difference is greater than or equal to this error level.

[051] Heel electrode 37: The putter 4 has moved away from the guideline toward the heel side if at any time during the putting stroke (including both the backswing and the downswing) the voltage decreases from the reference value for this electrode. This voltage difference is compared with the value for the selected error level (1-4) and an alarm triggered if the difference is greater than or equal to this error level.

[052] Toe height electrode 35: An increased voltage at this electrode (from the reference value for this electrode) indicates that the toe 6 of the putter 4 has been lifted from the putting surface 2 during the putting stroke (including both the backswing and the downswing). This voltage change is used to adjust the voltage determined at the toe electrode 34, compensating the toe electrode voltage for movement of the toe 6 above the putting surface 2 and thereby removing the effects of toe lift from the toe.
electrode voltage, since the latter is intended to detect only lateral toe deviation from the
guideline.

[053] Heel height electrode 36: An increased voltage at this electrode (from the reference value for this electrode) indicates that the heel 5 of the putter 4 has been lifted from the putting surface 2 during the putting stroke (including both the backswing and the downswing). This voltage change is used to adjust the voltage determined at the heel electrode 37, compensating the heel electrode voltage for movement of the heel 5 above the putting surface 2 and thereby removing the effects of heel lift from the heel electrode voltage, since the latter is intended to detect only lateral heel deviation from the guideline.

[054] Error level electrode 40: A decreased voltage at this electrode indicates that the putter 4 has been placed over the error level electrode 40 to change an error level setting (four error levels 1-4 in one embodiment). The error level cycles thru the four levels while the putter 4 is over the electrode, movement of the putter away from the electrode causes selection of the then-current error level.

[055] The error levels indicate a measured voltage deviation from the expected value that represents a deviation of the putter from the guideline. In an embodiment with four error levels, the error levels indicate deviations during any part of the putting stroke as follows.

<table>
<thead>
<tr>
<th>Error Level</th>
<th>&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1&quot;</td>
</tr>
<tr>
<td>2</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>3</td>
<td>5/&quot;</td>
</tr>
<tr>
<td>4</td>
<td>1/4&quot;</td>
</tr>
</tbody>
</table>

[056] One of the LEDs (light emitting diodes) 65, 66, 67 and 68 is illuminated to indicate the selected error level.

[057] Reset electrode 39: A decreased voltage at this electrode indicates that the putter has been placed over reset electrode. Responsive to the decreased voltage, the device 10 resets all alarms and reinitializes the system.

[058] A toe alarm LED 61 illuminates when the toe 6 deviates from the guideline 3 by more than the distance associated with the selected error level. For example, if error
level 3 is selected, the toe alarm LED 61 illuminates when the toe deviates from the
guideline by more than \( \frac{1}{4} \) inch.

[059] A heel alarm LED 63 functions similarly with respect to the heel 5. A height LED
62 illuminates when either the toe height or the heel height exceeds a starting height of
the putter 4 by an amount greater than the deviation of the selected error level.

[060] In one embodiment one or more of the LEDs 61-63 and 65-68 are partially
shielded by a shroud (not illustrated) extending upwardly from the surface 2, allowing
the golfer to determine if any one or more of the LEDs is illuminated when the device 10
is used under bright light conditions, such as outdoors in heavy sunlight.

[061] An audible alarm 70 is also activated responsive to one of the monitored
positions exceeding the selected error level deviation.

[062] The microprocessor 50 of Figure 2 illuminates the alarm LEDs 61-63 and
activates an audible alarm 70 responsive to the voltage comparison process above
when the putter 4 deviates from guideline 3 according to the selected error level or (with
respect to the LED 62) when the putter is raised above the surface 2 during the stroke.

[063] The power supply 80 of Figure 2 supplies all power for the various elements of
the training device 10, comprising either batteries or an external supply that is plugged
into a receiving jack (not illustrated) on the device 10. In one embodiment in which the
power supply 80 comprises batteries, the power supply 80 operates in conjunction with
the microprocessor 50 to optimize current drain and prolong battery life by utilizing such
known methods as auto shutoff, power saver modes, and strobing of the system.

[064] A data output module 82 of Figure 2 transfers data captured by putting training
device 10 to a remote computer or data processing device. The data transfer can be
accomplished according to any wired or wireless standard, such as RS-232, USB,
Ethernet, wireless IEEE 802.11x, Bluetooth or similar communication links. The
transferred data can be processed by the remote device to provide further insight into
the golfer's putting stroke, e.g., statistical information describing the putter's path during
a plurality of putts, information on trends such as a putter path that tends to move in a
certain pattern away from the desired path. The transferred data can be combined with
additional data such as the result of the putt (i.e., successful or not) to reinforce the proper putting technique.

[065] An alignment module 84 of Figure 2 provides a means to accurately align the guideline of the unit with a selected point on a desired ball path. This point may be directly behind the hole or a point on the putting surface that the ball should pass over to take into consideration the breaks in a putting surface. In one embodiment the alignment module 84 comprises a laser pointing device adjustable along the guideline 3 (see Figures 1 and 3) and beyond to a selected point on the desired path of the ball. Another embodiment utilizes an optical device for aligning the guideline 3 with a selected point along the desired ball path.

[066] The cadence module or indicator 88, controlled by the microprocessor 50 includes a plurality of LEDs that illuminate (or flash) responsive to the putting stroke. This feature teaches a player a proper cadence during the putting stroke, including the backstroke, the forward stroke and the transition between the back and forward strokes. The feature further provides an indication of the length of putter travel during the backstroke. The cadence feature trains the golfer to develop a smoother putting stroke, reducing clubface errors in the forward stroke by improving the player's ability to return the clubface to its original starting orientation and improves the golfer's ability to control ball speed by providing a better sense of distance control, i.e., the distance that the ball will travel when struck by the putter.

[067] In one embodiment the cadence control feature of the invention can measure the putter forward speed and provide the golfer with an indication of that speed. The putter forward speed directly affects the ball speed due to momentum transfer when the club strikes the ball, as determined by the mass of the ball and putter (or the difference in the two masses). Thus by controlling his putter speed according to indications provided by the cadence control feature, the golfer directly controls the balls speed and controls the ball travel distance.

[068] As described above, an advantageous feature of the golf putting aid of the present invention is the immediate, reliable and accurate verification of a putter's alignment and movement before and during the putting stroke in three dimensions, by
improving control of the putter's pitch angle through impact and by reducing any
unnecessary right and left movement of the putter through the back and forward
strokes. The combination of these unique features and the verification of the clubface
angle at address, impact and any other point in the backstroke or forward stroke allows
any golfer to improve distance control and clubface angle control relative to a linear or
arcuate desired clubface path. The golfer will thereby sink more putts, improve his
score and enjoy the game more often.

[069] Another embodiment of the invention, a golf putting aid 99 illustrated in Figure 4,
excludes the electronics elements described above, i.e., the electric field generator 30,
the microprocessor/microcontroller 50, the electrodes 34-38 and their associated
elements, comprising instead a laser alignment feature provided by a laser source 100,
a base 102 and a shroud 105 (see Figure 5) placed proximate the hole or at a ball break
point on the putting surface. The golf putting aid 99 assists the golfer with putter
alignment (as verified by the shroud 105) and speed control (and therefore with distance
control since ball speed controls distance traveled). In conjunction with the guideline 3
these elements allow the golfer to verify the putter's alignment with the golf ball on the
putting surface and therefore the putter's alignment with the intended path of the ball
before the putting stroke starts and during the stroke as the golfer strives to keep the
putter aligned with the guideline 3. This unique combination verifies a player's clubface
and ball alignment within 1/8" inch.

[070] The shroud 105 comprises a box-like structure with an open front surface as
illustrated. Indicia representing a golf ball (labeled G-L) and a hole (labeled A-E) are
formed on an inside surface of a lower face 105A of the shroud 105. The hole C
represents the cup (and in one application is aligned with the cup when the shroud 105
is placed on the green). An inch scale 108 (see Figure 6) is formed on an inside
surface of a rear face 105B. In one embodiment the shroud is about four inches high.

[071] A laser beam 110 generated by the laser source 100 illuminates the shroud 105
as illustrated in Figure 7. In this application the shroud 105 is placed proximate a hole
112. The laser beam 110 is directed to one of the golf ball representations, one of the
hole representations or one of the scaled inch marks on the shroud based on the
golfer's "reading" of the green. It is known that all golf putts are straight and the golfer
putts to a point on the ball path where it is believed that the ball will break and roll to the
hole. Thus, for example, if the golfer determines that based on the slope of the green it
is necessary to aim his putt one cup to the left of the hole for the ball to break to and fall
into the hole, the laser beam 110 is directed to the hole representation B.

[072] During the putt backstroke the golfer attempts to move his putter head 6 along
the guideline 3. Upon squarely striking the ball 1, the ball should follow the path of the
laser beam 110. If the golfer correctly reads the green and imparts the correct speed,
the ball will break at the speculated break point and fall into the cup.

[073] Thus the shroud 105 and the laser beam 110 provide the golfer with a visual
aiming point along a straight line that directs his attention during the swing. Without the
shroud and laser beam the golfer lacks an aiming point as there are no distinguishing
features that can serve as an aiming point on the putting surface. Use of the shroud
105 also provides the putter with a distance control mechanism as he attempts to strike
the ball with a momentum that will result in the ball reaching the shroud at the correct
speed. If the shroud is located at the hole, that desired ball speed is such that if the cup
was not present the ball would roll to a stop about 15 inches beyond the center of the
cup. To further assist with ball speed control if desired, the golfer can place the shroud
105 about 15 inches behind the cup and impart a speed to the ball that would bring the
ball to a stop at the shroud 105 if the hole was not present.

[074] The golfer experiences a known depth perception problem as he looks at the
hole 112 and lines up his putt, since the hole is a flat object (two dimensions) in his field
of view. The lack of depth perception causes the golfer to lose his "feel" for the distance
to the hole. The shroud, a three dimensional object, provides a better depth perception
visual clue for the golfer than the two-dimensional hole, giving her a better "feel" for the
distance to the hole.

[075] As illustrated in another application of Figure 8, the shroud 105 is located at a
break point 120 on the path to the hole 112 and the laser beam 110 is directed to the
center of the shroud 105. Using the device 99, the golfer hits the ball along the laser
beam 110 and if she has correctly determined the break point (and imparted correct ball
speed) the ball will break at the point 120 and roll to the hole 112. As is known, the correct ball speed is that speed that will cause the ball to break at the proper angle when it reaches the break point 120.

[076] The shroud can be used in full sunlight on the practice green or inside the comfort of the golfer's home, shadowing the aiming point to permit the golfer to see the laser beam 110. In another embodiment, the shroud further comprises an illuminating device (such as a light emitting diode) that is illuminated responsive to the impinging laser beam to further assist the golfer in identifying the aiming point.

[077] In lieu of the hole representations A-E, the golfer can also use one of the golf ball representations G-L (aiming for a point one balls to the right of the hole, for example) or the inch scale 108 (aiming for a point nine inches to the left of the hole, for example) as the end point alignment for the laser beam 110.

[078] In yet another embodiment, the guideline 3 comprises two linear line segments, a segment 130 collinear with guideline 3 and a segment 134 forming an acute angle with the segment 130. See Figure 4. In one embodiment the angle is about 2 degrees. By following the segment 134, the player tends to slightly open the clubface, which according to certain putting theories may be a desired backstroke trajectory.

[079] Another embodiment comprises an adjustable slope feature for the base 102 permitting adjustment of an angle $\alpha$ (see Figure 4) between the inclined trainer surface 2 and the surface on which the device rests. This feature helps the golfer to reduce the tendency of the ball to skip or bounce when struck by the putter. Putters are manufactured with varying degrees of loft in the clubface, as much as 4 to 5 degrees from a perpendicular clubface. Putting green conditions vary, resulting in variations of as much as eight feet in ball travel distance when struck with the same initial force by the putter. This effect is referred to as green speed. For example, a slower green requires more putter loft to reduce the ball bounce, skip and drag, all of which detrimentally affect ball speed control. The adjustable slope angle of the present invention improves ball speed control by reducing ball bounce, skip and drag caused by improper putter loft. By reducing these effects the golfer maintains better control of the ball's speed after impact.
[080] The guideline 3 (backstroke line) can be substantially straight as illustrated in Figures 1 and 3 or can be curved inside towards the golfer's right foot (for a right-handed golfer). This option allows the player to determine the best angle of approach for her putting style, i.e., a straight backstroke or a curved backstroke. The golfer can visually follow and focus on the putter's path along the backstroke line, taking her attention away from the hole and subconscious efforts to force the ball into the hole on short putts. The player's ability to execute a more fundamental stroke along the desired backstroke line improves through practice using the device of the present invention.

[081] In another embodiment illustrated in Figures 9A and 9B, two of the electrodes (in this embodiment the electrodes 35 and 36) are replaced with serrated electrodes 200 and 202 (defining notches or serrations in the edges thereof) for detection of the clubface angle, acceleration and speed. The clubface is identified by a reference character 208, with a toe 210 and a heel 212. An arrowhead 218 indicates direction of travel of the clubface 208.

[082] As the club is moved by the golfer along the electrodes 200 and 202, a sinusoidal waveform is produced at a frequency representative of the club speed and the disturbance of the electric field is proportional to the area of the electrode effected by the club. The microprocessor/microcontroller 50 of Figure 2 determines the club speed and can convert the value to a representative numerical value for recording or storage. Thus a plot of the instantaneous club speed at multiple points along the club path can be determined. Club acceleration and deceleration can be determined from changes in the club speed.

[083] In the embodiment including both the electrodes 200 and 202, the phase relationship between the two sinusoidal signals is representative of the clubface angle, such as in Figure 9B where the toe 210 lags the heel 212. For example, if the toe 210 lags the heel 212, the phase of the signal produced by the electrode 202 leads the phase of the signal produced by the electrode 200. The clubface angle at ball address and at ball impact can also be determined.

[084] Thus use of the electrodes 200 and 202 provides the following information:

- club speed at any point during the backstroke and forward stroke;
terminal point of the backstroke;
length of the backstroke;
clubface velocity, acceleration and deceleration at every stroke point;
clubface absolute angle at any point in the swing, including at ball impact;
clubface angle relative to a desired clubface path (such as a linear path or an arcuate path);
clubface offset from center line (or arc of desired club head path) at any point in the swing, including at ball impact; and
distance from club face to the surface at any point during the backstroke or forward stroke.

[085] The various stroke parameters measured and determined according to the various embodiments described above can be stored or recorded for later analysis, either in the form of data values or graphs/charts illustrating the club stroke path, for example. Using the graphical information, the golfer can verify the clubface angle (i.e., the angle between the clubface and the centerline) at any point during the stroke and determine where the clubface is opened or closed. This information can be used by the golfer (or his coach) to identify deficiencies in the putt stroke and initiate remedial measures, such as better club speed control.

[086] In another embodiment, one or more of the measured various parameters are combined to create a score for the putt stroke. The score can be displayed as a numerical value on a visual display or by illuminating a number of visual indicators (light emitting diodes) according to the score. Individual measured parameters can also be displayed in lieu of or as a supplement to the stroke score.

[087] Although the invention has been shown and described with respect to certain preferred embodiments, it is obvious that equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of this specification and the annexed drawings. In particular regard to the various functions performed by the above described components (assemblies, devices, circuits, etc.), the terms (including a reference to a "means") used to describe such components are intended to correspond, unless otherwise indicated, to any component which performs the specified
function of the described component (i.e., that is functionally equivalent), even though not structurally equivalent to the disclosed structure which performs the function in the herein illustrated exemplary embodiments of the invention. In addition, while a particular feature of the invention may have been disclosed with respect to only one of several embodiments, such feature may be combined with one or more other features of the other embodiments as may be desired and advantageous for any given or particular application.
WHAT IS CLAIMED IS:

1. A putting training device comprising:
   a surface over which a golfer executes a putting stroke;
   an electric field generator;
   an electric field detector;
   a plurality of electrodes responsive to the electric field generator each for producing an electric field; and
   wherein as the golfer executes the putting stroke one or more of the electric fields is perturbed, and wherein the electric field detector detects the perturbed electric field to determine parameters related to putter head movement.

2. The putting training device of claim 1 wherein the parameters related to putter head movement comprise one or more of putter head location, putter head speed, putter head acceleration, putter head orientation, putter head path relative to a desired putter head path, putter head backstroke path relative to a desired putter head arcuate backstroke path, putter head backstroke path relative to a desired putter head linear backstroke path, putter head angle of descent, putter head clubface orientation, putter head clubface orientation relative to a clubface putter head path, distance between the putter head and the surface, distance between a putter head heel and the surface, distance between a putter head toe and the surface, putter head heel deviation from a desired path and putter head toe deviation from a desired path.

3. The putting training device of claim 1 further comprising a visual or an aural indicator activated responsive to a predetermined relationship between a threshold value and one of the parameters related to putter head movement.

4. The putting training device of claim 1 wherein the plurality of electrodes are oriented to permit each electrode to produce a different electric field when activated by the electric field generator, and wherein the plurality of electrodes comprise a plurality of spaced apart electrodes oriented such that a line through the spaced apart electrodes is substantially parallel to the putting stroke.
5. The putting training device of claim 1 wherein each one of the plurality of electrodes comprises a conductive structure and at least one of the plurality is disposed parallel to a direction of club head travel during the putting stroke.

6. The putting training device of claim 1 wherein an angle formed by the surface of the putting training device and a surface on which the device rests is adjustable, and wherein the parameter related to putter head movement comprises a putter head angle of descent, and wherein different angles of descent can be determined responsive to adjustments in the angle formed by the surface of the putting training device and the surface on which the device rests.

7. The putting training device of claim 1 further comprising a guideline on the surface thereof and an alignment device for aligning the guideline with a hole or with a location on a putting surface.

8. The putting training device of claim 7 wherein the alignment device further comprises a laser beam.

9. The putting training device of claim 1 wherein the electric field generator supplies a signal sequentially to each of the plurality of electrodes such that each electrode produces an electric field at a different time and the electric field detector detects the produced field and any putter head induced perturbations of the field.

10. The putting training device of claim 1 further comprising a guideline on the surface thereof and a notch in the surface at an end of the guideline, the notch for receiving a golf ball.

11. The putting training device of claim 1 wherein one of the plurality of electrodes comprises a start electrode, and wherein the golfer activates the device by placing the putter head proximate the start electrode causing the electric field to be produced at each of the plurality of electrodes, and wherein the electric fields are determined by the electric field detector and a field reference value determined therefrom before movement of the putter head, and wherein the device is deactivated when the putter head crosses the start electrode on a putting forward stroke.

12. The putting training device of claim 1 wherein during the putting stroke the electric field detector determines whether at least one of a putter head heel region
orientation and a putter head toe region orientation is different from a desired putter head heel region orientation and a desired putter head toe region orientation.

13. The putting training device of claim 12 wherein the desired putter head heel region orientation and the desired putter head toe region orientation comprises an orientation perpendicular to a desired putter head path during the putting stroke.

14. The putting training device of claim 13 wherein the desired path comprises a linear path or a arcuate path.

15. The putting training device of claim 1 further comprising a guideline on the surface thereof, and wherein the electric field detector further determines angular deviation between a line extending from the putter head in the direction of head travel and the guideline.

16. The putting training device of claim 1 further comprising a guideline on the surface thereof, and wherein the electric field detector further determines a deviation of a putter head centerline from the guideline.

17. The putting training device of claim 16 further comprising selectable error margins, each error margin having a different value for declaring putter misalignment relative to the deviation of the putter head centerline from the guideline.

18. The putting training device of claim 17 wherein the selectable error margins comprise 1 inch, ¼ inch, ⅛ inch and ⅛ inch.

19. The putting training device of claim 1 further comprising an output device for advising the golfer of the parameters related to putter head movement.

20. The putting training device of claim 1 further comprising a module for analyzing one or more of the parameters related to putter head movement relative to a desired putting stroke and advising the golfer of deviations between the one or more parameters and the desired putting stroke.

21. The putting training device of claim 1 further comprising a network interface for communicating the parameters related to putter head movement to a remote site.

22. The putting training device of claim 1 further comprising a camera for capturing images of the putting stroke.
23. The putting training device of claim 1 further comprising a cadence indicator for indicating putter head speed.

24. The putting training device of claim 23 wherein the cadence indicator comprises a plurality of visual indicators controlled to on and off states to indicate the putter head speed.

25. The putting training device of claim 1 further comprising a guideline on the surface having a first linear segment and a second arcuate segment, wherein the parameters related to putter head movement comprise deviations of a putter head center from the guideline and orientation of a putter head clubface relative to the guideline.

26. The putting training device of claim 1 wherein one of the plurality of electrodes comprises a substantially rectangular shape having four sides, each side defining a plurality of serrations therein.

27. The putting training device of claim 26 wherein the one of the plurality of electrodes produces a signal representative of at least one of putter head speed from which putter head acceleration can be determined.

28. The putting training device of claim 27 wherein the signal comprises a sinusoidal signal having a frequency representative of the putter head speed.

29. The putting training device of claim 1 wherein two of the plurality of electrodes each comprises a substantially rectangular shape each side defining a plurality of serrations therein, and wherein responsive to an input signal from the electric field generator, each of the two electrodes produces a sinusoidal signal representative of putter head speed and a phase difference between the signals represents a putter head angle, and wherein the electric field detector is responsive to the sinusoidal signal.

30. The putting training device of claim 1 wherein one of the plurality of electrodes is shaped to create a cyclical electric field disturbance as the putter head is moved along the one of the plurality of electrodes, wherein a signal produced by the one of the plurality of electrodes has a frequency representative of a putter head speed, from which putter head acceleration can be determined.
31. The putting training device of claim 1 further comprising a guideline on the surface over which the golfer executes the putting stroke, an alignment laser beam for aligning the guideline with a hole or with a location on a putting surface.

32. The putting training device of claim 31 further comprising a shroud for placement proximate the hole or proximate the location on the putting green, the laser beam impinging the shroud.

33. A putting training device comprising:
   a surface over which a golfer executes a putting stroke;
   an electric field generator;
   an electric field detector;
   first, second, third and fourth electrodes responsive to the electric field generator each sequentially producing first, second, third and fourth electric fields; and
   wherein as the golfer executes the putting stroke one or more of the electric fields is perturbed and detected by the electric field detector, and wherein perturbation of the first electric field indicates a putter head toe height above the surface, perturbation of the second electric field indicates at least one of a putter head toe speed, acceleration, orientation and distance from a desired putter head toe path, perturbation of the third electric field indicates at least one of a putter head heel speed, acceleration, orientation and distance from a desired putter head heel path and perturbation of the fourth electric field indicates putter head heel height above the surface.

34. A putting training device comprising:
   a surface over which a golfer executes a putting stroke;
   a first guideline on the surface; and
   an alignment device for aligning the first guideline with a hole or with a location on a putting surface.

35. The putting training device of claim 34 wherein the alignment device further comprises a laser beam source for producing a laser beam, the device further comprising a shroud for placement proximate the hole or proximate the location on the putting surface, the laser beam impinging the shroud.
36. The putting training device of claim 35 wherein the shroud further comprises hole indicia to which the golfer aims the putt.

37. The putting training device of claim 35 wherein the shroud further comprises an illuminating element illuminated in response to the laser beam.

38. The putting training device of claim 34 further comprising a second guideline on the surface over which the golfer executes the putting stroke, the second guideline comprising a curved segment.

39. A method for conducting putting training for a golfer executing a putting stroke, comprising:
   - generating electric fields through which the golfer executes the putting stroke;
   - detecting perturbations in the electric fields caused by a putter moving through the electric fields during the putting stroke; and
   - responsive to detected perturbations, determining a relationship between the putting stroke and a desired putting stroke for various putting stroke parameters.

40. The method of claim 39 wherein the putting stroke parameters comprise putter head speed, putter head acceleration, putter head orientation, putter head path, putter head backstroke path, putter head forward stroke path, putter head angle of descent, putter head clubface orientation, distance between the putter head and a surface over which the putting stroke is executed, distance between a putter head heel and the surface, distance between a putter head toe and the surface, putter head heel deviation from a guideline on the surface and putter head toe deviation from a guideline on the surface.
FIG. 2