The present invention is directed towards a golf club head having integrally incorporated twisted face angles which are selected to match a particular golfer’s swing speed. The twisted profile front face is defined by a first horizontal plane through the center of the face and having a first tangent at an intersection between the first horizontal plane and a center vertical plane and a second horizontal plane located between the first horizontal plane and a top line, wherein the second horizontal plane has a second tangent at an intersection between the second horizontal plane and the center vertical plane that is an angle to the first tangent. The invention further includes a third horizontal plane located between the first horizontal plane and a bottom line, wherein the third horizontal plane has a third tangent at an intersection between the third horizontal plane and the center vertical plane that is an angle to the first tangent. Both tangents are between 0.05° and 2.0° to the first tangent, and are selected specifically to a particular golfer’s swing speed.
GOLF CLUB HEAD WITH TWISTED FACE ANGLE

FIELD OF THE INVENTION

[0001] This invention relates to a golf club head having a twisted face angle and a method of matching the swing speed of a golfer to a corresponding twisted face angle.

BACKGROUND OF THE INVENTION

[0002] Methods of custom fitting a golfer to the most suitable golf club, taking into account different swing characteristics, are well known within the golf industry. For example, the testing laboratory at the Acushnet Golf Center in New Bedford, Mass., has been measuring and analyzing the swing characteristics and ball launch conditions of thousands of golfers since the early seventies. As a result of this testing, Acushnet has developed an accurate method of matching a golfer with particularized golfing equipment. This method utilizes sophisticated equipment for measuring the launch conditions of struck balls. For example, the golfer hits a variety of drivers having variations in head and shaft characteristics, and golf balls of different construction and performance levels are measured. Cameras monitor the golfer’s launch conditions by tracking the movement of a cluster of light emitting diodes attached to specific locations on the golf ball. Each camera has strobe lights that emit light immediately after the golf ball is struck. The light reflects off the diodes and is captured by the camera and sent to a computer for processing. This data is then recorded and analyzed using complex mathematical models which are able to calculate, among other things, the distance that a golf ball travels when struck off the tee by the golfer.

[0003] The key variables in matching a golfer with the proper club and ball include the golfer’s swing characteristics, the mass and inertial properties of the club head, the geometry of the club head (i.e. loft angle, lie angle, face angle, offset), the shaft flex characteristics, and the physical properties of the ball. Accordingly, a golfer’s swing characteristics can be identified by a number of variables, including the path of the club head towards the golf ball, the rotation of the club head prior to impact, and the velocity and acceleration of the club head at impact, which may be the most significant variable. From this information, the most appropriate golf club and golf ball are accurately matched to the golfer.

[0004] However, even with the proper club, certain tendencies are inherent with golf shots where the impacts are located away from the sweet spot of the club head. For instance, when the club strikes the ball at a point above or below the center of gravity, i.e., toward the top or sole of the club, it is assumed that the club tends to rotate about a horizontal axis which extends through the center of gravity. This creates the well known “gear effect” and is thoroughly explored in U.S. Pat. No. 4,771,961 issued to Masghti et al. The gear effect spin is created by a metal wood club because the center of gravity of the club is usually spaced a substantial distance behind the striking face of the club. Gear effect is also produced by off-center impacts in the heel-toe direction. For example, the clockwise rotation of the club head as it recoils from a toe hit causes the ball to rotate in the opposite direction. The counterclockwise rotation is imparted to the ball because the club head and ball rotate together much like two enmeshed gears. On a heel hit, the club rotates in a counterclockwise direction, therefore imparting a clockwise or “slice” spin to the ball.

[0005] The clockwise rotation of a metal wood type driver club on a toe hit opens the face of the club and causes the ball to fly initially to the right of the intended line of flight. However, the counterclockwise or hook spin imparted to the ball by the gear effect will cause the ball to curve back toward the intended line of flight. In most wooden clubs the gear effect spin more than compensates for the effect of the open face, and the ball hooks to the left of the intended line of flight. For years golf club designers have helped compensate for the gear effect by incorporating a “bulge” into the face of the driver. Bulge is a convex curvature in the face of the club which can be seen when the face is viewed from above or below. The curvature extends about a vertical axis. However, bulge has never been incorporated as a variable in the process of club selection, except as to stipulate a degree of which the club may be closed or open faced. Another design feature of the club face is “roll”, which is a convex curvature in the face that can be seen when the face is viewed from the side. The curvature extends about a horizontal axis.

[0006] Bulge tends to make a toe hit fly to the right and a heel hit fly to the left. The bulge spin and the gear effect spin are advantageously adjusted so that a ball hit on either the toe or the heel lands approximately along the intended line of flight and shot dispersion is minimized. Similarly, when a driver type club strikes a ball above or below the center of gravity, the rotation of the club head about the horizontal axis through the center of gravity imparts gear effect spin on the ball which causes the backspin of the ball to be reduced for a high hit and increased for a low hit. The roll curvature is intended to compensate for excessive gear effect spin on high and low hits thereby minimizing distance loss.

[0007] In addition to altering the backspin of the golf ball, golf shots with impacts directly above and below the center of gravity can also produce a sidespin effect. Impacts above the center of gravity impact a slight counterclockwise sidespin, or hook spin, whereas impacts below the center of gravity produce a slight clockwise sidespin, or slice spin. This sidespin effect is second order in magnitude to pure “gear effect”, and it is caused by shaft flex in response to actual club head twist during impact.

[0008] Certainly, because the magnitude of the gear effect is proportional to club velocity, a high swing speed golfer will require a different bulge angle in the face than would a low swing player. A need exists in the club selection process to match the swing speed of the golfer to a bulge angle in the face plate. The present invention provides for a novel method in club design wherein a specific bulge face angle is correlated to a specific swing speed as a method for club selection.

[0009] Other objects and advantages of the present invention will become apparent from the following detailed description when viewed in conjunction with the accompanying drawings, which set forth certain embodiments of the invention.

SUMMARY OF THE INVENTION

[0010] The invention is related to a golf club head having a twisted profile front face that is defined by a first horizontal plane through the center of the face and having a first tangent at an intersection between the first horizontal plane and a center vertical plane and a second horizontal plane located
between the first horizontal plane and a top line, wherein the second horizontal plane has a second tangent at an intersection between the second horizontal plane and the center vertical plane that is an angle to the first tangent. The second tangent is between 0.05° to 2.0° to the first tangent in an open direction.

[0011] An embodiment of the invention further has a third horizontal plane located between the first horizontal plane and a bottom line, wherein the third horizontal plane has a third tangent at an intersection between the third horizontal plane and the center vertical plane that is an angle to the first tangent. The third tangent is at an angle between 0.05° and 2.0° to the first tangent in a closed direction.

[0012] The present invention is directed to a golf club head having a face angle that is twisted from high to low such that the face angle high on the face is open relative to the face angle at the center, and the face angle low on the face is closed relative to the face angle at the center. This twist eliminates the left/right dispersion produced when hitting the ball high or low on a normal clubface.

[0013] The invention also provides for a method of fitting a proper club to a particular golfer by choosing second and third tangent angle values which are selectively based upon a user's swing speed.

[0014] The present invention provides for a golf club head wherein the second tangent promotes an open upper toe quadrant of the front face and the third tangent promotes a closed lower heel quadrant on the front face. The extent to which the face quadrants are open or closed is selectively based on the player's swing speed.

[0015] The present invention provides for a plurality of clubs having different bulge and roll radii selectively based on a player's swing speed.

[0016] The present invention also achieves both simplicity and accuracy in the disclosed method. Unlike more complex methods, the present invention utilizes only a few key variables out of the many available to match a player to a particular club.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. 1 is a schematic view of a golf club front face having a top to bottom twisting face profile.

[0018] FIG. 2 is a schematic of the tangent that extends into the toe/crown quadrant of the face.

[0019] FIG. 3 is a schematic of the tangent that extends into the heel/sole quadrant of the face.

[0020] FIG. 4 is an exaggerated view of the twisted front face as it relates to the normal front face of a club.

DETAILED DESCRIPTION OF THE PREFERRED INVENTION

[0021] The present invention is directed to a golf club head having a face angle that is twisted from high to low such that the face angle high on the face is open relative to the face angle at the center, and the face angle low on the face is closed relative to the face angle at the center. This twist eliminates the left/right dispersion produced when hitting the ball high or low on a normal clubface.

[0022] With a normal golf club head, shots that are hit high on the face (with the face square to the intended target and club head path) tend to hook and land left of the target, while shots hit low on the face tend to slice and land right of the target. By precisely twisting the face as described, these trends can be decreased or eliminated. Thus, shots will more consistently land on target, regardless of how high or low they are hit on the face. For example, when a typical PGA Tour Player with about a 110 to 115 mph swing speed hits a golf ball with a prior art driver, such as a Titleist® 909T, the ball will land about ten yards right of the target when struck 0.5° low on the face, and will land 5 yards left of the target when struck 0.5° high on the face. Incorporating the face twist designed for this swing speed according to the present invention (approximately 0.5° closed at a point 0.5° low, and 0.25° open at a point 0.5° high), both shots (and all those in between) land on the centerline. For golfers having reduced swing speeds, the twist angles are designed into the face to correspond to the lower swing speed. For example, a golfer with a swing speed of only 90 mph, would have a twist angle built into the face of this driver of about 0.3° closed at the lower position and 0.1° open at the higher position. Thus, the present invention contemplates measuring a user's club head speed or ball speed and selecting the proper amount of face twist for that golfer.

[0023] While it would be obvious that the twisting effect of the present invention will cause the loft angle to change very slightly from the heel to the toe, any drop in distance will be almost negligible (approximately 1-2 yards).

[0024] The immediate use for the twist concept would primarily be for metal wood and hybrid clubs. The concept would work equally as well for iron type clubs, however since the rules of golf do not allow a curved face for irons, the present invention is primarily addressed to metal woods and hybrids.

[0025] A golf club head with a twisted face angle is depicted by the reference 10 in FIG. 1. The face 13 of the club head 10 is twisted from a relatively high position to a low position. The precise angles of the twist are selectively based upon a golfer’s swing speed. FIG. 4 illustrates how the twist creates an open angle in the toe/crown quadrant 15 and an open angle in the heel/sole quadrant 16. The dotted line in FIG. 4 depicts the normal face if it were not twisted. As shown in FIGS. 1-3, the club head 10 is comprised of a crown portion defined by a top line 11, a sole portion defined by a bottom line 12, and a front face 13 having a face center FC. A first horizontal plane A-A passes through the center FC and forms a first tangent TA (FIG. 2) at the intersection between the first horizontal plane A-A and a center vertical plane CP-CP. A second horizontal plane B-B is located at a distance x between the first horizontal plane A-A and the top line 11, wherein a second tangent TB is formed at an intersection between the second horizontal plane B-B and the center vertical plane CP-CP that is an angle α to the first tangent TA (also shown on FIG. 2). A third horizontal plane C-C is located a distance y between the first horizontal plane A-A and the bottom line 12, wherein the third horizontal plane C-C forms a third tangent TC that is formed at an intersection between the third horizontal plane C-C and the center vertical plane CP-CP that is an angle β to the first tangent TA (FIG. 3). The angles α and β are preferably at an angle between 0.05° and 2.0° to the first tangent TA in a respective open or closed direction. It will be appreciated that any suitable angle for the particular swing speed or range of swing speeds may be selected. In one embodiment, the distances of both x and y are at least 0.25 inch measured from the first horizontal plane A-A, and more preferably at least 0.5 inch from the first horizontal plane A-A. Most
preferably, the distances of both x and y are 0.5 inch measured from the first horizontal plane A-A.

[0026] Players are fitted to a particular type of club by using such variables as head speed, club loft angle, club shaft flex, and average club face thickness, golf ball weight, and golf ball spin. Once a particular type of club head is selected for the player, the concept of the present invention can be utilized to improve and refine the club selection by providing a simple and accurate method of selecting a club head based on selection of the proper twisted front face angle for that particular player’s swing speed. This will allow off-center hits that are either high or low to be compensated for the “gear effect” regardless of the swing speed. Just as each golf club is fitted to the swing characteristics of the player, each player may now also be fitted with the proper twist angle for his/her swing speed.

[0027] The method of the present invention is generally as follows. First, a measurement of the golfer’s swing characteristic is made. In the most preferred embodiment, the golfer’s club head speed is taken. Based on the players club head speed, the golfer is fitted to the golf club having the proper twist angle characteristics. Each club head will have its own unique twist angles for a range of swing speeds.

[0028] The golfer’s club head speed can be determined using any available device. Preferably, a device such as the Mini-Pro 100 Golf Swing Analyzer, the Pro V Golf Swing Analyzer or the Pro III Golf Swing Analyzer available from GolfTek, 2001 1st Street, Lewiston, Id. 83501; the DeadSolid Golf Simulator from DeadSolid Golf, 1192 Sathers Dr., Pittston, Pa. 18640; or the Double Eagle 2000 from Par T Golf, 7310 Smoke Ranch Rd., Suite H, Las Vegas, Nev. 89128 is used to measure the club head speed at impact during a golfer’s swing. More particularly, the golfer’s swing speed is measured using a golf club having a length between 43.5 to 46 inches. Most preferably, the golfer’s club head speed is measured using a club of 44 inches long. Examples of the classification of swing speeds could be from very high to low, such as professional, high, medium, low or senior speeds.

[0029] Thus, in the manner of carrying out the present invention the appropriate club head twist angles are determined for every club head so designed. Examples of the twist angle variations can be shown for a Titleist® 905R driver as follows:

EXAMPLE 1

[0030] Consider a high handicap player (i.e., 12-18) with a measured club head speed of 85 miles per hour, which would characterize the golfer under the present invention as having a medium swing speed. When such a golfer is equipped with a Titleist® 905R driver, having about a 11.5° loft and a R or S stiff flex shaft, preferably an R flex, to obtain optimum driving performance, the twist angles α and β designed by the present invention for the tangents at TB and TC respectively are 0.1° open for TB and 0.3° closed for TC.

EXAMPLE 2

[0031] Now consider a low handicap player (i.e. 0-5) having a swing speed of 110 to 115 mph, which would be a professional speed. For this level player, the Titleist® 905R driver would preferably have a loft no higher than 9.5° and the shaft would preferably be of a stiff flex. For this golfer the twist angles α and β for the tangents at TB and TC respectively are 0.3° open for TB and 0.5° closed for TC.

[0032] Swing speeds between those stated in the above examples would be basically extrapolated on a linear basis. The main concept is to have twist angles that match the player’s club speed for every golf club driver.

[0033] Although the present invention can be utilized by golfers of any skill level, the most preferred embodiment set forth in detail herein is most appropriate for medium to high handicap golfers. Furthermore, it will be understood that the claims are intended to cover all changes and modifications of the preferred embodiment of the invention, herein chosen for the purpose of illustration, which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. A golf club head comprising:
   a front face that is defined by a first horizontal plane through the center of the face and having a first tangent at an intersection between the first horizontal plane and a center vertical plane; and a second horizontal plane located a distance between the first horizontal plane and a top line, wherein the second horizontal plane has a second tangent at an intersection between the second horizontal plane and the center vertical plane that is at an angle to the first tangent.

2. The golf club head of claim 1, wherein the second tangent is at an angle of between 0.05° and 2.0° to the first tangent in an open direction.

3. The golf club head of claim 1, wherein the club head further comprises:
   a third horizontal plane located a distance between the first horizontal plane and a bottom line, wherein the third horizontal plane has a third tangent at an intersection between the third horizontal plane and the center vertical plane that is at an angle to the first tangent.

4. The golf club head of claim 3, wherein the third tangent is at an angle of between 0.05° and 2.0° to the first tangent in a closed direction.

5. The golf club head of claim 3, wherein the second and third tangents are at angles to the first tangent selectively based upon a user’s swing speed.

6. The golf club head of claim 3, wherein the second and third horizontal planes are at a distance of at least about 0.5 inch from the first horizontal plane.

7. A golf club head comprising:
   a front face that is defined by a first horizontal plane through the center of the face and having a first tangent at an intersection between the first horizontal plane and a center vertical plane; a second horizontal plane located a distance between the first horizontal plane and a top line; a third horizontal plane located a distance between the first horizontal plane and a bottom line; wherein the second horizontal plane has a second tangent at an intersection between the second horizontal plane and the center vertical plane that is an angle to the first tangent and the third horizontal plane has a third tangent at an intersection between the third horizontal plane and the center vertical plane that is an angle to the first tangent.
8. The golf club head of claim 7, wherein the second and third tangents are each at angles of between 0.05° and 2.0° to the first tangent.

9. The golf club head of claim 7, wherein the second and third tangents are at angles to the first tangent selectively based upon a user’s swing speed.

10. The golf club head of claim 7, wherein the second tangent extends into an upper toe quadrant of the front face and the third tangent extends into a lower heel quadrant of the front face,

wherein the front face is caused to have a twist extending along the center vertical plane.

11. The golf club head of claim 7, wherein the second and third horizontal planes are at a distance of about 0.5 inch from the first horizontal plane.

12. A method for fitting a player to a golf club based on player’s swing speed defined by selecting optimal bulge radii and roll radii for the player’s swing speed.

13. A golf club head comprising: a front face having a face angle that is twisted from high to low, wherein the face angle high on the face is open relative to the face angle at the center of the face, and the face angle low on the face is closed relative to the face angle at the center of the face.

14. The golf club head of claim 13, wherein the face angle high on the face is at an angle of between 0.05° and 2.0° to the angle at the center of the face in an open direction.

15. The golf club head of claim 13, wherein the face angle low on the face is at an angle of between 0.05° and 2.0° to the angle at the center of the face in a closed direction.

16. The golf club head of claim 13, wherein the face angles high and low on the face are at angles to the center of the face selectively based upon a user’s swing speed.

17. The golf club head of claim 13, wherein the face angle high on the face is at a distance of at least about 0.5 inch from the center of the face.

18. The golf club head of claim 13, wherein the face angle low on the face is at a distance of at least about 0.5 inch from the center of the face.

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