Embodiments of composite golf club hosels and methods of use thereof are generally described herein. In one embodiment, a golf club includes a golf club shaft and a hollow body. The body has a heel end, a toe end, a front wall, a sole, and a crown. The heel end of the crown includes a hosel for receiving the golf club shaft, and the hosel is at least partially comprised of a composite material. Other embodiments may be described and claimed.
PROVIDING A HEEL END OF A GOLF CLUB HEAD TO INCLUDE A HOSEL THAT IS AT LEAST PARTIALLY COMPRISED OF A COMPOSITE MATERIAL

PROVIDING A GOLF CLUB SHAFT

COUPLING THE GOLF CLUB SHAFT TO THE HOSEL

FIG. 8
COMPOSITE GOLF CLUB HOSELS AND METHODS OF USE THEREOF

TECHNICAL FIELD

[0001] The present invention relates generally to golf equipment and, in particular, to drivers, fairway woods, hybrid irons, and other golf clubs.

BACKGROUND

[0002] Over the past several years, golf club designers have attempted to improve drivers, fairway woods, hybrid irons, and other golf clubs by, for example, lowering the center of gravity and increasing the moment of inertia of such clubs (e.g., via increasing head size), while maintaining and/or reducing the weight of such clubs. As head size increases, however, less material is available for fabricating the face, crown, sole, and/or skirt of the club head, while maintaining the club head within acceptable weight limitations (e.g., around 200 grams of mass) as specified by golfing bodies.

[0003] Accordingly, a need exists for methods of increasing the head size of golf club heads, such as drivers, fairway woods, hybrid irons, and other golf clubs, while maintaining such clubs within acceptable weight limitations. In addition, a need exists for improved methods of lowering and/or adjusting the center of gravity of such golf clubs, while maintaining and/or reducing the total weight of such clubs. Similar needs also exist for golf clubs and golf club heads having such characteristics.

BRIEF DESCRIPTION OF THE FIGURES

[0004] FIG. 1 is a front elevated view of an example golf club head according to an embodiment of the apparatus, methods, and articles of manufacture described herein.

[0005] FIG. 2 is a front view of the golf club head of FIG. 1.

[0006] FIG. 3 is a top view of the golf club head of FIG. 1.

[0007] FIG. 4 is a front view of another example golf club head.

[0008] FIG. 5 is a top view of an exemplary stabilizing insert associated with the example golf club head of FIG. 4.

[0009] FIG. 6 is a top view of another exemplary stabilizing insert.

[0010] FIG. 7 is a front view of another example golf club head according to an embodiment of the apparatus, methods, and articles of manufacture described herein.

[0011] FIG. 8 is a flow chart for a method of manufacturing a golf club head described herein.

DESCRIPTION OF EXAMPLES OF EMBODIMENTS

[0012] The following will describe in detail several embodiments in which like references designate like elements. These embodiments are provided by way of explanation only, and thus, should not unduly restrict the scope of the invention. The present specification and the present drawings teach many variations and modifications, and numerous variations may be employed, used, and made without departing from the scope and spirit of the exemplary embodiments.

[0013] According to a first embodiment, a golf club is provided which comprises a golf club shaft and a golf club head, which comprises a hollow body having a heel end, a toe end, a front wall, a sole, a crown, and a hosel at the heel end for receiving the golf club shaft. The hosel is at least partially comprised of a composite material. According to another embodiment, an iron-type golf club head is provided, which comprises a golf club shaft and a golf club head, which comprises a heel end, a toe end, and a front wall. The heel end comprises a hosel for receiving the golf club shaft, and the hosel is at least partially comprised of a composite material. In these embodiments, the center of gravity of the golf club head can be lowered or otherwise adjusted, and the head size of such golf clubs may be increased, while maintaining and/or reducing the total weight thereof.

[0014] According to further embodiments, methods for lowering and/or adjusting the center of gravity of golf club heads are provided, which comprise providing the heel end of a golf club head with a hosel for receiving a golf club shaft, wherein the hosel is at least partially comprised of a composite material. In addition, various embodiments encompass methods for (i) reducing the total weight of a golf club head and (ii) increasing the size of a golf club head while maintaining the total mass of the golf club head, which comprise providing the heel end of a golf club head with a hosel that is at least partially comprised of a composite material, as described herein.

[0015] With reference to FIG. 1, a golf club head 10 comprises: (1) a hollow body 30 formed of one or more metal materials having a front wall including a face (front wall) 12 for impacting a golf ball, and (2) a hosel 14 to receive a golf club shaft 40. The golf club head 10 further comprises a crown 16, a sole 18, a heel end 20 and a toe end 22. The golf club head 10 may be assembled from a series of forged metal pieces that may be welded or brazed together, formed using investment casting (e.g., titanium investment casting), or manufactured by other suitable types of methods or processes.

[0016] In one example, the golf club head 10 comprises the hosel 14 that is at least partially comprised of a composite material. More specifically, the hosel 14 may be substantially comprised of a composite material, or partially comprised of a composite material, such that the hosel 14 may comprise, for example, one or more solid pieces of composite materials attached to one or more pieces of metallic materials. In addition, the hosel 14 may comprise a metallic base that is reinforced with a composite material, whereby, for example, a titanium or steel element configured in the shape of the hosel 14 is provided with a composite material on the exterior and/or interior portions thereof. Still further, the hosel 14 may comprise a combination of composite materials, whereby (a) such materials may be combined and mixed in a molten state and subsequently cast or molded into the hosel 14 (or a portion thereof) or (b) such composite materials may be layered onto one another to form the desired hosel configuration (or a portion thereof). In certain embodiments, however, the hosel 14 (or portion thereof) is comprised of a substantially homogeneous piece of composite material, such that the composite material used to construct the hosel 14 (or portion thereof) is manufactured from and consists essentially of the same type of composite material.

[0017] A variety of different types of composite materials may be used to form the hosel 14, such as any suitable resin having one or more types of fibers embedded therein. More particularly, for example, the composite material may comprise a resin that melts in the presence of heat and, when allowed to cool, converts into a solid or semi-solid state. Such resins may be provided and intermixed with one or more types of fibers, such as carbon fibers, glass fibers, metal fibers, aromatic polyamide fibers, or combinations thereof. Non-
limiting examples of certain thermoset resins that may be
employed include, but are not limited to, polyamide, polyb-
utadiene, polyether block amic (PEBA), polyetherimide,
polyimide, polyurea, polyurethane (PUR), silicone, vinyl
ester, and combinations thereof.

[0018] The composite material employed in the hosel 14
may be comprised of, for example, prepreg materials, carbon
fiber composites, metal matrix composites, or combinations
thereof. Still further, the composite material may be com-
prised of plastics, vulcans, and any other suitable polymer.
In the case of metal matrix composites, the composite ma-
terial may comprise at least one base metal and at least one
resin. Non-limiting examples of suitable base metals include,
but are not limited to, those consisting essentially of alumi-
nium, nickel, zinc, magnesium, titanium, or alloys thereof.
Non-limiting examples of suitable resins that may be used to
produce metal matrix composite materials include, but are not
limited to, those consisting essentially of silicon carbide,
titanium diboride, titanium carbide, aluminum oxide, silicon
nitride, or combinations thereof.

[0019] The resin, or combination of resins, used to produce
a composite material that is used in the hosel 14 may be
selected based on the vibration damping effects thereof. That
is, the hosel 14 may be designed to dampen certain vibrations
(or certain frequencies thereof) that result when the front wall
12 of the club head 10 strikes a golf ball (not shown).
Specifically, the resin (or combination of resins) used to manu-
facture a composite material may be purposely selected and
designed to dampen certain vibrations (or certain frequencies
thereof) that would otherwise result when the front wall 12 of
the club head 10 strikes a golf ball. The vibration damping
effects of the hosel 14 may enhance the “feel” that a golfer
experiences when striking a golf ball.

[0020] The hosel 14 may also be provided with one or more
types of metal-based nanomaterials. For example, the one or
more types of metal-based nanomaterials may be provided to
the interior, middle, or exterior portions of the hosel 14. In
certain embodiments, the exterior surface of the hosel 14 is
provided with one or more types of metal-based nanomateri-
als, such that the hosel 14 is coated or plated with such
materials. The inclusion of one or more types of metal-based
nanomaterials will enhance the overall strength and durabil-
ity of such hosel 14, while simultaneously minimizing the
amount of mass that is added to such hosel 14 (relative to
conventional hosels that are substantially comprised of met-
alic materials). Non-limiting examples of metal-based nano-
materials that may be provided to the hosel 14 of the present
invention include, but are not limited to, aluminum-, nickel-, zinc-, magnesium-, and titanium-based nanomaterials.

[0021] The hosel 14 may exhibit a variety of configurations
and dimensions. Referring to FIGS. 1-3, for example, the
hosel 14 may increase in size or diameter as it approaches the
crown 16 portion of the golf club head 10. Such configura-
tions may allow the hosel 14 to gradually become integrated
with the crown 16 portion of the golf club head 10, which may
also serve to stabilize and enhance the attachment of the hosel
14 and the golf club shaft 40 to the golf club head 10, thereby
improving the feel of the club upon impacting a golf ball and
reducing unwanted vibration. The hosel 14 may exhibit an
irregular shape (such as with the hosel 14 of golf club head 10
shown in FIGS. 1-3) or symmetrical shape (such as with the
cylindrically-shaped hosel 15 of golf club head 50 shown in
FIG. 4). In fact, the hosels 14 and 15 may be shaped and
configured in various ways, whereby such configurations
should not be limited to those shown or described herein. The
details described for hosel 14 may also apply to hosel 15 and
the golf club head 50.

[0022] The hosels 14 and 15 may be located near the heel
end 20 of the crown 16 at any desired point between a front
portion 32 and a back portion 34 of the golf club heads 10 and
50. In other words, referring to FIGS. 1, 3 and 4, the hosels 14
and 15 may be disposed anywhere along the axis shown
therein between points 32 (the front portion of the club) and
34 (the back portion of the club). The hosels 14 and 15 may be
disposed closer to the front portion of the club 16, such as, for
example, substantially adjacent to the plane of the face (front
wall) 12. In addition, the hosels 14 and 15 may also be located
in front of the face (front wall) 12 such that the plane of the
face (front wall) 12 will be “offset” from the axis of the hosels
14 and 15 and the golf club shaft 40.

[0023] The hosels 14 and 15 may be manufactured accord-
ing to any of a variety of methods. For example, the hosels 14
and 15 may be formed by a solid casting process, whereby an
open mold is provided with the desired composite material
(e.g., such as in a molten or otherwise malleable state), which
is subsequently allowed to cure or harden into a solid or
semi-solid state. More specifically, for example, two or more
open molds that are configured to produce hosels 14 and 15 of
the desired configuration may be provided with the desired
composite material in a molten state, which is then allowed to
cure or solidify within the mold, such that the hosels 14 and 15
may be subsequently removed from the mold(s) and affixed to
the golf club heads 10 and 50. The curing step may be carried
out by cooling the molten composite material (or otherwise
allowing the composite material to return to room tempera-
ture) or, depending on its composition, providing the com-
posite material with an appropriate cross-linking agent to
initiate a polymerization process. The hosels 14 and 15 may
be formed into a contiguous unit through the use of a single
mold or, alternatively, may be formed by producing two or
more pieces of the hosel (such as two sides thereof) using two
or more molds, whereby the two or more pieces of the hosel
may subsequently be integrally attached to one another to
produce a single hosel.

[0024] The hosels 14 and 15 may be attached to the golf
club heads 10 and 50, respectively, using any suitable means.
In general, the hosels 14 and 15 may be attached to the golf
club heads 10 and 50, respectively, through adhesives such as
epoxy-based adhesives, mechanical attachments, welding,
and/or combinations thereof. In addition, stabilizing inserts
may be used to assist in securing the hosels 14 and 15 (or a
portion thereof) to the golf club heads 10 and 50 and/or the
golf club shaft 40.

[0025] For example, referring to FIGS. 4 and 5, a stabiliz-
ing insert 60 may comprise a center opening 26 through
which the golf club shaft 40 may be inserted, an outer perim-
eter 24 that makes contact with the exterior portion of the
golf club shaft 40 and an interior portion of the hosel 15, and
one or more engaging elements 28 located on the outer perimeter
of the stabilizing insert 60. The one or more engaging ele-
ments 28 may be used to secure the hosel 15 to the golf club
shaft 40 and/or the interior portion of the golf club head 50.
Referring to FIG. 6, other stabilizing inserts 90 may comprise
multiple flat sides (e.g., side 92), such that the insert is unable
to rotate when disposed within a hosel 15.

[0026] The stabilizing inserts 60 or 90 may be used with the
hosel 15 that is substantially or partially comprised of one or
more composite materials. For example, the stabilizing
inserts may be used to secure the hosel 15 that is substantially (or entirely) comprised of a composite material (such as the hosel shown in FIG. 1) to the golf club shaft and/or the interior portion of the golf club head 50. In addition, the stabilizing inserts 60 or 90 may be used to secure the hosel 15 that is partially comprised of a composite material and partially comprised of a metallic material to the golf club shaft 40, the interior portion of the golf club head 50, and/or to secure two portions of the hosel 15 together.

[0027] More specifically, referring to FIG. 4, the golf club head 50 provides that the hosel 15 may comprise a top portion 36, which is comprised of one or more composite materials, and a bottom portion 30, which is comprised of a metallic material. In such embodiments, the bottom portion 30 is preferably formed integrally with the club head 50 and, therefore, comprises the same material as the club head 50. The stabilizing inserts may be disposed near the interface of the top portion 36 and the bottom portion 30 of the hosel 15, thereby securing the top portion 36 thereof to the golf club shaft 40, the interior portion of the golf club head 50, and/or the bottom portion 30 of the hosel 15. Alternatively, the stabilizing insert 60 may be disposed in other locations within the top portion 36 or the bottom portion 30 of the hosel 15. Still further, the invention provides that the hosels 15 may be secured to the golf club shaft and/or the interior portion of the golf club head 50 using two or more stabilizing inserts—limiting similar to stabilizing inserts 60 and/or 90.

[0028] The stabilizing inserts 60 and 90 may be attached to the hosel 15, the golf club shaft 40, and/or the interior portion of the golf club head 50 using any suitable means, including but not limited to adhesives, such as epoxy-based adhesives, mechanical attachments, welding, and/or combinations thereof. The stabilizing inserts 60 and 90 may be comprised of a composite material, a metal, or combinations thereof. In addition to securing the hosel 15 to the golf club shaft 40 and/or the interior portion of the golf club head 50, the inserts 60 and 90 may also be used to normalize and standardize the insertion depth of the golf club shaft 40, which will further normalize and standardize (a) the kick point of the golf club shaft 40, (b) the effective lie and loft of the club head 50, and (c) the golf club shaft 40 bending characteristics.

[0029] More particularly, by controlling the insertion depth of the golf club shaft 40 within the club head 50, the length of the shaft 40 between the top of the hosel 15 and a golfer’s hands, and thereby the kick point of the golf club shaft 40, bending characteristics of the shaft. The “kick point” (also called the bend point) refers to the location along the shaft 40 at which it exhibits the greatest amount of bend when a load is applied to the tip of the golf club. The location of the “kick point” within a golf club shaft is known to affect the trajectory (or ball flight) of a golf ball following impact.

[0030] According to further embodiments, methods for lowering and/or adjusting the center of gravity of a golf club head are provided. More particularly, such methods comprise providing the heel end of a golf club head with a hosel that is at least partially comprised of a composite material, such as the composite hosels described herein. The composite hosels described herein include less mass and/or have a lower density than conventional metal or other prior art hosels. As such, the total amount of weight located near the crown portion 16 of the golf club heads 10 and 50 is reduced, thereby lowering the center of gravity of the golf club heads 10 and 50 (towards the sole portion 18 thereof). Moreover, by providing the golf club heads 10 and 50 with the composite hosels 14 and 15 described herein, golf club designers may redistribute mass to other parts of the golf club heads 10 and 50, which may be necessary to, for example, increase the total size of the golf club heads 10 and 50 or front face 12 portion thereof, while maintaining the total mass of the golf club heads 10 and 50.

[0031] FIG. 8 is a flow chart 80 of a method of lowering or adjusting a center of gravity of a golf club head. The golf club head may include a heel end, a toe end, and a front wall. The flow chart 80 may include providing the heel end of the golf club head with a hosel for receiving a golf club shaft (block 82). The hosel is at least partially comprised of a composite material. As an example, the golf club head of the flow chart 80 may be similar to the golf club head 10 (FIG. 1) and/or 50 (FIG. 4), and the hosel of the flow chart 80 may be similar to the hosel 14 (FIG. 1) and/or the hosel 15 (FIG. 4). The block 82 may include three or more subblocks. For example, the block 82 may include: (1) providing a body for the golf club head; (2) providing the hosel; and (3) coupling the hosel to the body.

[0032] The flow chart 80 can also be used for manufacturing a golf club, in which case the flow chart 80 continues with providing a golf club shaft (block 84). As an example, the golf club shaft of the flow chart 80 may be similar to the golf club shaft 40 (FIG. 1). The providing blocks in the flow chart 80, including the block 82 (and its subblocks) and the block 84, may include designing and/or manufacturing processes. Next, the flow chart 80 proceeds with coupling the golf club shaft to the hosel (block 86). The coupling blocks of the flow chart 80 (e.g., block 86 and a subblock of the block 82) may be similar to the processes and techniques described above and may include, for example, epoxying, welding, and other techniques. The coupling blocks of the block 86 and the subblock of the block 82 may also include the use of a stabilizing insert, as explained previously.

[0033] For purposes of illustration, the figures described above represent non-limiting examples of woods that may employ or otherwise comprise the hosels and methods described herein. The invention, however, is not restricted to woods and, more particularly, may be used in connection with other club heads, such as hybrid irons, irons, and putters. For example, referring to FIG. 7, the composite hosels described herein may be used in connection with an iron-type golf club head 94. As shown in FIG. 7, for example, the composite hosel 96 assists in securing the shaft 40 to the club head 94.

[0034] The many aspects and benefits of the described embodiments are apparent from the detailed description, and thus, it is intended for the following claims to cover one or more of such aspects and/or benefits of the described embodiments which fall within the scope and spirit of the invention. In addition, because numerous modifications and variations will exist, the claims should not be construed to limit the invention to the exact construction and operation illustrated and described herein. Accordingly, all suitable modifications and equivalents fall within the scope of the embodiments as claimed herein.

What is claimed is:
1. A golf club head comprising a hollow body having a heel end, a toe end, a front wall, a sole, a crown, and a hosel at the heel end, wherein the hosel is at least partially comprised of a composite material.
2. The golf club head of claim 1, wherein the hosel is substantially comprised of a composite material.
3. The golf club head of claim 1, wherein the hosel comprises a bottom portion and a top portion, wherein the bottom portion is integral with the golf club head and the top portion is substantially comprised of the composite material.

4. The golf club head of claim 3, wherein the hosel comprises a stabilizing insert disposed near an interface between the bottom and top portions of the hosel, wherein the insert assists in securing the top portion of the hosel to the bottom portion thereof.

5. The golf club head of claim 1, wherein the composite material comprises a resin with one or more types of fibers embedded therein.

6. The golf club head of claim 5, wherein the resin is a thermoset material and the fibers comprise at least one of carbon fibers, glass fibers, metal fibers, or aromatic polyamide fibers.

7. The golf club head of claim 1, wherein the composite material comprises at least one of plastics, polymers, prepreg materials, carbon fiber composites, or metal matrix composites.

8. The golf club head of claim 7, wherein the composite material is a metal matrix composite.

9. The golf club head of claim 8, wherein the metal matrix composite comprises at least one base metal and at least one resin, wherein the base metal consists essentially of aluminum, nickel, zinc, magnesium, titanium, or alloys thereof, and wherein the resin consists essentially of silicon carbide, titanium diboride, titanium carbide, aluminum oxide, silicon nitride, or combinations thereof.

10. The golf club head of claim 1, wherein the hosel comprises an exterior surface that is provided with a metal-based nanomaterial.

11. A golf club comprising:
   a golf club shaft; and
   a hollow body having a heel end, a toe end, a front wall, a sole, and a crown, wherein the heel end of the crown comprises a hosel for receiving the golf club shaft, wherein the hosel is at least partially comprised of a composite material.

12. The golf club of claim 11, wherein the hosel is substantially comprised of the composite material.

13. The golf club of claim 11, wherein the hosel comprises a bottom portion and a top portion, wherein the bottom portion is integral with the golf club head and the top portion is substantially comprised of the composite material.

14. The golf club of claim 13, wherein the hosel comprises a stabilizing insert disposed near an interface between the bottom and top portions of the hosel, wherein the insert assists in securing the top portion of the hosel to the bottom portion thereof.

15. The golf club of claim 11, wherein the composite material comprises a resin with one or more types of fibers embedded therein.

16. The golf club of claim 11, wherein the resin is a thermoset material and the fibers comprise at least one of carbon fibers, glass fibers, metal fibers, or aromatic polyamide fibers.

17. The golf club of claim 11, wherein the composite material comprises at least one of plastics, polymers, prepreg materials, carbon fiber composites, or metal matrix composites.

18. The golf club of claim 17, wherein the composite material is a metal matrix composite.

19. The golf club of claim 18, wherein the metal matrix composite comprises at least one base metal and at least one resin, wherein the base metal consists essentially of aluminum, nickel, zinc, magnesium, titanium, or alloys thereof, and wherein the resin consists essentially of silicon carbide, titanium diboride, titanium carbide, aluminum oxide, silicon nitride, or combinations thereof.

20. The golf club of claim 17, wherein the hosel comprises an exterior surface that is provided with a metal-based nanomaterial.

21. A hosel of a golf club head, wherein the hosel is at least partially comprised of a composite material.

22. The hosel of claim 21, wherein the hosel is substantially comprised of the composite material.

23. The hosel of claim 21, wherein the composite material is a metal matrix composite.

24. The hosel of claim 23, wherein the metal matrix composite comprises at least one base metal and at least one resin, wherein the base metal consists essentially of aluminum, nickel, zinc, magnesium, titanium, or alloys thereof, and wherein the resin consists essentially of silicon carbide, titanium diboride, titanium carbide, aluminum oxide, silicon nitride, or combinations thereof.

25. The hosel of claim 21, wherein the hosel comprises an exterior surface that is provided with a metal-based nanomaterial.

26. A method for manufacturing a golf club head having a heel end, a toe end, and a front wall, the method comprising providing the heel end of the golf club head with a hosel for receiving a golf club shaft, wherein the hosel is at least partially comprised of a composite material.

27. The method of claim 26, wherein providing the heel end of the golf club head further comprises providing the composite material to be a metal matrix composite.

28. The method of claim 27, wherein providing the heel end of the golf club head further comprises providing the metal matrix composite to comprise at least one base metal and at least one resin, wherein the base metal consists essentially of aluminum, nickel, zinc, magnesium, titanium, or alloys thereof, and wherein the resin consists essentially of silicon carbide, titanium diboride, titanium carbide, aluminum oxide, silicon nitride, or combinations thereof.

29. The method of claim 26, wherein providing the heel end of the golf club head further comprises providing the hosel to comprise an exterior surface that is provided with a metal-based nanomaterial.

30. The method of claim 26, wherein providing the heel end of the golf club head further comprises providing the hosel to be substantially comprised of a composite material.

31. The method of claim 26, wherein providing the heel end of the golf club head further comprises providing the hosel to comprise a bottom portion and a top portion, wherein the bottom portion is formed integrally with the golf club head and the top portion is substantially comprised of a composite material.