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(54) **MULTIPLE MATERIAL DRIVER-TYPE GOLF CLUB HEAD**

(75) Inventors: **PATRICK DAWSON**, SAN DIEGO, CA (US); **BRADLEY C. RICE**, CARLSBAD, CA (US)

Correspondence Address:
CALLAWAY GOLF C0MPANY
2180 RUTHERFORD ROAD
CARLSBAD, CA 92008-7328 (US)

(73) Assignee: **CALLAWAY GOLF COMPANY**, CARLSBAD, CA (US)

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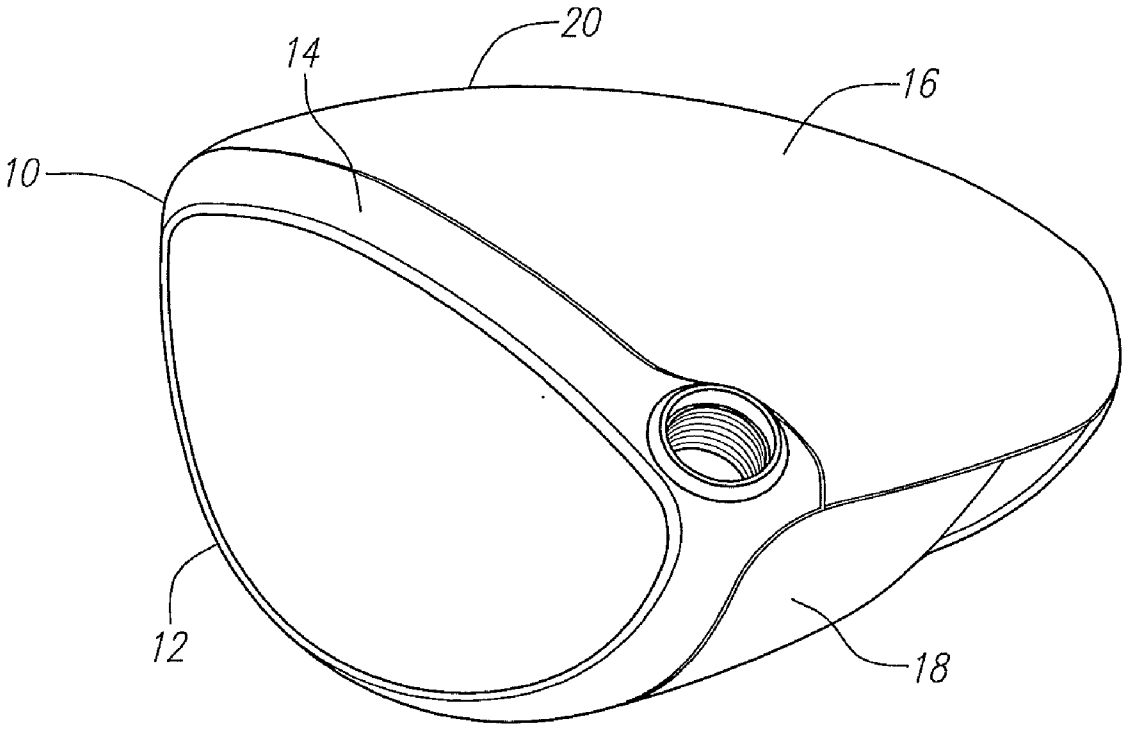
(57) **ABSTRACT**

A driver-type golf club head having a composite crown is disclosed herein. The driver-type golf club head includes a subassembly including a cast face component and a stamped sole component, and a compression molded crown component which is bonded to the subassembly. Each of the subassembly and the crown component has a non-overlapping bonding flange that bonds with an interior surface.



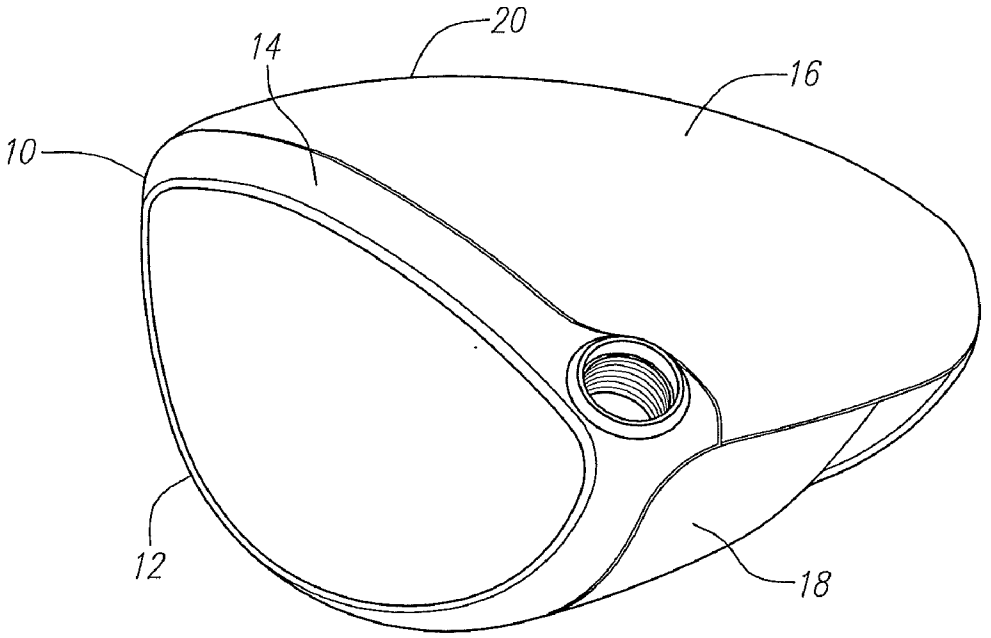


FIG. 1

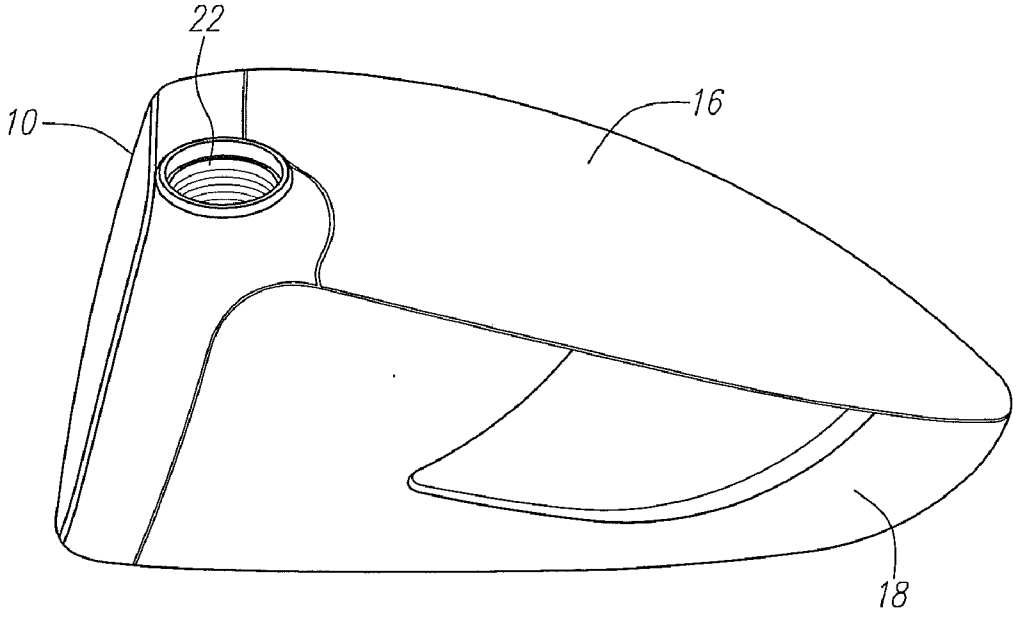


FIG. 2

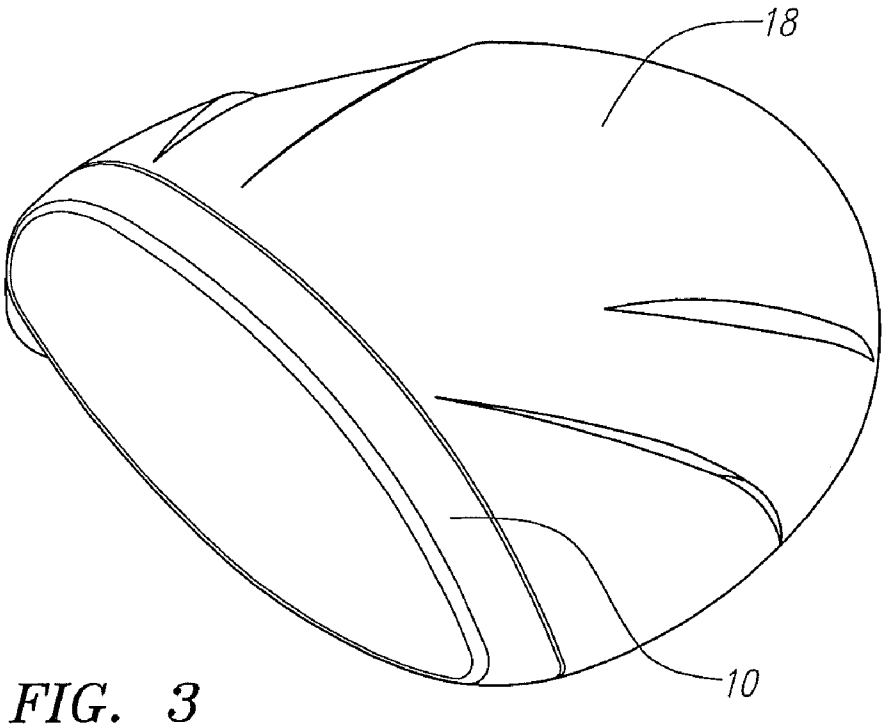


FIG. 3

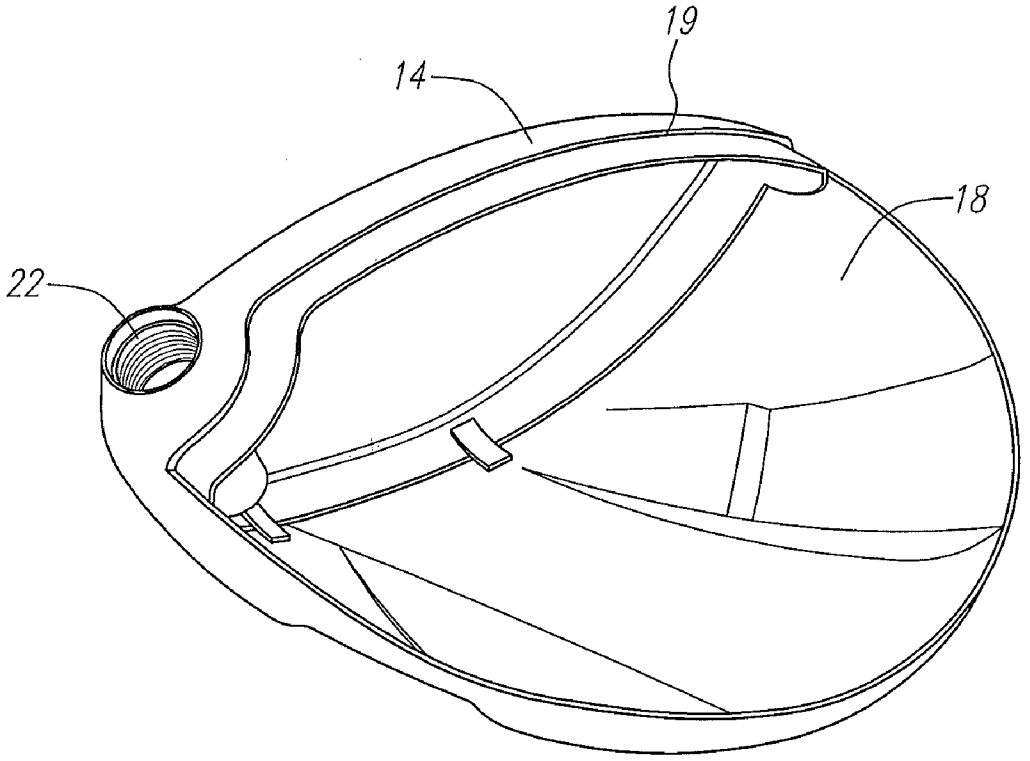


FIG. 4

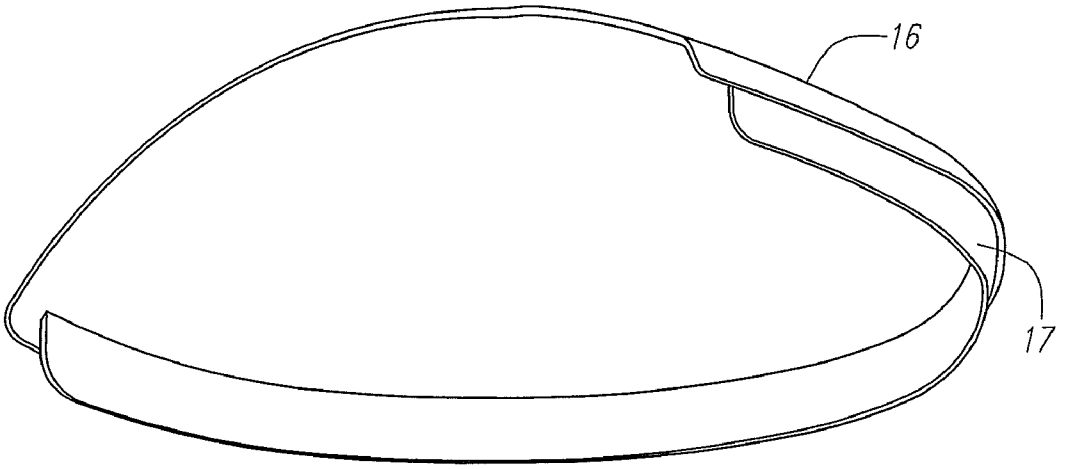


FIG. 5

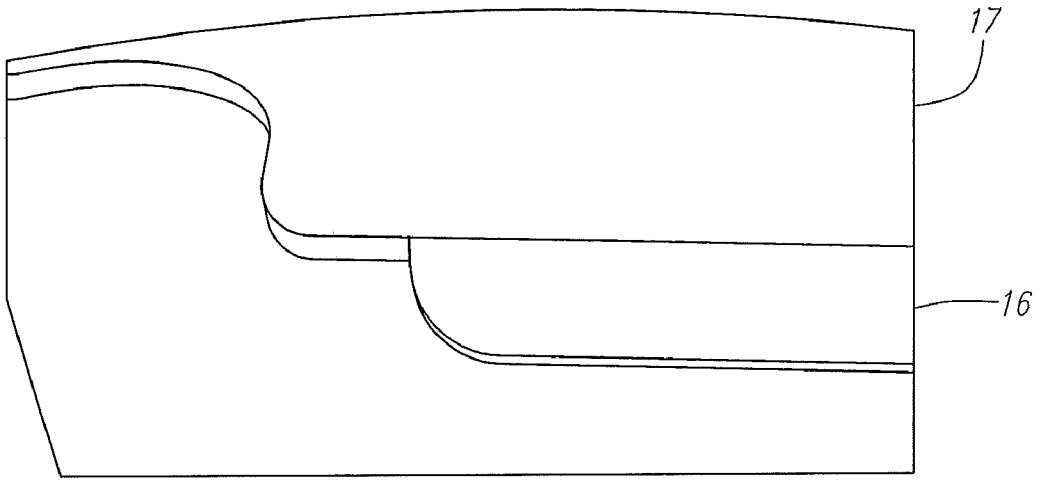


FIG. 6

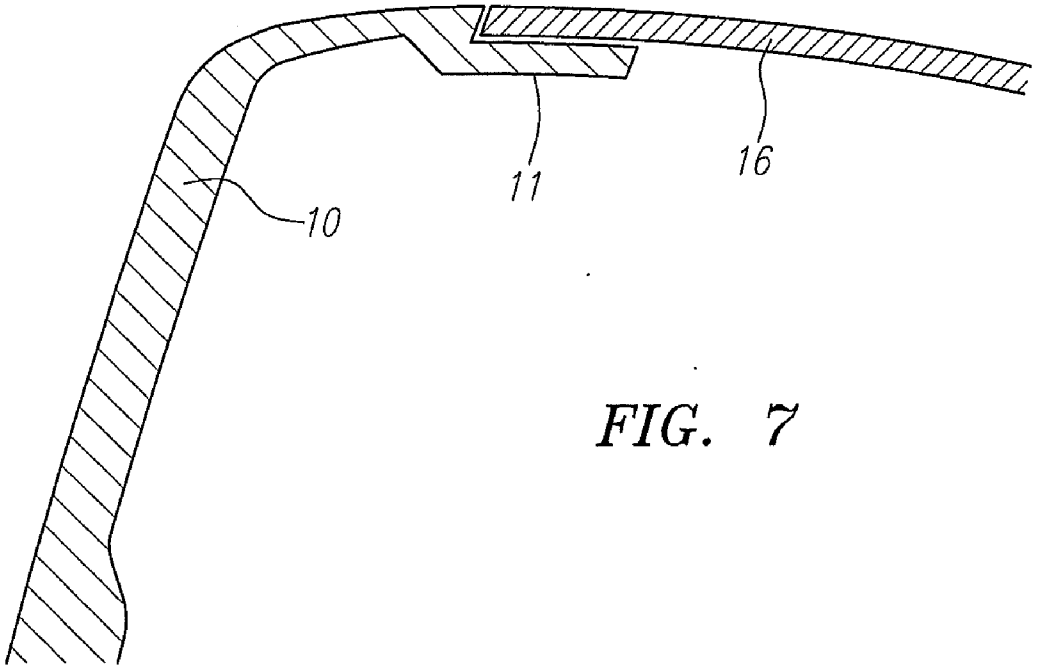


FIG. 7

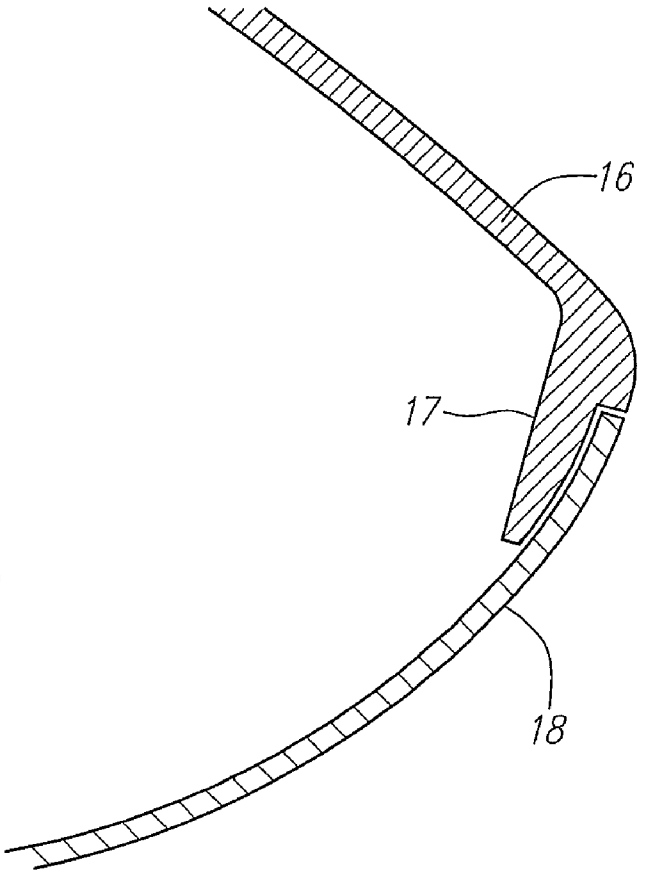


FIG. 8

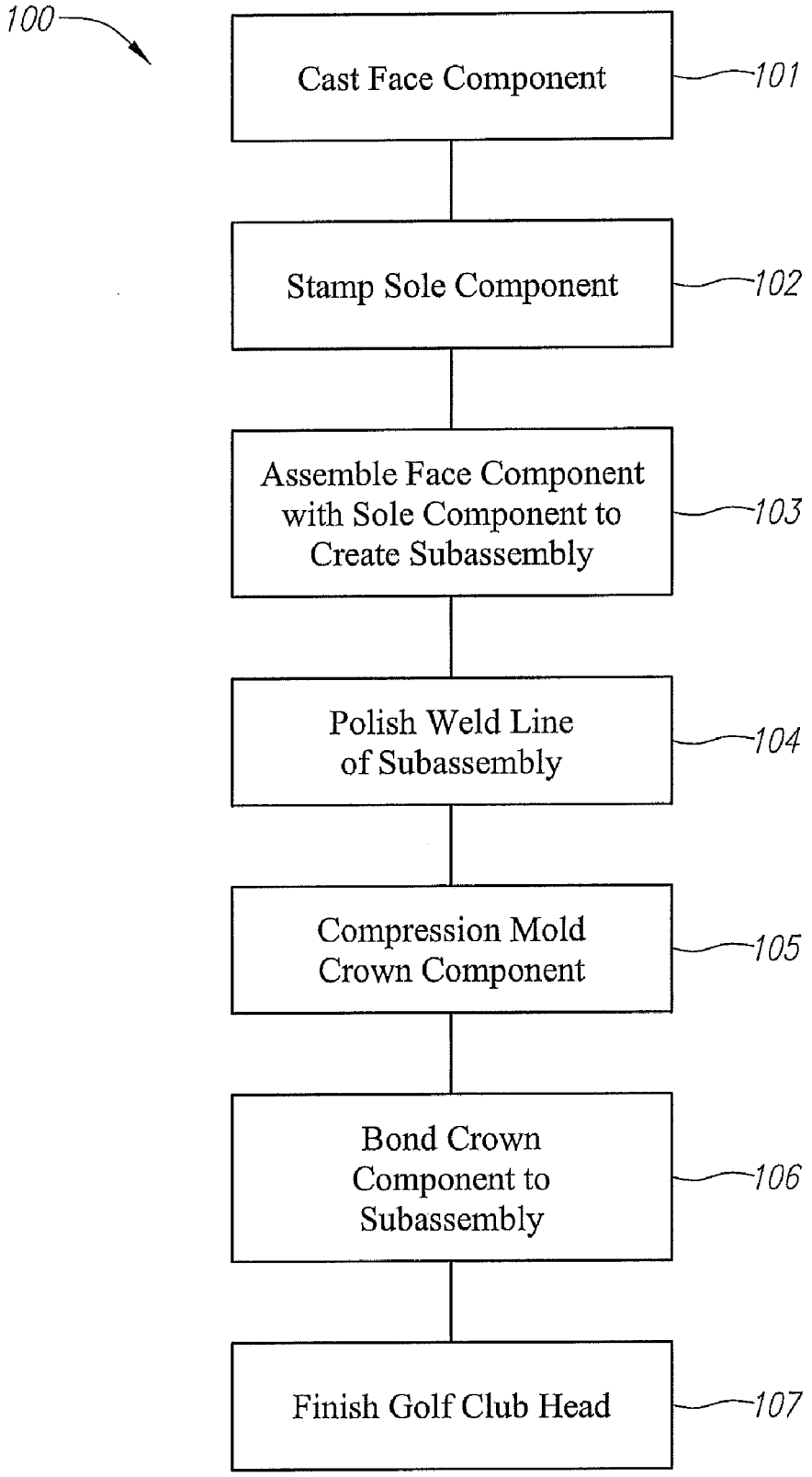

100
Cast Face Component
101
Stamp Sole Component
102
Assemble Face Component with Sole Component to Create Subassembly
103
Polish Weld Line of Subassembly
104
Compression Mold Crown Component
105
Bond Crown Component to Subassembly
106
Finish Golf Club Head
107

FIG. 9

MULTIPLE MATERIAL DRIVER-TYPE GOLF CLUB HEAD

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] The present application claims priority to U.S. Provisional Patent Application No. 61/119,997, filed on Dec. 4, 2008.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

BACKGROUND OF THE INVENTION

[0003] 1. Field of the Invention

[0004] The present invention relates to a method for a multiple material driver-type golf club head.

[0005] 2. Description of the Related Art

[0006] The prior art discloses several methods for forming a golf club head.

[0007] One method is full casting which involves casting the entire golf club head, usually with a face pull tool. Duquette et al., U.S. Pat. No. 6,978,976 for a Magnetized Core With Pneumatic Release System For Creating A Wax Mold For A Golf Club Head describes certain aspects of the full casting method. Then a face insert is welded to the golf club head.

[0008] Another method is using a full casting method, using a face pull tool and then cutting a crown opening. A graphite crown is then bonded to cover the opening thereby forming a multiple material golf club head.

[0009] Yet another method is forming an entire golf club head from multiple pieces. In this method, several pieces (crown, sole, face and hosel) are welded together to form a precursor golf club head. Then, an opening is cut in the crown creating an opening. A graphite crown is then bonded to cover the opening thereby forming a multiple material golf club head.

[0010] Yet another method is a high performance multiple piece golf club head. This forming method involves making a multiple piece golf club head. The crown material needs to be of high quality expensive titanium so prior to welding the crown component to the sole component, the crown is chemically milled to the limits of drop tower durability. The chemical milling process is necessary to render the crown component to be competitive with graphite strength to weight ratio.

[0011] The current construction includes tacking a face component to sole (called face subassembly). Manually trim and tack crown to face subassembly. Fully weld face, crown, and sole (21 inches of weld). Grind weld and polish head.

[0012] Each of these prior art methods have drawbacks. Both multiple piece graphite crown and full casting require the manufacturer to produce a complete golf club head. The crown opening is then cut and replaced with a graphite crown. This is obviously wasteful because of the need to fabricate an entire golf club head and then removing a portion. The high performance multiple piece golf club head remedies this wastefulness by utilizing an expensive titanium material and which adds more cost to render the crown component weight competitive to graphite crowns.

BRIEF SUMMARY OF THE INVENTION

[0013] The present invention seeks to reduce the waste from current blacktop manufacturing methods while achieving similar or better performance than the high performance multiple piece golf club heads at a price point that is similar to conventional multiple piece golf club heads.

[0014] The process includes a face component and a stamped metal sole component preferably welded together without a crown component. The face component and the sole component are preferably welded together with a high tolerance. The face components and sole components are preferably manufactured past "desired points" and trimmed back to match 'net' CAD designs. The face component and the sole component weld line is then polished. This weld line is approximately six inches in length for a 460 cubic centimeter volume driver-type golf club head. In prior art multiple piece golf club head construction methods the weld line is typically twenty-one inches in length or more for a 460 cubic centimeter volume driver-type golf club head.

[0015] Thus, the present invention results in a significant reduction in finishing costs. More specifically, the finishing process for weld polishing requires expensive polishing belts. There are approximately five different belts ranging from very coarse to very fine. Each belt can usually polish around four to five golf club heads.

[0016] In the present invention a crown is bonded to the golf club head subassembly.

[0017] The resulting weight of the crown in carbon composite ranges from 15 grams to 35 grams, more preferably from 20 grams to 30 grams and is most preferably 24 grams. The weight of the crown in the high performance multi-piece of the prior art is approximately 31 grams. By using the method of construction of the present invention, a manufacturer obtains at least an additional seven grams of discretionary weight that can be used in other sections of the golf club head to improve mass properties such as moment of inertias (Izz, Iyy and Izz) through the center of gravity of the golf club head, durability (thicker face regions or other regions open to stress during loading), and lower positioning of the center of gravity by shifting the mass of the golf club head.

[0018] The process for forming a driver-type golf club head includes welding the face component to the sole component to create a golf club head subassembly. This comprises only six inches of welding as opposed to the prior art twenty-one inches of welding. The golf club head subassembly is ground and polished, specifically the six inches of weld. The crown component is glued to the golf club head subassembly to create an unfinished golf club head. The unfinished golf club head is cleaned and finished.

[0019] This present invention is unique from other composite crown golf club heads or high performance multi-piece construction golf club heads because material is not wasted beyond what is necessary to form the golf club head. In traditional composite crown golf club heads, the whole golf club head is formed (either by casting or welding) and then an opening is cut from this whole golf club head for the composite crown. In the high performance multi-piece construction golf club heads, the crown component material is very expensive relative to conventional stamped or cast materials, and this high performance multi-piece construction golf club head crown component material needs to be chemically

milled to achieve its performance. The cutting and chemical milling wastes material and adds cost to achieve performance. The method of the present invention achieves the same performance without adding additional costs.

[0020] Having briefly described the present invention, the above and further objects, features and advantages thereof will be recognized by those skilled in the pertinent art from the following detailed description of the invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0021] FIG. **1** is a perspective view of an unfinished golf club head.

[0022] FIG. **2** is a side view of an unfinished golf club head.

[0023] FIG. **3** is a bottom perspective view of an unfinished golf club head illustrating the weld line to be polished.

[0024] FIG. **4** is an isolated top perspective view of an interior of a subassembly of a golf club head to illustrate the bonding flange of a face component.

[0025] FIG. **5** is an isolated front perspective view of a crown component of a golf club head illustrating the bonding flange of the crown component.

[0026] FIG. **6** is an enlarged isolated view of a crown component of FIG. **5** illustrating the bonding flange and joint for bonding with the subassembly.

[0027] FIG. **7** is a cross-sectional view of a bonding joint of a golf club head illustrating a bonding flange of the face component and the crown component.

[0028] FIG. **8** is a cross-sectional view of a bonding joint of a golf club head illustrating a bonding flange of a crown component and a sole component.

[0029] FIG. **9** is a flow chart of the method of forming a driver-type golf club head of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0030] The driver-type golf club head is formed by a process that preferably includes the manufacture of a cast face component **10** and a stamped metal sole component **18**. The face component **10** and the sole component **18** are assembled together in a welding fixture. The welding fixture locates on the inside of the face component **10** and inside of the sole component **18**. The welding fixture also locates on some sections of the outside surfaces of the face component **10** and the sole component **18**. The crown component **16** is preferably formed from a carbon composite. Once the face component **10** and sole component **18** are welded into a golf club head subassembly, the golf club head subassembly is polished and prepared for adhesive bonding. The composite crown is bonded to the golf club head subassembly using an adhesive. After the adhesive cures, the unfinished golf club head is cleaned and finished (typically painting).

[0031] Preferably the face component **10** is cast from titanium 6-4 alloy. The face component **10** has a bonding flange **11** along the top of the face component **10** extending about 0.200 inch below the OML parting line. Preferably the sole component **18** is a stamped titanium alloy. The thickness of the sheet material for the sole component **18** is determined by performance needs and manufacturability. The sole component **18** is trimmed. Preferably the crown component **16** is formed by compression molding a sheet molding compound. The crown component **16** has a bonding flange **17** between itself and the sole **18**. Because of this design feature, the compression molded manufacturing technique is a preferred manufacturing technique. Alternative forming techniques include continuous fiber laminate construction and plastic injection molding.

[0032] As shown in FIGS. **1-8**, a golf club head **20** is composed of a face component **10** with a bonding flange **11**, a sole component **18** and a crown component **16** with a bonding flange **17** in order to construct the golf club head **20** according to a method of the present invention.

[0033] In one example, the face component section **10** comprises a striking plate section **12** and a return section **14** extending rearward from a perimeter of the striking plate section **12**. The return section **14** has a bonding flange **19** formed as an undercut extending rearward approximately 0.200 inch from a top rearward edge of the return section **14**. The subassembly is composed of a titanium alloy material and comprises at least 70% of the mass of the golf club head **20**.

[0034] The crown component **16** is composed of a compression molded graphite material. The crown component **16** has a top section and a bonding flange **17** substantially perpendicular to the top section. The bonding forms an undercut relative to an edge of the top section.

[0035] The crown component **16** is adhesively bonded to the subassembly with an interior surface of a front portion of the top section of the crown component **16** bonded to an exterior surface of the bonding flange **19** of the return section **14** of the face component **10** of the subassembly. An exterior surface of the bonding flange **17** of the crown component **16** is bonded to an interior surface of a portion of the sole component **18** of the subassembly.

[0036] In one embodiment, the golf club head **20** has a loft angle of at least thirteen degrees. In a preferred embodiment, the fairway-wood type golf club head has a volume of 460 cubic centimeters. The subassembly may further comprise a hosel **22**, which may be interior or exterior.

[0037] In another example, the subassembly comprises a sole component **18** and a face component **10** with a bonding flange **19** formed as an undercut extending rearward. The crown component **16** has a top section and a bonding flange **17** substantially perpendicular to the top section. The bonding is formed as an undercut relative to an edge of the top section.

[0038] The crown component **16** is bonded to the subassembly with an interior surface of a front portion of the top section of the crown component **16** bonded to an exterior surface of the bonding flange **19** of the face component **10** of the subassembly. Also, the exterior surface of the bonding flange **17** of the crown component **16** is bonded to an interior surface of a portion of the sole component **18** of the subassembly. The subassembly may be composed of a titanium alloy material or a stainless steel material. In one embodiment, the crown component is composed of a non-metal material.

[0039] A method for forming a golf club head **20** is illustrated in FIG. **9** and generally designated **100**. At block **101**, a face component **10** is cast. At block **102**, a sole component **18** is stamped from metal, preferably titanium. At block **103**, the face component **10** and sole component **18** are assembled, preferably through welding, into a subassembly. At block **104**, the weld line of the subassembly is polished. At block **105**, a crown component **16** is compression molded from a graphite compound. At block **106**, the crown component **16** is adhesively bonded to the subassembly. At block **107**, the golf club head **20** is finished.

[0040] Variable face thickness patterns of the striking plate insert are disclosed in U.S. Pat. No. 6,471,603, for a Contoured Golf Club Face, U.S. Pat. No. 6,368,234 for a Golf Club Striking Plate Having Elliptical Regions Of Thickness, U.S. Pat. No. 6,398,666 for a Golf Club Striking Plate With Variable Thickness, U.S. Pat. No. 7,448,960, for a Golf Club Head With Face Thickness which are all owned by Callaway Golf Company and which pertinent parts related to the face pattern are hereby incorporated by reference.

[0041] The present invention is directed at a golf club head that has a high coefficient of restitution thereby enabling for greater distance of a golf ball hit with the golf club head of the present invention. The coefficient of restitution (also referred to herein as "COR") is determined by the following equation:

$$e = \frac{v_2 - v_1}{U_1 - U_2}$$

[0042] wherein U_1 is the club head velocity prior to impact; U_2 is the golf ball velocity prior to impact which is zero; v_1 is the club head velocity just after separation of the golf ball from the face of the club head; v_2 is the golf ball velocity just after separation of the golf ball from the face of the club head; and e is the coefficient of restitution between the golf ball and the club face.

[0043] The values of e are limited between zero and 1.0 for systems with no energy addition. The coefficient of restitution, e, for a material such as a soft clay or putty would be near zero, while for a perfectly elastic material, where no energy is lost as a result of deformation, the value of e would be 1.0. The present invention provides a club head having a coefficient of restitution ranging from 0.81 to 0.94, as measured under conventional test conditions.

[0044] The mass of the club head of the present invention ranges from 165 grams to 250 grams, preferably ranges from 175 grams to 230 grams, and most preferably from 190 grams to 205 grams. Preferably, the subassembly preferably has a mass ranging from 140 grams to 200 grams, more preferably ranging from 150 grams to 180 grams, yet more preferably from 155 grams to 166 grams, and most preferably 161 grams. The crown component has a mass preferably ranging from 4 grams to 20 grams, more preferably from 5 grams to 15 grams, and most preferably 7 grams.

[0045] The golf club head preferably has a volume that ranges from 290 cubic centimeters to 600 cubic centimeters, and more preferably ranges from 330 cubic centimeters to 510 cubic centimeters, even more preferably 350 cubic centimeters to 495 cubic centimeters, and most preferably 415 cubic centimeters or 460 cubic centimeters.

[0046] The axes of inertia are designated X, Y and Z. The X axis extends from the striking plate insert through the center of gravity, CG, and to the rear of the golf club head. The Y axis extends from the toe end of the golf club head through the center of gravity, CG, and to the heel end **66** of the golf club head. The Z axis extends from the crown section through the center of gravity, CG, and to the sole section.

[0047] As defined in *Golf Club Design, Fitting, Alteration & Repair,* 4th Edition, by Ralph Maltby, the center of gravity, or center of mass, of the golf club head is a point inside of the club head determined by the vertical intersection of two or more points where the club head balances when suspended. A more thorough explanation of this definition of the center of gravity is provided in Golf Club Design, Fitting, Alteration & Repair.

[0048] The center of gravity and the moment of inertia of a golf club head are preferably measured using a test frame (X^T, Y^T, Z^T), and then transformed to a head frame (X^H, Y^H, Z^H). The center of gravity of a golf club head may be obtained using a center of gravity table having two weight scales thereon, as disclosed in U.S. Pat. No. 6,607,452, entitled High Moment Of Inertia Composite Golf Club, and hereby incorporated by reference in its entirety.

[0049] In general, the moment of inertia, Izz, about the Z axis for the golf club head preferably ranges from 2800 g-cm^2 to 5000 g-cm^2, preferably from 3000 g-cm^2 to 4500 g-cm^2, and most preferably from 3750 g-cm^2 to 4250 g-cm^2. The moment of inertia, Iyy, about the Y axis for the golf club head preferably ranges from 1500 g-cm^2 to 4000 g-cm^2, preferably from 2000 g-cm^2 to 3500 g-cm^2, and most preferably from 2400 g-cm^2 to 2900 g-cm^2. The moment of inertia, Ixx, about the X axis for the golf club head **40** preferably ranges from 1500 g-cm^2 to 4000 g-cm^2, preferably from 2000 g-cm^2 to 3500 g-cm^2, and most preferably from 2500 g-cm^2 to 3000 g-cm^2.

[0050] In general, the golf club head has products of inertia such as disclosed in U.S. Pat. No. 6,425,832, and is hereby incorporated by reference in its entirety. Preferably, each of the products of inertia, Ixy, Ixz and Iyz, of the golf club head **40** have an absolute value less than 100 grams-centimeter squared. Alternatively, the golf club head **40** has a at least one or two products of inertia, Ixy, Ixz and Iyz, with an absolute value less than 100 grams-centimeter squared.

[0051] The width, W, preferably ranges from 4.0 inches to 5.5 inches, and most preferably from 4.75 inches to 5.0 inches. The height, H, preferably ranges from 2.0 inches to 3.0 inches, and most preferably ranges from 2.40 inches to 2.65 inches. The length, L, preferably ranges from 3.5 inches to 4.5 inches, and most preferably from 4.0 inches to 4.25 inches. The golf club head **40** may have an aspect ratio such as disclosed in U.S. Pat. No. 6,338,683 for a Striking Plate For A Golf Club Head, assigned to Callaway Golf Company, and which pertinent parts are hereby incorporated by reference.

[0052] From the foregoing it is believed that those skilled in the pertinent art will recognize the meritorious advancement of this invention and will readily understand that while the present invention has been described in association with a preferred embodiment thereof, and other embodiments illustrated in the accompanying drawings, numerous changes, modifications and substitutions of equivalents may be made therein without departing from the spirit and scope of this invention which is intended to be unlimited by the foregoing except as may appear in the following appended claims. Therefore, the embodiments of the invention in which an exclusive property or privilege is claimed are defined in the following appended claims.

We claim as our invention the following:

1. A driver-type golf club head comprising:

a subassembly comprising a face component and a sole component, the face component section comprising a striking plate section and a return section extending rearward from a perimeter of the striking plate section, the return section having a bonding flange formed as an undercut extending rearward approximately 0.200 inch from a top rearward edge of the return section, the sub-

assembly composed of a titanium alloy material and comprising at least 70% of the mass of the golf club head;

a crown component composed of a compression molded graphite material, the crown component having top section and a bonding flanged substantially perpendicular to the top section, the bonding formed as an undercut relative to an edge of the top section;

wherein the crown component is adhesively bonded to the subassembly with an interior surface of a front portion of the top section of the crown component bonded to an exterior surface of the bonding flange of the return section of the face component of the subassembly and an exterior surface of the bonding flange of the crown component bonded to an interior surface of a portion of the sole component of the subassembly.

2. The driver-type golf club head according to claim **1** wherein the golf club head has a loft angle of at least thirteen degrees.

3. The driver-type golf club head according to claim **1** wherein the fairway-wood type golf club head has a volume of 460 cubic centimeters.

4. The driver-type golf club head according to claim **1** wherein the subassembly further comprises a hosel.

5. The driver-type golf club head according to claim **4** wherein the hosel is an exterior hosel.

6. The driver-type golf club head according to claim **4** wherein the hosel is an interior hosel.

7. A driver-type golf club head comprising:

a subassembly having a sole component and a face component with a bonding flange formed as an undercut extending rearward;

a crown component having top section and a bonding flanged substantially perpendicular to the top section, the bonding formed as an undercut relative to an edge of the top section;

wherein the crown component is bonded to the subassembly with an interior surface of a front portion of the top section of the crown component bonded to an exterior surface of the bonding flange of the face component of the subassembly and an exterior surface of the bonding flange of the crown component bonded to an interior surface of a portion of the sole component of the subassembly.

8. The driver-type golf club head according to claim **7** wherein the subassembly is composed of a titanium alloy material.

9. The driver-type golf club head according to claim **7** wherein the subassembly is composed of a stainless steel material.

10. The driver-type golf club head according to claim **7** wherein the crown component is composed of a non-metal material.

* * * * *