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(54) NANOCRYSTALLINE PLATED PUTTER HOSEL

(75) Inventors: **Augustin W. Rollinson**, Carlsbad, CA (US); **Alan Hocknell**, Carlsbad, CA (US)

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

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

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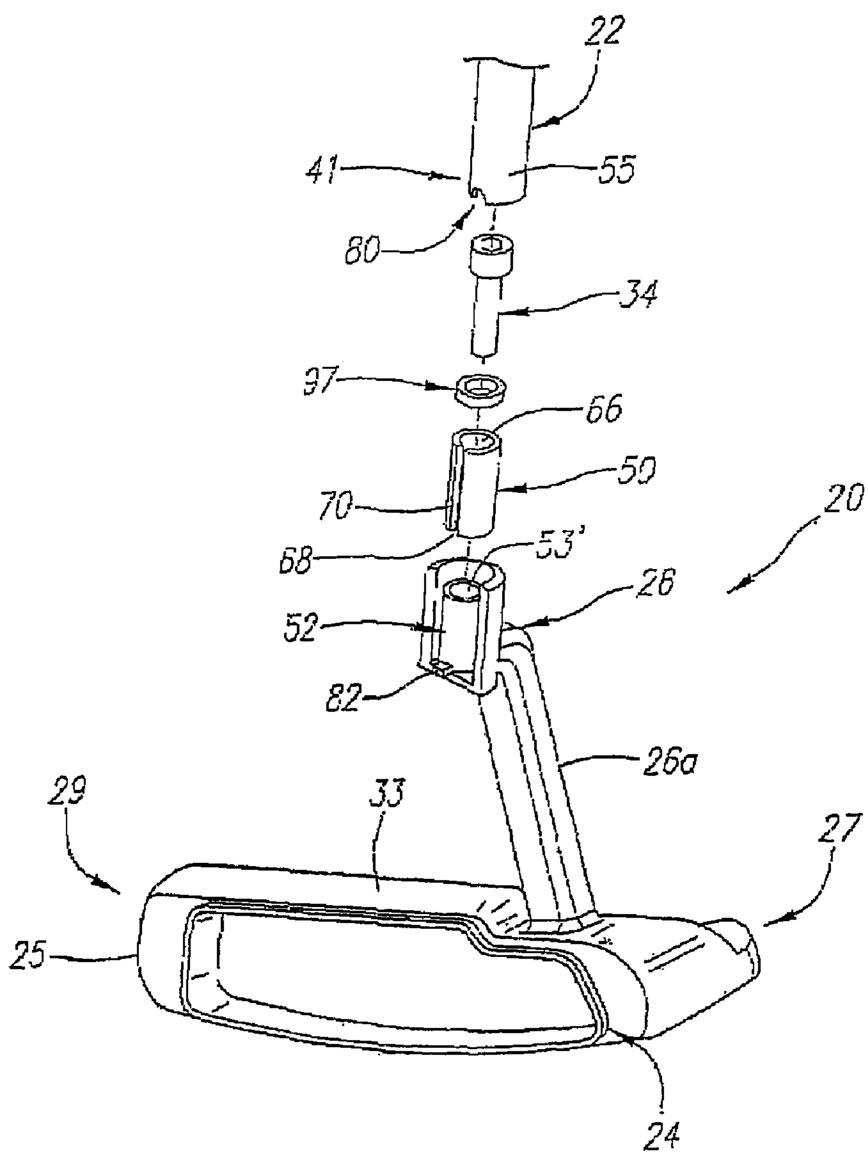
(52) U.S. Cl. **473/313**; 473/282; 473/349

(57) **ABSTRACT**

A hosel for a golf club composed of a low-mass material coated with a nano-metal is disclosed herein. Also disclosed herein is a golf club having a hosel composed of a low-mass material coated with a nano-metal. The nano-metal is preferably composed of a nickel-alloy material. The low-mass material is preferably a nylon material.



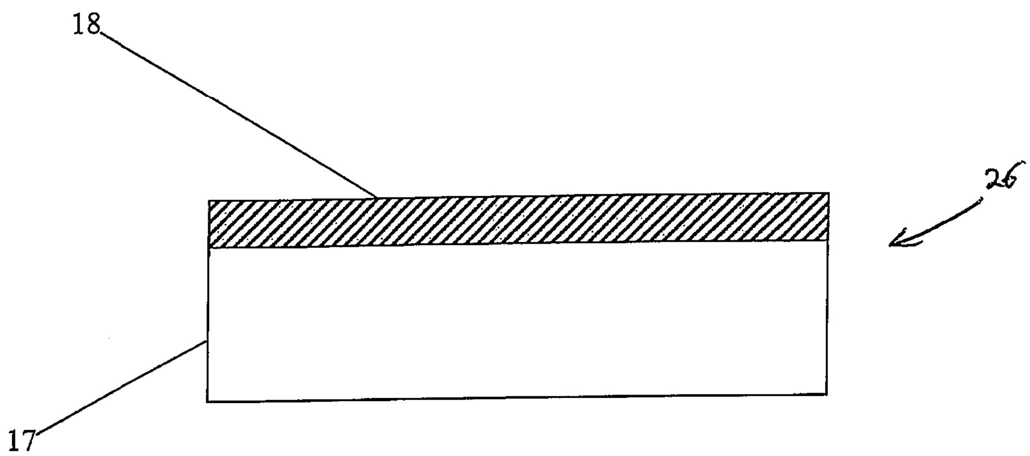


FIG. 1

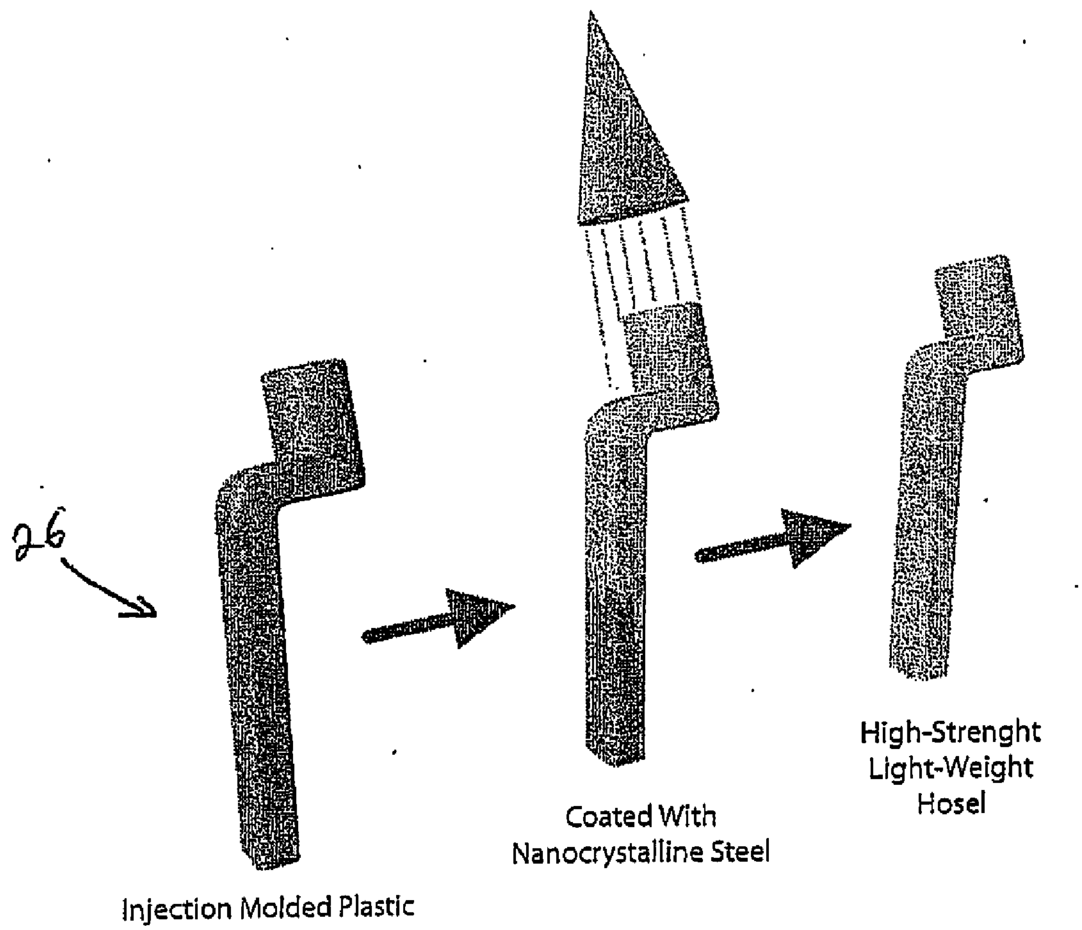

26
Injection Molded Plastic
Coated With
Nanocrystalline Steel
High-Strenght
Light-Weight
Hosel

FIG. 2

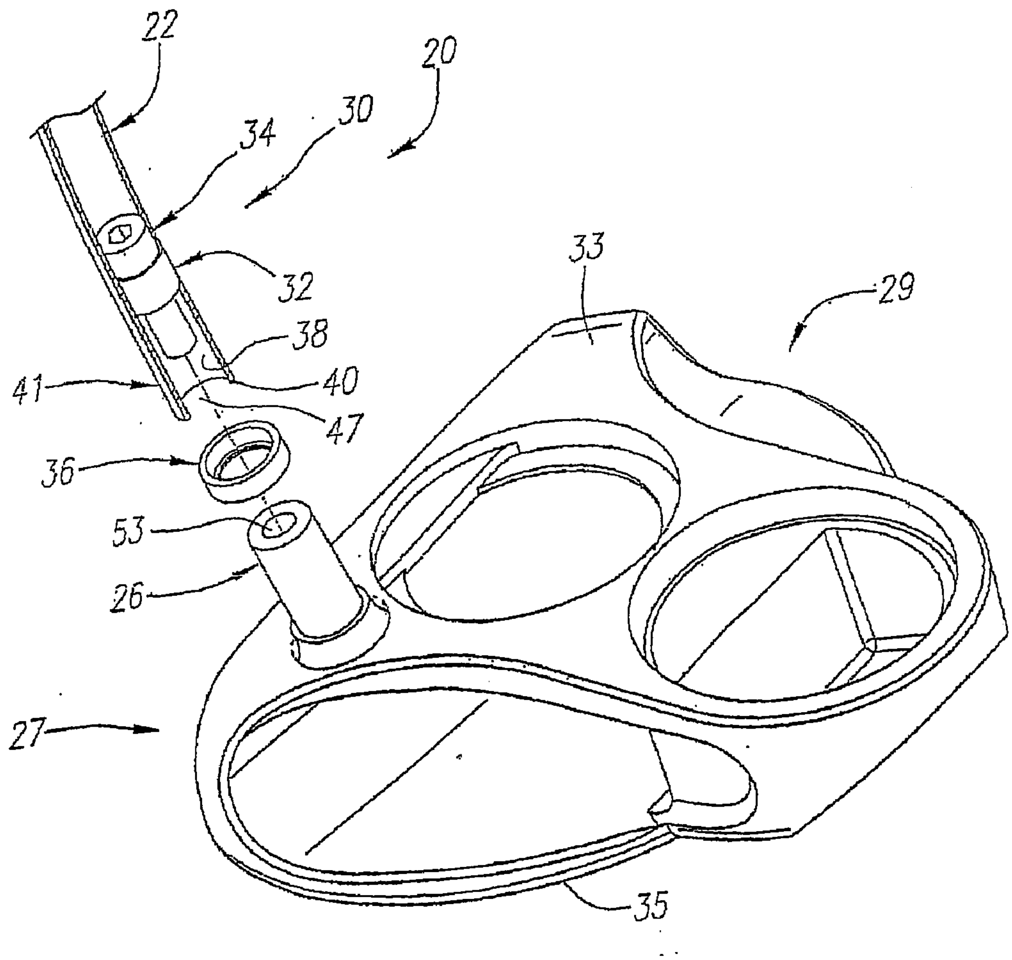


FIG. 3

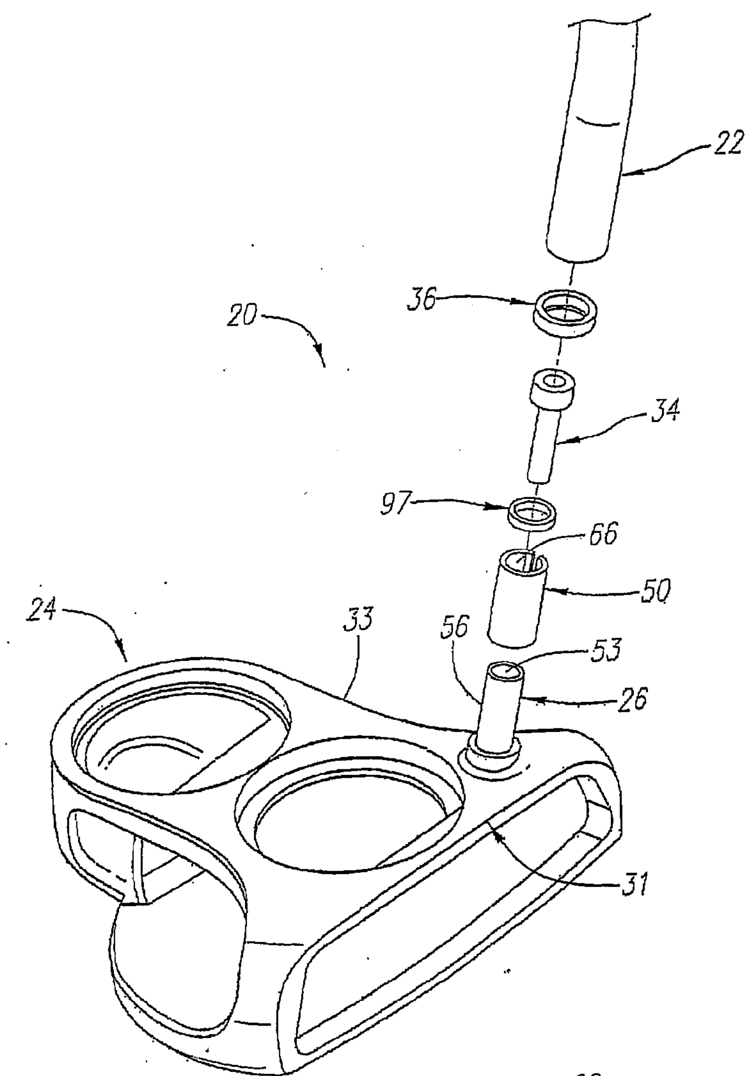


FIG. 4

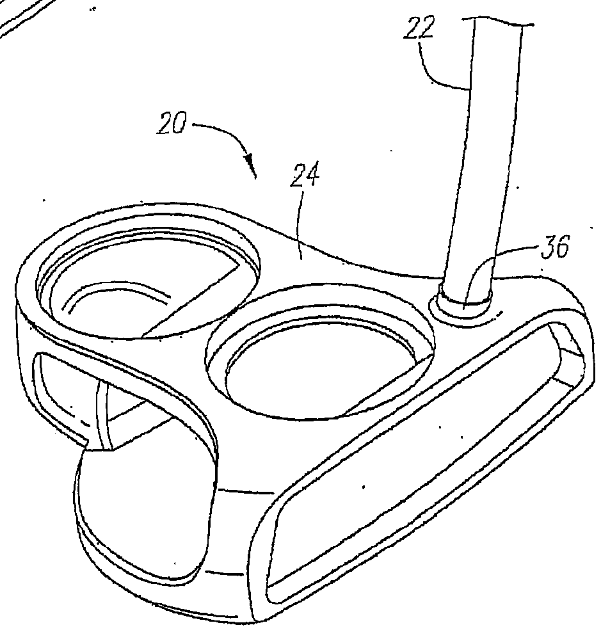


FIG. 5

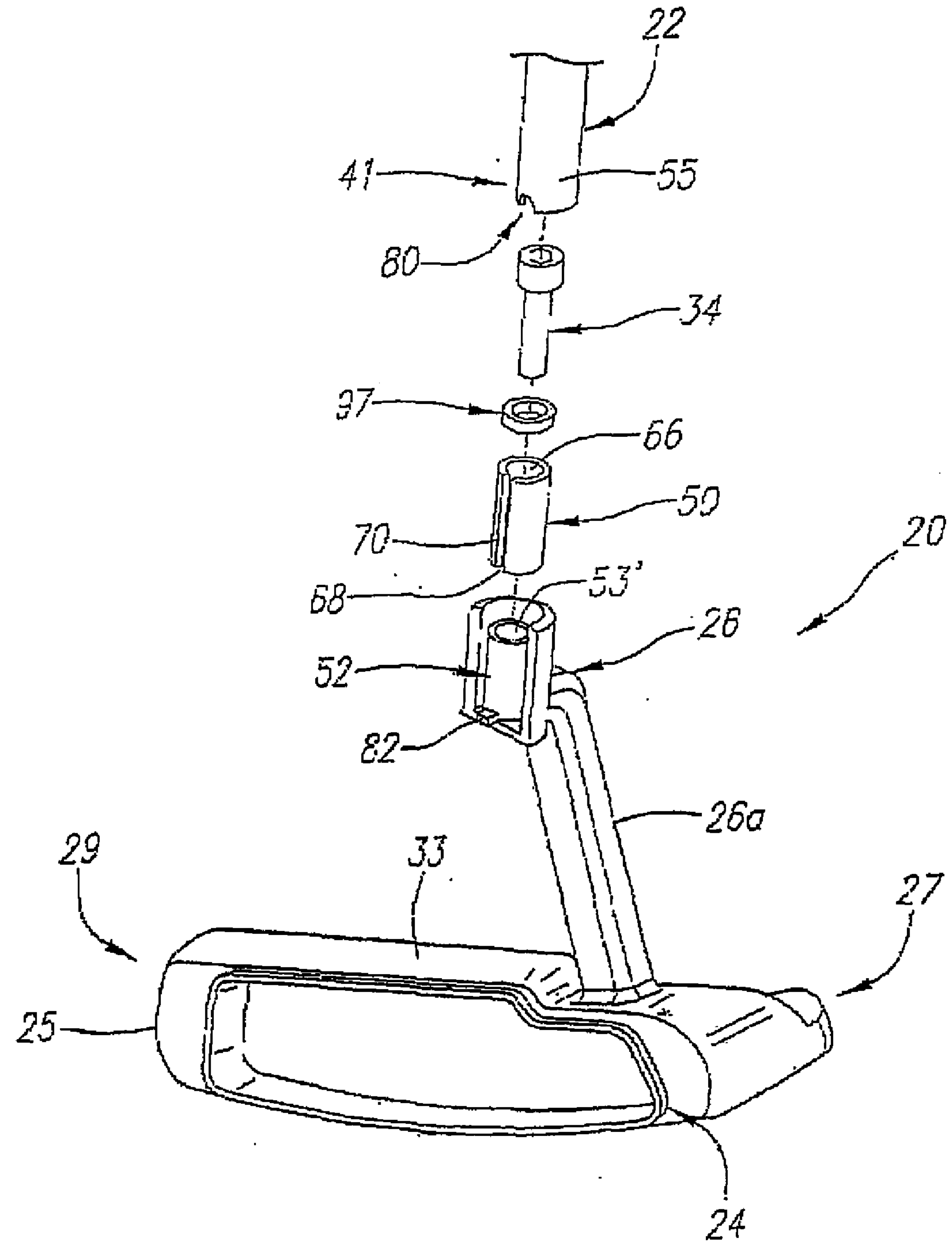


FIG. 6

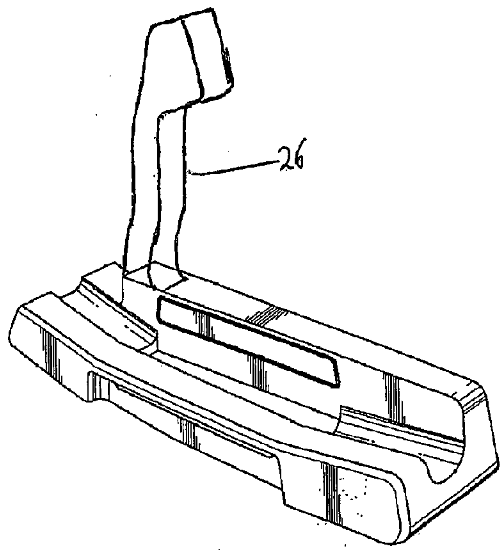


FIG. 7

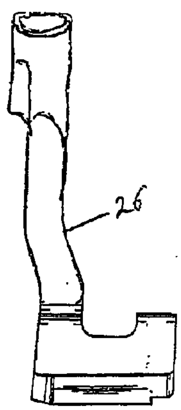


FIG. 10

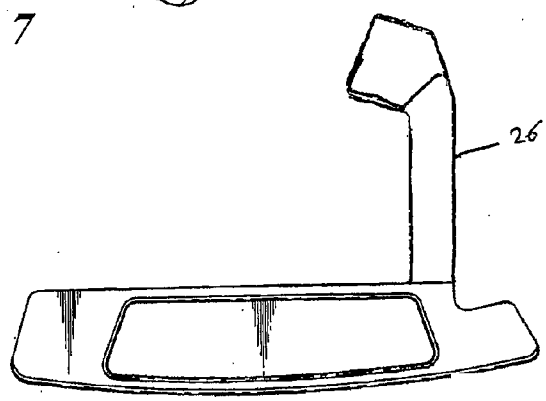


FIG. 8

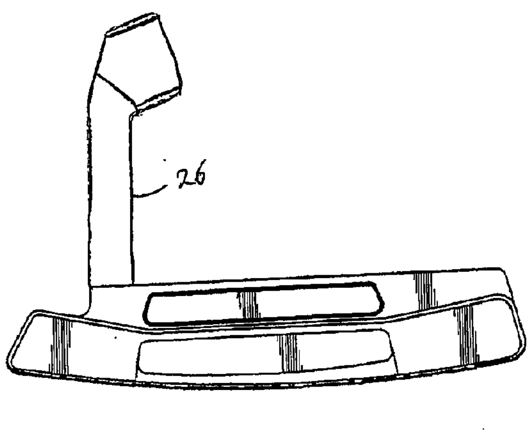


FIG. 9

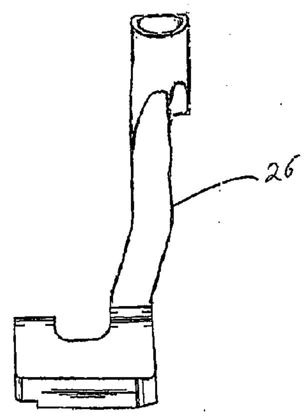


FIG. 11

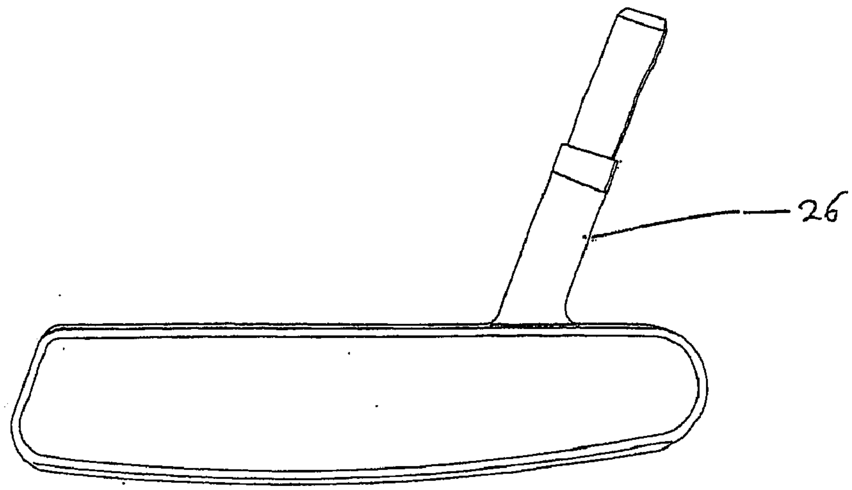


FIG. 12

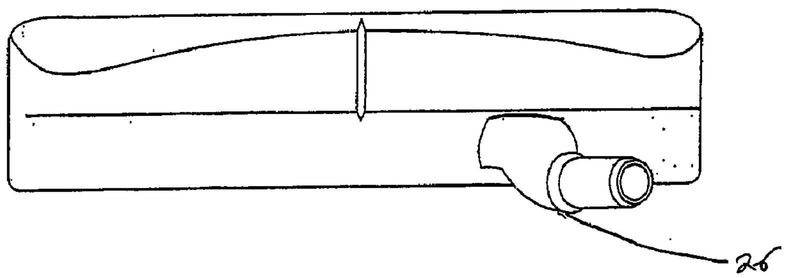


FIG. 13

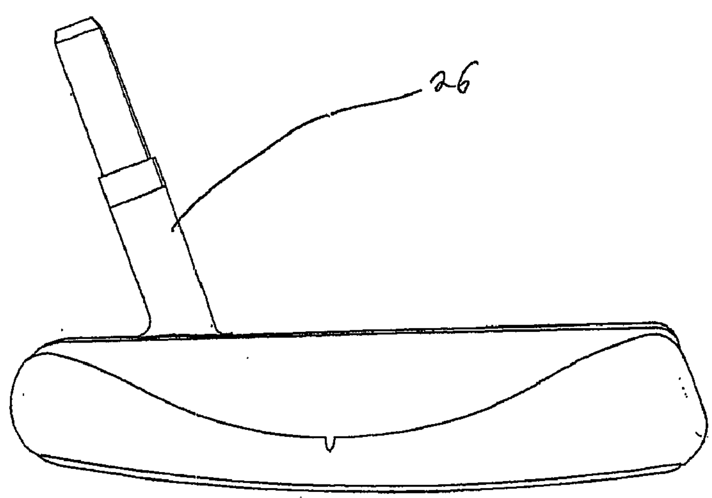


FIG. 14

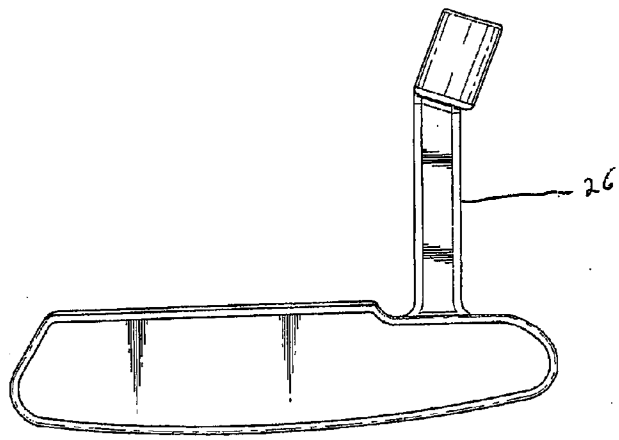


FIG. 15

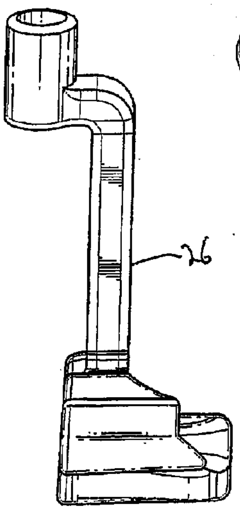


FIG. 19

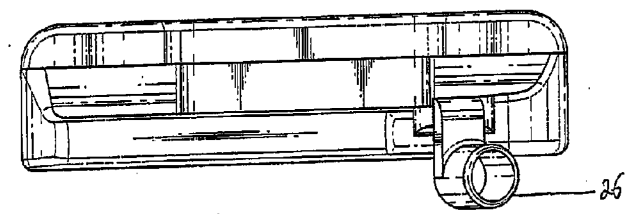


FIG. 16

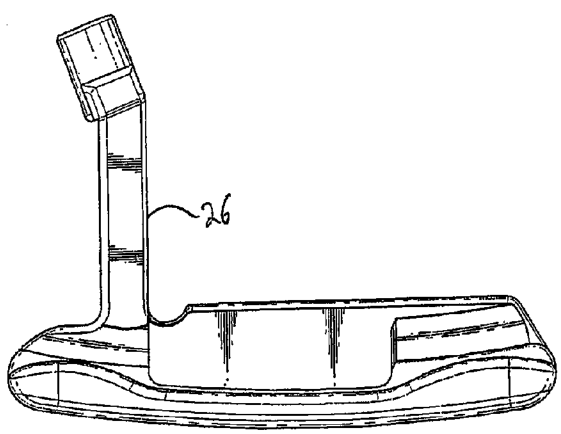


FIG. 17

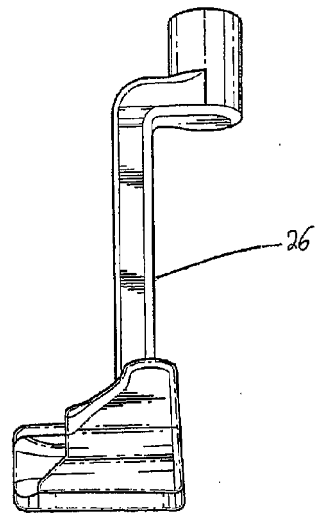


FIG. 18

NANOCRYSTALLINE PLATED PUTTER HOSEL

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] The Present Application claims priority to U.S. Provisional Patent Application No. 60/871,526, filed on Dec. 22, 2006.

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 low mass hosel for a putter. More specifically, the present invention relates to a putter hosel composed of a low-mass internal layer and a nanocrystalline plated external layer.

[0005] 2. Description of the Related Art

[0006] Weight that is locked in a putter's hosel hiders the efforts of designers to position the center of gravity (CG) location of the putter low and deep in the head. The positioning of the CG in this position helps to reduce backspin imparted on a ball at impact due to the loft of the putter. Reducing the backspin on the putt cause to ball to have less skid off of the putter face and, thus, help to produce a truer and purer roll.

[0007] Reducing the mass of the putter's hosel also enables designer to position mass in the design in positions to help increase the moment of inertia (MOI) of the putter head. This increased MOI helps to stabilize the putter head during the stroke and through impact.

[0008] Nanocrystalline or nanophase technology originated a number of decades ago. The technology has progressed since its origin and application of the technology to various goods have been explored and documented by numerous individuals.

[0009] One of the earliest patents for this technology is U.S. Pat. No. 5,433,797 to Erb et al.,for a Nanocrystalline Metals. This patent discloses a process for producing nickel-iron alloy nanocrystalline metals having a grain size of less than eleven nanometers.

[0010] U.S. Pat. No. 6,051,046 to Schulz et al., and U.S. Pat. No. 6,277,170 to Schulz et al., both for Nanocrystalline Ni-Based Alloys, disclose nanocrystalline nickel based alloys having grain sizes less than 100 nanometers.

[0011] U.S. Pat. No. 6,200,450 to Hui, for a Method and Apparatus for Depositing Ni—Fe—W—P alloys, discloses electrodepositing a nickel-iron-tungsten phosphorous alloy to promote wear resistance.

[0012] U.S. Pat. No. 6,080,504 to Taylor et al., for Electrodeposition of Catalytic Metals Using Pulsed Electric Fields, discloses a method for forming nanocrystalline metals on a substrate.

[0013] U.S. Pat. No. 5,589,011 to Gonsalves for a Nanostructured Steel Alloy, discloses a steel powder having a grain size in the nanometer range, specifically in the 50 nanometer size, and the steel power is an alloy composed of iron, chromium, molybdenum, vanadium and carbon.

[0014] U.S. Pat. No. 5,984,996 to Gonsalves et al., for Nanostructured Metals, Metal Carbides, and Metal Alloys, discloses nanostructured steel, aluminum, aluminum oxide, aluminum nitride, and other metals having crystallite size ranging from 45 nanometers to 75 nanometers.

[0015] U.S. Pat. No. 6,033,624 to Gonsalves et al., for Methods for the Manufacturing of Nanostructured Metals, Metal Carbides, and Metal Alloys, discloses a chemical synthesis method for producing nanostructured metals.

[0016] U.S. Pat. No. 5,603,667 to Ezaki et al., discloses an iron with a striking face composed of copper or a copper alloy and nickel plated.

[0017] U.S. Pat. No. 5,207,427 to Saeki discloses an iron with an non-electrolytic nickel-boron plating and a chromate film, and a method for manufacturing such an iron.

[0018] U.S. Pat. No. 5,792,004 to Nagamoto discloses an iron composed of a soft-iron material with a carbonized surface layer.

[0019] U.S. Pat. No. 5,131,986 to Harada et al., discloses a method for manufacturing a golf club head by electrolytic deposition of metal alloys such as nickel based alloys.

[0020] U.S. Pat. No. 6,193,614 to Sasamoto et al., discloses a golf club head with a face portion that is arranged to have its crystal grains of the material of the face portion oriented in a vertical direction. The '614 Patent also discloses nickel-plating of the face portion.

[0021] U.S. Pat. No. 5,531,444 to Buettner discloses an iron composed of a ferrous material having a titanium nitride coating for wear resistance.

[0022] U.S. Pat. No. 5,851,158 to Winrow et al., discloses a golf club head with a coating formed by a high velocity thermal spray process.

[0023] U.S. Pat. No. 7,087,268 to Byrne et al., for a Method Of Plating A Golf Club head discloses a method of plating a golf club head composed of magnesium, magnesium alloys, aluminum, or aluminum alloys.

[0024] U.S. Pat. No. 7,063,628 to Reyes et al., for a Plated Magnesium Golf Club Head discloses a golf club head having a magnesium portion that is plated with a nickel or nickel alloy based material.

[0025] U.S. Patent Publication 2006/0135281 to Palumbo et al., for a Strong, Lightweight Article Containing A Fine-Grained Metallic Layer discloses a shaft or face plate that is plated on a single surface with a nanocrystalline material.

[0026] The prior art has failed to disclose a nanocrystalline plated material for a golf club head component.

BRIEF SUMMARY OF THE INVENTION

[0027] The idea of this invention is to create a light-weight and high-strength hosel for use on a putter. Prior techniques utilize light weight material such as aluminum or titanium. However, these devices have disadvantages of lower strength or higher costs than the traditional steel hosel. They can also be difficult to achieve the necessary cosmetic finishes.

[0028] The invention that is proposed will utilize an injection molded plastic putter hosel that is coated with a high-strength nanocrystalline steel material. This thin coating increases the strength of the part comparable to steel while adding very little to the overall weight of the part. The potential density of the new hosel with the coating could be as low as 1-2 g/cc, while the steel, titanium, and aluminum hosels have densities of 7.8, 4.5, and 2.5 g/cc, approximately.

[0029] A putter hosel will be created in a high-strength, high-stiffness plastic material using an injection molding process. The hosel will then go through a plating process where nanocrystalline steel will be deposited on the plastic part. The thickness of the plating will depend on the mechanical properties desired in the final part. The plated part will then be polished and finished to achieve the desired cosmetic appearance.

[0030] The hosel will be attached to the putter head using adhesive glue, or some other mechanical bonding process like screws, for example. For the use of screws, a threaded metal part may need to be co-molded with the initial plastic hosel part in order to receive the threaded attaching screw.

[0031] 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

[0032] FIG. **1** is an isolated cross-sectional view of a hosel.

[0033] FIG. **2** is an illustration of the processing for fabricating the hosel.

[0034] FIG. **3** is a perspective exploded view of a golf club.

[0035] FIG. **4**is a perspective exploded view of a golf club.

[0036] FIG. **5** is a perspective view of the golf club of FIG. **4**.

[0037] FIG. **6** is a perspective exploded view of a golf club.

[0038] FIGS. **7-11** are views of a golf club having an alternative embodiment of the hosel of the present invention.

[0039] FIGS. **12-13** are views of a golf club having an alternative embodiment of the hosel of the present invention.

[0040] FIGS. **15-19** are views of a golf club having an alternative embodiment of the hosel of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0041] A hosel for a putter having a lightweight substrate layer plated with a nano-metal is disclosed herein. As shown in FIG. **1**, in a most preferred embodiment, the substrate **17** is plated on an exterior surface with an exterior plating layer **18**. The nano-metal is preferably a nano-metal as discussed below.

[0042] Iron Nickel (FeNi) Nanopowder or Nanoparticles, nanodots or nanocrystals are spherical or faceted high surface area nanocrystalline alloy particles with magnetic properties. Nanoscale Iron Nickel Particles are typically 20-40 nanometers ("nm") with specific surface area (SSA) in the 30-50 m^2/g range and also available in with an average particle size of 100 nm range with a specific surface area of approximately 7 m^2/g. Nano Nickel Iron Particles are also available in ultra high purity and high purity and coated and dispersed forms.

[0043] Nickel (Ni) Nanoparticles, nanodots or nanopowder are black spherical high surface area particles. Nanoscale Nickel Particles are typically 10-40 nm with SSA in the 30-50 m^2/g range and also available in with an average particle size of 50-100 nm range with a specific surface area of approximately 5-10 m^2/g. Nano Nickel Particles are also available in passivated and Ultra high purity and high purity and coated and dispersed forms.

[0044] Tungsten Oxide (WO) Nanopowder or Nanoparticles, nanodots or nanocrystals are spherical or faceted high surface area oxide magnetic nanostructure particles. Nanoscale Tin Oxide Particles are typically 20-40 nm with SSA in the 10-80 m^2/g range and also available in with an average particle size of 100 nm range with a specific surface area of approximately 5-10 m^2/g. Nano Tungsten Oxide Particles are also available in rutile, ultra high purity and high purity, transparent, and coated and dispersed forms.

[0045] Tungsten (W) Nanoparticles, nanodots or nanopowder are black spherical high surface area metal particles. Nanoscale Tungsten Particles are typically 40-80 nm with a SSA in the 1-45 m^2/g range. Nano Tungsten Particles are also available passivated and in Ultra high purity and high purity and coated and dispersed forms.

[0046] Titanium (Ti) Nanoparticles, nanodots or nanopowder are spherical or faceted high surface area metal particles. Nanoscale Titanium Particles are typically 10-80 nm with a SSA in the 15-20 m^2/g range and also available in with an average particle size of 300-700 nm range with a specific surface area of approximately 1-5 m^2/g. Nano Titanium Particles are also available in Ultra high purity and high purity and coated and dispersed forms.

[0047] Goodfellow Nanocrystalline Nickel: Nickel with a grain size of the order of 5-30 nm can be produced by an advanced electroplating process, resulting in material of negligible porosity and greatly enhanced physical, mechanical and electrical properties. Hardness is increased fivefold, strength is tripled and wear resistance is increased by a factor of 150. The coefficient of friction is halved and electrical resistivity is increased threefold. Stress corrosion cracking is eliminated, and both hydrogen diffusivity and solubility are increased. However, density, tensile modulus, thermal expansion and saturation magnetization show very little change when compared with material of a larger grain size.

[0048] Silver (Ag) Nanoparticles, nanodots or nanopowder are spherical or flake high surface area metal particles. Nanoscale Silver Particles are typically 1-40 nm with a SSA in the 1-1 m^2/g range and also available as flakes with an average particle size of 2-10 micron range with a specific surface area of approximately 1 m^2/g. Nano Silver Particles are also available in Ultra high purity and high purity and coated and dispersed forms.

[0049] Nickel Titanium (NiTi) Nanoparticles, nanodots or nanopowder are black spherical high surface area alloy particles. Nanoscale Nickel Titanium Particles are typically 10-40 nm with a SSA in the 30-50 m^2/g range and also available in with an average particle size of 50-100 nm range with a specific surface area of approximately 5-10 m^2/g. Nano Nickel Titanium Particles are also available in passivated and Ultra high purity and high purity and coated and dispersed forms.

[0050] Magnesium (Mg) Nanoparticles, nanodots or nanopowder are spherical black high surface area particles. Nanoscale Magnesium Particles are typically 20-60 nm with SSA in the 30-70 m^2/g range. Nano Magnesium Particles are also available in Ultra high purity and high purity and coated and dispersed forms.

[0051] Copper (Cu) Nanoparticles, nanodots or Nanopowder are black brown spherical high surface area metal particles. Nanoscale Copper Particles are typically 10-30 nm with a SSA in the 30-70 m^2/g range and also available in with an average particle size of 70-100 m range with a specific surface area of approximately 5-10 m^2/g. Nano Copper Particles are also available in passivated and in Ultra high purity and high purity and carbon coated and dispersed forms.

[0052] Cobalt Iron (CoFe) Nanopowder or Nanoparticles, nanodots or nanocrystals are black spherical or faceted high surface area nanocrystalline alloy particles with magnetic properties. Nanoscale Cobalt Iron Particles are typically 20-40 nm with a SSA in the 30-50 m^2/g range and also available in with an average particle size of 100 m range with a SSA of approximately 7 m^2/g. Nano Cobalt Iron Particles are also available in ultra high purity and high purity and coated and dispersed forms.

[0053] Aluminum (Al) Nanoparticles, nanodots or Nanopowder are black spherical high surface area metal particles. Nanoscale Aluminum Particles are typically 10-30 nm with a SSA in the 30-70 m^2/g range and also available in with an average particle size of 70-100 nm range with a specific surface area of approximately 5-10 m^2/g. Nano Aluminum Particles are also available in passivated and in Ultra high purity and high purity and carbon coated and dispersed forms.

[0054] FIG. **2** illustrates a method for producing the hosel of the present invention.

[0055] A hosel of the present invention is generally designated **26**. The hosel **26** is a component of a golf club which also includes a shaft **22**, a golf club head **24** and optionally an attachment assembly **30**. The optional attachment assembly **30** secures the shaft to the hosel **26** of the golf club head **24** with a minimum amount of adhesive or preferably without any adhesive material. In a preferred embodiment, the golf club is a putter. Preferably the shaft **22** is composed of a metal material such as stainless steel, a titanium alloy, or a like metal material.

[0056] A relatively fragile hosel composed of an injectable polymer material is transformed into a very durable golf club component since the injectable polymer material is essentially encased within the plating. The plating layer preferably ranges from 20 microns to 2000 microns. Preferably, the plating is composed of a nanocrystalline material. Preferably, the nanocrystalline material is selected from the group of nickel, nickel alloy, nickel-iron-molybdenum alloy, a nickel-iron-chromium alloy, iron alloy, iron, chromium or chromium alloy. The injectable polymer material is encased by the plating layer. The plating layer preferably comprises an exterior surface, an interior surface and a perimeter surface.

[0057] An interstitial layer is preferably formed between the injectable polymer layer and the plating layer. This interstitial layer represents the integration of the nanocrystalline material of the plating layer with the polymer material of the injectable polymer material.

[0058] A preferred plating process is electroless plating which involves plating onto a substrate by chemical reduction. Electroless platings are produced without an externally applied electric current. An alternative plating process is electrolytic plating, which is well-known and involves passing a direct current between an anode and a cathode to deposit metal or metal alloys particles, which are in an electrolyte medium, on the cathode.

[0059] A golf club **20** is illustrated in FIG. **3**. The shaft **22** has a tip end **41** and a butt end **43**, not shown. At the tip end **41** is an opening **47** to the hollow interior **38** of the shaft **22**. A shaft wall **40** defines the hollow interior **38**. In a preferred embodiment, the diameter of the shaft **22** tapers from the butt end **43** to the tip end **41**, with the tip end **41** of the shaft **22** having a smaller diameter than the butt end **43**. A typical shaft diameter at the tip end is approximately 0.335 inch. Preferably the shaft **22** has a notch **80** at the opening **47**. Typically, the shaft **22** has a length of thirty to forty inches, with longer length shafts available for unconventional golf clubs such as "belly putters."

[0060] The golf club head **24** preferably has a body **25** with a face **31**, a crown **33** and a sole **35**. A putter-type golf club head is disclosed in U.S. Pat. No. 6,471,600, entitled Putter Head, which is hereby incorporated by reference in its entirety. The hosel **26** is positioned at a heel end **27** of the club head **24** with a toe end **29** opposite the heel end **27**. The hosel **26** is generally defined as a means for connecting the shaft **22** to the club head **24**. A preferred hosel **26** is a cylindrical extension extending outward from the crown **33** of the body **25**. Other hosels include interior hosels, which are generally cylindrical tubes within a club head. The hosel **26** extends outward from the crown **33** a length, Lh, of preferably between 0.5 inch and 1.5 inches, and most preferably 0.625 inch. The hosel **26** preferably has an opening **49** and a threaded bore **53**. The hosel **26** preferably has a diameter, Rh, ranging from 0.15 inch to 0.20 inch, and most preferably has a diameter, Rh, of 0.171 inch. A protuberance **82** is preferably located on an exterior surface **56** of the hosel **26** to engage the notch **80** of the shaft **22**. The notch **80**/protuberance **82** engagement provides an alignment mechanism for the shaft **22** and provides an initial engagement of the shaft **22** to the club head **24** prior to a final connection by the attachment assembly **30**.

[0061] FIGS. **4** and **5** illustrate yet another embodiment of the present invention. In this embodiment, the hosel **26** includes a hosel extension arm **26**a, which extends the hosel **26** upward and positions the attachment of the shaft **22** to the club head **24** above the surface of the crown **33**. In this embodiment, the hosel **26** has an opening **49**, a hollow interior **51**, a hosel stud **52** with a threaded bore **53'**, and a protuberance **82** on the exterior surface of the hosel stud **52**.

[0062] As shown, the hosel stud **52** preferably has a length, L_{hs}, ranging from 0.25 inch to 1.0 inch, and most preferably 0.560 inch. The hosel stud **52** preferably has a diameter ranging from 0.150 inch to 0.5 inch, and most preferably 0.259 inch. The hosel stud **52** preferably has a taper of from 1-3 degrees and most preferably 1.5 degrees from a top to a bottom of the hosel stud **52**.

[0063] FIGS. **7-11** are views of a golf club having an alternative embodiment of the hosel of the present invention.

[0064] FIGS. **12-14** are views of a golf club having an alternative embodiment of the hosel of the present invention.

[0065] FIGS. **15-19** are views of a golf club having an alternative embodiment of the hosel of the present invention.

[0066] 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:

1. A hosel for a putter, the hosel comprising:

a base layer composed of a first material; and

an external layer disposed on the base layer, the external layer composed of a nano-metal material.

2. The hosel according to claim **1** wherein the base layer is composed of a material selected from the group consisting of nylon 6, nylon 66, thermoplastic polyurethane, polycarbonate, plies of pre-preg, and glass-fiber reinforced polymers.

3. The hosel according to claim **1** wherein the hosel has a density ranging from 1.0 to 2.0 grams per cubic centimeter.

4. The hosel according to claim **1** wherein the nano-metal is an iron-nickel nano-metal.

5. The hosel according to claim **1** wherein the nano-metal is a nickel nanoparticle nano-metal.

6. The hosel according to claim **1** wherein the nano-metal is a titanium nano-metal.

7. The hosel according to claim **1** wherein the nano-metal is a nanocrystalline nickel nano-metal.

8. The hosel according to claim wherein the hosel has a density less than 3 g/cc.

9. The hosel according to claim **1** wherein the nano-metal is a nanocrystalline steel.

10. A golf club comprising:

a golf club head;

a shaft; and

a hosel comprising

a base layer composed of a first material, and

an external layer disposed on the base layer, the external layer composed of a nano-metal material.

11. The golf club according to claim **10** wherein the base layer is composed of a material selected from the group consisting of nylon 6, nylon 66, thermoplastic polyurethane, polycarbonate, plies of pre-preg, and glass-fiber reinforced polymers.

12. The golf club according to claim **10** wherein the hosel has a density ranging from 1.0 to 2.0 grams per cubic centimeter.

13. The golf club according to claim **10** wherein the hosel has a density less than 3.0 g/cc and the golf club head has a density greater than 4.0 g/cc.

14. The golf club according to claim **10** wherein the nano-metal is a nanocrystalline steel.

15. The golf club according to claim **10** wherein the hosel comprises a bore for receiving the shaft, the bore of the hosel having an internal surface with a layer of a nano-metal material.

16. A golf club comprising:

a golf club head;

a shaft; and

a hosel comprising

a base layer composed of a first material, and

an external layer disposed on the base layer, the external layer composed of a nanocrystalline plating deposited on the base layer, the nanocrystalline plating comprising a nickel or nickel-based alloy material.

17. The golf club head according to claim **16** wherein the nanocrystalline plating has a thickness ranging from 20 microns to 2000 microns.

18. The golf club head according to claim **16** wherein the nanocrystalline plating is composed of a nickel-iron-molybdenum alloy.

19. The golf club head according to claim **16** wherein the nanocrystalline plating is composed of a nickel-iron-chromium alloy.

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