PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
A63B 53/10, 53/00, 53/04

A2

(11) International Publication Number: **WO 98/36802**

(43) International Publication Date: 27 August 1998 (27.08.98)

(21) International Application Number: PCT/GB98/00530

(22) International Filing Date: 19 February 1998 (19.02.98)

(30) Priority Data:
9703429.2 19 February 1997 (19.02.97) GB
9715581.6 23 July 1997 (23.07.97) GB

(71) Applicant *(for all designated States except US)*: MAXIBUY LIMITED [GB/GB]; Manor Farm, Dunton Bassett, Lutterworth, Leicestershire LE17 5JJ (GB).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: TILLEY, Gordon [GB/GB]; Manor Offices, Manor Farm, Dunton Bassett, Lutterworth, Leicestershire LE17 5JJ (GB).

(74) Agents: WATKINS, David et al.; Urquhart–Dykes & Lord, 91 Wimpole Street, London W1M 8AH (GB).

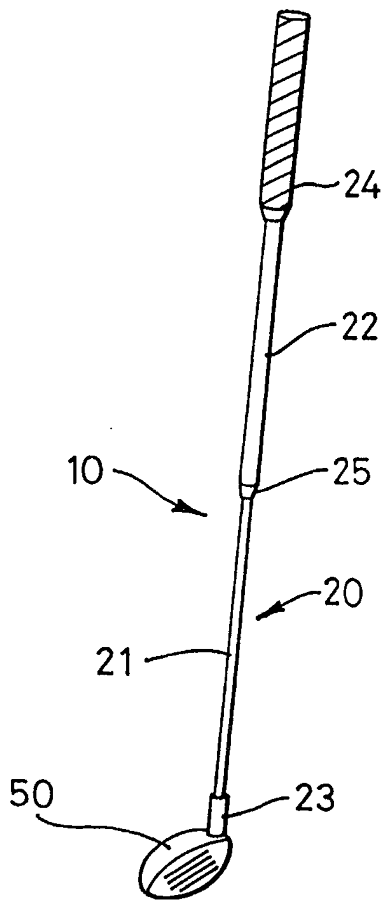
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: GOLF CLUB

(57) Abstract

A golf club (10) comprises a shaft (20) formed of a plurality of co–axially disposed tubes (21, 22) connected to one another at a stabilising joint or joints. Shaft (20) has an upper section forming a grip (24) and a lower section connected to club head (50). Tubes (21, 22) are parallel–sided and of differing cross–sectional sizes. The lower section is constituted by the tube of smallest cross section. The relative diameters of the tubes (21, 22) are such that the upper end of a tube is receivable within the bore at the lower end of its neighbour. Preferably, the material from which tubes (21, 22) are formed is selected from: (a) a titanium alloy; (b) a combination of (i) an extruded polymeric matrix reinforced with continuous, straight, pre–stressed and tensioned carbon fibres (26), said fibres (26) being aligned with the longitudinal axis of shaft (20), and (ii) continuous filament windings (27) that are also pre–stressed, tensioned and unbroken, or (c) a combination of materials from categories (a) and (b).



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

GOLF CLUB

The present invention relates to a golf club and, in particular, to a golf club constructed from state-of-the-art materials in a manner that brings high performance equipment within the affordable range of the majority of players.

It has long been a desirable goal of golf equipment manufacturers to develop equipment which, by virtue of its design, contributes to improved playing performance on the part of a user without contravening the rules of the game.

An example of such a development is the golf club formed with a shaft of carbon fibre composite material. Carbon-fibre shafted golf clubs are nowadays produced in large numbers with a reasonable degree of reproducibility and controllable flexibility. High handicap and casual golfers derive the most benefit from clubs fitted with shafts having relatively low stiffness: The behaviour of a highly flexible club during a golf swing is such that its flexure contributes to club head speed at the moment of impact with the ball, thereby compensating in part for irregularities in the player's swing. Low handicap players will prefer stiffer clubs that enable the "feel" of the playing stroke to be conveyed through the shaft to the player's hands.

Another recent development has been the introduction of so-called metal "woods" and golf club heads made from metal are now well established throughout the golf industry. They usually conform in shape to that of a conventional wood, with multiple curves in three dimensions. The correspondingly complex shape of the metal club head is usually formed by casting from stainless steel or similar easy to cast metals.

More recently, high specification metal "woods" have been produced using complex and volatile materials for the club head, such as titanium or its alloys. These are difficult to cast and require very complicated and expensive foundry methods. In particular, special measures are necessary to eliminate oxygen which can cause explosions if allowed to come into contact with molten titanium.

New model castings in titanium are therefore very expensive and there are currently no signs that the high costs associated with such designs will lessen to any considerable degree in the near future.

Some manufacturers have attempted to avoid the high costs of titanium casting by utilising titanium sheet forged into complex shapes with multiple curves, producing a club head which retains the appearance of a conventional cast metal "wood". However, these forged products are even more expensive due to the complicated double curves that require expensive tooling and hot forging, not to mention the labour-intensive subsequent stages of welding the numerous shaped pieces together, and dressing and polishing the welds and the completed shapes. Furthermore, internal reinforcing and thick cross-sections are required to prevent unwanted bending and distortion of the curves of the club head upon impact with a ball during execution of a golf stroke.

In this respect, it should be noted that an essential requirement of a golf club head is to transfer maximum energy to the ball without distortion. Conventional hollow metal club heads under extreme impact deform slightly along their curves in the plane of impact, dissipating energy and thereby reducing energy transfer to the ball. Consequently, the distance travelled by the ball is reduced.

Even though carbon fibre-shafted clubs are increasing in popularity, their high cost means that such equipment is inaccessible to the majority of players. The currently-used manufacturing techniques for producing carbon fibre shafted golf clubs are labour-intensive, which contributes to the high cost: Typically, reinforced carbon fibre shafts are made in one piece from loose sheets wrapped around a mandrel. To produce a tapered shaft, a tapered mandrel is required, the usual arrangement being such that the largest diameter section is positioned near the butt or handle section of the shaft, tapering down to the smallest diameter near the point where the shaft is joined to the club head.

The same difficulties in processing titanium are encountered if its alloys are used in the manufacture of golf club shafts. Hence, titanium-shafted clubs are generally very expensive and beyond the normal price range of the average player because of the special measures which are required during processing.

The shaft portion of relatively small diameter near the head of the club is the weakest point and, inevitably, the shaft is susceptible to breakage in this region.

Computer stress analysis shows that the portion of the shaft at which the club head joins the shaft has the greatest stress when a player swings the club and strikes a golf ball. The head tries to break away from the shaft on impact with the stationary golf ball.

It is therefore an object of the present invention to provide an improved golf club which utilises state-of-the-art technology and materials in a combination that permits manufacture of such equipment in high volume at affordable prices by eliminating some of the processing difficulties. It is a further object of the present invention to provide a golf club that contributes to improved performance on the part of a user without contravening the rules of the game. It is yet another object of the present invention to provide a golf club that is capable of enduring the repeated stresses that are experienced during impact with a golf ball by reducing the risk of breakage at conventional stress concentration points. It is a still further object of the present invention to provide a golf club that has highly controllable flexibility, thereby enabling a set of clubs to be constructed having matching flexibilities throughout.

In a first aspect, the invention is a golf club shaft comprising a plurality of co-axially disposed tubes connected to one another at a stabilising joint or joints, said golf club shaft having an upper section adapted to form a grip portion and a lower section adapted to be connected to a club head, characterised in that:

said tubes are parallel-sided and of differing cross-sectional sizes, the arrangement being such that said lower section is constituted by the tube of smallest cross-section, and the relative diameters of the tubes being such that the upper end of a tube is receivable within the bore at the lower end of its neighbour.

Extensive tests - both robotic and human - indicate that frequency curves and playing characteristics are significantly enhanced by the use of parallel sided tubes. They are superior to the performances of conventional tapered shafts constructed of graphite or steel.

With the parallel tube type of shaft construction a perfectly consistent range of flexes is produced throughout a set of clubs. This is achieved by adjusting the lengths of thick and thin tubes in relation to the type of club being constructed. For example the "frequency", expressed in cycles per minute (cpm) can be perfectly controlled from 292 cpm for a number 2 iron through to 328 cpm for a sand wedge. This produces virtually perfect and consistent flexes throughout a set made of graphite. Such consistency was previously impossible. This in turn leads to increased distance - up to 15 yards on every iron club - and improved accuracy, i.e. straighter hitting.

The terms "frequency" and "frequency matching" will be well understood by persons skilled in the art. The frequency is a measure of a club's rigidity and the term frequency matching is used to describe the even vibration of each club in a set.

The present invention enables perfect frequency matching of individual clubs within a set because of the parallel tube shaft design and the method of construction.

It is believed that a golf club shaft constructed in accordance with the above is the first of its type to use parallel-sided tubes of titanium alloy or a pre-stressed carbon fibre composite material. In the carbon fibre variant, or variants including at least one length of parallel-sided pre-stressed carbon fibre reinforced composite material, the fibre orientation is such that the loads and stresses are transmitted along the co-axial tubular array *via* the carbon fibre reinforcements, thereby avoiding concentration of stress at traditionally vulnerable positions. The loads and stresses are dissipated evenly and efficiently throughout the shaft, thereby minimising the risk of breakage. Moreover, this efficient transfer of energy allows greater impact force to be imparted to a golf ball during execution of a golf stroke, from the player's hands and arms to the club head, *via* the shaft.

Preferably, the polymeric matrix material is a thermosettable material, such as an epoxy resin or a vinyl ester resin.

The connections between adjoining lengths of tube may be strengthened with a ferrule of, for example, titanium or titanium alloy. In embodiments comprised entirely of parallel-sided pre-stressed carbon fibre reinforced composite tubing, or variants including at least one length of such tubing, the ferrule may be embedded in the fibre layers.

As indicated above, a length of parallel-sided tube constructed from titanium alloy may be used as the lowermost tube in the golf club shaft. Furthermore, the same alloy may also be used for the other tube or tubes in the shaft. The construction of parallel-sided titanium tubes is much cheaper and more consistent than swaging or forging tapered tubes, and they have the same benefits as the tubes constructed from extruded carbon fibre material described elsewhere in this specification. Moreover, many of the difficulties associated with processing titanium are eliminated by such a simplified construction, hence contributing to the affordability of the finished product.

The most preferred arrangement is a hybrid construction in which the lowermost tube is formed of a parallel-sided titanium alloy tube and the uppermost tube is formed of a parallel-sided tube of pre-stressed carbon fibre composite material. Such an arrangement is thought to provide the optimum distribution of weight, since the butt end of the shaft is light in weight, whilst the tip end nearest the club head is relatively more heavy. A further advantage of this preferred arrangement is that the lowermost tube is less susceptible to minor variations in its structural homogeneity, at the very point where stress concentration might occur.

Just as a ferrule may be used for strengthening purposes between adjoining lengths of tube, so a ferrule may also be used at the tip of the golf club shaft where it is joined to the club head. Where the lowermost tube is formed of extruded carbon fibre material, the ferrule may overlap or partially encase the fibre ends to protect them from accidental impact or abrasion leading to fibre breakage. In the case in which the lowermost tube is formed of titanium alloy, the ferrule may be omitted and the lowermost tube may be considered as an elongated ferule extending to the first intermediate tube joint above the golf club head.

As discussed above in relation to the prior art, the point of attachment of a golf club shaft to the club head is widely recognised as a point of weakness since stresses are concentrated here. However, in a construction according to the present invention, the stressing forces are transmitted away from this potential area of weakness, so risk of shaft breakage is considerably reduced.

The invention also includes within its scope a golf club using a golf club shaft as described above in combination with a forged golf club head, said golf club head comprising an assembly of a top element, a base element and a face element welded together to form a club head with a wedge-shaped cross-section in the fore to aft direction, each of said elements being constituted by a sheet of forged metal shaped with only a single curvature, and further comprising a metal tube inserted through said top element serving as a seat for a golf club shaft, said tube being welded to connecting surfaces provided on the elements.

An additional metal plate or feet may be attached to the bottom of the club head to stabilise the club to sit on the ground at the desired angle.

The invention will now be described by way of example only with reference to the drawings, in which:

Figure 1 is a perspective view of a golf club fitted with a modular shaft in accordance with one embodiment of a first aspect of the invention;

Figure 2 illustrates the construction of a constituent tube of the modular shaft of Figure 1, showing the arrangement of carbon fibre reinforcement;

Figure 3 is a part cross-sectional view showing a stabilising joint and ferrule;

Figure 4 is another part cross-sectional view showing an arrangement of a reinforcing ferrule at the tip of the shaft where it is joined to a club head;

Figure 5 is a perspective view of a complete welded assembly of forged metal sheets forming a golf club head in accordance with a second aspect of the invention;

Figure 6 is an exploded perspective view showing the component forged metal sheets prior to assembly;

Figure 7 is a perspective view of a part-finished assembly showing a hole provided in the top sheet for receiving a metal tube serving as a seat for the golf club shaft;

Figure 8 is a perspective view of the finished assembly complete with tube welded in position, and

Figure 9 is a cross-sectional view through the club head of Figures 5 to 8, showing the wedge shape.

Referring now to Figures 1 to 4, a golf club 10 is shown consisting essentially of a shaft 20 and a head 50. The shaft 20 is of a modular construction and consists of a pair of parallel-sided tubes 21 and 22 of different diameters arranged co-axially, with a portion of the smaller diameter tube 21 received in the bore of the larger diameter tube 22. The smaller diameter tube 21 forms the lowermost portion of the shaft 20 and is reinforced at its lower end by a titanium ferrule 23 where the shaft is joined to the club head 50. The larger diameter tube 22 forms the upper part of the shaft 20 and is provided at its upper end with a grip portion 24. An intermediate ferrule 25 is provided at the lower extremity of tube 22 to protect the end thereof for reasons which will be explained in more detail below.

Figure 2 shows the construction of the tubes 21 and 22, in particular the arrangement of carbon fibre reinforcement. The main constructional feature of the tubes is a layer 26 of straight, pre-stressed and tensioned carbon fibres embedded in a matrix of curable plastics material. The layer 26 is overwound by more carbon fibres 27 oriented at approximately $\pm 45°$ relative to the longitudinal axis of the tube. The fibres in the overlayer 27 are also under tension.

Figure 3 is a part cross-sectional view showing a stabilising joint between the two tubes 21 and 22 and an intermediate ferrule 25 at the base of larger diameter tube 22. The purpose of the intermediate ferrule 25 is to provide protection to the fibre ends which would otherwise be exposed at the lower extremity of the tube 22. The upper end of tube 21 is received within the bore of tube 22 and the two tubes overlap by an amount "ℓ" which is at least as great as 4 times the internal diameter of tube 22. This degree of overlap ensures that the joint is stable and that flexure of the modular shaft does not result in separation of its component tubes. The outer surface of tube 21 is bonded to the inner surface of tube 22 in the region of overlap.

Figure 4 is a part cross-sectional view showing a reinforcing ferrule 23 at the tip of the shaft 20 where it is joined to the club head 50. The ferrule 23 is a titanium tube and may be welded to formations provided within the club head 50 for ensured rigidity. The bore of ferrule 23 is adapted to receive the lower end of tube 21 and protects the exposed fibre ends thereof from accidental damage.

The parameters for the tensile modulus measured using "Impregnated Strand Test - SACMA Methodology" are between 35 GPa ranging through 40 GPa, to 55 GPa up to a maximum of 64 GPa. The resulting carbon fibre composite, impregnated with epoxy resin or vinyl ester resin as a matrix typically contains 65%, but possibly up to 75%, by volume of fibre in proportion to resin content. It is designed to produce an upper tube of a stiffness measured in a vibration frequency of between 900 and 1000 cycles per minute, measured on a one metre length sample. The lower tube requires a vibration frequency of between 500 and 600 cycles per minute, also measured on a one metre length sample. The higher modulus materials give the optimum frequency at a lighter weight due to less material being required. Lighter weight is desirable in the upper or larger tube to compensate for greater weight in the lower and thinner tube, which is helpful in assisting the pendulum effect when swinging the complete club, without increasing overall weight.

It will be understood by persons skilled in the art that the above-quoted vibration frequency values apply to the shaft alone and that lower frequency values are obtained for an assembled golf club which includes a relatively massive club head portion. The frequency values given in the earlier discussion of "frequency matching" relate to the assembled golf club complete with club head and the two frequency ranges, though different, are entirely consistent with one another.

When titanium alloy is employed in the shaft material, the vibration frequency is within the range given above for the carbon fibre variant, but at the lower end of the scale due to the lower modulus of elasticity of titanium compared to carbon fibre composite. Experiments have shown that the best alloy of titanium for this application is titanium containing 3% aluminum and 2.5% vanadium commonly denoted Ti-3-2.5. Typical wall thicknesses range from 0.48 mm to 0.89 mm, with 0.48 mm being the lightest and most flexible suitable for ladies and slow swinging players. At the other end of the scale, 0.89 mm thick tubing is better suited to professional and hard hitting players. All the alloys are preferably work hardened and heat treated to provide optimum and consistent flex, surface hardness and torsional strength suitable for lasting qualities required in a golf club shaft.

Therefore, in a variant of the above-described embodiment, at least the lowermost tube 21 may be substituted by a parallel-sided tube of titanium alloy. As indicated, the alloy may be a commercially-available aerospace alloy commonly designated as Ti-3-2.5. This alloy has a titanium metal base and contains as its major alloying constituents roughly 3% by weight of aluminium and 2.5% by weight of vanadium. The other tubes in the shaft may also be substituted by such parallel-sided titanium alloy tubes.

Although Figures 1, 3 and 4 have not been drawn to represent a titanium alloy-shafted golf club in particular, persons skilled in the art will appreciate that the tubes illustrated in these Figures could equally well be made from titanium alloy. Their parallel-sided construction, nested arrangement and method of jointing are the same as described above for the pre-stressed carbon fibre composite variant.

Referring now to Figures 5 to 9, a metal club head 50 is shown which is a hollow construction formed from a welded assembly of three forged titanium sheets or plates. These plates, namely the top plate 51, the bottom plate 52 and the face plate 53 are shown in exploded view in Figure 6. Figure 7 shows a partially-assembled club head 50 in which the top plate 51 and the bottom plate have already been welded together. Top plate 51 is formed with a hole 54 which receives a tube 23 that serves as a seat for the golf club shaft. The tube 23 is shown in position in Figure 8. It is welded in place at weld lines 55 prior to the final step of welding the face plate 53 in position. Figure 8 also shows in dotted outline a triangle ABC which is more clearly discernible in Figure 9. This Figure shows the club head 50 in cross-section from fore to aft and clearly illustrates its wedge shape.

The three plates 51, 52 and 53 are each formed with only a single curvature. There are no compound curves in the club head 50 and hence it is easier and cheaper to manufacture than club heads of the prior art which mimic traditional "woods" in profile. Moreover, an added benefit of the wedge-shaped cross-section is that more of the stroke energy is imparted to the ball during impact.

In a conventionally-shaped club head, some of the force of the impact is dissipated in the club head itself by bending forces acting to distort the shape of the club head. By virtue of its compound curvature, some distortion is inevitable and both the top and bottom surfaces of the club head become slightly more bowed momentarily. By the time the club head reverts to its undistorted shape, the ball has already left the club face so the distortion energy is wasted.

With the wedge-shaped club head of the present invention, however, the top plate 51 and bottom plate 52 are better configured to resist such deformation. The inventive club head does not become domed during impact with a golf ball because the curvature of the component plates is not a compound curvature. Instead, the impact forces are transmitted to the apex "B" of the wedge and reflected back to the face plate 53. This reflection serves to increase the amount of effective energy transferred to the ball, so it is able to travel further.

Although the invention has been particularly described above with reference to specific embodiments, it will be understood by persons skilled in the art that these are merely illustrative and that variations are possible without departing from the scope of the claims which follow.

CLAIMS

1. A golf club shaft (20) comprising a plurality of co-axially disposed tubes (21, 22) connected to one another at a stabilising joint or joints, said golf club shaft (20) having an upper section adapted to form a grip portion (24) and a lower section adapted to be connected to a club head, characterised in that:

said tubes (21, 22) are parallel-sided and of differing cross-sectional sizes, the arrangement being such that said lower section is constituted by the tube of smallest cross-section, and the relative diameters of the tubes (21, 22) being such that the upper end of a tube is receivable within the bore at the lower end of its neighbour.

2. A golf club shaft (20) as claimed in claim 1 wherein the material from which the tubes (21, 22) are formed is selected from the group consisting of:

- (a) a titanium alloy;
- (b) a combination of
  - (i) an extruded polymeric matrix reinforced with continuous, straight, pre-stressed and tensioned carbon fibres (26), said fibres (26) being aligned with the longitudinal axis of the golf club shaft (20), and
  - (ii) continuous filament windings (27) that are also pre-stressed, tensioned and unbroken, or
- (c) a combination of materials from categories (a) and (b).

3. A golf club shaft (20) as claimed in claim 2 wherein at least the uppermost tube is formed from said combination of:

  - (i) extruded polymeric matrix reinforced with continuous, straight, pre-stressed and tensioned carbon fibres (26), said fibres (26) being aligned with the longitudinal axis of the golf club shaft (20), and

(ii) continuous filament windings (27) that are also pre-stressed, tensioned and unbroken.

4. A golf club shaft (20) as claimed in claim 2 wherein a length of parallel-sided tube constructed from titanium alloy is used as the lowermost tube (21).

5. A golf club shaft (20) as claimed in any preceding claim wherein the connections between adjoining lengths of tube (21, 22) are strengthened with a ferrule (25).

6. A golf club shaft (20) as claimed in claim 5 wherein the ferrule (25) is formed of titanium or an alloy thereof.

7. A golf club shaft (20) as claimed in any preceding claim wherein a ferrule (23) is provided at the tip of the golf club shaft (20) where it is joined to the club head (50).

8. A golf club shaft (20) as claimed in any one of claims 5 to 7 when appended to claim 3, wherein the ferrule (23, 25) overlaps or partially encases the fibre ends.

9. A golf club shaft (20) as claimed in claim 3, or any one of claims 5 to 8 when appended to claim 3, wherein the polymeric matrix is a thermosettable material.

10. A golf club (10) formed from a golf club shaft (20) as claimed in any preceding claim in combination with forged golf club head (50), said golf club head (50) comprising an assembly of a top element (51), a base element (52) and a face element (53) welded together to form a club head (50) with a wedge-shaped cross-section in the fore to aft direction, each of said elements (51, 52, 53) being constituted by a sheet of forged metal shaped with only a single curvature, and further comprising a metal tube (23) inserted through said

top element (51) serving as a seat for a golf club shaft (20), said tube (23) being welded to connecting surfaces provided on the elements (51, 52, 53).

11. A golf club (10) as claimed in claim 10 further comprising an additional metal plate attached to the bottom of the club head (50).

12. A golf club (10) as claimed in claim 10 further comprising foot means attached to the bottom of the club head (50).

13. A golf club shaft (20) substantially as described herein with reference to Figures 1 to 4 of the drawings.

14. A golf club (10) substantially as described herein with reference to the drawings.

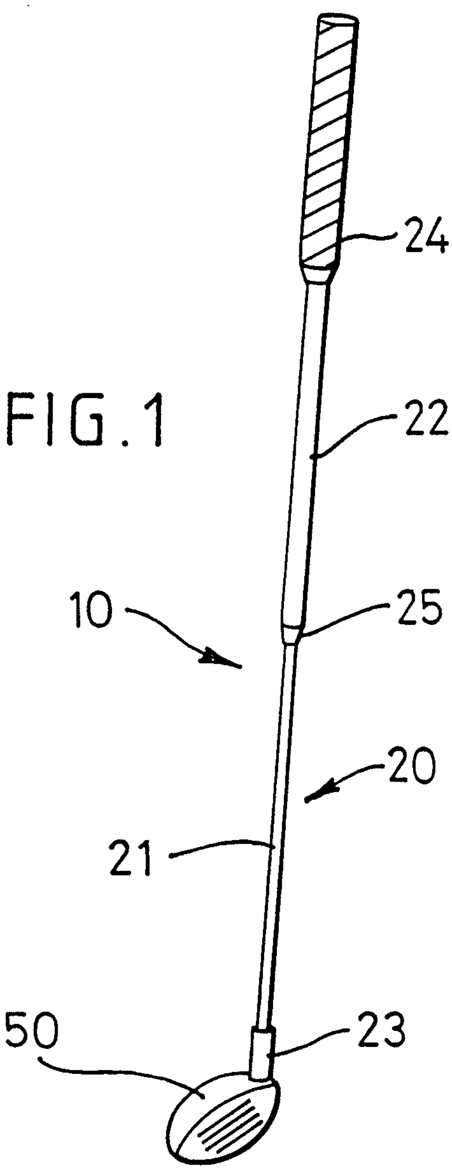


FIG.1

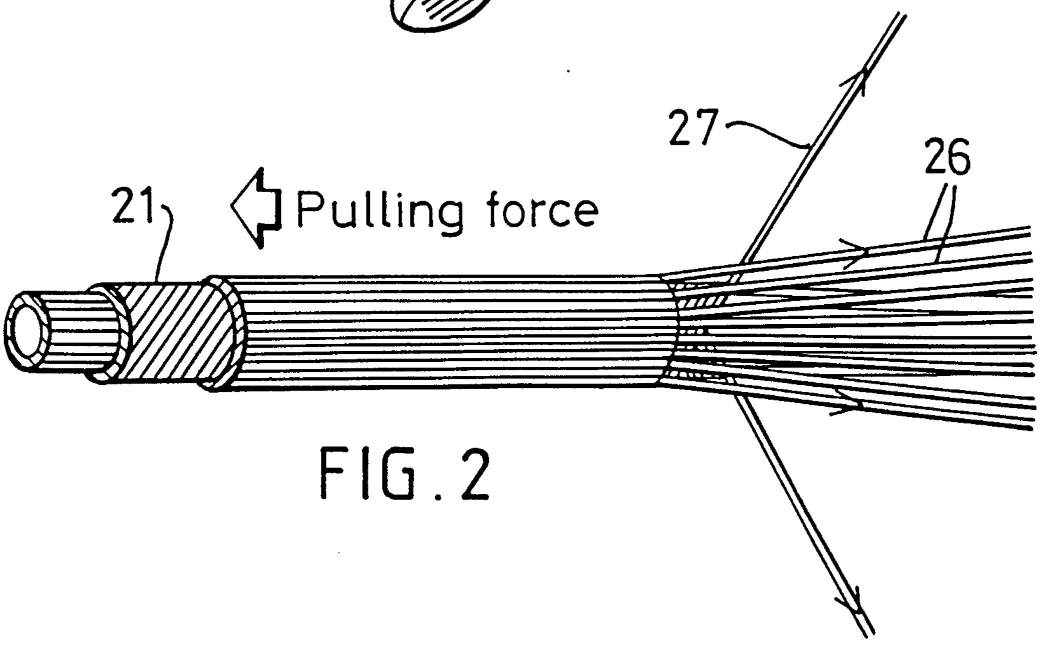


FIG.2

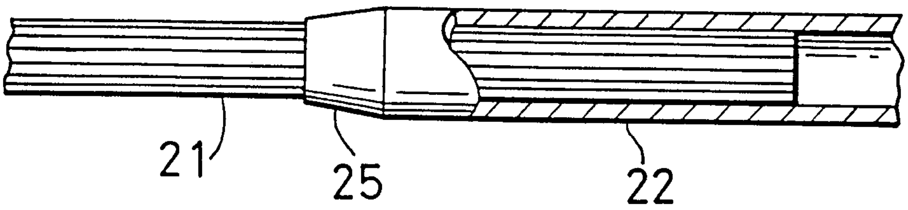


FIG. 3

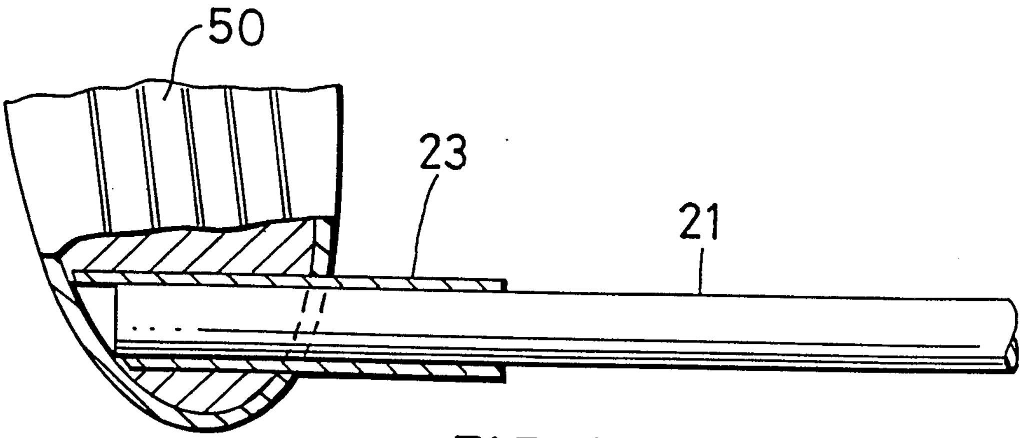


FIG. 4

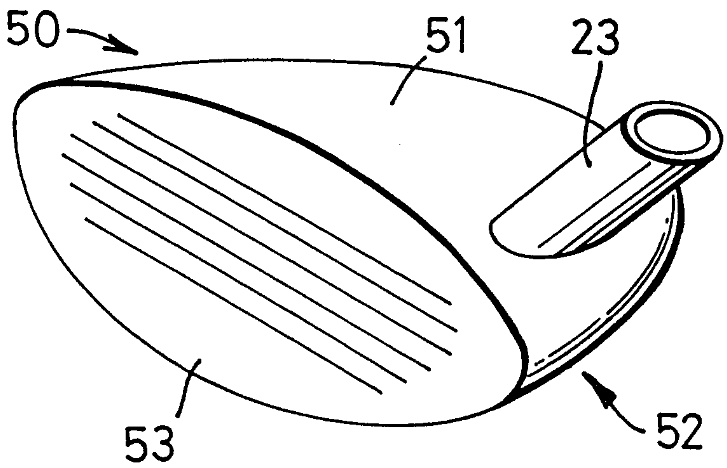


FIG. 5

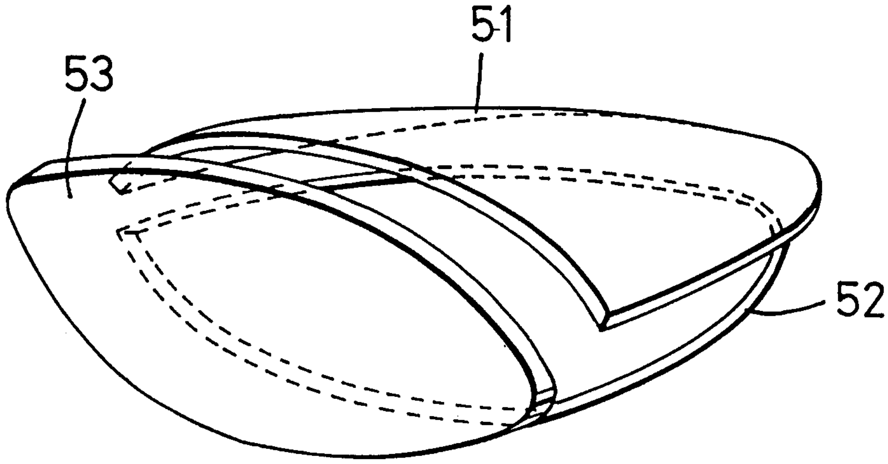


FIG. 6

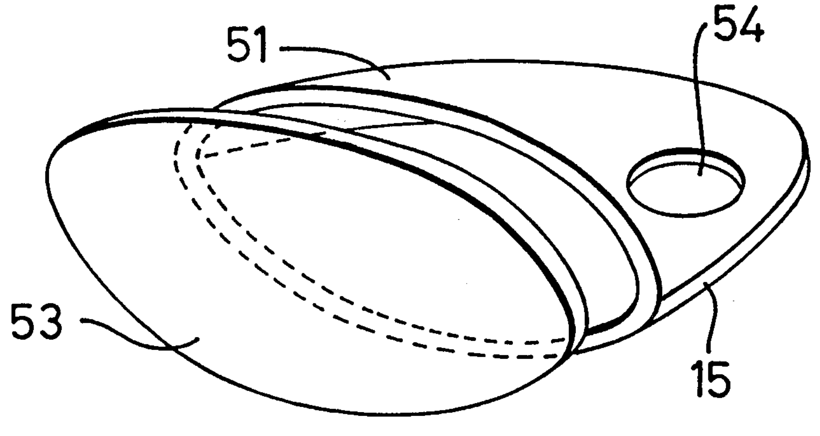


FIG. 7

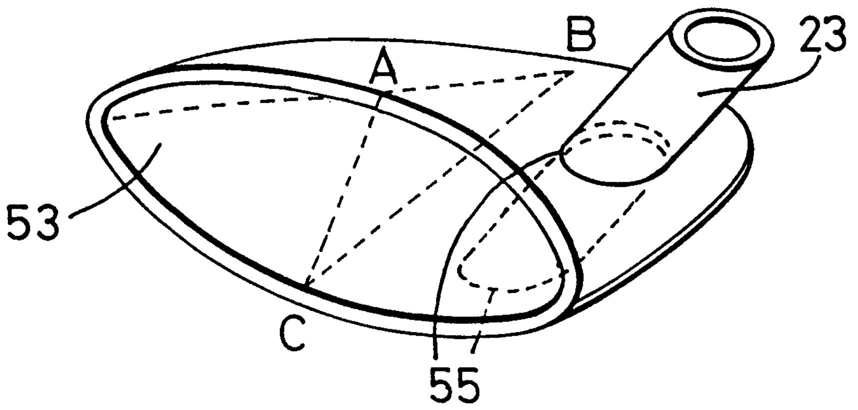


FIG. 8

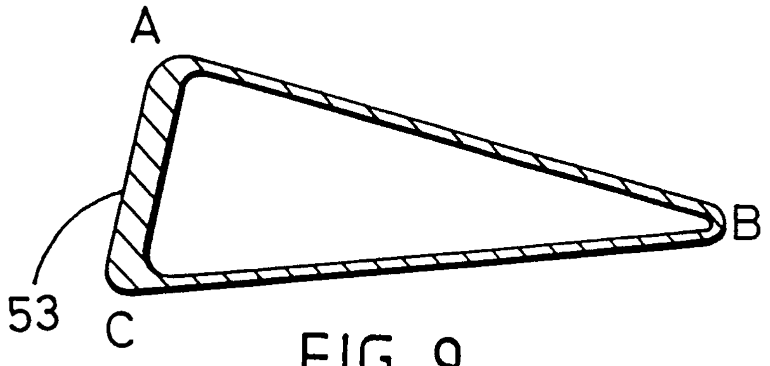


FIG. 9