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SHAFT FOR GOLF CLUBS OR THE LIKE

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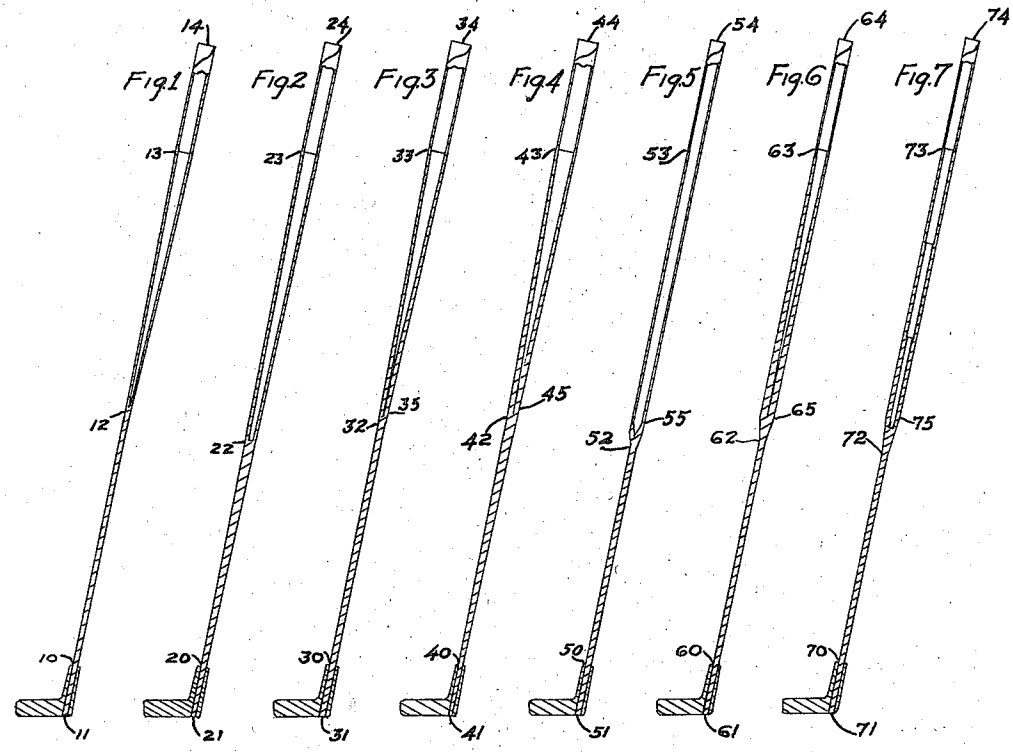

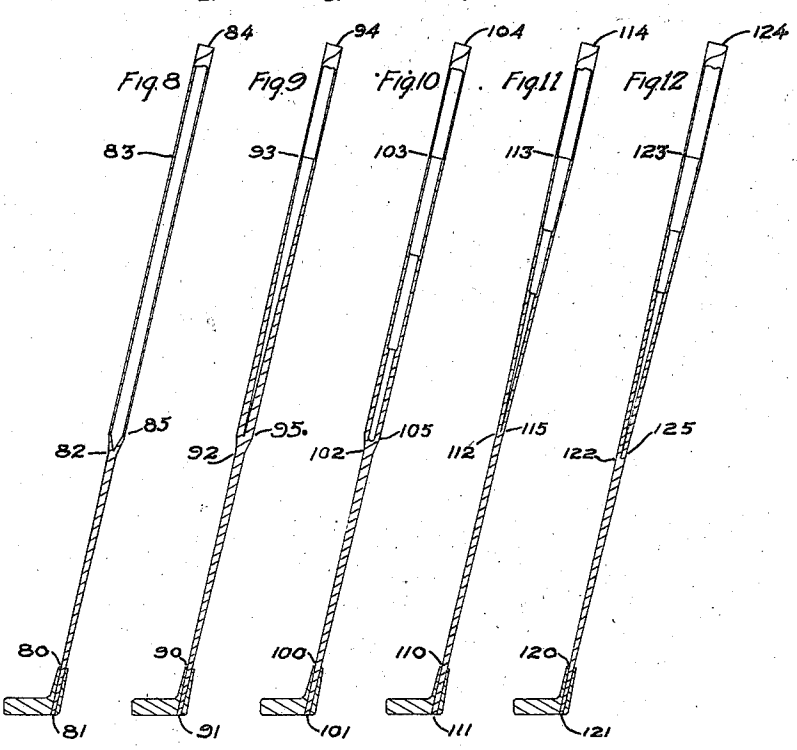

INVENTOR.
Lloyd Cross

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SHAFT FOR GOLF CLUBS OR THE LIKE

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Application April 16, 1934, Serial No. 720,787

4 Claims. (Cl. 273—80)

This invention relates to metallic shafts for golf clubs and particularly to those which have a lower length in the nature of a solid rod and a hollow upper length in the nature of a tube and adapted for manufacture from metals possessing a relatively low value of specific gravity, possessing a relatively high value of modulus of resilience and possessing a relatively low value of modulus of elasticity.

This application is a continuation in part of my application Serial Number 683,274, filed August 2, 1933.

Metallic shafts for golf clubs have been manufactured in the past but they have been made from hollow tubing over the entire length and the metal used therein has been of steel. Steel tubing, because of its weight causes the center of gravity of the entire club to be located well up the shaft towards the handle; on the other hand, shafts made from aluminum or magnesium alloys, because of the low values of specific gravity of the metals, tend to move the center of gravity of the entire club down the shaft towards the head end of the club. Shafts for golf clubs, made from aluminum or magnesium alloys, because of the low values of modulus of elasticity possessed by these metals, are more flexible than steel shafts and hence require higher values of moment of inertia in the horizontal cross sections of the lower part of the shaft in order to control flexibility; this is accomplished by making the lower portion of the shaft solid in horizontal cross section. Alloys of magnesium and aluminum possess approximately one and one half to three times the resilience of steel respectively and in order to increase the advantage thus derived from this characteristic, the construction of the lower portion of the shaft as a solid rod is a distinct advantage. The construction of the lower part of the shaft with a solid horizontal cross section raises the resistance of the aluminum and magnesium alloy shafts against the deflecting forces and impact strains which result when the club head impacts golf ball. The construction of the lower portion of the shaft with a solid horizontal cross section tends to move the center of gravity of the entire club in the direction of the club head.

The object of this invention is to provide a shaft for a golf club which will place the center of gravity of the entire club at a minimum distance from the club head; to provide a shaft for a golf club so proportioned that a maximum of kinetic energy will be imparted to the golf ball by utilizing the maximum resilience which may be derived from the proper design of the horizontal cross sections and longitudinal section of the shaft; to provide a shaft for a golf club which will give extreme resistance to the force of impact resulting when club head impacts golf ball; to provide a shaft for a golf club which will cause the center of percussion of the entire club to coincide more nearly with the striking point on the club head; to provide a shaft for a golf club which will impart maximum distance to a golf ball; to provide a shaft for a golf club and other implements for sports use made entirely of certain alloys of magnesium; to provide a shaft for a golf club and for other implements for sports use with a lower length in the nature of a solid rod and hollow upper length in the nature of a tube; to provide a shaft for a golf club which by reason of its longitudinal section will be adaptable for manufacture from metals of different characteristics so that one type of metal may be used in the lower solid rod portion and another type of metal may be used in the upper hollow tubular portion.

Figures 1 to 12, inclusive, are cross-sectional views of various forms of golf clubs embodying my invention.

An ideal shaft for a golf club is one which possesses the following physical characteristics:—low value of specific gravity, high value of tensile strength at the elastic limit of the material, a relatively low value of modulus of elasticity and a relatively high value of modulus of resilience.

The specific gravity of a material is the ratio of its density to that of some standard substance. In comparing the specific gravity of metals in this specification, each metal of which the specific gravity is stated, is compared to some common standard substance. The specific gravity of steel is about 7.8; that of aluminum alloy about 2.8; that of magnesium alloy about 1.8. In the construction of golf clubs, the use of metals with low values of specific gravity permit the concentration of more weight in the vicinity of the club head; total weight of clubs compared being equal, with the resultant movement of the center of gravity of the entire club towards the club head and a resultant movement of the center of percussion of the entire club towards the striking point of the club head.

In the matter of tensile strength at the elastic limit of the material, steel suitable for shafts for golf clubs may have a tensile strength of approximately 55,000 pounds per square inch at the elastic limit; aluminum alloy has a tensile strength of approximately 53,000 pounds per square inch

at the elastic limit; magnesium alloy has a tensile strength of approximately 35,000 pounds per square inch at the elastic limit.

In the matter of modulus of elasticity, designated by the symbol "E", steel has a value of "E" of about 30,000,000; aluminum alloy has a value of "E" of about 10,000,000; magnesium alloy has a value of "E" of about 6,250,000. Values of "E" shown for aluminum and magnesium alloys permit shafts manufactured from either aluminum or magnesium alloys to have a "whip" or flexibility hitherto unobtainable in steel shafted clubs; horizontal cross sections of clubs compared being equal.

Resilience of a material is defined literally as the springing back of a deformed body after the deforming force has been removed. As used in mechanics however, it is the work done by the body in this springing back, which is the same as the work done on the body in deforming it, so long as this is inside the elastic limit of the material. Expressed in terms of energy, the resilience proper is the amount of work, or energy, in foot pounds, which can be stored in an elastic body, up to a given stress per square inch, and which can be given out again by the body as useful work, if desired. This theorem is expressed mathematically by the formula:—

$$\frac{f^2}{E} \times V$$

In this formula, "f" is the stress intensity; "E" is the modulus of elasticity of the material; "V" is the volume of the body under consideration. Hence when comparing shafts of different materials but of the same volumes, those manufactured from aluminum alloy have a resilience about three times that of steel and those manufactured from magnesium alloy have a resilience about one and one half times that of steel. If this comparison be carried on still further and the volume factor introduced, it will be seen that by making the lower portion of an aluminum or magnesium alloy shaft with a solid horizontal cross section, in the nature of a rod, the resilience of the aluminum or magnesium alloy shaft has its resilience further increased over that of a hollow steel shaft in the same direct proportion as the comparative increase in volumes.

It is particularly emphasized that a golf club, when impacting the ball deforms in greatest amount at that portion of the shaft, just above the club head and consequently if this portion of the shaft be made solid the additional resilience derived thereby and the consequent increased energetic springing back of the shaft to normal position will give an added impulse or "kick" to the ball and an added distance to the player's shot.

Thus it will be seen that an object of this invention is to take advantage of the low values of modulus of elasticity, the low values of specific gravity, the high values of tensile strength at the elastic limit and the high values of modulus of resilience possessed by certain metals, by constructing the lower portion of the shaft with a solid horizontal cross section in the nature of a rod and the upper part of the shaft of hollow horizontal cross section in the nature of a tube and adapting such shafts for manufacture from alloys of aluminum and magnesium.

Other objects of this invention are to manufacture a shaft for a golf club from certain alloys of magnesium in order (1) that high values of modulus of resilience will be obtained from the shaft, (2) that the center of gravity of the entire club will more nearly coincide with the club head, (3) that the center of percussion of the club will more nearly coincide with the striking point of the club head; (4) that a high degree of flexibility will be imparted to the shaft.

Referring to Figure 1 there is disclosed a golf club equipped with a metal shaft of the form preferred by this invention and shown in longitudinal section. As indicated in this figure the shaft is solid between the head end **10** and **12**, and this solid portion between **10** and **12** also has the same external diameter or the same external dimensions for its horizontal cross sections. The portion of the shaft situated between **12** and the handle end **13** is tubular and so fashioned that the external diameter or external dimensions are greater near the handle end **13** than at **12**, and this tubular portion is tapered or successively decreased in outside diameter or outside dimensions from **13** to **12**. The wall thickness of the tubular portion between **12** and **13** is uniform. The shaft is so constructed that it has an extension of the lower solid rod portion from **10** to **11** for insertion within and attachment to the club head. The shaft is so constructed that it has an extension of the upper hollow tubular portion from **13** to **14** to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 2 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design the shaft is solid between the head end **20** and **22**, but the external diameter or external dimensions of the horizontal cross section at **22** are greater than at **20** and this solid portion is tapered or successively decreased in outside diameter or outside dimensions from **22** to **20**. The shaft situated between **22** and the handle end **23** is tubular and so fashioned that the external diameter or external dimensions are greater near the handle end **23** than at **22**, and this tubular portion is tapered or successively decreased in outside diameter or outside dimensions from **23** to **22**. The wall thickness of the tubular portion between **22** and **23** is uniform. The shaft is so constructed that it has an extension of the lower solid rod portion from **20** to **21** for insertion within and attachment to the club head. The shaft is so constructed that it has an extension of the upper hollow tubular portion from **23** to **24** to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 3 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design the shaft is solid between the head end **30** and **32**, and this lower solid rod portion between **30** and **32** also has the same external diameter or the same external dimensions for its horizontal cross sections. The portion of the shaft situated between **35** and the handle end **33** is tubular and so fashioned that the external diameter or external dimensions are greater near the handle end **33** than at **32** and this tubular portion is tapered or successively decreased in outside diameter or outside dimensions from **33** to **32**. The wall thickness of the upper hollow tubular portion between **35** and the handle end **33** is greater at **35** than at **33**. The shaft is so constructed that it has an extension of the lower solid rod portion from **30** to **31** for insertion

within and attachment to the club head. The shaft is so constructed that it has an extension of the upper hollow tubular portion from 33 to 34 to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 4 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design the shaft is solid between the head end 40 and 42 but the external diameter or external dimensions of the horizontal cross section at 42 are greater than at 40 and this solid rod portion is tapered or successively decreased in outside diameter or outside dimensions from 42 to 40. The portion of the shaft situated between 45 and the handle end 43 is tubular and so fashioned that the external diameter or external dimensions are greater near the handle end 43 than at 42 and this tubular portion is tapered or successively decreased in outside diameter or outside dimensions from 43 to 42. The wall thickness of the upper hollow tubular portion between 45 and the handle end 43 is greater at 45 than at 43. The shaft is so constructed that it has an extension of the lower solid rod portion from 40 to 41 for insertion within and attachment to the club head. The shaft is so constructed that it has an extension of the upper hollow tubular portion from 43 to 44 to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 5 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design the shaft is solid between the head end 50 and 52, and this solid portion between 50 and 52 also has the same external diameter or the same external dimensions for its horizontal cross sections. The portion of the shaft situated between 55 and the handle end 53 is tubular and this tubular portion between 55 and the handle end 53 has the same external diameter or the same external dimensions for its horizontal cross sections. The wall thickness of the tubular portion between 55 and the handle end 53 is uniform. The transition between the upper hollow tubular portion and the lower solid rod portion is accomplished by tapering the metal between the two portions or by successively decreasing the external and internal dimensions of the portion between 55 and 52 as shown in longitudinal section between those points. The shaft is constructed so that it has an extension of the lower solid rod portion from 50 to 51 for insertion within and attachment to the club head. The shaft is constructed so that it has an extension of the upper hollow tubular portion from 53 to 54 to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 6 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design the shaft is solid between the head end 60 and 62, and this portion between 60 and 62 also has the same external diameter or the same external dimensions for its horizontal cross sections. The portion of the shaft situated between 65 and the handle end 63 is tubular and this tubular portion between 65 and the handle end 63 has the same external diameter or the same external dimensions for its horizontal cross sections. The wall thickness of the upper hollow tubular portion between 65 and the handle end 63 is greater at 65 than at 63. The transition between the upper hollow tubular portion and the lower solid rod portion is accomplished by tapering the metal between the two portions or by successively decreasing the external and internal dimensions of the portion between 65 and 62 as shown in longitudinal section between these points. The shaft is so constructed that it has an extension of the lower solid rod portion from 60 to 61 for insertion within and attachment to the club head. The shaft is constructed so that it has an extension of the upper hollow tubular portion from 63 to 64 to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 7 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design, the shaft is solid between the head end 70 and 72, and this portion between 70 and 72 also has the same external diameter or external dimensions for its horizontal cross sections. The portion of the shaft situated between 75 and the handle end 73 is tubular and this tubular portion between 75 and the handle end 73 has the same external diameter or the same external dimensions for its horizontal cross sections. The wall thickness of the upper hollow tubular portion between 75 and the handle end 73 is greater at 75 than at 73 and this increased wall thickness is accomplished by assigning increasing thicknesses progressively to the subdivisions of the length from 73 toward 75. The transition between the upper hollow tubular portion and the lower solid rod portion is accomplished by tapering the metal between the two portions or by successively decreasing the external and internal dimensions of the portions between 75 and 72 as shown in longitudinal section between these points. The shaft is so constructed that it has an extension of the lower solid rod portion from 70 to 71 for insertion within and attachment to the club head. The shaft is constructed so that it has an extension of the upper hollow tubular portion from 73 to 74 to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 8 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design, the shaft is solid between the head end 80 and 82 but the external diameter or external dimensions of the horizontal cross section at 82 are greater than at 80 and this solid rod portion is tapered or successively decreased in outside diameter or outside dimensions from 82 to 80. The portion of the shaft situated between 85 and the handle end 83 is tubular and this tubular portion between 85 and the handle end 83 has the same external diameter or the same external dimensions for its horizontal cross sections. The wall thickness of the tubular portion between 85 and the handle end 83 is uniform. The transition between the upper hollow tubular portion and the lower solid rod portion is accomplished by tapering the metal between the two portions or by successively decreasing the external and internal dimensions of the portions between 85 and 82 as shown in the longitudinal section between these two points. The shaft is so constructed that it has an extension of the lower solid rod portion from 80 to 81 for insertion within and attachment to the club head. The shaft is constructed so that it has an extension of the upper hollow tubular portion from 83 to 84 to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 9 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design, the shaft is solid between the head end 90 and 92 but the external diameter or external dimensions of the horizontal cross section at 92 are greater than at 90 and this solid rod portion is tapered or successively decreased in outside diameter or outside dimensions from 92 to 90. The portion of the shaft situated between 95 and the handle end 93 is tubular and this tubular portion between 95 and the handle end 93 has the same external diameter or the same external dimensions for its horizontal cross sections. The wall thickness of the upper hollow tubular portion between 95 and the handle end 93 is greater at 95 than at 93. The transition between the upper hollow tubular portion and the lower solid rod portion is accomplished by tapering the metal between the two portions or by successively decreasing the external and internal dimensions of the portion between 95 and 92 as shown in longitudinal section between these points. The shaft is so constructed that it has an extension of the lower solid rod portion from 90 to 91 for insertion within and attachment to the club head. The shaft is also constructed so that it has an extension of the upper hollow tubular portion from 93 to 94 to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 10 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design, the shaft is solid between the head end 100 and 102 but the external diameter or external dimensions of the horizontal cross section at 102 are greater than at 100 and this solid portion is tapered or successively decreased in outside diameter or outside dimensions from 102 to 100. The portion of the shaft situated between 105 and the handle end 103 is tubular and this tubular portion between 105 and the handle end 103 has the same external diameter or the same external dimensions for its horizontal cross sections. The wall thickness of the upper hollow tubular portion between 105 and the handle end 103 is greater at 105 than at 103 and this increased wall thickness is accomplished by assigning increasing thicknesses progressively to the sub-divisions of the length from 103 toward 105. The transition between the upper hollow tubular portion and the lower solid rod portion is accomplished by tapering the metal between the two portions or by successively decreasing the external and internal dimensions of the portions between 105 and 102 as shown in longitudinal section between these points. The shaft is so constructed that it has an extension of the lower solid rod portion from 100 to 101 for insertion within and attachment to the club head. The shaft is constructed so that it has an extension of the upper hollow tubular portion from 103 to 104 to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 11 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design the shaft is solid between the head end 110 and 112 and this lower solid rod portion between 110 and 112 also has the same external diameter or the same external dimensions for its horizontal cross section. The portion of the shaft situated between 115 and the handle end 113 is tubular and so fashioned that the external diameter or external dimensions of the horizontal cross sections are greater near the handle end 113 than at 115 and this tubular portion is tapered or successively decreased in outside diameter or outside dimensions from 113 to 115. The wall thickness of the upper hollow tubular portion between 115 and the handle end 113 is greater at 115 than at 113 and this increased wall thickness is accomplished by assigning increasing thicknesses progressively to the subdivisions of the length from 113 toward 115. The shaft is so constructed that it has an extension of the lower solid rod portion from 110 to 111 for insertion within and attachment to the club head. The shaft is constructed so that it has an extension of the upper hollow tubular portion from 113 to 114 to be wrapped or otherwise prepared for use as a handle.

Referring to Figure 12 there is disclosed a golf club equipped with a modified form of the metal shaft preferred by this invention and shown in longitudinal section. In this variation of the design the shaft is solid between the head end 120 and 122 but the external diameter or external dimensions of the horizontal cross section at 122 are greater than at 120 and this solid rod portion is tapered or successively decreased in outside diameter or external dimensions from 122 to 120. The portion of the shaft situated between 125 and the handle end 123 is tubular and so fashioned that the external diameter or external dimensions are greater near the handle end 123 than at 125 and this tubular portion is tapered or successively decreased in outside diameter or outside dimensions from 123 to 125. The wall thickness of the upper hollow tubular portion between 125 and the handle end 123 is greater at 125 than at 123 and this increased wall thickness is accomplished by assigning increasing wall thicknesses progressively to the subdivisions of the length from 123 toward 125. The shaft is so constructed that it has an extension of the lower solid rod portion from 120 to 121 for insertion within and attachment to the club head. The shaft is constructed so that it has an extension of the upper hollow tubular portion from 123 to 124 to be wrapped or otherwise prepared for use as a handle.

There are other modifications of the design which may result from the application of the principle of constructing a metal shaft for a golf club, having its lower portion in the nature of a solid rod and its upper portion in the nature of a hollow tube. This same principle may be applied to the construction of shafts for implements for general sports use; for example a shaft for a polo mallet or a vaulting pole and the like.

As in Figures 5, 6, 7, 8, 9 and 10, where there is a marked and appreciable difference in measurement between the outer diameter or the outside dimensions of the upper hollow tubular portion and those of the lower solid rod portion, the transition from one exterior surface to the other exterior surface may be accomplished by either gradually or abruptly decreasing the outer diameter or the outside dimensions of the intervening metal, or by tapering the intervening metal or by any other desired manner.

Shafts of this type and principle are not restricted to the same kind of metal throughout. The lower solid rod portion may be of solid steel and the upper hollow portion may be of tubular aluminum alloy; or the lower solid rod portion may be of solid aluminum alloy with an upper

hollow portion of tubular magnesium alloy. These combinations are dependent entirely upon the results desired, or the requirements of the game, or the temperaments of the individual players in the consideration of the elements of golf club design involving balance, whip, flexibility, concentration of weight in the club head and strength of shaft as applied to the various types of clubs known as drivers, brassies, spoons, cleeks, mid-irons, mashies, niblicks, putters and the like.

The external periphery of the horizontal cross sections of the various portions of the shaft taken perpendicular to the longitudinal axis may be circular, elliptical, hexagonal, irregular or of any other desired external contour. In the case of the upper hollow tubular portion, the inner contour of the horizontal cross section may be either circular, elliptical, hexagonal, irregular, or of other geometric figure or other desired periphery.

The wall thickness of the upper hollow tubular portion may be increased in any desired manner when progressing from the handle end toward the lower solid rod portion. The wall thickness may be increased gradually and uniformly with a reverse taper, or the upper hollow tubular portion may be subdivided along its longitudinal axis into a series of minor lengths and each minor length may be progressively increased in wall thickness as the lower solid rod portion of the shaft is approached and the handle end departed from.

The ratio of the length of the lower solid rod portion of the shaft to the length of the upper hollow tubular portion of the shaft is not a fixed quantity. The length of the lower solid rod portion and the length of the upper hollow tubular portion are dependent entirely upon the degree of flexibility desired in the shaft, the desired location of the center of gravity of the entire club, the desired resilience of the shaft and the desired flexural strength of the shaft.

Certain alloys of magnesium because of the peculiar values possessed by them, of modulus of elasticity, tensile strength at the elastic limit, modulus of resilience and specific gravity, are particularly adapted for use as metals which may be incorporated into shafts for golf clubs. When these magnesium alloys are so utilized, new and unexpected results are obtained from golf clubs so equipped, because the increased resilience of the shaft combined with increased flexibility of the shaft impart more energy and hence more distance to the ball, while the harmonic vibration of the shaft constructed from this material gives added and unexpected snap or "come-back" to the player's shot.

The alloys of magnesium preferred by this invention are the following: (*a*) comprising approximately 4.0 percent aluminum, 0.2 to 0.4 percent manganese, balance magnesium; (*b*) comprising approximately 6.5 percent aluminum, 0.4 percent manganese, 0.75 percent zinc, balance magnesium; (*c*) comprising approximately 8.5 percent aluminum, 0.2 to 0.4 percent manganese, 0.5 percent zinc, balance magnesium; (*d*) comprising approximately 0.9 to 1.5 percent manganese, 6.0 percent tin, balance magnesium; (*e*) comprising approximately 3.0 to 4.0 percent aluminum, 0.6 percent manganese, 5.0 percent tin, balance magnesium; (*f*) comprising approximately 1.0 percent manganese, 5.0 percent tin, 4.0 percent zinc, balance magnesium; (*g*) comprising approximately 1.3 to 2.0 percent manganese, balance magnesium; (*h*) comprising approximately 0.6 to 1.0 percent manganese, 4.5 to 5.5 percent tin, 3.5 to 4.0 percent zinc, balance magnesium.

The term "golf clubs or the like" as used herein implies not only those clubs specifically known by the names drivers, brassies, spoons, cleeks, mid-irons, mashies, niblicks and putters, but also implies croquet and polo mallets and similar types of ball-impacting implements commonly used in sports. Furthermore, by the use of the word "hollow" in connection with the shafts described above, no intention is to be presumed of excluding from the scope of my invention shafts in which the space within the handle portion is filled with a material, as for example cork or fibrous compositions, of substantially lighter weight than the material of the enclosing wall of the shaft. While the invention will find special utility in connection with the manufacture of all-metal shafts, it is not to be considered as so limited, but the inventive idea manifestly may be embodied in shafts of part metal construction.

Having thus described my invention, what I claim is:—

1. A sporting implement such as a golf club or the like comprising an elongated metal shaft and an offset ball-impacting head attached to one end of the shaft, said shaft having an enlarged handle end opposite the ball-impacting head, and said shaft being hollow for the major portion of its length including its handle end and being of solid metal construction for a substantial distance adjacent the ball-impacting head.

2. A sporting implement such as a golf club or the like comprising an elongated shaft of a relatively light, resilient metal and an offset ball-impacting head attached to one end of the shaft, said shaft having an enlarged handle end opposite the ball-impacting head, and said shaft being hollow for the major portion of its length including its handle end and being of solid metal construction for a substantial distance adjacent the ball-impacting head.

3. A sporting implement such as a golf club or the like comprising an elongated metal shaft of aluminum content and an offset ball-impacting head attached to one end of the shaft, said shaft having an enlarged handle end opposite the ball-impacting head, and said shaft being hollow for the major portion of its length including its handle end and being of solid metal construction for a substantial distance adjacent the ball-impacting head.

4. A sporting implement such as a golf club or the like comprising an elongated metal shaft of magnesium alloy and an offset ball-impacting head attached to one end of the shaft, said shaft having an enlarged handle end opposite the ball-impacting head, and said shaft being hollow for the major portion of its length including the handle portion and being of solid metal construction for a substantial distance adjacent the ball-impacting head, the solid end of the shaft having its maximum cross-sectional area of metal located at a point a substantial distance above the ball-impacting head but below the midpoint of the shaft.

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