

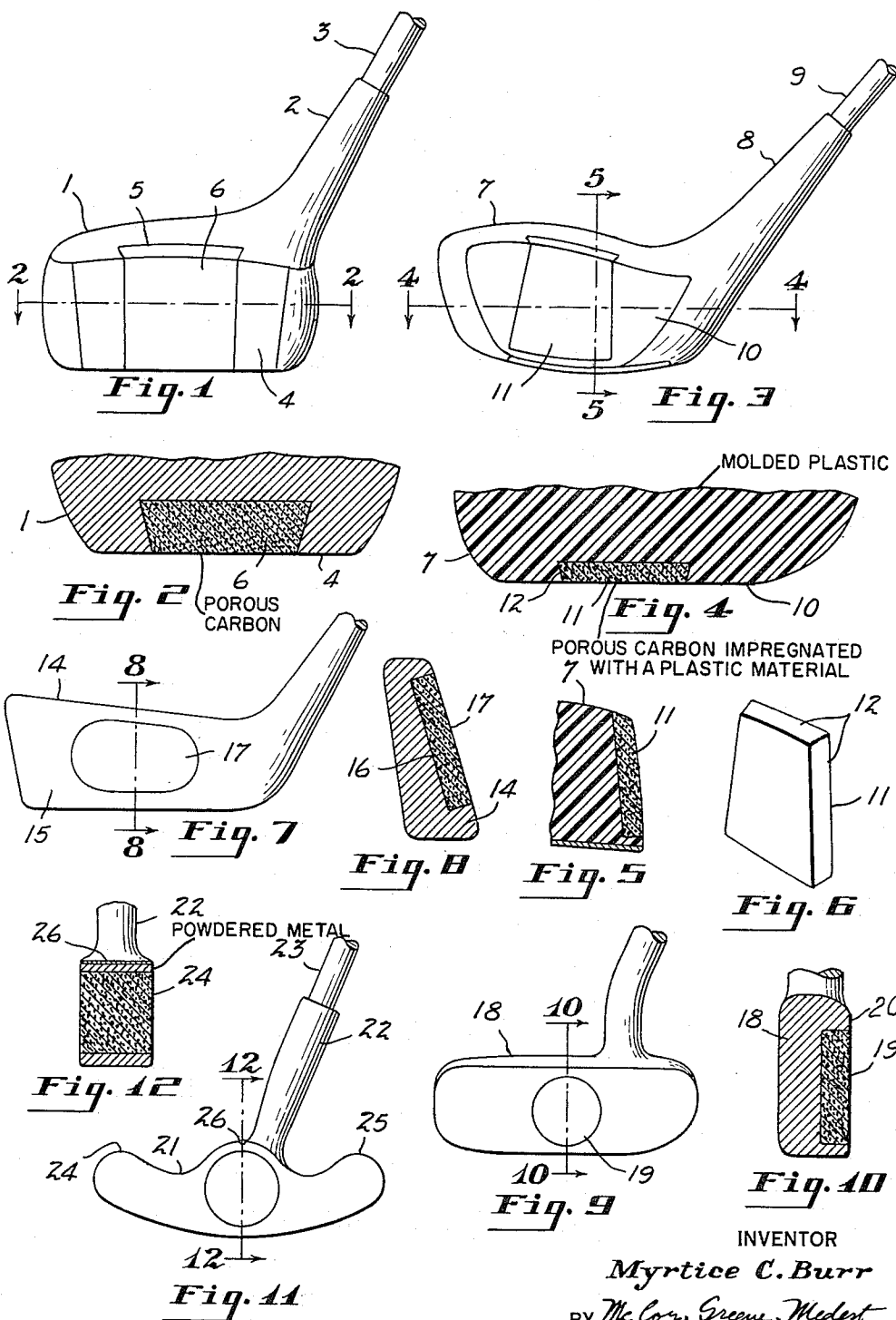
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GOLF CLUB INCLUDING A STRIKING FACE OF POROUS CARBON

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## GOLF CLUB INCLUDING A STRIKING FACE OF POROUS CARBON

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This application is a continuation-in-part of prior co-pending application for patent of Myrtice C. Burr, entitled "Striking Heads for Golf Clubs," Serial No. 184,999, filed April 4, 1962, and now abandoned.

This invention relates to golf clubs and more particularly to an improvement in the striking heads of such clubs that is applicable generally to the three classes of clubs known as woods, irons and putters.

Since a golf ball is a highly resilient body which is soft enough to be substantially deformed by the impact of the club head, the rebound from the striking face of the head is due mainly to the elastic energy stored up in the ball immediately upon engagement of the striking face of the club with the ball which reacts upon the striking face during the final portion of the stroke. The impact force acting on the club head may also cause some elastic energy to be transmitted from the club head to the ball before the ball moves out of contact with the striking face. Since it is desirable to propel the ball a maximum distance with as great accuracy as possible, the golf club should be so designed that the desired distance may be obtained with a minimum expenditure of energy. In order to advantageously utilize the elastic energy generated in the ball, it is essential that the striking face of the club head be flat or slightly convex and hard and unyielding enough to preclude any deformation of said face that would appreciably increase the area of contact between said face and the ball, so that the impact force applied to a point on the surface of the spherical ball is not appreciably diminished by dissipation of energy in the club head. In the metal head golf clubs commonly used the compressive impact force exerted on the head at point of contact with the ball does not set up sufficient elastic energy in the body of the club head at the point of contact to contribute materially to the rebound of the ball from the striking face because of the very low resilience of the metal of the head per unit of volume under the relatively small compressive stresses which may be created by impact with a golf ball.

It has been proposed to provide golf club heads with inserts in the portion of the striking face that engages with the ball that are composed of various materials intended to increase the rebound of the ball from the striking face. Any looseness in the connection of such inserts to the material of the head will result in excessive absorption of energy in the club head and reduce instead of increase the rebound. The provision of a rigid mounting for hard inserts such as those composed of glass or porcelain for the wood club heads adds greatly to the cost of manufacture and are of doubtful value for the reason that these hard materials, like the metals, have low resilience per unit volume under moderate compressive stresses.

The clubs of the present invention are provided with impact receiving faces formed by blocks or inserts composed of hard, porous carbon which may be individually molded or cut from molded or extruded blocks or bars. The porous carbon inserts have relatively high resilience per unit volume and have appreciable compressibility under moderate stresses. The compressibility and elasticity of porous carbon makes it possible to firmly secure such inserts in club heads solely by the expansive thrust of the insert against the confining walls of the recesses

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in which they are placed, making unnecessary the use of adhesives, screws or other attaching devices.

The term "carbon" as herein used is to be understood to include materials composed mainly of carbon or graphite or mixtures of carbon and graphite. The carbon material employed in the inserts is produced by thoroughly mixing carbon powder, graphite powder or suitable proportions of carbon and graphite powders with an amount of a suitable bonding material such as coal tar pitch sufficient to coat each particle of carbon and graphite, molding to the shape and density desired and then baking the molded pieces at a temperature sufficient to carbonize the bond.

Porous carbon is an advantageous material for use as a facing for golf club heads, not only because of its resilient properties, but also because it is a relatively inexpensive material that is readily machinable and that is highly resistant to thermal shocks so that it can be readily cast into a metal or plastic body.

The porous carbon may be made impervious to moisture and strengthened by impregnation with a plastic or metal. Such impregnation is accomplished by immersing the porous carbon pieces in the molten metal or molten plastic and subjecting the molten material to a high pressure. The impregnated pieces have considerable porosity since the pores of the carbon body are not completely filled with the impregnating material. The molten material does not ordinarily penetrate all of the pores and, because of the solidification shrinkage and the shrinkage due to cooling after solidification, the pores are not completely filled with the impregnating material. The porosity of the insert is believed to contribute greatly to the superior rebound characteristics of the insert. Porous carbon and carbon graphite products follow Hooke's law for stresses below the rupture point. While the deformation is proportionate to the force exerted on the material, a longitudinal compression is not necessarily accompanied by an equivalent lateral expansion as is the case with solid materials, since the compressive force may reduce the size of the voids in the porous material. The walls separating the pores within the body of a porous carbon block will be deflected by pressure when the block is subjected to impact and will store up elastic energy in the manner of thin metal springs when deflected and this energy will be concentrated in the portion of the insert engaged but the ball, so that it will be released and act upon the ball simultaneously with the recovery of the ball from its initial distortion.

Many grades of unimpregnated porous carbon, graphite or carbon graphite have sufficient strength to withstand impacts against a golf ball to which the insert will be subjected and such inserts may be used in any of the clubs. Impregnated carbon inserts are preferred particularly for the driving clubs, because they are least likely to be damaged by accidental impacts against hard objects such as stones or other club heads. Metals such as babbit, cadmium, copper or silver are commonly used for impregnating porous carbon articles and various resinous plastics may also be used. Copper impregnated inserts have been found to be quite satisfactory.

The molded carbon insert may be incorporated in a cast metal club head by positioning it in the mold in which the club head is formed. When so cast into the body of the head, the insert is subjected to considerable radial compression due to shrinkage of the metal body, and the prestressing of the insert so obtained is highly advantageous since the insert is very rigidly held in the metal body and its impact strength is increased due to the compressive stress to which it is subjected.

A rigid mounting and a similar prestressing of the insert may be obtained in forged club heads by cutting a

recess in the striking face of the forged head of the same shape but somewhat smaller than the insert.

The insert may then be forced into the recess so that it is slightly compressed and held tightly in position. An interference fit such as this is preferable since it is the simplest and most economical method of assembly; however, the insert may also be mounted by heating the head to expand the recess and then forcing the insert into position. The insert will then be held tightly in the head when the metal cools and contracts.

The club head may also be formed of powdered metal which is molded under pressure with a suitable recess or opening to receive the porous carbon insert.

Since the coefficient of thermal expansion of carbon is much less than that of metals used in club heads, the impact strength of the insert will be substantially increased by the radial pressure to which it is subjected.

The heads of driving clubs may be formed of a suitable molded plastic composition instead of a wood and such molded heads may be of substantially the same size and shape as the heads made of wood. By selecting a plastic composition of low specific gravity, the heads may be made of substantially the same size, shape and weight as the wood heads.

Since practically all of the moldable plastics have coefficients of thermal expansion much greater than carbon or carbon graphite, the inserts are prestressed in the same way as when cast into a metallic head or matrix. The plastic molding compositions preferred are those having a density not greatly in excess of the woods commonly used in making the club heads. Compositions which satisfy these conditions and which have adequate tensile and impact strength are polycarbonates, i.e., a polyaryl carbonate polymer which is an ester of carbonic acid and bisphenol A. These polycarbonates are sold by The General Electric Company under the trade name "Lexan" and by the Mobay Chemical Company of Pittsburgh under the trade name "Merlon." Other plastic molding compositions which have the desirable low density together with adequate strength are various epoxy casting resins, particularly the blends of epoxy resins and polysulfide known as flexibilized epoxy resins. Polystyrene and nylon molding compositions are also suitable. Many other plastic molding compositions may be used, but the ones above mentioned are preferred because of their low specific gravity combined with desirable strength and thermal expansion characteristics.

When used in a molded plastic head, it may in some instances be desirable to impregnate the insert with a resin of substantially the same composition as that employed in the body of the head in order to provide an integral joining of the material of the head with the impregnating material of the insert.

The present invention has for its object to provide a golf club head with an impact receiving face which is not yieldable enough to materially increase the area of contact with the ball, so that the rebound due to the resilience of the ball is not appreciably lessened, but which is composed of a material having a high modulus of resilience, that is capable of storing up considerable elastic energy when subjected to compressive stresses such as those imposed by the impact of the golf ball, and of returning such energy to the ball.

Porous carbons made from powdered carbon, powdered graphite and mixtures of carbon and graphite are commonly used for bearings, friction blocks, molds, seals, pistons and other articles requiring substantial structural strength. For some purposes the porous carbon is impregnated with a resinous material or a metal to increase structural strength. The porosity of the product can be controlled. The porosity of an unimpregnated product of good structural strength may be from 10% to 30% and of impregnated materials from 5% to 25%. The

compression strength may vary from 4000 to 50,000 pounds per square inch. The compression at the rupture point varies from .01 to .02 and the modulus of elasticity from 600,000 to 3,000,000. These porous carbons, however, have a high modulus of resilience and sufficient yieldability under compressive stresses such as caused by impact with a golf ball to materially increase the elastic energy which imparts velocity to the ball.

Reference should be had to the accompanying drawings forming part of the specification in which:

FIGURE 1 shows a golf club of the wood type having a porous carbon striking face, and embodying the invention;

FIGURE 2 is a fragmentary section taken on the line indicated at 2—2 in FIGURE 1;

FIGURE 3 shows another golf club of the wood type formed of molded plastic and having a porous carbon striking face;

FIGURE 4 is a fragmentary section taken on the line indicated at 4—4 in FIGURE 3;

FIGURE 5 is a fragmentary section taken on the line indicated at 5—5 in FIGURE 3;

FIGURE 6 is a perspective view of a porous carbon block of the type used in the golf club head of FIGURES 1 and 3;

FIGURE 7 shows the invention applied to a club of the iron type, the porous carbon block having a tight fit in a recess cut in the striking face of the club;

FIGURE 8 is a sectional view taken on the line indicated at 8—8 in FIGURE 7;

FIGURE 9 shows the invention applied to a putter having a forged metal head with a circular recess that receives a radially compressed porous carbon insert;

FIGURE 10 is a sectional view taken on the line 10—10 of FIGURE 9;

FIGURE 11 shows the invention applied to a putter having a head formed of pressed powdered metal and having a circular recess that receives a radially compressed porous carbon insert; and

FIGURE 12 is a sectional view taken on the line 12—12 of FIGURE 11.

In FIGURES 1 and 2 of the drawings, a golf club of the wood type is shown which has a head 1 with a shank 2 and shaft or handle 3. The head 1 has a substantially flat striking face 4 that is provided with an undercut recess 5 extending across it from top to bottom in which an insert in the form of a block of porous carbon 6 has a close fit.

The head 1 may be made of wood, plastic material, or of a light metal such as aluminum or magnesium alloy and the recess 5 may be cut across its face. The porous carbon block 6 may be molded to approximately the desired shape and then accurately finished to snugly fit in the recess 5 with its outer face flush with the face 4. If the head is made of wood, the carbon insert 6 may be rigidly secured in the recess 5 by means of a suitable adhesive preferably an epoxy resin or similar cement. If the club head is formed of a plastic material it may be molded around the porous carbon insert. If the club head is formed of an aluminum or magnesium alloy it may be cast around the porous carbon insert. If the club head is composed of a metal or plastic the carbon insert may be firmly held by expansive thrust on the walls of the recess into which it has been forced under pressure.

FIGURES 3, 4 and 5 show another form of golf club of the wood type having a head 7 of molded plastic which has been cast to the desired shape. The club head 7 includes a shank 8, a shaft or handle 9, a striking face 10 and an insert 11 in the form of a block of porous carbon. The insert 11 may be integrally mounted in the head 7 during the casting or molding of the plastic material. Molding techniques well known in the art, such as injection molding, may be used for this purpose. The plastic material has a higher coefficient of thermal expansion than

the carbon and shrinks upon cooling to place the insert 11 under compression.

FIGURE 6 shows a porous carbon block of the type used in the plastic club head shown in FIGURES 3, 4 and 5. The block has a trapezoidal form and beveled edges 12 and 13 so that it is locked in place in the plastic head when the head is formed.

FIGURES 7 and 8 show a club of the iron type having a metal head 14 which may be in the form of a forging and which has a striking face 15 in which a recess 16 has been cut. A porous carbon insert 17 is accurately machined to a shape corresponding to that of the recess but preferably slightly oversize so that it can be forced into the recess 16 after the head 14 has been expanded by heat. Since the coefficient of thermal expansion of the porous carbon is much less than that of the metal, the insert will be firmly held under radial compression when the head is cooled. The insert may also be pressed into the recess 16 without thermally expanding the head 14 since the porous carbon is compressible and will not stretch the surrounding metal. This interference fit is just as effective to hold the insert in place and is preferred because it is a much cheaper method of assembly.

FIGURES 9 and 10 show a club of the putter type having a metal head 18 that may be cast around a porous carbon insert 19. The metal of the club head is preferably brass or bronze and has a face 20 that is flush with the face of the insert 19. Here, too, the insert may be mounted equally as well by press fitting it in a recess machined to size.

FIGURES 11 and 12 show another golf club of the putter type having a head 21 formed of powdered metal which has been pressed into the desired form and sintered. The club head 21 includes a hollow shank portion 22 which receives the end of a shaft or handle 23, and a cylindrical insert 24 of porous carbon which extends through the central portion of the head 21.

The head is initially formed with a circular opening slightly smaller than the porous carbon insert 24 so that the insert may be pressed into the opening and compressed sufficiently to hold it tightly in place. The club has two striking faces with porous carbon surface portions so that it may be used equally as well by both right handed and left handed golfers. The head is axially balanced with respect to the axis of the club shaft and has forward and rearward raised portions 24 and 25 which provide more mass at the extremity to give the club improved stability during the putting stroke.

Located on the top of the club head 21 immediately above the center of the insert 24 is a shallow groove 26 which is useful in aligning a golf ball with the center of the insert which is the center of the striking face.

It is to be understood that in accordance with the provisions of the patent statutes, variations and modifications of the specific devices herein shown and described may be made without departing from the spirit of the invention.

What I claim is:

1. A golf club having a head provided with a recess opening to its striking face and an impact member in

the form of a porous carbon insert fitting in said recess and subjected to compression stresses exerted thereon by the material of said head acting in planes substantially parallel to said striking face and resisting movements of said insert in said recess.

2. A golf club as set forth in claim 1 in which a body of metal surrounds the porous carbon insert and exerts a compressive stress thereon.

3. A golf club as set forth in claim 1 in which the club head is composed of a moldable plastic material having a coefficient of thermal expansion greater than that of the porous carbon insert and that is cast around the porous carbon insert.

4. A golf club as set forth in claim 3 in which the porous carbon insert is impregnated with a plastic material that is compatible with the plastic material of the head.

5. A golf club having a head provided with a recess opening to its striking face and having a circumferentially continuous peripheral wall substantially perpendicular to said striking face and an impact member in the form of a porous carbon insert fitting within said peripheral wall and thereby subjected to radial compression.

6. A golf club having a head formed of powdered metal, said head having an impact member in the form of a porous carbon insert mounted therein flush with the striking face of said club head and having compression stresses exerted thereon by the material of said head acting in planes substantially parallel to said striking face and resisting movements of said insert in said club head.

7. A golfer's putter for use by both right handed and left handed golfers, having a head with two oppositely facing striking surfaces and having an impact member in the form of a porous carbon insert mounted therein and extending transversely therethrough with end faces flush with the striking surfaces of said head, said insert being subject to compression stresses exerted thereon by the material of said head acting in planes substantially parallel to said striking face and resisting movements of said insert in said club head.

8. A golfer's putter as defined in claim 7 wherein said club head is formed of powdered metal.

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