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2,908,502

**CERAMIC COATED GOLF CLUB HEAD**

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This invention relates to golf clubs and more particularly to such clubs having heads coated with a non-brittle ceramic material.

Practically all golf club manufacturers are faced with the problem of coating the ball-striking head of their products with long lasting protective materials. The head surface not only suffers repeated impacts with golf balls and tees but in normal usage is vigorously contacted with earth, sand, mud, pebbles, and the like. Since club heads are made basically of iron or steel (the "irons"), or wood combinations (the "woods") surface protection of such heads must be provided, first to guard against physical damage and second against rust, moisture, and other natural elements.

In the case of the irons either individual metals such as copper or alloys have been plated onto the head surface. While this may temporarily alleviate the physical destruction and rusting problems, as the plated surface is subjected to normal play, portions of the plated material are destroyed, nicks develop in the head and marked pitting may result. In the woods, on the other hand, plastic coatings have been applied primarily to protect against shock and moisture. Here again, as the club is used, the coating is destroyed with the subsequent deterioration of the head. We have found that golf club heads may be coated with non-brittle ceramic materials, whereby longer-lived superior products are obtained. Irons thus coated may be used for long periods of time without the aforementioned deteriorating effect illustrated by the metal coatings. Head surfaces retain their dimensions without pitting or cutting and the rusting process is either considerably diminished or completely prevented.

A further factor in golf club head surfacing is the fact that such surface should impart a certain degree of spin to the golf ball upon impact. By providing a somewhat roughened granular ceramic coating the head surface readily imparts such spin.

It is therefore an object of the instant invention to provide golf clubs having ceramic coated heads.

Other objects, features and advantages of our invention will become obvious to those skilled in the particular art from the following detailed disclosure thereof.

Ceramic coatings may be applied to golf clubs by any known means as, for example, by spraying, painting or dipping. In those cases where the base or club head may withstand moderate heating ceramic particles may be coated thereon by the spraying process described in the United States Patent No. 2,763,569, or the coating may be applied by a flame spraying process as described in our copending patent application Serial No. 524,598, filed July 26, 1955.

Certain characteristics are required of the ceramic coatings which may be used in this invention. They must be strongly adherent to the club head's surface, quite non-brittle, and be capable of undergoing rather violent shock without cracking. We have found that thin coatings are best suited for our purposes since thick

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coatings have a tendency to crack, chip or peel from the surface to which they are applied. Furthermore thick coatings are more responsive to thermal shock and thus temperature variations could be a problem. Another factor to consider is weight. Thin ceramic coatings add only a negligible weight factor to the club and thus do not interfere with standards imposed for club weights or the balance of the club head.

We have found that crypto crystalline titanium oxide (TiO<sub>2</sub>) coatings are admirably suited for the instant invention. This is readily applied as a thin tenacious coating to provide a long lasting finished surface. When this coating is applied by a flame spraying technique an almost black coating results, of somewhat granular nature that is retained in place despite intensive and repeated shock subjection.

In order that our invention may be fully understood the following detailed examples of how the instant coatings may be applied is presented:

*Example I*

An appropriate coating is flamesprayed rutile. The working area of the face of the club in the case of an iron or putter or the heel and sole plates of a wood, or the entire head of a sand wedge or "exploder" is first cleaned and roughened by a blasting technique. For this purpose a coarse abrasive such as sand, alumina grain, silicon carbide or steel grit, all of approximately 20 mesh size, may be used as the blasting medium. In actual operations we found that iron or steel grit, while useful and operative, are the least satisfactory agents. Prior to blasting the club head is masked in order that only the area to be coated is affected.

The apparatus necessary for the flame spraying of rutile consists essentially of a powder feed dispenser, and oxyhydrogen torch, and attendant tanks, gauges, hoses, and preferably a vibrator for the feed dispenser. As is fully described in our identified copending flame spraying patent application the material is fed through the flame onto the surface to be coated. The feed material is carried into the flame by one of the gases, preferably oxygen. The fuel gas may be, for example, hydrogen or acetylene, but hydrogen is preferred. A commercial grade of milled rutile is used as the feed material. The feed rate is regulated by the action of the vibrator and by a by-pass conduit on the oxygen stream. We prefer to use a stoichiometric hydrogen to oxygen ratio in order to obtain maximum coating toughness and deposition rate, although suitable coatings may be produced with a 50 percent excess of either gas. We found that 120 cubic feet per hour (c.f.h.) of hydrogen and 60 c.f.h. of oxygen, and a powder feed rate of about 2½ pounds per hour (20 grams per minute) provides optimal results. Assuming a spray efficiency even as low as 50% a 5 mil coating is applied at the rate of 15 to 20 square feet per hour. Such rutile coating has a density of about 200 pounds per cubic foot.

The roughness of the coating is controlled by the particle size of the material fed, which may be as small as -325 mesh but may also include particles as large as 30-25 mesh where a rough coating is desired.

The coating is formed apparently by the sintering of the rutile on the surface of the club head due to the heat of the flame. From such heating the rutile is reduced to form a blue-black oxygen deficient coating which is quite tough and only slightly porous. For the purposes of the instant invention a coating 2 to 3 mils thick is quite adequate and for normal usage thickness in excess of 5 mils is unnecessary. Where the thickness exceeds 15 mils there may be a tendency toward chipping failure from impact.

For thin coatings (i.e., less than 5 mils) cooling of

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the club head during the coating process is not required for the coating will be fully applied before the flame can overheat the head. The same is, of course, true of those coatings for the plates attached to woods and brass heads if such plates are coated prior to assembly.

*Example II*

The rutile coating described in Example I provides a dark coating for club heads. A white coating is obtained by flame spraying alumina (aluminum oxide). Since such coating is porous, it may be colored after deposition if such is required.

The surface to be coated is first blasted with preferably 20 mesh alumina grain or sand. Following this, the alumina is applied. The feed is again carried in the oxygen stream of an oxyacetylene torch. We prefer to use an oxyhydrogen flame, but oxyacetylene may also be used. In those cases where the alumina is carried into the flame as a sintered rod or is not aspirated into the flame in one of the fuel gases the use of oxyacetylene is more suitable.

We have found that a feed rate of 40 grams/minute of powdered alumina at 120 c.f.h. hydrogen and 60 c.f.h. oxygen produces a coating of optimum characteristics. Higher feed rates may result in spurts of incompletely heated powder whereas lower feed rates are inefficient commercially.

The above conditions permit an application rate of from 15 to 20 square feet per hour for a coating 10 mils thick (assuming a 50% spraying efficiency). The density of the coating is approximately 167 lbs./ft. The alumina employed is a finely ground (-325 mesh), pure (99% plus) calcined material.

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Alumina coatings may be applied at a thickness of from 2 to 30 mils before the danger of chipping is incurred. Preferably a 5 to 10 mil coating is used in order to assure even coloration thereof. The coating may be polished by grinding with emery or the like.

Other oxides, phosphate bonded ceramics, silica bonded ceramics, and the like, may be used in the instant invention.

We claim as our invention:

1. A metal golf club head, the impact surface of which is coated with a roughened, granular, crystalline oxide coating, said oxide being selected from the class consisting of rutile and alumina.

2. A steel golf club head, the impact surface of which is coated with a roughened, granular, crystalline oxide coating, said oxide being selected from the class consisting of rutile and alumina.

3. A metal golf club head, the impact surface of which is coated with roughened, granular, crystalline rutile, said rutile coating being from 2 to 15 mils thick.

4. A metal golf club head, the impact surface of which is coated with roughened, granular, crystalline alumina, said alumina coating being from 2 to 30 mils thick.

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