

Sept. 23, 1969

A. J. ANTONIOUS
GOLF CLUB OF THE WOOD TYPE WITH IMPROVED
AERODYNAMIC CHARACTERISTICS

3,468,544

Filed Oct. 22, 1965

3 Sheets-Sheet 1

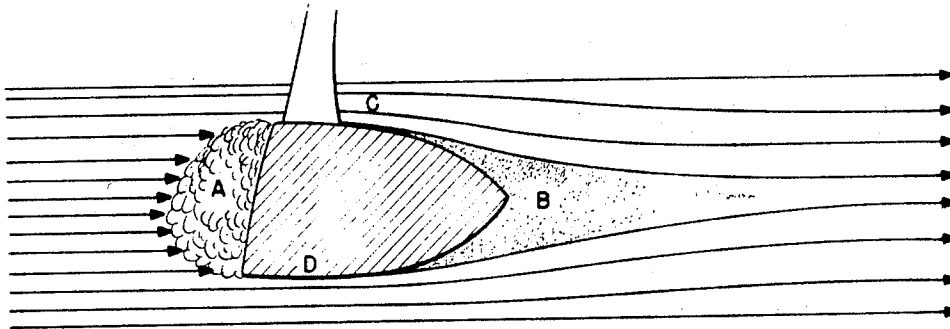


FIG. 1. PRIOR ART

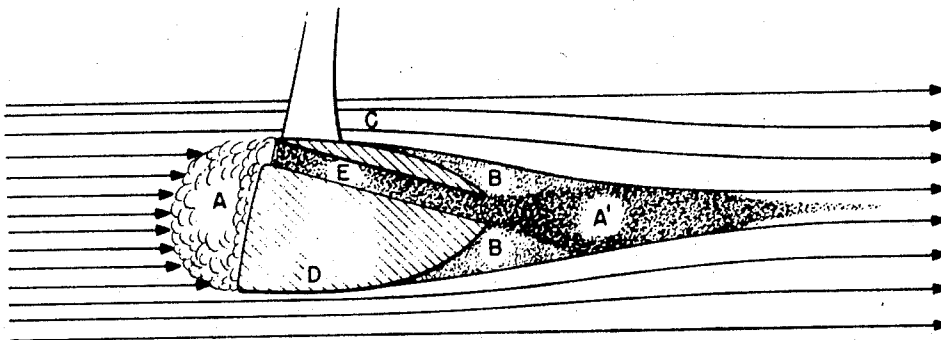


FIG. 2.

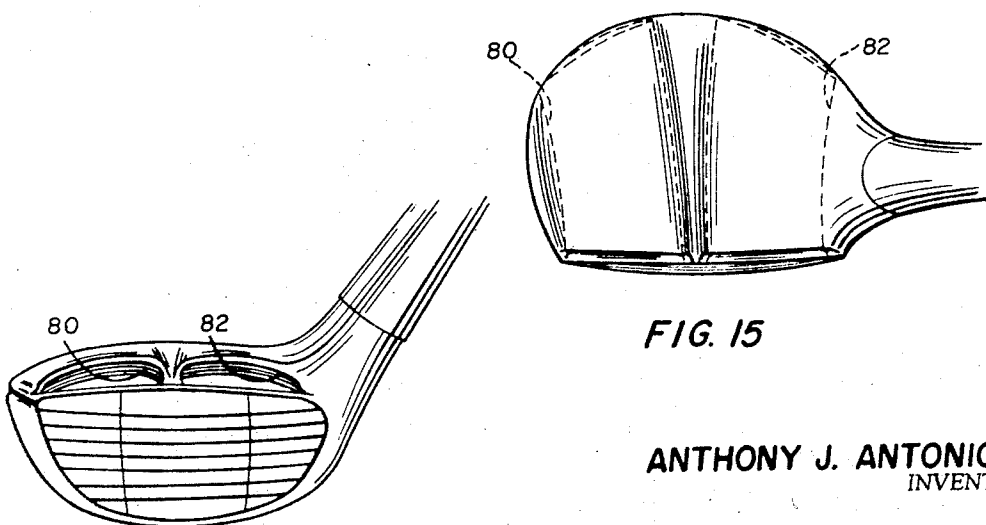


FIG. 15

FIG. 16

ANTHONY J. ANTONIOUS
INVENTOR

BY *Sughrue, Rothwell, Moin, Lunn & Macpeak*
ATTORNEYS

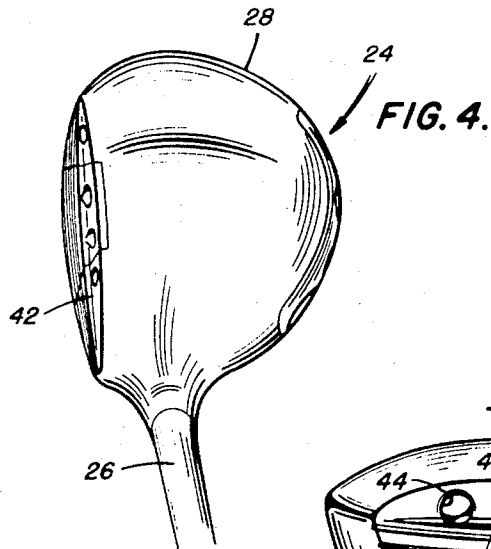
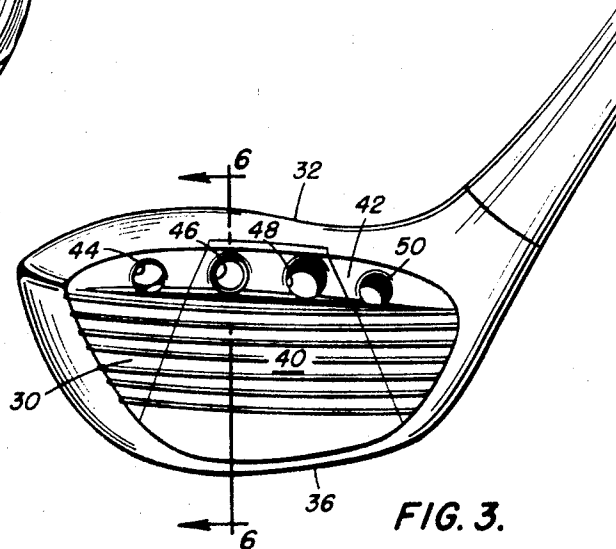
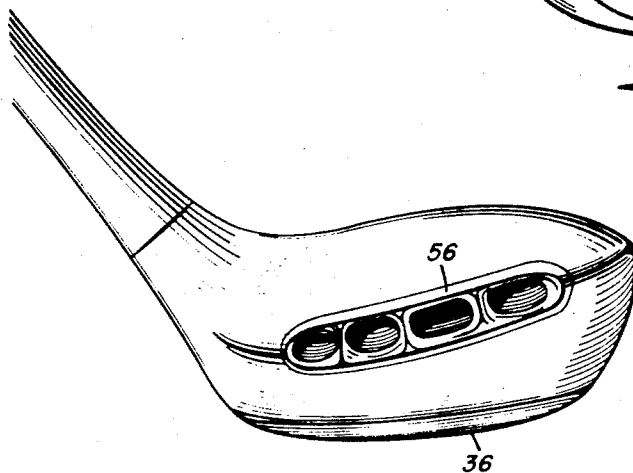
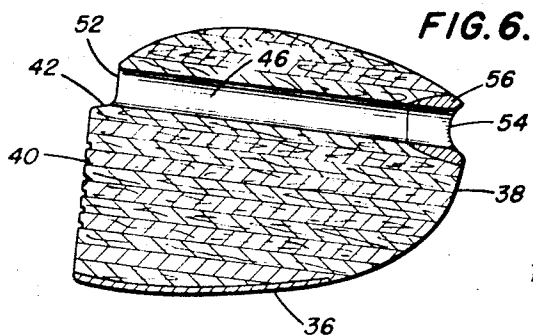
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ANTHONY J. ANTONIOUS
INVENTOR

BY *Stephen R. Rottman, Mon. L. L. & M. J. M. J.*

ATTORNEYS

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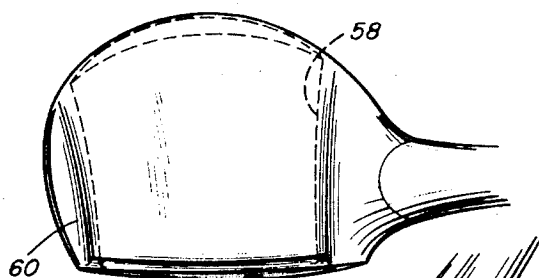


FIG. 7.

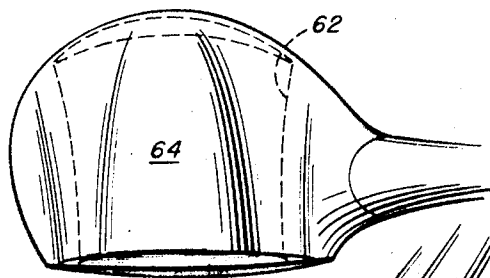


FIG. 9.

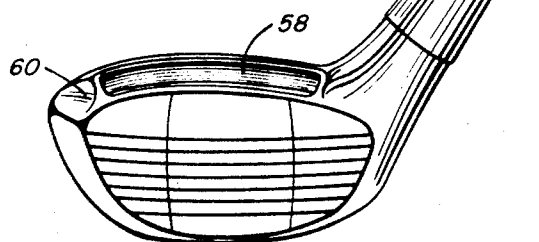


FIG. 8.

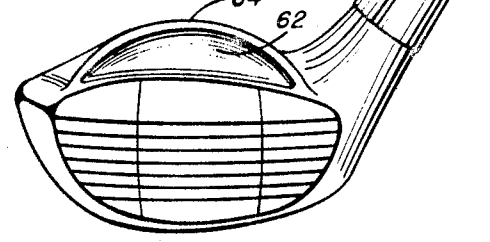


FIG. 10.

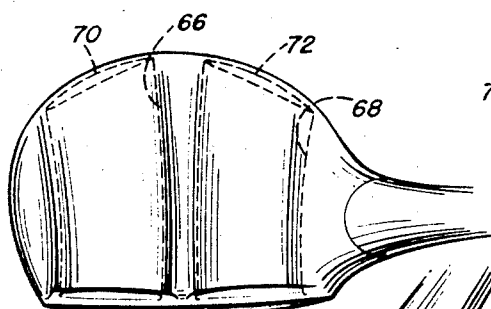


FIG. 11.

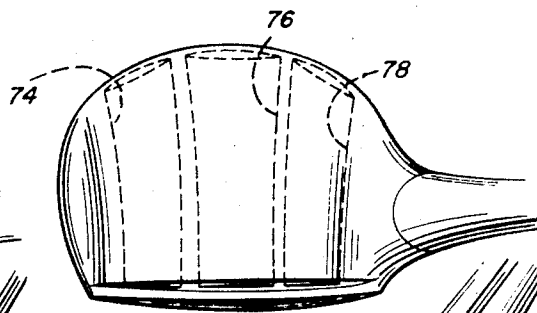


FIG. 13.

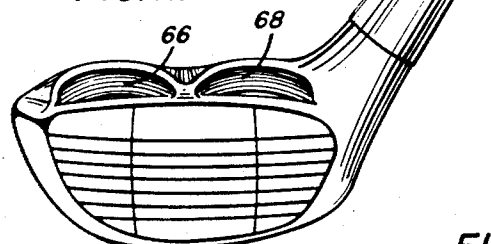


FIG. 12.

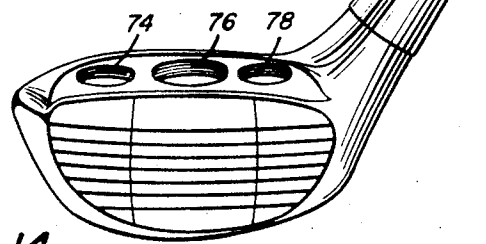


FIG. 14.

ANTHONY J. ANTONIOUS
INVENTOR

BY *Seymour, Rothman, Miron, Linn, & Mayne*

ATTORNEYS

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GOLF CLUB OF THE WOOD TYPE WITH IMPROVED AERODYNAMIC CHARACTERISTICS

Anthony J. Antonious, 3608 Cedar Drive,
Baltimore, Md. 21228

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2 Claims

ABSTRACT OF THE DISCLOSURE

A golf club of the wood type has aerodynamically sized and shaped holes extending therethrough under the top surface of the club head with the inlet to the holes above and set back from a ball striking face and the outlet of the holes on the back surface of the club at a level below the inlet.

This invention relates to improvements in golf clubs and, more particularly, to improvements in golf clubs incorporating advanced aerodynamic designs.

In the game of golf, woods are used for some of the longer shots such as the tee shots and such woods are usually heavier and have longer shafts and, for most golfers, are more difficult to control than the irons which are used for fairway play and shorter shots. Since the standard woods are longer shafted and generally heavier than golf club irons, they are capable of producing a larger swing arc. A golfer can thereby obtain more distance in his drives by using such clubs, but they are more difficult to control.

The broad general objectives of this invention are to provide a golfer with a wood club head capable of driving a golf ball a greater distance with greater control and confidence than golf clubs currently available and used, without requiring any more energy or force normally used by a golfer using comparable standard equipment.

This accomplishment has been realized by the appropriate aerodynamic principles applied to the design and construction of the club head wood as explained hereinafter.

Other features of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose by way of example, the principle of the invention and the best mode which has been contemplated of applying that principle.

In the drawings:

FIGURE 1 is a schematic illustration of the air flow over a golf club of the wood type known in the prior art;

FIGURE 2 is a schematic illustration of the air flow through a golf club of the wood type as disclosed in this invention;

FIGURE 3 is a front elevation view of a preferred form of the golf club of this invention;

FIGURE 4 is a top plan view of the club shown in FIGURE 3;

FIGURE 5 is a rear elevation view of the club shown in FIGURES 3 and 4;

FIGURE 6 is a sectional view taken along line 6-6 of FIGURE 3;

FIGURE 7 is a top plan view of a modification of the golf club of this invention;

FIGURE 8 is a front elevation view of the club of FIGURE 7;

FIGURE 9 is a top plan view of another modification;

FIGURE 10 is a front elevation view of the club of FIGURE 9;

FIGURE 11 is a further embodiment of the club of this invention;

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FIGURE 12 is a front elevation view of the club of FIGURE 11;

FIGURE 13 is an additional modification of the golf club of this invention;

FIGURE 14 is a front elevation view of the club of FIGURE 13;

FIGURE 15 is a still yet another embodiment of a golf club including the features of this invention;

FIGURE 16 is a front elevation view of the club of FIGURE 15.

In this invention substantial increase in club head speed has been realized by providing a golf club head having means defining one or more air passages, ducts, tunnels, vents or scoops cut therethrough. This permits air to also flow through the club head rather than just around it, thereby reducing wind resistance considerably. The air that flows through the passages is controlled and directed to exhaust in the low pressure area at the rear of the club. This ram air exhausting through the club head into the wake or base region (rear of club head) raises the base pressure and decreases the base drag. Therefore the total drag of the club head is reduced by allowing a certain portion of the impinging air to pass through, rather than around the club head and by increasing the pressure in the near wake region. As a result the club, when swung, will accelerate more freely, increasing its speed as it strikes the ball. In fact, configurational studies and tests have already demonstrated drag reductions on the order of 20%. Greater drag reductions are possible by modifying the size of ducts and/or increasing the number of ducts through the club head.

The standard golf wood of the prior art, FIGURE 1, generally has an air flow as shown. In region A the air is compressed against the face creating a high pressure region. As the air flows about the club head, it separates from the surface forming a low pressure region B. The aerodynamic drag associated with the club head is determined by the difference of the pressures in A and B acting on the club head. In the case of this invention, FIGURE 2, air is ducted through the club head E and introduced into this former low pressure area B, raising the pressure in area A'. Since the pressure difference is now reduced the aerodynamic drag is also reduced.

The air ducts of the golf club of this invention have been aerodynamically designed to permit the most effective flow of air currents through the club head. This constant stream of ram air generates a buoyant force or lift that makes the club head feel like it is floating when it is swung with some force. By virtue of such lift capabilities, a golfer is able to swing a heavier golf club with the same ease and proficiency that he can swing a lighter one, thereby increasing the distance of his drives. By way of illustration, a golfer can easily swing a golf club wood of this design whose club head weight has been increased 10% or even more. FIGURE 1 demonstrates how a regular standard golf wood obtains its lift properties. The increased acceleration of the air C flowing over the curved top of the club head as compared to the air D flowing under the flat bottom of the club head creates a higher pressure at the bottom. This pressure difference causes a resultant lifting force. FIGURE 2 demonstrates the use of ducts to increase the lifting force. The ducts act as a lifting air foil by increasing the pressure within the club head itself to assist in the lifting direction. Further the jet-air exhausting in a downward direction causes an opposite or upward reaction on the club head which also increases the lifting capabilities.

By introducing ducts through the club head, air drag has been reduced and the lifting capability has been increased. This has the following effect on a golfer who swings a golf club at the rate of 100 miles per hour.

Newton's second law of motion is that force is equal to mass times acceleration. Rewriting this equation as

$$F = \frac{W_c V_c^2}{2gS} \quad (1)$$

allows calculation of the force required to accelerate a club head to the desired velocity.

W_c is the weight of the club head, assumed 7 oz. or .437 lb.

V_c is the club head velocity.

g is the acceleration of gravity, 32.2 ft./sec./sec.

S is the distance of club head travel, assumed 17 feet.

Thus, to accelerate the club head at 100 m.p.h. or 146.7 ft./sec. it requires a force of 8.59 pounds. In addition, it is necessary to overcome the aerodynamic drag acting on the club head. Based on results obtained in wind tunnel tests, the drag acting on a standard manufactured driver is 1.43 pounds at 100 m.p.h., whereas for the driver of this invention the drag is 1.10 pounds. For the standard driver, the total force required is 10.02 pounds and for the driver of this invention it is 9.69 pounds. Since the golfer is able to exert the 10.02 pounds of force required by the standard club, an additional 0.33 pound is available for acceleration with the driver of this invention.

Rewriting Equation 1 gives

$$V_c = \sqrt{\frac{2gSF}{W_c}} \quad (2)$$

and the velocity associated with the additional force may be calculated. This results in a velocity of 149.7 ft./sec. or an increase of 3.0 ft./sec. using the driver of this invention with the same total force.

Additionally, it has been demonstrated in the wind tunnel tests that the duct configuration of the club head of this invention generates a lifting force which overcomes a part of the club head weight. Thus a golfer is able to swing a heavier (greater swing weight) club with the same ease and proficiency that he formerly swung the lighter standard club. Conservatively this lift force is taken as 10% of the club head weight to demonstrate this feature. Thus, a club head weighing 0.481 pound with this feature would "feel" and swing like a club head weighing 0.437 pound and could be accelerated to the same final velocity for the same force input. However, now a greater weight or mass is available for impacting the golf ball.

The following relation may be used to obtain the momentum transfer between the club head and golf ball.

$$V_b = \frac{W_c V_c}{W_b W_b} (1 + e) \quad (3)$$

where

V_b is the velocity of the golf ball, ft./sec.

W_b is the weight of the golf ball, 1.62 oz. or 0.101 lb.

e is the coefficient of restitution

The coefficient of restitution is assumed to act according to the empirical relation

$$e = 0.85 - 0.0025 V_c \quad (4)$$

With Equations 3 and 4 the velocity of the gold ball leaving the club head can be obtained. Taking the weights as 0.437 and 0.481 pound and velocities as 146.7 and 149.7 ft./sec. for the standard and the clubs of this invention respectively, the golf ball velocities are 176.5 and 182.4 ft./sec.

Using the results presented in an article by J. M. Davies appearing in the Journal of Applied Physics, September 1949, pp. 821-828 entitled The Aerodynamics of Golf Balls and Equations 3 and 4, it is possible to obtain a relation between golf ball velocity and distance. This may be written as

$$\text{Distance} = 154.3 + 2.42 (V_b - 151.0) \quad (5)$$

Therefore, for the standard driver, the distance is 213 yards (carry). For the driver of this invention, with reduced drag and increased lift, the distance is 227 yards (carry) or a net gain of 14 yards (carry).

Thus, it is demonstrated that by using a driver with the principles contained herein and embodied in it, it is possible for a golfer who swings a standard club at 100 miles per hour to increase the distance of his drive by 14 yards or 6.7% without exerting any additional force.

In addition to reducing drag and generating lift, it has been found that club heads, with air passages or ducts, have greater flight stability when swung. The passages or ducts act as directional vanes and tend to maintain the club head in its desired glide path, thereby minimizing twisting of the club and permitting the club face to remain square throughout impact with the ball, hitting the ball solidly rather than glancingly. This also permits a wider controlled swing arc in the impact region giving the golfer the maximum force at impact from his swing. Thus, the golfer will experience a greater "sensing" control or "feel," and the likelihood of hitting the ball with the center of the club face will be greatly increased. These latter features are of particular importance to the amateur golfer who frequently fails to hit the ball squarely, thereby causing a severe decrease in the energy transferred to the ball from the club.

Club heads constructed with air passages in accordance with the teachings of this invention have also been found to produce a "humming" or "swhooshing" sound when swung properly along its glide path. This sound emanates from within the club head itself, and is a potent training factor as a constant indication to the golfer of the quality of his swing.

It has been found that a golfer can develop the proper golf swing more easily and quickly by audibly recognizing a distinctive whistling or humming sound created by the club when it is swung properly. Devices have been created which set on top of club heads and whistle when the clubs are swung forward or backward, but such devices have not proven to be entirely satisfactory. Such devices whistle regardless of the direction in which the clubs are swung, and thus do not effectively indicate speed or direction. Another disadvantage of such devices is that they ordinarily must be imbedded on the tops of wood club heads or in recessed openings in iron clubs. Thus, they detract from the beauty of the clubs and depreciate their value. Moreover, they are often cumbersome and vulnerable to being knocked off or out of proper alignment with the club heads when they are replaced in bags after use. Still another disadvantage of such a device is that it may be disconcerting to the golfer to have the device on top of the club head. Also, grass, dirt and other particles can imbed in the openings of these devices and render them inoperable; and some golfing associations prohibit the use of such devices. The present invention provides a golf club head equipped with means for creating a distinctive humming or swhooshing sound when the club is swung in a proper path and plane, and which is not subject to any of the foregoing deficiencies.

Referring now to the FIGURES 3-6 embodiment for a general description of the entire invention, as applied to a specific embodiment, a golf club 24 of the wood type includes a shaft 26 and a club head 28. The club head includes a front surface 30, a top surface 32, a bottom surface 36 and a rear surface 38. There is a ball striking area 40 on the front surface 30 of the club head.

The invention resides in aerodynamically designed air flow passages extending through the club head. In the embodiment of FIGURES 3-6 there is a set back 42 above the ball striking surface 40 and through this set back extend four passages 44, 46, 48 and 50. These passages are all similar, although they extend in slightly different directions as shown in FIGURE 3. Each passage such as passage 46 shown in FIGURE 6 includes an inlet 52 in the front face of the club and outlet 54 in the rear surface

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of the club and an outlet insert 56 to assist in the aerodynamic air flow. This construction results in the advantages as set forth above in that it results in a substantial increase in the club head speed by permitting air to flow through the club rather than around it and this reduces the air resistance considerably. The air ducts through the head permit the stream of ram air going through the head to generate a buoyant force or lift that makes the club head float. In addition to reducing drag and generating lift, the air passages also contribute to greater club head stability and control since the passages or ducts act as directional vanes and tend to maintain the club in its desired flight. Finally, the air passing through the club head in the passages makes a distinct noise which emanates from the club head itself and is a unique training aid.

FIGURES 7 and 8 illustrate one modification of the invention wherein there is an air passage 58 extending through the club head as a single unitary passage and the sides of the passage extending upwardly creating fillets 60 in the top of the club head.

FIGURES 9 and 10 illustrate another variation wherein air passage 62 includes a dome-shaped intake or top 64.

In the embodiment of FIGURES 11 and 12 there are two air passages 66 and 68 extending through the club head in a somewhat curved fashion and terminating in outlets 70 and 72.

In FIGURES 13 and 14 there are three air passages 74, 76 and 78 extending through the club head above the ball striking surface.

In FIGURES 15 and 16 two air passages 80 and 82 have inlets of general airfoil section and this configuration is somewhat similar to FIGURES 11 and 12 other than the shape of the inlet to the air passages.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the

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foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A golf club of the wood type including a shaft and wood club head having improved aerodynamic characteristics, the club comprising; the wood club head having front, rear, opposite sides, top and bottom surfaces, a ball striking area on the front surface of the club head, means defining at least one aerodynamically shaped enclosed air flow passage through the club head, said passage having an inlet in the front surface of the club head above the ball striking area and set back from the ball striking area, said passage extending through the club head underneath and adjacent to the top surface of the club head and opening in the rear surface of the club head at a level below the inlet.

2. A golf club as defined in claim 1 wherein there are at least two separate generally parallel air passages.

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ANTON O. OECHSLE, Primary Examiner

PAUL E. SHAPIRO, Assistant Examiner

U.S. Cl. X.R.

273—167