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This invention relates generally to golf clubs, and more particularly to golf club irons of improved construction to achieve advantages, such as audible sound attenuation, twist resistance, during impact with golf balls, and delayed momentum transfer to golf balls during stroking. In this regard, and in the past, irons evolved in design from flat back to hollow back structure, the present invention providing a further evolution in back structure to achieve virtual head enlargement effects, and attenuation of audible sound created during impact with a golf ball.

Many efforts have been made to design iron heads to achieve higher energy availability for transfer to the golf ball when the ball is impacted by the head. However, no way was known, to our knowledge, to achieve delayed momentum transfer to the ball, over the very short time interval when the ball remains in contact with the head face, in the novel and unusual manner as achieved by the present invention; and no way was known to couple such delayed energy transfer with head twist resistance, in the manner to be described.

Also, no way was known to attenuate audible sound created by impact with a golf ball by a front wall that has reduced peripheral rigidity due to weight

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displacement, as will be described.

Embodiments of the invention variously provide an improved iron head construction meeting the need for delayed momentum transfer to the ball during club stroking and attenuation of audible vibration as well as club head increased twist resistance. Basically, the invention as embodied in a head metallic body, is constructed to define two intersecting recesses rearwardly of the head front wall, and bounded by head metallic extents projecting rearwardly proximate peripheral regions of the head face defining front wall via web means adjacent the head front wall periphery. For example, the head may include:

a) a body defining a forwardly extending main recess located rearwardly of the front wall,

b) and the body also defining an undercut recess located directly rearwardly of the front wall and extending outwardly from the main recess toward at least one of the following:

i) the top wall

ii) the bottom wall

iii) the toe

iv) the heel,

c) together with means on the front wall and located forwardly of the main recess for attenuating audible vibration created when a golf ball is struck by the front face.

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As will be seen, the attenuation means may include a thin plate, and adhesive material securing the plate to the rear side of the front wall. The front wall rear side may be recessed to receive and confine the plate and adhesive. Further, the undercut recess may extend outwardly from its intersection with the main recess and away from the attenuation plate periphery toward both of the top and bottom walls, and toward the toe and heel, whereby the undercut recess may then bound the main recess. This construction also facilitates slightly delayed forward transfer of momentum of the body metal rearwardly of the undercut recess, to the front wall and front face, via peripheral extents of the head. Such peripheral extents may be localized due to provision of slits, as will appear.

The metal of the head may have reduced thickness to form webs directly rearwardly of the front wall periphery, due to the provision of the undercut recess, as referred to. Thus, the undercut recess typically extends upwardly to points along the head length rearwardly of the top of the front wall front face, and downwardly to points along the head length rearwardly of the bottom of the front wall front face. This also enables reallocation of some metal to project rearwardly from the looping recess, enhancing head peripheral weighting for anti-twist effect; and any tendency of the front wall to create sound may be partly and significantly reduced due to provision of the attenuation means.

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The recess, as referred to, may extend in a loop that lies generally parallel to the inclined front face of the iron. The slits, as referred to, extend toward that loop, the inclination of which varies with the number of the iron, designating different front face inclinations, as for example 1 to 9 irons and wedges.

The head may be provided with a rearward projection with upward thickening between the bottom wall and the main recess, and rearwardly of the undercut recess that extends toward the bottom wall; and the head may also have a rearward projection with downward thickening between the top wall and the main recess, and rearwardly of the undercut recess that extends toward the top wall.

A set of irons may be provided, each iron incorporating the dual intersecting recesses, with audible vibration attenuation, as referred to, and the rearward projections extending generally horizontally irrespective of the angles of the front faces of the irons in the set.

These and other aspects and advantages of the invention, as well as the details of illustrative embodiments, will be more fully understood from the following specification and drawings, in which:

Fig. 1 is a rear elevation of the head of a #6 iron of a golf club set incorporating the invention;

Fig. 2 is a section taken on lines 2-2 of Fig.

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Fig. 3 is a section taken on lines 3-3 of Fig. 1;

Fig. 4 is a top plan of the Fig. 1 head;

Fig. 5 is an enlarged, fragmentary vertical section similar to Fig. 2; and

Fig. 6 is a still further enlarged, vertical section taken through a thin plate and adhesive means thereon, for use on the head.

Referring first to Figs. 1-3, the illustrated golf club head 10, in the form of a #6 iron of a set, has a body 11 defining a heel 12, toe 13, top wall 14, and sole 15. The rear of the sole is beveled at 15c, as shown. The body also defines an upwardly and rearwardly inclined front face 16 at the frontal side of an associated front wall 17. A hosel is shown at 18 and integrally joins the head via offset 18a; and a shaft 19 extends into a through bore 18b in the hosel as shown, and is anchored therein in a suitable manner, as for example by adhesive or mechanically. See for example U.S. Patent 5,042,806, incorporated herein by reference. The head and hosel may consist of a one-piece, metallic steel casting, other metals and alloys being usable.

The body defines two intersecting recesses related to rearwardly elongated body projections, typically extending rearwardly, as will be described, irrespective of the head front face angularity. The two

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recesses include a forwardly and rearwardly extending main recess 21, and an undercut recess 22 located directly rearwardly of the front wall and extending outwardly from the forwardmost extent of the main recess 21, toward at least three of the following:

i) top wall 14

ii) bottom wall or sole 15

iii) the toe region 13

iv) the heel region 12.

Typically, the undercut recess portions 14a and 15a, associated with walls 14 and 15, are elongated directionally between the toe and heel, over the major length of the head, thereby enhancing the benefits which include metal redistribution toward the upper and lower peripheries of the head, and projecting rearwardly at 24 and 25, for enhancing anti-twist of the head during stroking and ball impact. Such metal rearwardly redistribution, i.e., lengthening in a rearwardly and functionally outwardly (enlarging effect) direction, as at 24 and 25, rearwardly of undercuts 14a and 15a, is believed to achieve somewhat delayed momentum transfer from the metal portions 24 and 25, to the front wall and front face 16, thereby maintaining a greater time interval of front face contact with the ball during stroking, for better ball control.

This effect may be further enhanced by the provision of at least one elongated slit extending generally parallel to the front face 16 and spaced rearwardly from that face 16, to intersect undercut 14a and the upper surface of 24.

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Note that such momentum transfer, visualized in the form of forward waves, is required to pass around and through the reduced thickness forward portions 14b and 15b of the rearwardly projecting portions 24 and 25, and at the corners 54 and 55, as well as at regions 56 and 57 near the heel; and delay of momentum or inertia travel through such restricted, narrowed regions 14b and 15b, and at 54-57, is facilitated by the outwardly concave curvature at 14c and 15c, or other similar thickness narrowing shape, bounding the outermost extents of the undercuts 14a and 15a. Enhanced performance is thereby achieved in terms of better ball stroking and directional control, through delayed momentum transfer to the struck ball.

The undercut recess portions 12a and 13a, associated with the heel and toe, and associated metal redistribution rearwardly and functionally outwardly (i.e., enlarging effect) from those undercuts, at corners 54-57, contribute to and add to the same effects as described above for the undercut recess portions 14a and 15a at those corners. The undercut recess projects outwardly to an extent w_1 (which may vary, as shown); however, the front-to-rear thickness t_1 of the undercut recess is approximately as follows:

$$.5t_1 < w_1 < 1.5t_1$$

The radii of the circular curvatures at 14c and 15c are typically between .150 and .160 inches for #1 through #7 irons; between .210 and .230 for #8 and #9 irons; and between .300 and .320 for a pitching wedge; however, these dimensions can vary somewhat.

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In this regard, the rearward projections extending rearwardly from the toe and heel undercuts are rearwardly elongated in relation to their thickness dimensions, showing that metal has been redistributed to those projections to enhance the effects described and without increasing the overall vertical dimension of the head.

Note also that the dimension of the recess 21, between internal corners 29 and 30, is at least about three times greater than the depth dimension of each of the undercut recess portions 14a and 15a, in an outward direction from those corners. The inner sides 32 and 33 of the projections 24 and 25 are substantially flat in a forward to rearward direction; however, they define a loop in combination with the corresponding inner and curved sides 34 and 35 of the projections 26 and 27, that loop subtending the major aerial extent of the front face, including a "sweet spot". Correspondingly, all undercut sections 14a and 15a, 12a and 15a, also define, preferably, a loop.

It will be understood that #1-5 and #7-9 irons have the same construction, but with associated changing front face inclinations, as in a set of such irons. Accordingly, each iron of the set has the invention incorporated therein.

Referring now to Figs. 1, 2, 4, and 5, means is provided on the front wall 17 and located forwardly of the main recess 21 for attenuating audible vibration created when a golf ball is struck by the front face.

Such means is typically attached to the rear

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side 17a of the front wall and is openly exposed to both recesses 21 and 22, the undercut recess extending about and spaced from the attenuation means. The latter is shown, for example, in the form of a thin plate (see also Fig. 4) 450 with a thin layer 451 of adhesive material adhering the thin plate to the rear side 17a of the front wall. As seen in Fig. 6, such material may take the form of a tape 451a having adhesive layers 451b and 451c at its opposite sides, to secure to the plate and also to the rear side 17a of the front wall.

The front wall rear side is shown as forming a shallow re-entrant recess 17a' receiving and peripherally confining the tape and plate. See also ridge 454 on the front wall rear side adjacent the tape and plate peripheral configurations and projecting rearwardly. The latter include like medial planar medial portions 450d and 451d, and two tape wings 450e and 450f projecting in opposite directions, i.e., toward the heel and toe, respectively, as well as corresponding adhesive wings 451e and 451f. The entirety of the plate and adhesive material are effectively in the plane of the rear side of the front wall of the head, to vibrate therewith, front to rear, and to dampen or attenuate front wall vibration. The rearward projection of the plate defines an area between 25% and 75% of the cross sectional area of the recess 21, in planes parallel to the plane of the thin plate. Also, the plate area is between 20% and 65% of the area of the rear side of the front plate subtended by both recesses 21 and 22.

The plate 450 is typically metallic and may

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consist of aluminum, with thickness between .02 and .05 inches, and total area between .35 and .75 square inches. The tape 451a may consist of paper, and the adhesives 451b and 451c may consist of epoxy resins.

Indicia 470 may be employed on the plate, to be observed via recess 21. Such indicia may be on a decal 470a adhered to the plate (see Fig. 6).

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CLAIMS

1. A golf club head having a body defining a heel, toe, top wall, sole defining a bottom wall, and a front wall defining an upwardly and rearwardly inclined front face, and comprising

a) said body defining a forwardly extending main recess located rearwardly of said front wall,

b) and said body also defining an undercut recess located directly rearwardly of said front wall and extending outwardly from said main recess toward at least one the following:

i) said top wall

ii) said bottom wall

iii) said toe

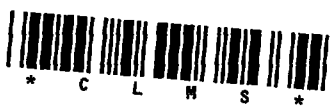
iv) said heel,

c) and means on said front wall and located forwardly of said main recess for attenuating audible vibration created when a golf ball is struck by said front face; and, optionally, either:

A) wherein said front wall has a rear side and said means is attached to said rear side and openly exposed to said recesses; or

B) wherein said undercut recess extends about said means; or

C) wherein said means includes a thin plate and



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adhesive material securing said plate to said front wall; or

D) wherein said front wall has a rear side and said means is attached to said rear side and openly exposed to said recess and said means include a thin plate and adhesive material securing said plate to said rear side of the front wall; in which case, further optionally, either:

i) wherein said thin plate has a periphery, and said front wall has a shallow re-entrant recess at said rear side receiving said plate, closely adjacent said periphery; or

ii) wherein said rear plate has an enlarged central portion and two wings projecting oppositely generally toward the toe and heel respectively of the head.

2. The golf club head of claim 1 wherein either:

a) said undercut recess extends outwardly from said main recess and adjacent said front wall in spaced relation to said thin plate toward at least two of the following:

i) said top wall

ii) said bottom wall

iii) said toe

iv) said heel; or

b) said undercut recess extends outwardly from said main recess and adjacent said front wall in spaced relation to said thin plate toward at least three of the following:

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to said thin plate toward at least three of the following:

i) said top wall

ii) said bottom wall

iii) said toe

iv) said heel; or

c) said undercut recess extends outwardly from said main recess and in spaced relation to said thin plate toward all four of the following:

i) said top wall

ii) said bottom wall

iii) said toe

iv) said heel; in which case, optionally, wherein said undercut recess extends in a loop that is generally parallel to the inclined front face.

3. The golf club head of any preceding claim wherein

a) said body has at least one elongated slit therein extending generally parallel to the front face and spaced rearwardly therefrom, the slit intersecting an outer surface defined by the body; and, optionally, either one or both of:

b) said head has rearward projection with upward thickening between said bottom wall and said main recess, and rearwardly of said undercut recess that extends toward said bottom wall; and

c) said head has rearward projection with downward

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thickening between said top wall and said main recess, and rearwardly of said undercut recess that extends toward said top wall.

4. The golf club head of any preceding claim wherein either:

a) said body is metallic; or

b) said body consists of a metallic casting; or

c) said body is a one-piece casting, and defines an iron golf club head; or

d) said undercut recess projects outwardly to an extent w_1, and has front to rear thickness t_1, where $0.5_1 < w_1 < 1.5t_1$.

5. The golf club head of claim 3 including option b) and/or c) wherein said rearward projection from the undercut recess has substantially greater overall rearward dimension than vertical thickness dimension.

6. The golf club head of claim 2 with option c) wherein said undercut recess extends outwardly toward said top wall and toward said bottom wall, the depth of the undercut recess toward said top wall being lesser than the depth of said undercut recess toward said bottom wall; and, optionally, either:

i) wherein said undercut recess toward said top wall has a substantially circular cross section adjacent said

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top wall, and said undercut recess toward said bottom wall has a substantially circular cross section adjacent said bottom wall, and rearward of the uppermost level of said front wall; or

ii) wherein said undercut recess proximate said heel and proximate the toe decreases gradually in depth in an upward direction.

7. The golf club head of claim 1 with option D) wherein said means includes a tape, with said adhesive material at opposite sides of the tape to adhere to the thin plate and to adhere to said rear side of the front wall; and, optionally, including a re-entrant recess in said rear side of the front wall, the recess and said plate and tape having corresponding peripheries, in which case, further optionally, either:

a) including a ridge on said rear side of the front wall and projecting rearwardly at said periphery of the recess; or

b) wherein the thin plate and tape define a medial enlarged portion, and wing portions projecting oppositely from said medial portions and toward the head, toe, and heel, respectively, the plate being metallic; or

c) including indicia on the plate and facing said main recess.

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