United States Patent [19]

Moreland

[11] **3,907,292**

[45] **Sept. 23, 1975**

[54] **DYNAMICALLY VARIABLE TENNIS RACKET**

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[22] Filed: **Sept. 27, 1973**

[21] Appl. No.: **401,179**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 259,459, Feb. 5, 1972, abandoned.

[52] **U.S. Cl.** ..... **273/73 C**

[51] **Int. Cl.**[2] **A63B 49/04**

[58] **Field of Search** .... 273/73 R, 73 C, 73 D, 73 H, 273/73 J, 73 L, 170

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Primary Examiner—Richard J. Apley

[57] **ABSTRACT**

A tennis racket has a tubular member, formed to the racket shape, which defines two tubular paths extending along opposite sides of the handle portion of the racket from approximately the top of the grip completely around the periphery of the string area to the topmost point of the head. Within each tubular path is a plurality of weights. Fixed at the topmost point of each tubular path is a coiled spring which maintains the weights in the lowermost portion of each tubular path, but whose force is overcome by the weights under the centrifugal force of the swing so that the two sets of weights move upwardly to the sides of the racket head.

6 Claims, 4 Drawing Figures

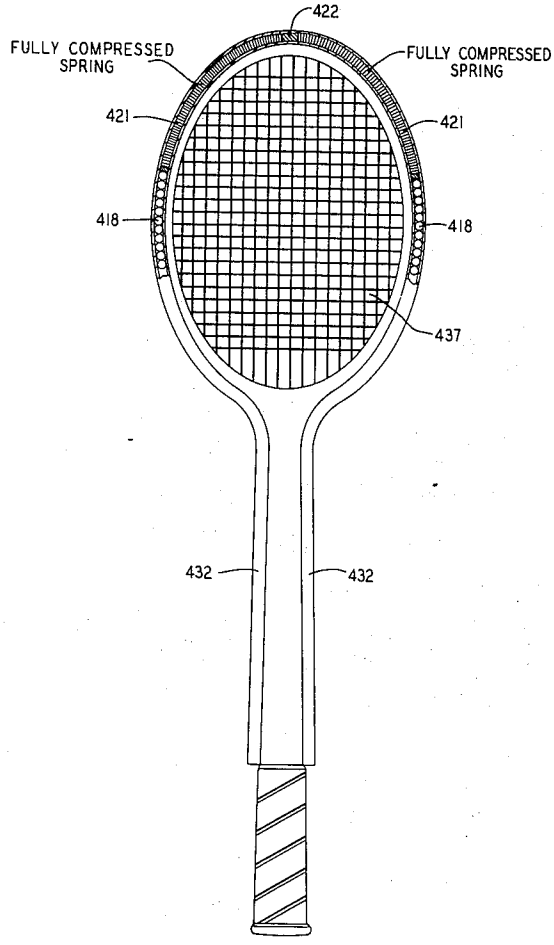


FIG. 1

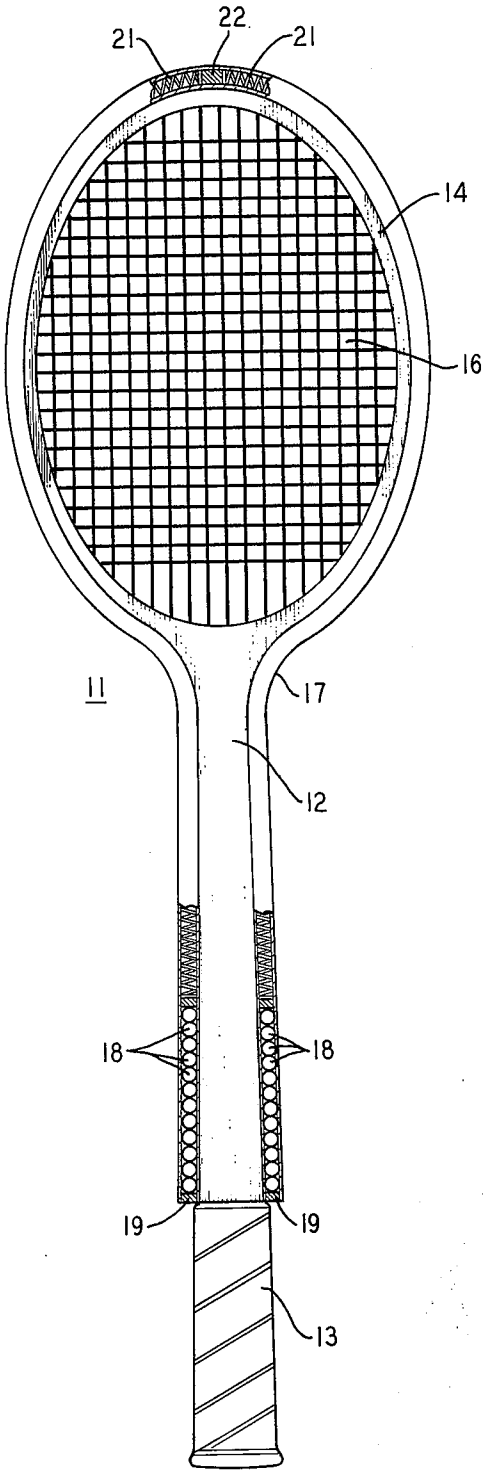


FIG. 4

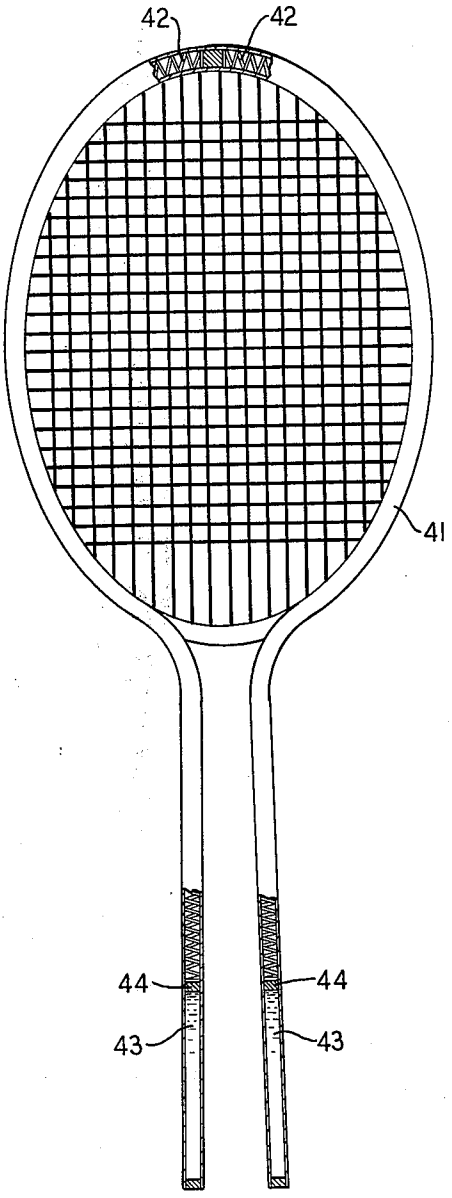


FIG. 2

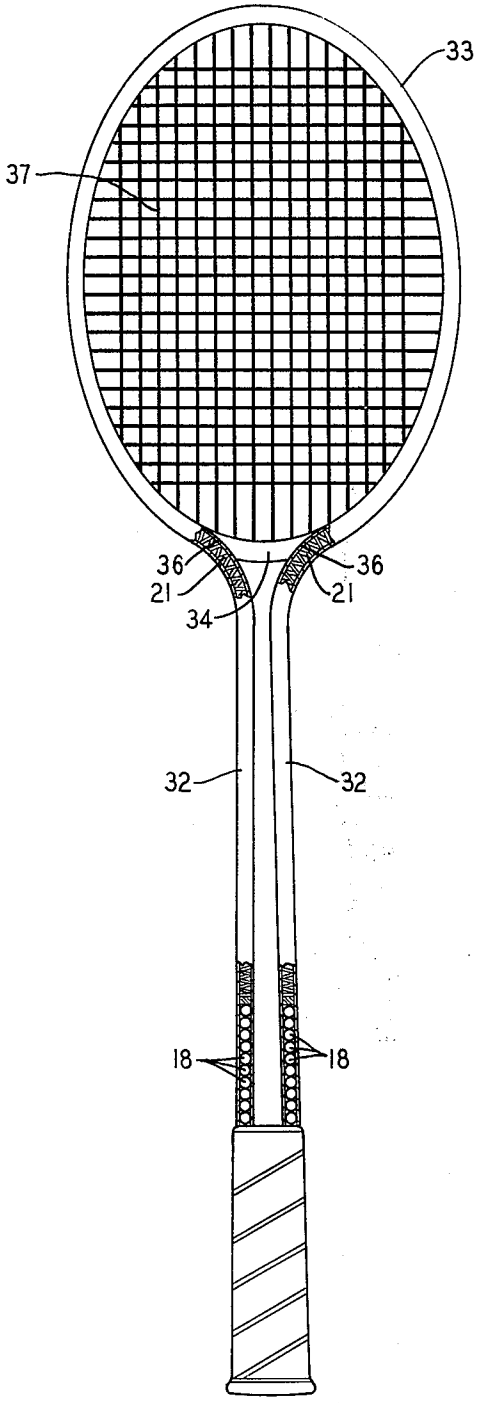
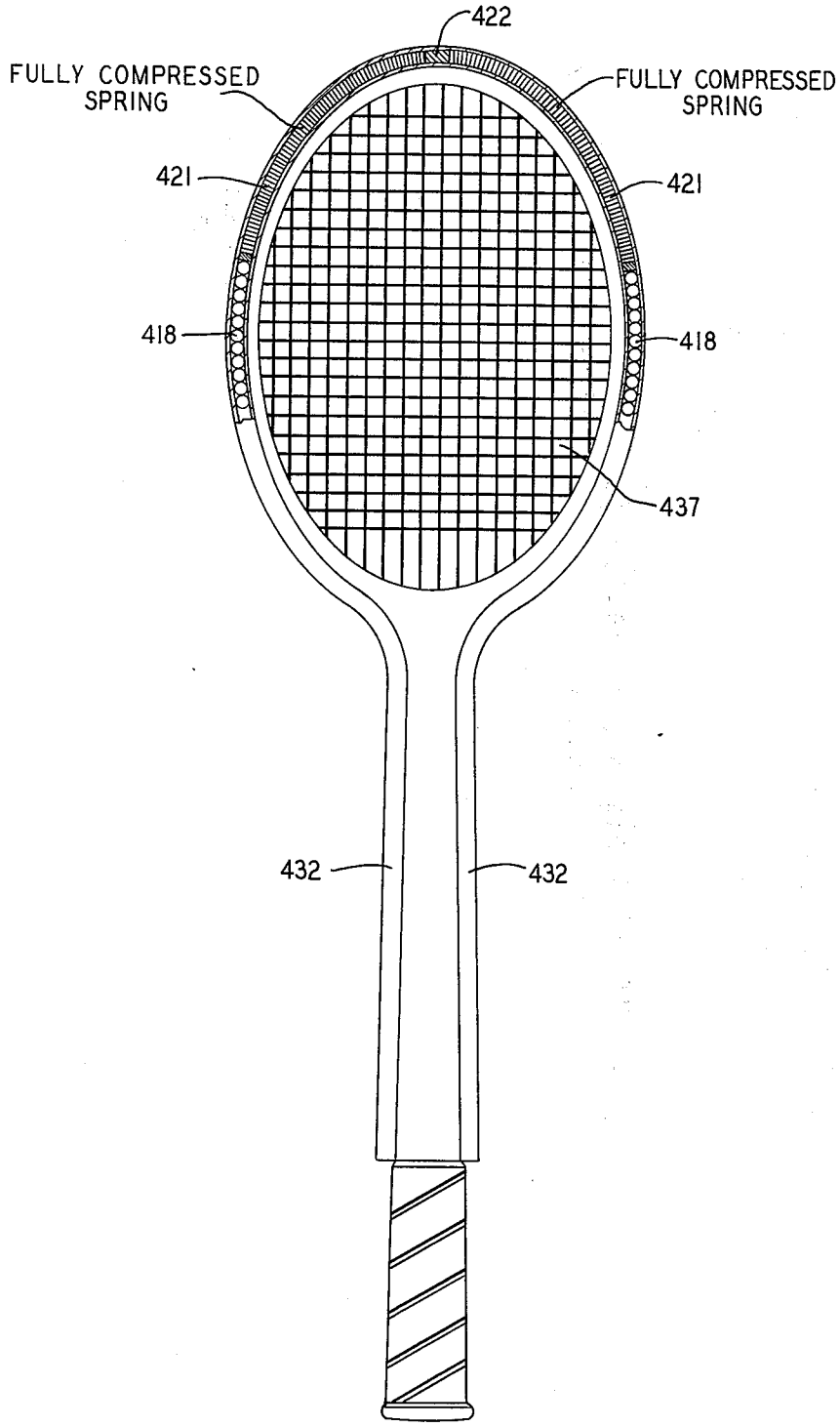


FIG. 3


422
FULLY COMPRESSED SPRING
FULLY COMPRESSED SPRING
421
421
418
418
437
432
432

DYNAMICALLY VARIABLE TENNIS RACKET

CROSS REFERENCE TO RELATED APPLICATION

This is a continuation-in-part of copending application Ser. No. 259,459, filed Feb. 5, 1972, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to tennis rackets and, more particularly, to tennis rackets in which the weight distribution is dynamically variable.

The handling and playing characteristics of any tennis racket are directly related to, and affected by, the weight distribution of the racket. While the overall weight of a racket suitable for use by a player is dependent upon the strength of the player and his personal preference, the manner in which the weight is distributed has a very definite bearing on the accuracy attainable on a given stroke and on the power or force of that stroke. In addition, the weight distribution determines the manueverability of the racket, i.e., the speed with which the racket may be brought into position for striking the ball.

In tennis parlance, a "heavy" racket is one in which the center of gravity is relatively closer to the head, i.e., string area of the racket, while a "light" racket is one in which the center of gravity is relatively closer to the handle of the racket. Equivalently, a "heavy" racket is one in which a greater portion of the total weight resides in the head relative to a "light" racket. Thus even though two tennis rackets may weigh exactly the same, one may be "heavy" and the other "light." A "light" racket is the more maneuverable of the two, that is, it can be brought into position more quickly to make the stroke. On the other hand, a "heavy" racket insures greater control and power by virtue of its having a larger "sweet spot." "Sweet spot" is that area of the strings of the racket within which contact with the ball must be made to provide both control and power. When the racket contacts the ball outside of the "sweet spot," the resulting twisting or turning moment applied to the racket causes both control and power to be significantly diminished. In a "light" racket this "sweet spot" is relatively small, hence, although the racket can be moved quickly into striking position, accuracy and power are more difficult to achieve than with a "heavy" racket. Conversely, the "heavy" racket is not as easily brought into striking position, but accuracy and power are more readily achievable.

Obviously it would be highly desirable, for optimum results, to combine the characteristics of both a "light" and a "heavy" racket in such a way as to utilize the best features of each.

It is, a primary object of the present invention to provide a dynamically variable tennis racket which has facility for both transverse and longitudinal enlargement of the sweet spot at the time it makes contact with the ball.

2. Description of the Prior Art

Heretofore, arrangements for producing a variable weight distribution in a tennis racket have generally consisted of a portion of the handle of the racket being hollow and partially filled with a liquid or a spring-loaded weight.

Where a liquid is used, it moves toward the head of the racket due to centrifugal force, hence, during the stroke the racket changes from "light," at commencement of the stroke, to "heavy" at the moment of impact. However, such an arrangement suffers from the lack of any means for automatically returning the liquid to the lower portion of the handle after the stroke. This can only be done by the player raising the head of the racket to a position above the handle so that gravity causes the liquid to return to its original position. Obviously this requirement on the part of the player is highly undesirable.

The use of a spring-loaded weight in the handle overcomes the return problem presented by the liquid. The spring force is such that the centrifugal force of the swing can overcome it, but, in the absence of centrifugal force, the weight is maintained at its lowermost position in the handle.

In all such arrangements when a weight, either solid or liquid, moves back and forth within a hollow handle, the variation in weight distribution is along the longitudinal axis only of the racket. As a consequence, the "sweet spot" is enlarged only in the longitudinal direction, and not transversely thereto, thereby not reducing the amount by which the racket twists or turns when contact is made with the ball on either side of the longitudinal axis. Therefore, since both control and power are lost primarily through such turning of the racket about the longitudinal axis, such arrangements do not lead to significant increase in the ability to achieve either control or power.

SUMMARY OF THE INVENTION

The present invention realizes all of the advantages of the spring-loaded weight in varying the weight distribution of a racket during the swing, as discussed heretofore, but also it produces an effective enlargement of the "sweet spot" not only along the longitudinal axis of the racket, but also at right angles to that axis, with the net effect that the amount by which the racket twists or turns when the ball is struck off-axis is materially reduced, with a consequent increase in control and power. This two-dimensional enlargement of the sweet-spot is accomplished by permitting the weight to move not only along the longitudinal axis but also around the periphery of the string area and hence at right angles to that axis. Specifically two sets of balanced weights move up the handle and into opposite sides of the head so as to be directly opposite the center of the sweet-spot during impact with the ball. The enlargement of the sweet-spot about, specifically, the axis transverse to the longitudinal axis, is due, then, to the increase in the moment of inertia about the longitudinal axis.

In a first illustrative embodiment of the invention, a tennis racket has a tubular member, formed to the racket shape, which defines two tubular paths extending along opposite sides of the handle portion of the racket from approximately the top of the grip completely around the periphery of the string area to the topmost point of the head. Within each tubular path is a plurality of small weights, which are preferably, but not necessarily, spherical in shape for freedom of movement. Fixed, at the topmost point of each tubular member is a coiled spring which maintains the weights in the lowermost position within each tubular path, but whose force is overcome by the weights under the centrifugal force of the swing so that the two sets of balanced weights move up the tubular paths and into the head of the racket. During impact with the ball, the

fully compressed springs maintain the two sets of weights directly opposite the center of the sweet-spot. At cessation of the swing, the weights return to their at rest position on either side of the handle.

In a second illustrative embodiment of the invention, the frame of the tennis racket itself is tubular, and the weights are carried within the actual frame of the racket.

In still another embodiment of the invention, the weighting material is a liquid.

In all embodiments of the invention, access to the tubular member is provided to permit addition or removal of weights, thereby affording a degree of "tuning" of the racket to the personal idiosyncracies of the player.

BRIEF DESCRIPTION OF THE DRAWINGS

The various principles and features of the invention will be readily apparent from the following detailed description and the drawings, in which:

FIG. 1 depicts a first illustrative embodiment of the invention;

FIG. 2 depicts a second illustrative embodiment of the invention;

FIG. 3 shows the embodiment of FIG. 1 exactly at the moment of impact during the swing; and

FIG. 4 depicts still another illustrative embodiment of the invention.

DETAILED DESCRIPTION

In FIG. 1 there is shown a tennis racket **11** embodying the feature and principles of the present invention. Racket **11** comprises a handle **12** of suitable material, such as wood, a portion of which is wound with or otherwise has affixed thereto a suitable material, such as, for example, leather, forming a grip **13.** Racket **11** includes a head portion **14** which is strung, as shown, with suitable material such as gut or synthetic fiber, forming the hitting area **16** of the racket. For the purposes of the following discussion, the head **14** of the racket is referred to as the top while the handle **12** and grip **13** are referred to as the bottom.

In accordance with the present invention, a tubular member **17** extends along the handle of the racket from a point near the top of the grip **13,** up around the head **14** and back down the other side of handle **12,** as shown. Member **17** may be any of a number of suitable materials; in practice it has been found that plastic tubing of approximately three-eighths of an inch internal diameter and a wall thickness of approximately one-sixteenth of an inch is excellent. As will be apparent hereinafter, it is necessary that the tubing **17** have sufficient wall thickness that it does not dimple or buckle, especially at the region where the handle merges into the head. Tubing **17** may be held in place by suitable clips, by tapping, or by gluing, if desired.

For example, head **14** may either be laminated or unitary in structure, with the stringing **16** either attached by drilled holes or by securement members affixed to the head **14;** in either case, the tubing **17** is bonded to the outer surface of the head **14,** without interference or alteration of the stringing **16** or its attachment to the head **14.**

Situated within the tubular member **17** are a plurality of weights **18.** Weights **18** are preferably spherical in shape for easy movement within member **17** and, for durability, are preferably, although not necessarily, made of steel. In practice it has been found that where the internal diameter of tubing **17** is three-eights of an inch, spherical steel balls of approximately eleven-thirty seconds of an inch diameter function quite well, freely moving within member **17.** Suitable plugs **19** prevent the weights **18** from falling out of the tubing **17.**

Weights **18** are held in place by a pair of coil compression springs **21,** which are anchored at the top of the racket by an anchor plug **22** within the tubing **17.** Alternatively, a single long coil spring may be used. The ends of the springs **19** in contact with the weights are preferably flattened to bear more fully against the topmost weights.

The springs **21** are selected such that when completely compressed (i.e., when contact is made in the swing), they hold the weights **18** in position opposite one another substantially centered on the minor, or transverse, axis of the head portion **14.** Such is the arrangement shown in FIG. **3.**

As used herein, the terms "minor" and "transverse" axes refer to the shorter axis of the generally elliptically shaped head portion of the racket. Conversely, the terms "major" or "longitudinal" axes shall be used to refer to the long axis thereof which is generally in line with the handle portion of the racket.

For proper operation of the racket of FIG. **1,** the spring parameters, i.e., stiffness and length, must be so chosen that the weights remain at the bottom of the racket while the racket is being positioned for a stroke particularly during net play where a "light" racket is advantageous, and for a fast forehand, backhand or service-like stroke they arrive in the head of the racket before contact with the ball. The second condition determines a required average of the spring force between the butt or handle of the racket and the head. This average must be such that, under the combined effects of centrifugal force and spring force, the weight reaches the head at the desired part of the stroke. For a typical fast forehand or backhand, the racket is swung in an approximately circular arc with an angular velocity of approximately ten radians per second. This results in a centrifugal force of approximately 3W, where W is the total weight of the weights **18** on one side of the tube **17,** at the butt of the racket. The centrifugal force is approximately 9W at the head or top of the racket. It has been found that a spring force having a numerical average of approximately 1.5W places the weights in the head as shown in FIG. **3** just before the moment of impact.

The first condition set forth in the preceding requires that the spring force at the butt be at least sufficient to hold the weights in the butt with the racket held head down, in a vertical position. Thus, the minimum spring force at the butt is W which gives, from the numerical average, a maximum force of 2W at the head. In practice it has been found that a spring stiffness of approximately 0.4W pounds per foot and a total length of approximately five feet produces a spring force at the butt of 1.2W and at the head a force of 1.8W, giving an average force of 1.5W. With such a spring, the weights arrive in the head almost at the exact instant of impact. Generally, a spring which meets the foregoing compression requirements will have a compressed length such that the weights will be located on the transverse axis of the head, as provided hereinbefore. If a shorter spring is used, spacers may be provided either at the top of the racket or between the springs and the

weights. In practice, it has been found that a weight W of approximately one-sixteenth of a pound gives satisfactory results.

From the foregoing, it can be seen that the racket may be readily "tuned" to an individual player's taste. Addition or removal of one or more weights **18**, or the substitution of a spring with slightly different parameters can produce either small or large changes in the handling characteristics of the racket. Thus, for example, a slightly lower average spring force will cause the weights to reach the head sooner. On the other hand, the addition of more weights **18** accomplishes a similar result while increasing the total weight of the racket.

It should be noted, however, that the features of the present invention will be realized completely so long as the spring **21** and the weights **18** are properly selected as shown above. That is to say that the spring dynamics or the like during compression are not deemed to be significant factors.

In FIG. **2** there is shown a tubular metal frame racket **31** of a type currently quite popular. The tubular construction of the racket readily lends itself to the present invention. Thus, the handle of the racket consists of a pair of hollow tubular members **32** which, extended, form the head **33** of the racket. Thus, the entire frame of the racket forms a hollow tubular member for containing the weights **18** and spring **21**. Alternatively, where the inside diameter of the tubular frame permits, a plastic tubular member may be inserted within the hollow frame **32, 33**. Access to the weights may be had by the addition of small openings, not shown, preferably at the lower end of the frame adjacent the grip. These openings may be closed by simple plugs when the racket is in use.

Thus far the principles of the invention have been set forth in embodiments utilizing solid weights. In FIG. **4** there is shown an embodiment of the invention utilizing a liquid as the weighting material. For simplicity, only the tubular member **41** containing the springs **42** and the weighting material **43** have been shown. In all other respects it is to be understood that the racket of FIG. **4** may be like that of FIG. **1** or that of FIG. **2**.

The tubular member **41** contains springs **42** which bear against pistons **44**. It is necessary that pistons **44** be freely movable within tubular member **41**, and yet form a seal to prevent the weight material which may be, for example, mercury, oil, or other suitable material, from leaking into the spring area above the pistons. The operation is substantially the same as that of FIGS. **1** and **2**, with the springs and pistons acting to return the liquid **43** to the handle between strokes.

The foregoing embodiments of the invention are intended to illustrate the principles and features thereof. Numerous other embodiments of the principles of the invention may occur to workers in the art without departure from the spirit and scope thereof.

I claim:

1. A tennis racket comprising:

a. a handle portion and a head portion having longitudinal and transverse axes, a closed tubular member formed to the shape of said racket and defining first and second tubular paths, said first tubular path extending on one side of said head and handle portions from the top of said head portion, along the periphery of said head portion to said handle portion, and along at least a part of said handle portion, and said second tubular path extending similarly on the side of said head and handle portions opposite that of said first tubular path;

b. first and second substantially similar weighting means slidably disposed within said first and second tubular paths, respectively, and normally disposed at the handle portion of said tubular paths; and

c. first and second spring means located respectively in said first and second tubular paths, each of said spring means having one end fixed at the top end of its respective tubular path, each of said spring means being substantially coextensive with its respective tubular path and having its other end engaging the weight means, each of said spring means having a stiffness and length so proportioned to the mass of said weight means and to the centrifugal forces developed during the conventional arcuate full swing of any type of hitting stroke so that the spring force produced thereby is such that the weight means remain in said normal disposition when the racket is at rest in any orientation and upon impact with the ball each of said spring means will be compressed to a degree sufficient to locate said weight means substantially on the transverse axis of said head portion.

2. A tennis racket as described in claim **1** wherein the average spring force of said springs is 1.5W, where W is the total weight of said weighting means in one of said tubular paths.

3. A racket as described in claim **1** wherein said racket comprises a hollow structural member and constitutes said first and second tubular paths.

4. A racket as described in claim **1** wherein said racket comprises a solid structural member and wherein said tubular member circumscribes said structural member.

5. A racket as described in claim **1** wherein said first and second weighting means comprise equal volumes of liquid.

6. A racket as described in claim **1** wherein said first and second weighting means comprise an equal quantity of spherical metal members.

* * * * *