APPARATUS FOR COMPARING MOMENTS OF INERTIA OF GOLF CLUBS

Inventors: Denis A. N. Osborne, Liverpool; Robert C. Haines, Huddersfield; John A. Kilshaw, Netherton, near Wakefield, all of England

Assignee: The Dunlop Company Limited, London, England

Filed: May 11, 1970

Appl. No.: 36,478

Related U.S. Application Data


U.S. Cl. 73/65

Int. Cl. G01m 1/12

Field of Search 73/65, 456

References Cited

UNITED STATES PATENTS

1,351,768 9/1920 Lawton 73/65

FOREIGN PATENTS OR APPLICATIONS

381,729 10/1932 Great Britain 73/65

Primary Examiner—Richard C. Queisser
Assistant Examiner—C. E. Snee, III
Attorney—Stevens, Davis, Miller & Mosher

ABSTRACT

A set of golf clubs is provided which is balanced on the principle of common "moment of inertia" as opposed to the prior art sets which are balanced on the principle of common "moment of weight." The moment inertia about a given axis of any club in the set is no more than 5 percent, preferably 2 percent, particularly 1 percent greater than that of the club having the lowest moment of inertia in the set. Usually the said axis is one which passes horizontally through the top end of the shaft.

4 Claims, 4 Drawing Figures
FIG. 1

CLUB MOMENT OF WEIGHT - g cm\(^2\) x 10\(^3\) ABOUT AXIS A.

MOMENT OF INERTIA g cm\(^2\) x 10\(^3\) ABOUT AXIS A.

INCREASING HEAD WEIGHTS

IRONS

9-35°
8-35\(\frac{1}{2}\)°
7-36°
6-36\(\frac{1}{2}\)°
5-37°
4-37\(\frac{1}{2}\)°
3-38°
2-38\(\frac{1}{2}\)°

WOODS

4-41\(\frac{1}{2}\)°
3-42°
2-43°
1-43°
FIG. 3

TRUE MOMENT OF INERTIA – $g \cdot cm^2 \times 10^5$ ABOUT AXIS A.

FIG. 4

TRUE MOMENT OF INERTIA – $g \cdot cm^2 \times 10^5$ ABOUT AXIS A.
APPARATUS FOR COMPARING MOMENTS OF INERTIA OF GOLF CLUBS

The application is a continuation in part of application Ser. No. 702,668 filed Feb. 2, 1968, now abandoned.

This invention relates to golf clubs and is particularly concerned with a new method and apparatus for grading clubs.

In the game of golf, a set of clubs usually comprises a total of seven to fourteen woods and irons having different lengths, weights and loft of club heads, enabling the golfer to hit shots of varying distance and trajectory and with varying degrees of control. In this specification unless otherwise stated the term "set of clubs" excludes the putter.

At the present, most golf sets are graded to a common "moment of weight" about some point for every club in the set. In one commonly used machine for balancing clubs this point is 30 cm. from the top end of the club. When the club is placed on the machine to balance it to a given "moment of weight" a force is applied to the top end of the club so that when the club is balanced the moment of this force about the balance point (i.e., 30 cm. from the top end of the club) plus the moment of that 30 cm. of club will be equalized by the moment of the remainder of the club about the balance point.

For any set of clubs to be balanced to a given "moment of weight" the force applied to the top end of each club when being balanced on the machine is constant. Thus, two clubs of the same type could be balanced by this machine but the weight of the various parts of the club (i.e., the head, shaft and grip) might be widely differing and to a golfer they would have a different "feel." It follows that within any set of clubs balanced on these "swing weight" machines not all clubs will have the same "feel" with consequent disadvantages to the golfer's game.

We have now found according to the present invention that for golf clubs in a set to have the same "feel," that is to be a balanced set, they must have the same moment of inertia about an axis round which the golfer swings the club.

FIG. 1 is a graph showing the relationship between the moment of weight and the moment of inertia of golf clubs for clubs of a number of different lengths and varying head-weights;

FIG. 2 is a diagrammatic representation of a machine for measuring moment of inertia according to the invention;

FIG. 3 is a graph showing the true moments of inertia of a set of golf clubs graded to constant moment of weight against the moments of inertia obtained using the machine of FIG. 2;

FIG. 4 is a similar graph to FIG. 3 but for a number of golf clubs of identical length but different weight.

Sets of clubs balanced to a common "moment of weight" or by other previously known methods do not exhibit constant moments of inertia about any axis. We have found that the moment of inertia of clubs in golf sets balanced by previously known methods can differ by as much as 8 per cent or more.

The present invention is based on the principle of a common "moment of inertia" about an axis for each golf club in the set. Any axis which is at an angle of from 45° to 90° with the shaft of the club and is positioned at or above the average midpoint where the golfer grips the club can be specified (i.e., usually 5 to 15 cm. but more usually 7.5 to 12.5 cm. from the top end of the golf club), but the following description is with particular reference to an axis perpendicular to the longitudinal axis of the golf shaft at the top end of the golf club. This axis corresponds to an axis through the wrist of the upper hand of the golfer and is the most important axis a golf club turns about during a golf stroke. Hereafter, this axis is called axis A.

Accordingly, the present invention provides a set of golf clubs (as hereinbefore defined) in which the moment of inertia of any club in the set is no more than 5 percent greater than that of a club having the lowest moment of inertia in the said set; the said moments of inertia being those about an axis through a point in the shaft of the club, said axis being at an angle of from 45° to 90° with the shaft of the club and said point being no more than 15 cm. from the top end of the club. Preferably, the variation in the said moments of inertia is no greater than 2 percent, particularly 1 percent. If desired the putter can also be balanced to within the same tolerances.

In a modification of the invention the set balanced according to the invention may exclude the woods and in a further modification it may exclude the irons, i.e., the invention merely provides a set of irons or woods as the case may be.

As stated previously the preferred axis is perpendicular to the longitudinal axis of the shaft at the top end of the golf club (axis A) and will of course depend on where the golfer grips the club but is usually no more than 5 cm. from the end and is more usually at the very end of the shaft.

The moment of inertia of golf clubs about axis A is the sum of the moments of inertia of its component parts — the golf head, the shaft and the grip — about that axis.

The component parts of present day golf clubs are fairly standardized in weight and general form, and if these components are used then the moment of inertia of a particular length of shaft about axis A can be assumed constant, while the moment of inertia of the grip about this axis can be assumed negligible.

Under these conditions, the moment of inertia of an assembled golf club is dependent upon the length of the club and the weight of the head. We have found that it is possible to predict the moment of inertia of a golf club about an axis A from the value of its moment of weight about some other axis.

The moment of weight of the golf club can be measured about any axis. However, an axis near to the center of gravity of the golf grip leads to the best prediction of club moment of inertia, because in this position variations in the golf grip which have a negligible effect on the moment of inertia of the club have a negligible effect on the moment of weight of a club. An axis 9 cm. from the end is usually chosen as the most suitable point with these considerations in mind. Hereafter this axis will be referred to as axis B.

The relationship between the moment of inertia of golf clubs about axis A and their moment of weight about axis B for varying club head weights and club lengths is illustrated in FIG. 1.
The relationship shows that club head weights must be chosen on a progressive scale to give a constant moment of inertia value to clubs of different length. For a unit change in club length, the shortest clubs need a much larger change in head weight than the longest clubs if they are all to have a constant moment of inertia.

The invention includes an apparatus for measuring or comparing the moment of inertia of a golf club based on our discovery described above so that a set balanced according to the invention can be easily made up, which comprises a balancing bar carrying a cradle for the golf club, and a stop; the cradle and stop being so arranged with respect to each other and the bar that they support a golf club in a horizontal position above the bar; a pivot point for the bar which is positioned beneath a chosen axis in the golf club when the golf club is in position, the balance of the bar being adjusted by two counter-weights which move over separate scales, the first scale being positioned on part of the bar and being calibrated in units of moment of inertia or a similar empirical derivation and the second scale being positioned on another part of the bar and being calibrated in length of golf club or golf club number.

The pivot is preferably positioned to coincide with an axis near the center of gravity of the golf grip, usually about 9 cm. from the stop, (i.e., axis B).

Usually, there are at least three of the first type of scale, one for long clubs; one for medium length clubs; and one for short clubs, since the relationship between moment of inertia and moment of weight varies with clubs of different length. Thus for absolute accuracy there should be a scale for each club.

The second scale is not a linear scale but is progressively varying according to the relationship of FIG. 1.

To make up a set there are chosen the requisite clubs such that their moments of inertia about the specified axis do not vary by more than the requisite amount. When making up a complete set, it is usual to correlate the moment of inertia of a substantial number of irons and then to select from that number a set of irons such that their moments of inertia do not vary by more than the requisite amount. The woods to complete the set are then taken and their moments of inertia adjusted so that they do not vary by more than the requisite amount from those of the irons.

The invention is further illustrated in FIGS. 2 to 4 of the accompanying drawings. FIG. 2 is a diagrammatic representation of a machine for measuring moment of inertia according to the invention.

It consists of a balancing bar 1 carrying a cradle 2 and a stop 3 so that when a golf club 4 is placed in position, the pivot 5 of the machine is positioned beneath axis B on the golf grip 10. The distance from the pivot point 5 to the stop 3 is usually 9 cms.

Two counterweights 6 and 7 move over scales 8 and 9. Scale 8 is calibrated in inches length of the golf club or in golf club number. It is not a linear scale but varies according to the relationship of FIG. 1.

Scale 9 is a linear scale calibrated in units of moment of inertia. Three scales are shown, one for long clubs, one for medium length clubs and one for short.

In operation, counterweight 6 is set at the length of the particular golf club on the machine and counter-weight 7 moved until the whole system balances, this giving the value of the moment of inertia of the club on the appropriate scale.

Alternatively counterweight 7 is set at a predetermined value and the system balanced by adjusting the weight of the golf club head in any convenient way.

FIG. 3 is a plot of the true moment of inertia values (as measured by the classical oscillation method) of a set of golf clubs graded to a constant moment of weight against the moment of inertia values given by the machine described above with reference to FIG. 2.

FIG. 4 is the same plot for a number of golf clubs of identical length but different weight. No pre-selection of shafts or grips on these golf clubs had taken place. These graphs show that the machine of this invention gives accurate measurements of moment of inertia within the limits of experimental error.

We claim:

1. An apparatus for comparing the moment of inertia of one golf club with that of another golf club of different length and head weight which comprises a balance beam disposed on a fulcrum, a cradle for supporting a golf club shaft carried by the beam on one side of the fulcrum, means carried by the beam on the opposite side of the fulcrum adapted to receive the grip end of a golf club, said cradle and receiving means being adapted to support a golf club with its longitudinal axis substantially parallel to the longitudinal axis of the beam, a first weight adapted to slide along the beam between the fulcrum and receiving means for counter-balancing the shaft and head of the club, and a second weight on the beam between the fulcrum and head of the golf club, a scale on the beam adjacent one of said weights graduated in club lengths and a second scale adjacent the other of said weights graduated in moments of inertia.

2. The apparatus of claim 1 wherein the fulcrum coincides with an axis near the center of gravity of the golf grip of the club.

3. The apparatus of claim 1 wherein the moment of inertia scale is three individual scales, one for medium length clubs, one for shorter clubs and one for longer clubs.

4. The apparatus of claim 1 wherein the moment of inertia scale is a plurality of scales, one for each club of a set of clubs.