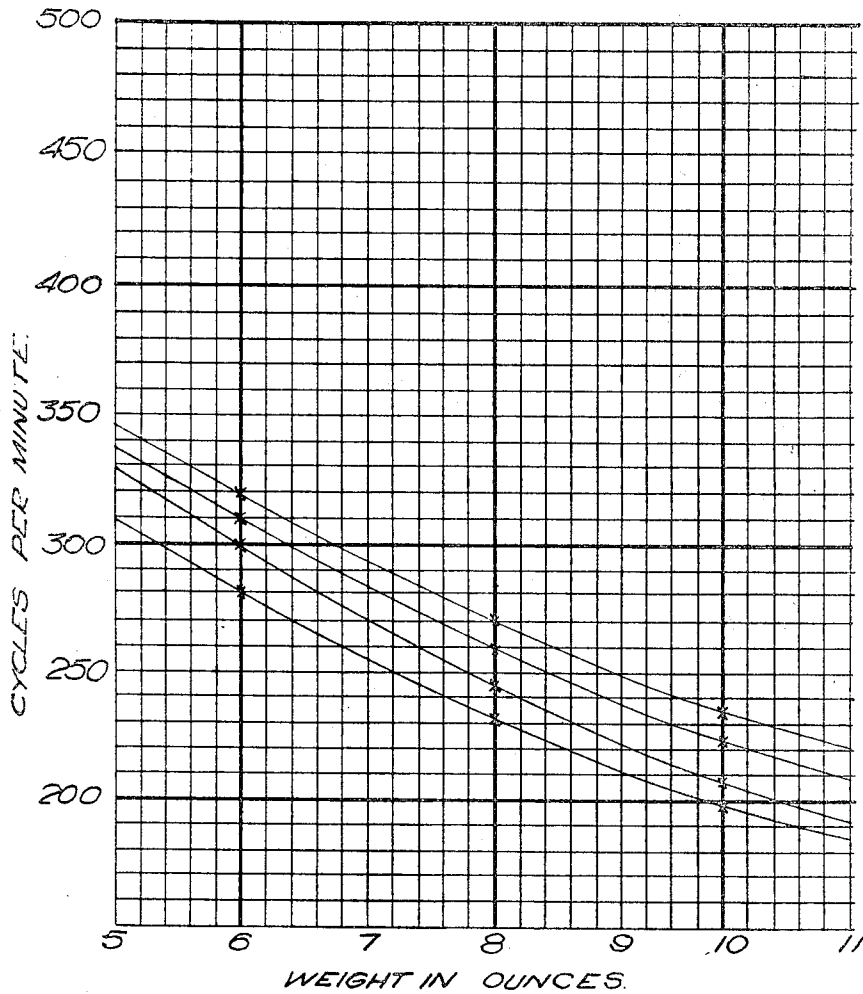


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VIBRATION TESTING METHOD FOR PRODUCING
A MATCHED SET OF GOLF CLUBS
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VIBRATION TESTING METHOD FOR PRODUCING A MATCHED SET OF GOLF CLUBS

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ABSTRACT OF THE DISCLOSURE

Golf clubs are matched according to the natural frequency of vibration of the shafts. In establishing the frequency, a golf club shaft having a club head thereon is firmly gripped at the end remote from the club head, and is plucked so as to be set in vibration, the frequency of vibration being measured in any convenient way for a range of club head weights. The clubs are "matched" by selecting for a given shaft length and club head weight, shafts of an appropriate frequency.

This invention relates to golf clubs and has more particular reference to a method of testing therefor whereby the matching of a set of clubs is facilitated.

Various systems are used both in this country and abroad for "matching" golf clubs but none has been universally adopted and none accepted as being wholly satisfactory. Such systems as are used do in fact, "match" one club to another on the basis of a comparison between mathematical computations of certain of the physical properties of the respective clubs, no regard being had to any particular characteristic of the intended user, the integer common to all clubs relating to a physical characteristic of the club and its value for any given club being so selected as to give the desired "matching."

The present invention is predicated upon a new concept of matching whereby not only are the individual clubs compared with each other and matched having regard to certain characteristics of the clubs themselves, but so also is a factor introduced into the selection which relates to the intended user, the integer common to all the clubs of a matched set being this factor.

From experiments and investigations carried out I have concluded that in producing a set of "matched clubs" particular attention must be paid to the intended user and the basis of selection of the individual clubs of a set must be related to such user in one way or another. I have shown, for example, that each user has what might be termed "a natural frequency" of swing and that ideally the clubs of a set should each individually be matched to this frequency.

In arriving at this conclusion, I have examined, by utilizing accelerometers, strain gauges, oscilloscopes and the like, the forces acting on a golf club during its swing and have established that a golf swing can be compared, very broadly, to the double swing of a pendulum, the golf swing being a three stroke cycle of events and comprising, successively, backward accelerations, backward deceleration plus forward accelerations and follow through decelerations. The point of maximum acceleration is also that of zero speed at the top of the swing. Considering the forces acting on the shaft of the club during the back swing, the force used in decelerating the club creates a store of energy in the elastic bending of the shaft. As the bent shaft recovers, the elastic energy is temporarily converted into kinetic energy, as the shaft moves through the mid-point of its oscillation. But only with proper synchronism can the golfer ensure that this moment is also that at which the club hits the ball. Releasing the energies

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of swing and spring at the same time and in the same direction, they reinforce one another. It is believed that proper synchronism of the release of the energies of swing and spring both energies being released so as to act in the same direction, can be assisted by the golfer in that whilst the energy of spring or its moment of release is a function of the golf club, or more properly the shaft thereof, and is thus determined by the club, the release of the energy of the swing is a function of the golfer, being related to his swing, and is, therefore, controlled by the golfer.

It is the object of the present invention to provide a method of testing a golf club or a shaft thereof which is such as will allow of a quantitative classification thereof in order that once a club is formed the physical characteristics of which are such that the club can be "synchronised" with a golfer, other clubs of similar classification will be known to be "synchronised" also.

Thus according to the present invention, a method of testing a golf club or a shaft thereof so as to facilitate the "matching" thereof comprises the steps of gripping the shaft at a location spaced from one end thereof, flexing the said club at or adjacent the said one end so as to cause the shaft to vibrate, measuring the frequencies of vibration of the said shaft when fitted with club heads or equivalent structures of different weights, and plotting a graph thus to show the relationship between applied weight and frequency.

The invention also includes the method of matching golf clubs whereby each club is tested as aforesaid and the individual clubs of a set are selected on the basis of a common frequency of vibration, of the shaft thereof.

The invention also includes a golf club having adjustment means therein whereby the club head weight may be varied.

The invention will now be described further, by way of example only and with reference to the single figure of the accompanying drawing, which shows in graphical form the relation between frequency of vibration of a golf shaft of a given length and the weight of the club head or other applied weight.

In practicing my invention I clamp a club shaft in an appropriate support means and pluck the free end thereof, measuring the frequency of vibration thereof in any convenient manner. By applying club heads or equivalent structures of various weights to the said shaft and measuring the corresponding frequencies of vibration, I am able to plot a graph of frequency against applied weight thus to obtain a characteristic curve for that particular shaft.

By repeating the measurements for other shafts characteristic curves for these can be obtained, the various curves being shown in the accompanying drawing and being similar one to another, but being separated either vertically or horizontally when plotted on the same axes and to the same scale.

To match a set of clubs it is necessary only to ensure that for a given shaft length of any individual club, a weight of club head is selected such as will give the requisite frequency of vibration to the shaft.

I have established that the range of between 250 to 400 cycles per minute constitutes substantially the whole of the range of useful frequencies, and thus the portions of the various graphs as shown in the drawing are the parts which are relevant to the question of matching.

Having once "matched" a club to a golfer by feel and then measuring the frequency of vibration of such club, it is possible readily to identify the ideal frequency for that golfer and thus to select a matched club or set of clubs which will have a like feel.

If it is desired to effect a marginal change in club performance, that is to say the frequency of vibration thereof, then it is sufficient merely to vary the weight of the

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club-head, and this can be done in any convenient manner.

It is to be appreciated that although the invention has hereinbefore been described with reference to the transverse vibration of the shaft, a like matching is possible if the basis of comparison is the torsional vibration of the shafts, the useful range of frequencies being somewhat different from those as before referred to.

What I claim is:

1. A method of testing a golf club, or a shaft therefor, so as to facilitate the "matching" thereof, which comprises the steps of positively and immovably gripping the shaft at a location spaced from one end thereof, applying a force to said one end of the club to deflect the same and subsequently releasing said shaft thus to cause the shaft to vibrate, measuring the respective natural frequencies of vibration of the said shaft when fitted with club heads or equivalent structures of different weights, and establishing the relationship between applied weight and frequency

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as an indication of the "feel" characteristic of the club or shaft.

2. A method of matching golf clubs whereby each club or the shaft thereof is tested in accordance with the method as set forth in claim 1, and the individual clubs of a set are selected on the basis of said natural frequency of vibration of the shaft thereof.

3. A set of golf clubs or shafts thereof when "matched" in accordance with the method as set forth in claim 2.

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