April 9, 1968

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3,376,734

GOLF BALL HARDNESS TESTER

Filed Oct. 5, 1964

2 Sheets-Sheet 1

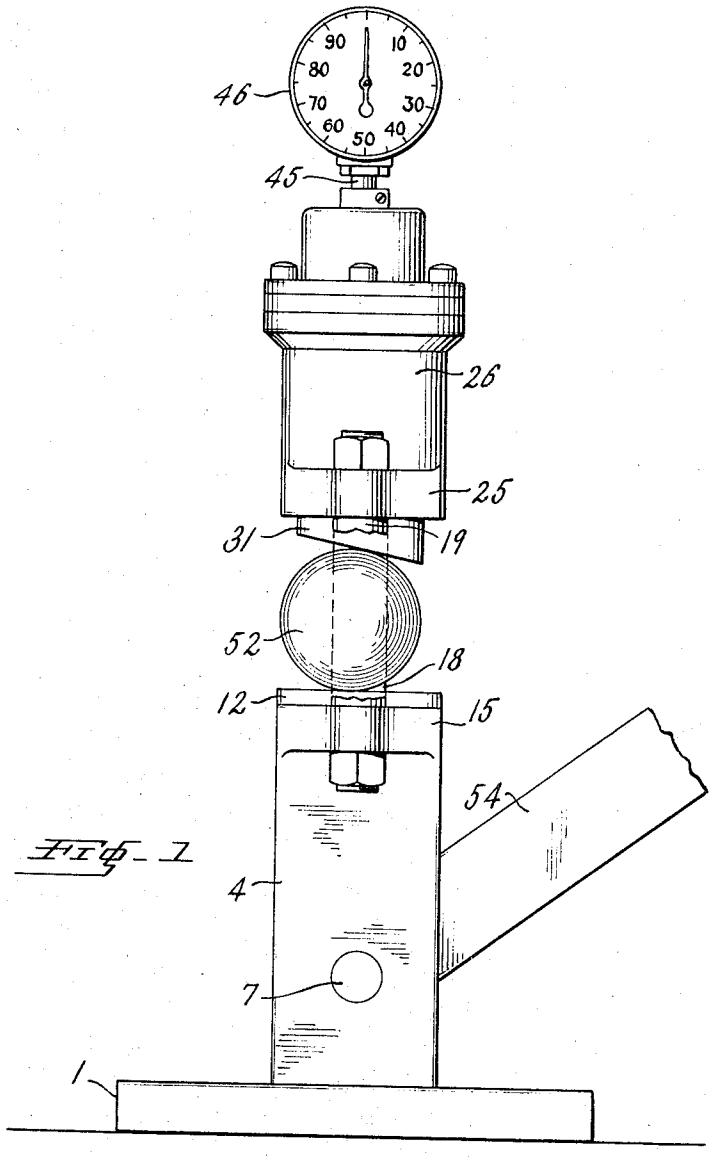


Fig. 1

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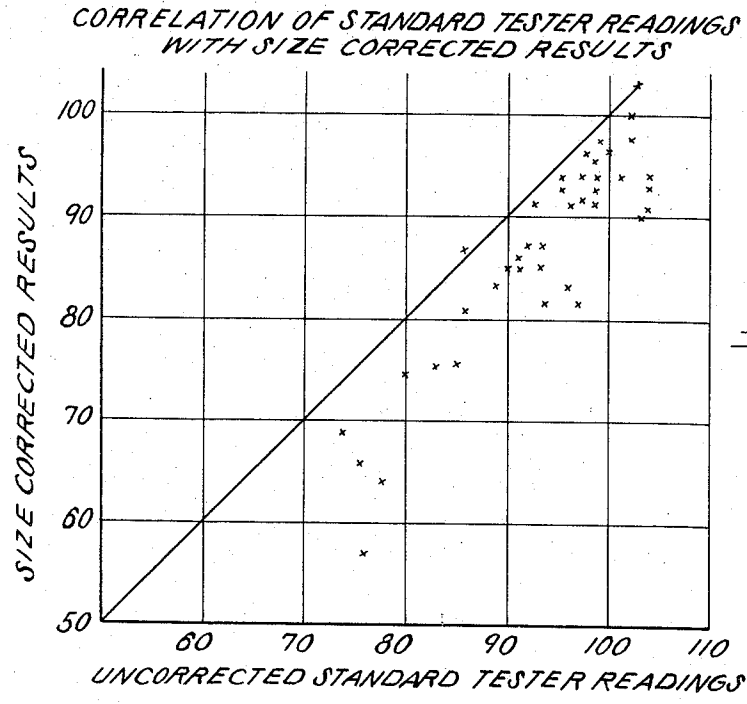


Fig. 2

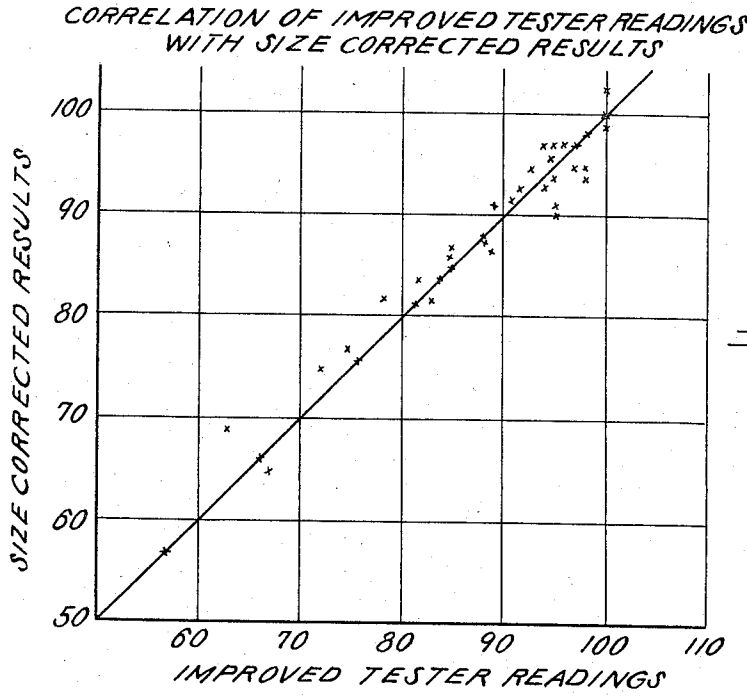


Fig. 3

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GOLF BALL HARDNESS TESTER

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7 Claims. (Cl. 73—78)

The present invention relates in general to a golf ball hardness tester, and more particularly concerns an improved golf ball hardness tester which automatically compensates for size variations in the golf balls being tested.

U.S. Patent No. 2,278,416 (dated Apr. 7, 1942), the drawings and specification of which are hereby incorporated by reference, shows and describes a golf ball hardness tester which will henceforth be called the standard tester. A slidably spring-loaded upper anvil is connected to the supporting yoke by a strong spring resisting upwards displacement of the upper anvil; a slidable handle-loaded lower anvil is connected to the supporting yoke by a handle-operated eccentric cam arrangement. The opposing anvil surfaces which contact the ball during the test are parallel. Display means connected to the upper anvil reflect the displacement of the upper anvil during a test from its initial position. The hardness or compressional modulus of a golf ball measured by the standard tester is shown by the display means as a reading theoretically proportional to the upwards displacement of the upper anvil against the spring. The upward movement of the handle-loaded lower anvil is controlled by an eccentric cam responsive to a handle and is limited to a constant final position.

In an actual test, the ball to be tested is placed on the lower anvil, and the handle is rotated, thereby causing the lower anvil to slide upwards to a final position. The upward motion of the ball upon the lower anvil is strongly, but givingly, resisted by the spring-loaded upper anvil after the ball makes contact therewith. Thus the ball is compressed in diameter between and by the two anvils, soft balls being compressed in diameter by the anvils more than hard balls and thus causing less upward displacement of the upper anvil. The hardness of the ball is therefore, in theory, measured by the compressed diameter of the ball. However, this is not the case in practice.

In practice, the "hardness" reading is both a function of the hardness and the upwards distance travelled by the ball on the lower anvil before contact is made between the ball and the upper anvil. To allow for variations in ball size, there exists a gap between the top of the small or medium sized balls inserted in the tester and the lower surface of the upper anvil. As the lower anvil and the top of a perfectly rigid, non-compressible golf ball both are moved upwards by the eccentric cam only a fixed distance, the distance or gap travelled before any contact is made between the ball and the upper anvil may be considered as "lost motion" distance. For a gap of any given length, this "lost motion" distance may be automatically corrected or compensated for. However, as the gap will vary in length depending upon the size of the ball being tested, no single correction factor for balls of differing sizes may be built into the standard tester. Further details on the structure and use of the standard tester may be found in the above-cited patent.

Since the actual compressions of balls with the same hardness but differing sizes are nearly independent of the ball size, in the standard tester any variation from ball to ball in size (or in the different diameters of an eccentric ball) is reflected almost mil for mil in the hardness reading. Standard practice has been to measure the size of the ball to be tested and then to apply a size correction to the tester reading, so as to determine a corrected hardness which is nearly independent of the size of of the ball. Naturally it would be desirable to obtain a tester reading corresponding to a corrected hardness directly from the tester and eliminate the burdensome steps of (1) measuring the size of each ball, (2) determining from a chart the size correction to be applied, and (3) applying the correction to the tester reading so as to obtain a corrected hardness.

Although it is possible to eliminate the gap or "lost motion" distance by means of a hand-screw device such as that responsive to the turning of element **52** of U.S. Patent No. 1,596,003 (Aug. 17, 1926), the incorporation of such a device in a standard tester does not completely obviate the objectionable features of the standard tester as it is still necessary for the operator to perform an extra manual step on the tester after the positioning thereon of each ball.

The present invention contemplates and has as a primary object the provision of an improved hardness tester which will give a direct reading substantially equivalent to the corrected hardness of the ball being tested, i.e., will automatically compensate for variations in ball size without the need either for determining and applying a size correction factor or for manual operation of a screw device to adjust the initial gap between anvils after positioning of the ball.

Broadly speaking, the present invention contemplates an improved hardness tester wherein the opposing planar surfaces of the anvils are angularly disposed and not parallel.

Other objects and advantages will become apparent from a perusal of the following detailed specification in connection with the accompanying drawings in which:

FIG. 1 is an elevational view of an improved golf ball hardness tester with a golf ball inserted therein;

FIG. 2 is a graphical correlation of standard tester readings and corrected standard tester results;

FIG. 3 is a graphical correlation of improved tester readings and corrected standard tester results.

Referring now to FIG. 1, the improved golf ball hardness tester is similar to that shown in the drawings of U.S. Patent No. 2,278,416 to Atti (issued on Apr. 7, 1942) with the following major exceptions: (1) The relative configuration of the opposing anvil surfaces, and (2) the elimination of Atti's centering mat (his element No. **53**) which is neither required nor desirable in my invention. (In FIG. 1 the hardness dial display means **46** has been turned 90° and one of the supporting posts **10** has been partially cut away purely to better illustrate the embodiment.) The internal mechanisms of the two devices are identical, and the numbering (if not the terminology) of my elements corresponds to the numbering of Atti's elements.

The supporting yoke comprises a flat base **1**, a lower cylindrical supporting member **4** perpendicularly resting upon the base **1**, an upper cylindrical supporting member **26** aligned with the lower cylindrical supporting member **4**, and a pair of cylindrical posts **18** and **19** connecting (on each side of the yoke) outward flanges (one such flange **25** being visible in FIG. 1) on the upper cylindrical supporting member **26** to corresponding outward flanges (one such flange **15** being visible in FIG. 1) on the lower cylindrical supporting member **4** and thereby maintaining the supporting members **4** and **26** in fixed, end-to-end, spaced relation. A handle member **54** is connected to an eccentric cam arrangement **7** (partially visible) located in the lower supporting member **4**. A slidable cylindrical lower anvil **12** located within and extending above the lower supporting member **4** is handle-loaded, i.e., raising of the handle member **54** causes the eccentric cam arrangement **7** to raise the lower anvil **12** a

fixed distance. A slidable cylindrical upper anvil **31** located within and extending below the upper supporting member **26**, in opposing face-to-face relation with lower anvil **12**, is spring-loaded, i.e., upward movement of the upper anvil **31** is resisted by a springy member (not shown) axially aligned with and located within the upper supporting member **26**. A pressure dial **46** or other display means are connected, as through neck **45**, to the upper anvil **31**, so that the reading of the display means is proportional to the extent of the upwards displacement of the upper anvil **31**, e.g., in mils of displacement.

In the standard tester, the upper anvil **31** and the lower anvil **12** have parallel, planar opposing surfaces, the initial center distance between the surfaces being more than enough to facilitate insertion of the golf ball **52** upon the lower anvil **12**. Contact between the golf ball **52** and the upper anvil **31** is first made upon upward movement of the golf ball **52** and lower anvil **12** responsive to rotation of the eccentric cam arrangement **7** upon the rotational displacement of the handle member **54**.

The present invention resides in the improvement upon the standard tester wherein the flat (planar) opposing surfaces of the anvils **31**, **12** are angularly disposed towards one another. The minimum initial center distance between the two opposing anvil surfaces (with the tester in "open" position) is slightly less than is the diameter of the smallest reasonably anticipatable ball to be measured; the maximum initial center distance, slightly greater than the largest reasonably anticipatable ball. A golf ball **52**, lightly but firmly inserted through the front of the "open" tester (the side nearest the maximum initial center distance) and between the supporting posts **18**, **19** lodges in a position between the two anvil surfaces (which constitute the opposing sides of a wedge) determined primarily by the vertical diameter of the ball. A ball with a small diameter will lodge in the narrow part of the wedge; a ball with a large diameter, in the wide part of the wedge. In brief, automatic compensation is made for variations in ball diameter. The result is that, when the lower anvil **12** moves upward to its limited raised position upon movement of the handle member **54** during testing, the upper anvil **31** will compress the spring and be displaced upwards by an amount which depends solely upon the compressional modulus of the ball being tested.

Either one or both of the anvil surfaces may deviate from the horizontal. If both deviate, the deviation of each may be reduced to only a few mils or they may both deviate a considerable number of mils so that balls of widely varying sizes may be introduced between them. To allow adjustment for wear of the anvil surfaces or to enable testing of a group of balls greatly varying in size from the previous group, a hand-screw device such as that responsive to the turning of element **52** in FIG. 5 of U.S. Patent 1,596,003 (issued to Davis on Aug. 17, 1926), may be used to adjust the initial location of the lower anvil and therefore the initial minimum and maximum center distances between the two anvil surfaces.

Example 1

A group of forty-four golf balls of widely different sizes and hardnesses were measured in a standard tester having an initial center distance of 1.680 inches between anvil surfaces and in the improved tester hereabove described, each ball being lightly but securely placed between the anvil surfaces.

The diameter of each ball was then measured and the size correction factor, as determined from the correction chart accompanying the standard tester, was applied to the standard tester reading to compute the "corrected" standard tester result for that ball.

FIG. 2 is a graphical plot showing the correlation of the corrected standard tester results (after application of the size correction factor) and the uncorrected standard tester readings. The 45° reference line represents the locus of points defined by an identity of corrected results and uncorrected readings, such as might occur when measuring an ideal ball having a 1.680 inches diameter. Deviations from the 45° reference line represent the scatter due to size variation in the balls being tested.

FIG. 3 is a graphical plot of the correlation of corrected standard tester results (after application of the size correction factor) and the uncorrected improved tester readings. The 45° reference line represents the locus of points defined by an identity of the uncorrected improved tester readings and the corrected standard tester results. Deviations from the 45° reference line represents the scatter due to size variation in the balls being tested.

The high average deviation of the data points of FIG. 2 from the 45° reference line reflects an undesirably low correlation between the uncorrected standard tester readings and the corrected standard tester results. The low average deviation of the data points of FIG. 3 from the 45° reference line reflects a desirably high correlation between the uncorrected improved tester readings and the corrected standard tester results. Assuming that the corrected standard tester results in fact represent the hardness of the balls, it would appear that the improved tester gives direct readings which are considerably more accurate than the direct readings (uncorrected) of the standard tester. As a matter of fact, the proximity of the points of FIG. 3 to the 45° reference line indicates a near identity between the improved tester readings and the corrected standard tester results.

Depending upon the need for approaching 100% accuracy and upon the need for a swifter and simplified operational procedure, the improved tester will find utility is a quality control device in the production of golf balls and/or as a laboratory testing device. General use of the improved tester will, furthermore, eliminate the uncertainty which often results when standard testers are used and the results are given without specifying whether a size correction factor was applied in all or any of the cases.

Of course, many modifications of this device may now become apparent to those skilled in the art. For instance, a cap with a tilted surface may be placed over at least one of the parallel anvil surfaces of a standard hardness tester so as to achieve an angular disposition of the effective anvil surfaces with respect to one another, thereby producing the equivalent of an improved tester. All such modifications are within the spirit and scope of this invention.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. In a hardness tester for golf balls comprising a spring member, a handle member, a movable spring-loaded upper anvil member, a movable handle-loaded lower anvil member, display means operatively connected to and reflecting the displacement of said upper anvil member from an initial position, and support means supporting all of said members and said display means, said anvil members having opposing planar end surfaces; the improvement comprising said opposing planar end surfaces being angularly disposed with respect to one another so as to grippingly accommodate golf balls of varying sizes therebetween, whereby movement of said handle member causes an upward displacement of said lower anvil member and a golf ball resting thereon and contacting the opposing planar end surfaces, said golf ball in turn causing a responsive upward displacement of said upper anvil member against said spring member, thereby causing on said display member a responsive display which is independent of the size of said golf ball and a measure of the hardness of said golf ball.

2. In a hardness tester, in combination, anvil means comprising opposing non-parallelly disposed object-engaging surface portions for wedgingly receiving therebetween an object to be tested, said surface portions automatically compensating for variation in sizes of the objects to be tested; and actuating means operatively connected to said anvil means for urging said surface por-

tions toward each other so as to increase the pressure exerted by said surface portions on the object wedged therebetween, the amount of relative movement of said surface portions in response to actuation of said actuating means being indicative of the hardness of the object.

3. In a hardness tester according to claim 2, wherein said anvil means comprises a pair of opposing anvil members respectively including said surface portions, said opposing anvil members being supported for relative movement along a common axis.

4. In a hardness tester according to claim 3, said actuating means comprising manually operable means operatively connected to one of said anvil members for moving said one anvil member toward the other anvil member, and spring means cooperating with said other anvil member for urging the latter toward said one anvil member.

5. In a hardness tester according to claim 4, indicator

means operatively connected with said other anvil member for indicating the amount of displacement of said other anvil member along said common axis.

6. In a hardness tester according to claim 3, wherein each of said anvil members is supported for movement along said axis.

7. In a hardness tester according to claim 2, wherein said surface portions are planar.

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