Dec. 9, 1952 H. L. CAMPBELL 2,620,654

CORE HARDNESS TESTER

Filed Feb. 4, 1950 2 SHEETS—SHEET 1

Fig. 1

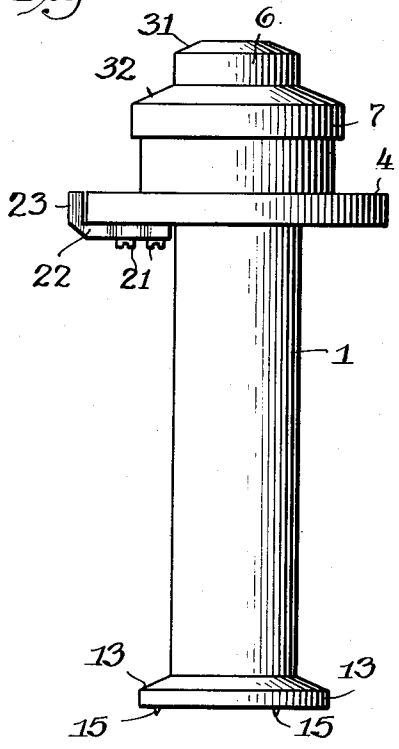
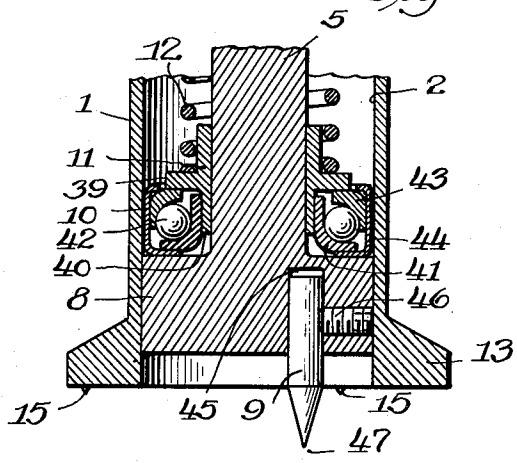


Fig. 7.



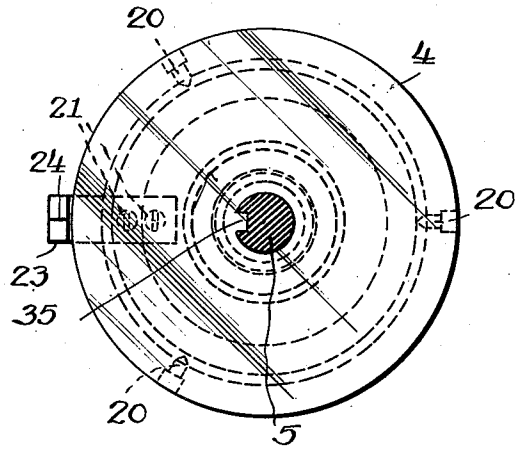


Fig. 8.

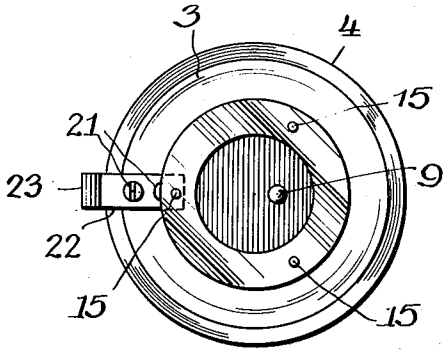


Fig. 2.

Inventor
Harry L. Campbell
By: Frederick F. Mason
Atty.

Dec. 9, 1952 H. L. CAMPBELL 2,620,654

CORE HARDNESS TESTER

Filed Feb. 4, 1950 2 SHEETS—SHEET 2

Fig. 4.

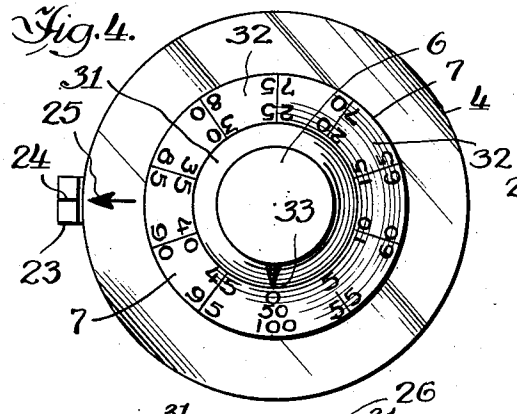


Fig. 6.

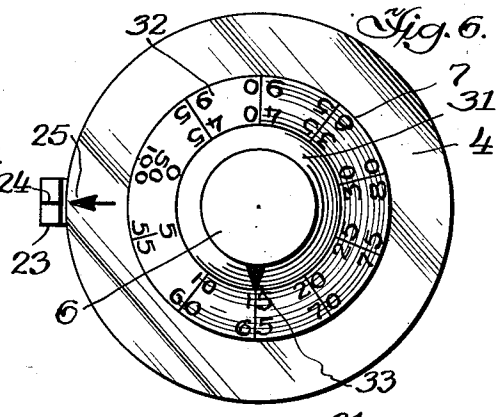


Fig. 3.

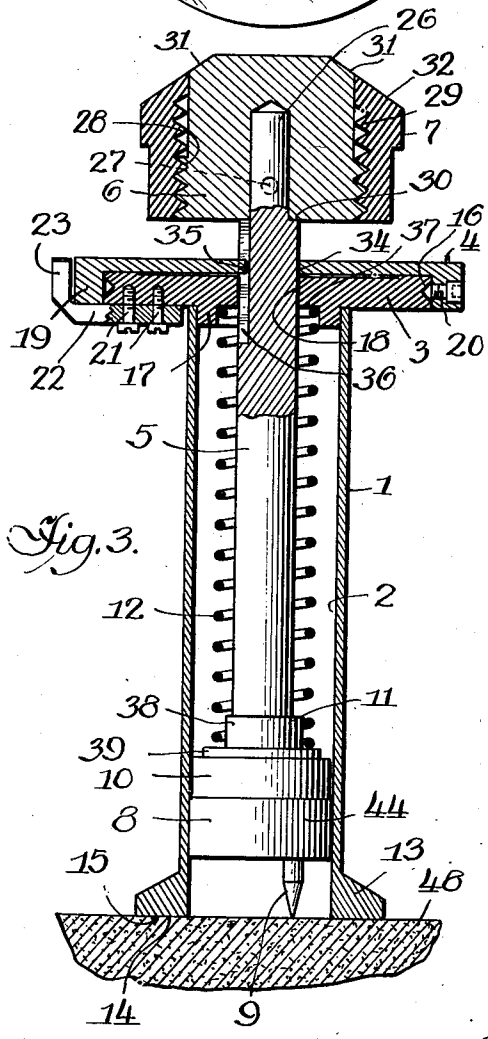
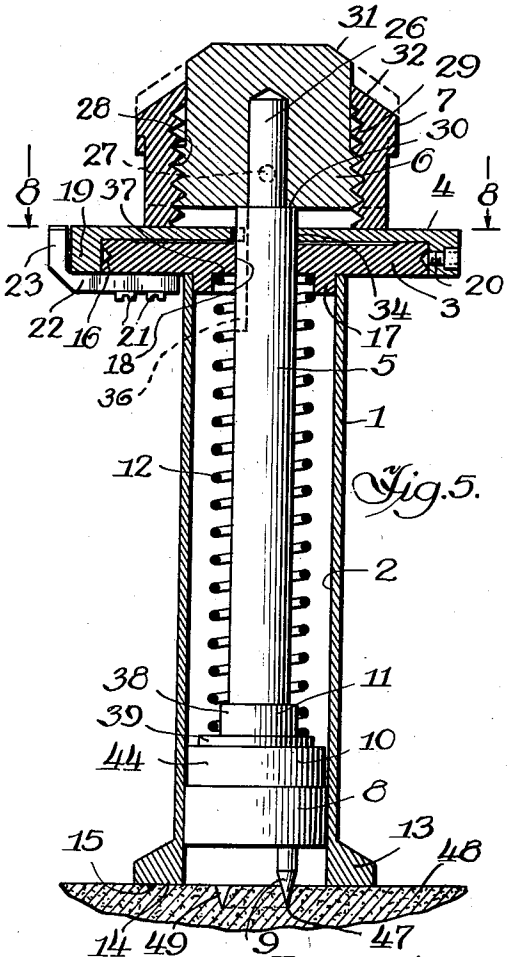


Fig. 5.



Inventor,
Harry L. Campbell
By Frederick F. Mason
Atty.

Patented Dec. 9, 1952

2,620,654

UNITED STATES PATENT OFFICE

2,620,654

CORE HARDNESS TESTER

Harry L. Campbell, Oak Park, Ill., assignor to Claud S. Gordon Company, Chicago, Ill., a corporation of Illinois

Application February 4, 1950, Serial No. 142,379

13 Claims. (Cl. 73—78)

1

This invention relates to a core hardness tester, and more particularly to such device in which an abrading point is moved under predetermined pressure over a predetermined distance of travel against an exposed surface of a baked foundry core, for ascertaining the hardness of the core and its adaptability for making satisfactory castings for various kinds of work.

The making of foundry cores requires skill and care in selecting the right kind of core sand, and the right kind and proportions of binding material to be added to the sand, such as core compound, molasses water, or whatever nature of binding material the particular foundry is using in the making of its cores. The core sand and binding materials will vary in both kind and proportion, for different kinds of castings. One of the essential requirements of foundry cores is that they have sufficient porosity to carry off the gases generated therein by the heat of the molten metal being poured therearound, and at the same time have adequate strength to prevent breaking or crumbling that would result in an imperfect hole in the casting. If the gas generated in the core during casting is not vented or relieved to the outside of the mold sufficiently quickly, cavities called "blow holes" will be formed in the body of the casting, and possibly cause the casting to be rejected.

For the above and other reasons, the core materials must be carefully selected and proportioned, as well as properly compressed when the core is being formed, so as to meet the many core requirements for making good castings. After the cores have been formed they are baked in an oven, and by the use of the present invention one or more of the baked cores may be selected at random and tested to ascertain their hardness which will indicate their suitability for the particular job in which they are to be used, and whether the core mix should be changed. If desired a few test cores may be first made, baked and tested, or such tests may be carried out from time to time and from day to day as the foundry work proceeds, to ascertain whether the core mix is satisfactory. If the baked cores are too hard they will not have the required porosity to carry the generated gases therefrom and out of the mold, and if too soft they will not stand up to the required work. With the present invention it is thus easily and quickly possible to test the baked cores to ascertain whether they meet the requirements of good foundry practice for the particular job in which they are to be used.

Among the objects of this invention are: to

2

provide a new and improved core hardness tester; to provide a core hardness tester that is small and portable and can be readily carried around from place to place, can be easily and conveniently manipulated, and is efficient and accurate in operation; to provide such tester having a stationary part within which is mounted a rotatable portion provided with an eccentric abrading element, and means for indicating the amount of penetration of the abrading element into the core after the abrading element has moved a predetermined distance, under a predetermined pressure, over the core surface; to provide a core hardness tester having means for abrading the surface of a baked core, and means for reading the depth of abrasion to determine the hardness of the core; to provide a core hardness tester having an abrading element movable both laterally and longitudinally, and novel means for indicating the amount of longitudinal movement of the abrading element when the tester is operated against a baked core; and such further objects, advantages and capabilities, inherently possessed by the invention, as will later more fully appear.

My invention further resides in the combination, construction and arrangement of parts illustrated in the accompanying drawings, and while I have shown therein a preferred embodiment, I wish it understood that the same is susceptible of modification and change without departing from the spirit of the invention.

In the drawings:

Fig. 1 is a side elevation of my core hardness tester in the position indicating maximum hardness of a core upon which it had been operated;

Fig. 2 is a bottom plan view of Fig. 1;

Fig. 3 is an enlarged, longitudinal section on a median plane, parts being shown in elevation for clearness;

Fig. 4 is a top plan view of Fig. 3, but including the portions removed by section in Fig. 3;

Fig. 5 is a view similar to Fig. 3, but showing the parts in a different relative position;

Fig. 6 is a top plan view of Fig. 5, but including the portions removed by section in Fig. 5;

Fig. 7 is an enlarged, fragmentary longitudinal section on a median plane, of the lower end portion of the tester; and

Fig. 8 is a transverse section on the line 8—8 of Fig. 5.

In the form shown in the drawings for illustrative purposes, and referring to Figs. 1, 3 and 5, my core hardness tester comprises generally a stem 1 having a cylindrical bore 2, a supporting element 3 fixed on the top of the stem, a knurled

wheel 4 rotatable on the supporting element, a shaft 5 rotatable with the knurled wheel but longitudinally slidable therein, an externally threaded head 6 fixed to the upper end of the shaft, a knurled nut 7 threadably mounted on the threads of the head 6, a cylindrical foot member 8 fixed to the lower end of the shaft to rotate and slide in bore 2, and abrading point 9 fixed eccentrically to protrude from the lower face of the foot member, an annular ball bearing device 10 resting on the upper face of the foot member, a ferrule 11 above the ball bearing device, and a coil compression spring 12 between the ferrule and the supporting element 3. The tubular stem 1 is of a length to be comfortably held within the grip of one hand of the operator. This stem has fixed at its lower end an outwardly extending flange 13, downwardly and outwardly beveled on its upper surface and with its bottom face 14, as viewed in Figs. 3 and 5, falling within a plane at right angles to the longitudinal axis of shaft 5. Fixed to the lower face 14 of flange 13, at suitably circumferentially spaced points, are any suitable number of short, sharp-pointed pins 15, sufficiently small to be readily embedded a short distance into the surface of a baked core being tested so as to prevent the tester from slipping with relation to the core, and yet prevent any penetration damage to the core during testing. Three of such points are shown for illustration in Fig. 2.

The supporting element 3 has an outer marginal edge circular in contour and formed in its vertical face with a circumferential groove 16 extending entirely therearound. On its under face, supporting element 3 is formed with a downwardly extending annular flange 17 fixed in any suitable manner in the top of stem 1, to be stationary therewith during operation of the tester. Supporting element 3 is provided with a central opening 18 within which shaft 5 is rotatable and longitudinally slidable.

Knurled wheel 4 is provided with a downwardly extending annular marginal flange 19 of a size to fit over and be freely rotatable on supporting element 3. Flange 19 is formed with any suitable number of circumferentially spaced, threaded, radially extending holes to each receive a threaded stud 20 having an extending inner end positioned within the circumferential groove 16 of supporting element 3, to hold the knurled wheel against removal from the supporting element but permit free rotation thereon. Three of such studs are shown for illustration, see Fig. 8, but any other number may be used as desired. Fixed by screw-bolts or the like 21, to the under face of supporting element 3, is a radially extending stationary arm 22, having its outer end turned upwardly to form an index member 23, the upper end of which is flush with the upper face of the knurled wheel 4 and formed with a radial stationary index line 24. Also formed at a desired marginal location on the upper face of knurled wheel 4 is a radial index line 25 which moves with relation to the stationary index line 24 as the knurled wheel 4 rotates on the supporting element 3.

The externally threaded head 6 is fixed to the reduced diameter portion 26 of shaft 5, preferably with a set screw, as indicated at 27 in Figs. 3 and 5, the outer end of this set screw when tight being inside of the outer surfaces of threads 28 of the head, so as to permit the inside threads 29 of knurled nut 7 to freely pass

thereover when the knurled nut is being rotated thereon. When the threaded head 6 is fixed on the reduced end of the shaft, it will be positioned with its lower face bearing against the shoulder 30 formed between the reduced end and the main portion of the shaft. As will be seen in Figs. 3 and 5, the externally threaded head 6 is formed with only three threads at the bottom portion of its external surface, the remaining portion being unthreaded and of a diameter slightly less than the root diameter of the threads thereon, so as to be sure and clear the threads on the inside of the knurled nut 7. The outer annular corner of the top end of head 6 is beveled to provide a slanting surface 31 which is of the same angle as the upper beveled slanting surface 32 at the top of the knurled nut 7, so that these two slanting surfaces will form continous, uninterrupted surfaces when they are brought into registry, as shown in Fig. 3. For this purpose the threads on the inside of this nut are terminated a slight distance short of the top of the nut where they merge into an inner cylindrical surface freely rotatable on the unthreaded side portion of the head 6, and of a diameter slightly greater than that of said unthreaded side portion. This enables a quick detection of the registry of slanting surfaces 31 and 32.

It is also to be noted that when slanting surfaces 31 and 32 are in registry, the bottom surface of knurled nut 7 and the bottom surface of head 6 fall in the same plane, which, when the abrading point 9 is free and out of contact with any object, is also the plane of the upper surface of the knurled wheel 4. At this same time the point of the index marker 33, stamped on the slanting surface 31 of the head 6, will point to the radial line bearing the numbers "0," "50" and "100" as stamped on the slanting surface 32. This latter surface also has stamped around its inside edge, circumferentially equally spaced marks and numbers from 5 to 45, and on its outside edge similar marks and numbers from 55 to 100, for a purpose later more fully explained.

Knurled wheel 4 is also formed with a central opening 34 within which shaft 5 is longitudinally slidable but is prevented from rotation therein by a key member 35 integrally fixed to knurled wheel 4 and seated in key slot 36 over which key member the slot is longitudinally slidable. In this connection see Figs. 3, 5 and 8. This construction causes shaft 5 to be rotated with knurled wheel 4, and to be longitudinally slidable therein. As seen in Figs. 3 and 5, the coil compression spring 12 is seated at its top end in the recess 37 formed in the bottom face of the supporting element 3, this spring surrounding shaft 5. At its bottom end spring 12 is seated over the upstanding tubular neck 38 of ferrule 11 to bear against the lateral annular flange 39 thereof.

As seen in Fig. 7, the ferrule 11 is slidably mounted on the shaft 5 to be rotatable with relation thereto, and is provided with a downwardly extending integral sleeve or neck 40, which is loosely inserted within the inner circular opening of the annular inner ball-race member 41, within the latter of which are rollably seated a series of anti-friction balls 42 which, on their opposite face, rollably contact the annular outer ball-race member 43 which is fixed within the annular ball-bearing casing 44 which in turn is slidably mounted within the bore 2 of

stem 1 and rests at its bottom on the foot member 8. The inner ball-race member 44 is rotatably slidable with relation to the bottom flange of casing 44. This ball-bearing assembly as described above, and indicated generally in Figs. 3 and 5, at 10, is a conventional device obtainable on the market.

The abrasion member 9 is a steel pin, adjustably fixed in hole 45 in the foot member 8 by a set screw 46 for longitudinal adjustment as desired. The bottom end of this pin is tapered to a sharp point 47, see Fig. 7, and is eccentrically located in foot member 8 so that when shaft 5 is rotated under pressure of spring 12, this abrading point will rotate in a circle and scratch into a baked core against which the tester is positioned. In the position shown in Fig. 5 the shaft 5 has been rotated for three revolutions, which caused the abrading point 47, under the constant pressure of spring 12, to travel in a circle against the surface of the core 48 and, during such travel, dig into the body of the baked core to a depth proportionate to the hardness of the core. The groove thus cut into the core is indicated at 49 in Fig. 5.

While other suitable values may be used without departing from the spirit of my invention, I have obtained good results in the present core hardness tester by making the spring 12 of such construction as to exert a pressure of 16 ounces on the abrading point, rotating the knurled wheel 4 three revolutions, and moving the abrading point 47 in a circle three-eighths of an inch in diameter. The abrading pin 9 is preferably 0.250 inch in length from where it begins to taper to the tip of the point, and the pins 15 are sharp pointed and merely long enough to prevent slipping of the bottom face 14 of the tester when the knurled wheel 4 is rotated with the tester pressed against the core. The threads 28 on the head 6 are made with a pitch of one eighth of an inch, or in other words, eight threads to the inch. This means that one revolution of the knurled nut 7 will move it one eighth of an inch with relation to the head, and two revolutions will move it one quarter of an inch thereon.

The operation of the device will be understood from the above description. The maximum hardness value indicated by the hardness tester is 100 for zero penetration. When the abrading point moves down a distance of 0.250 inch, the hardness of the core is 0. Intermediate values can be found within these two extremes as indicated by the scale. When a reading of 0 is referred to, it means that the marker index point 33 on the slanting surface 31 of the head 6 stands opposite the 0–50–100 line on the slanting surface 32 of the knurled nut 7, with these two slanting surfaces in registry and the bottom faces of the head and nut in the same plane and resting on the top surface of the knurled wheel 4. This means that the tester was pressed against a baked core flat surface with the head and nut standing at 0, and the knurled wheel 4 rotated three revolutions starting and stopping with the index point 25 of the wheel in registry with the index line 24 of the index arm 22—23. During these three revolutions the abrading point 47 cut into the core a distance of one quarter of an inch, with the top of the taper in the plane of the bottom face 14 of the stem flange 13 as seen in Fig. 7, and with the bottom faces of the head and nut contacting the upper face of the wheel, thus indicating that the core was of 0 hardness. A space still intervenes between the top of the taper of the pin and the bottom face of the foot member 8, to receive any loose particles forced up thereinto by the abrading point.

Again, with the head and nut standing at 0 with relation to each other, and with the tester pressed against a baked core flat surface, if the wheel 4 is rotated three revolutions and the abrading point still stands in the position shown in Fig. 3 with no penetration into the core, a rotation of the nut 7 clockwise for two revolutions will be required, with the wheel 4 held stationary, in order to make the bottom surface of the nut touch the top surface of the wheel, which will bring the marker index point 33 in registry with the 0–50–100 line, thus reading 100 on the outside, because of the two revolutions of the nut. This 100 reading after two clockwise revolutions of the nut indicates that the core being tested is of maximum hardness with zero penetration of the abrading point. After the three revolutions of the wheel, preferably in a clockwise direction, and the clockwise rotation of the nut until it touches the wheel, with the tester during this time being pressed against the core, the tester may then be removed from the core and the reading read on the top of the nut with relation to the index 33 on the top of the head 6. Any intermediate degrees of penetration of the abrading point into the core may likewise be read on the scale.

In other words, to make a hardness test of any baked core desired to be tested, set the pointer or line 25 on the wheel in registry with the stationary index line 24, turn the knurled nut 7 until the two slanting surfaces are even, with marker point 33 opposite the zero on index line 0–50–100, place the tester on a flat surface of the core and hold the tester against the core with one hand while the wheel 4 is turned clockwise for a total of three complete revolutions, and with the tester still held against the core turn the nut 7 clockwise (to move it downwardly) until it touches the wheel 4. Then lift the tester from the core and read the hardness value on the dial opposite the arrow on the central head. The inside figures on the dial are for the first revolution of the nut and the outside figures are for the second revolution of the nut.

To check the instrument, see that the end of the abrading point is even with the bottom of the tester when the dial is at 100. At a reading of 0, when the two slanting surfaces are in line, the abrading point extends 0.250 inch from the bottom of the instrument.

Hardness readings can be taken on horizontal, vertical, or intermediate surfaces, as well as in recesses. When the required hardness standards are established for a given practice, the condition of any core can be determined quickly and easily.

While it has been stated that abrasion member 9 is a steel pin, it is to be understood that the same is very hard to be abrasive resistant, or it may be of any other material sufficiently hard to maintain its sharp point for long durations of use.

Also while I have, for illustrative purposes, shown and described my hardness tester as applied to the testing of the hardness of baked foundry cores, I wish it understood that it may be employed for the testing of the hardness of plaster, plaster-of-Paris, mortar, soft plastics, and any other material of semi-hardness to which it may be adaptable.

I claim:

1. A hardness tester, comprising, a stem having a supporting element fixed to one end, a shaft mounted in said stem and supporting element for rotation and longitudinal movement therein, a wheel member rotatable on said supporting element for rotating said shaft, the shaft also being longitudinally slidable through the wheel member, a threaded head fixed to the shaft beyond said wheel member, a nut threaded to move longitudinally on the head, an abrading element eccentrically mounted on the end of the shaft removed from said head, and a scale on one of said nut and head and an index marker on the other for indicating the value of penetration of the abrading element into a surface being tested.

2. A tester as claimed in claim 1, including a spring connected to the shaft and stem for urging the shaft and abrading element in a direction away from said supporting element at a predetermined pressure.

3. A tester as claimed in claim 2, including a foot member at the bottom portion of said shaft in which said abrading element is fixed, an annular anti-friction device resting on the foot member, and an annular ferrule bearing against said anti-friction device and against which said spring exerts its pressure.

4. A tester as claimed in claim 3, in which said spring is a coil, compression spring surrounding the shaft and bearing against the ferrule at its lower end and against the supporting element at its upper end.

5. A baked foundry core hardness tester, comprising, a tubular upright stem, a circular supporting element fixed to the top of the stem and having a circumferential groove around its outer edge, a wheel member rotatable on the supporting element and having an annular depending flange encompassing the outer edge thereof, adjustable and removable means at spaced intervals around the circumference of said flange to enter said groove to enable rotation of the wheel on the supporting element but prevent separation thereof, a shaft rotated by rotation of the wheel member but longitudinally slidable therein, said shaft being rotatable in the supporting element and in the stem, an eccentric abrading element mounted in the bottom end of the shaft, said shaft extending above said wheel member and having a threaded head fixed thereto, a nut threadably mounted on the threads of the head, and a scale on one of the nut and head and an index marker on the other, for reading the amount of penetration of the abrading element into a core after rotation of the abrading element on the core and when the nut has been screwed down until it touches the wheel member.

6. A tester as claimed in claim 5, in which the supporting element and the wheel member have respective index marks to enable a predetermined amount of movement of the wheel member and the abrading element.

7. A tester as claimed in claim 6, in which a coil compression spring encircles the shaft and bears at one end against the shaft and bears at the other end against the supporting element to exert a predetermined downward pressure on the abrading element.

8. A hardness tester, comprising, a tubular stem having a supporting element fixed to the upper end thereof, a wheel member rotatably mounted on said supporting element, a shaft extending into the stem and rotatable in the supporting element and rotatable with the wheel member, said shaft being longitudinally slidable through the supporting element and the wheel member and extending beyond the top of the latter, an externally threaded head fixed on the top end of the shaft, a nut threadably mounted on the threads of the head to move up and down with relation thereto upon rotation of the nut depending on the direction of rotation, an enlarged foot member fixed on the bottom of the shaft, a ferrule on the shaft, an anti-friction device between the ferrule and the foot member, a coil compression spring bearing against the ferrule at one end and against the supporting element at the other end, and an eccentric abrading point fixed in the lower face of the foot member of the shaft.

9. A tester as claimed in claim 8, in which a scale is mounted on the nut to cooperate with in index marker on the head, and an index marker is provided on each of the supporting element and the wheel member to enable counting of the number of full revolutions of the wheel member on the supporting element.

10. A tester as claimed in claim 9, in which the ferrule is formed with a radially extending flange to seat the ferrule on the anti-friction device, and to receive the thrust of the lower end of the compression spring.

11. A hardness tester comprising, a stationary tubular stem, a rotatable and longitudinally movable shaft in said stem, an eccentric abrading point on the bottom end of said shaft, a wheel for rotating said shaft, the shaft being longitudinally slidable in the wheel and rotatable therewith, a spring for normally urging said shaft longitudinally downwardly, and a two-part member on the upper end of the shaft, one part of the two-part member being fixed to the shaft, and the other part thereof being longitudinally movable with relation to said one part to measure the value of downward movement of the abrading point when testing the hardness of a material being tested.

12. A hardness tester, comprising, a tubular stem, a supporting element fixed to the top of the stem, a shaft rotatably and longitudinally movable in said supporting element and having a foot member assembly at its lower end, a wheel member rotatably mounted on the supporting element, resilient means for normally urging said shaft downwardly, a downwardly extending abrading element eccentrically fixed to the lower face of said foot member assembly to rotate with the shaft, and means on the top portion of the shaft above the wheel member to indicate the value of hardness of an article against the surface of which the abrading element is moved under pressure by rotation of the wheel member and shaft, the wheel member and the shaft being interconnected for rotation together but with longitudinal movement of the shaft with relation to the wheel member.

13. A hardness tester, comprising, a stationary member, a shaft mounted in the stationary member for rotation and longitudinal movement therein, an abrading member eccentrically mounted on one end of the shaft, a wheel member rotatable on the stationary member and interconnected with the shaft for providing rotation and longitudinal movement of the shaft with relation to the wheel member, said abrading member being movable along a closed circular path a plurality of times when pressed against a surface to be tested during rotation of the shaft.

and means on the tester for measuring the value of the penetration of the abrading member into said surface when the abrading member has moved over said path under a predetermined pressure.

HARRY L. CAMPBELL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,091,128	Guillery	Mar. 24, 1914
1,283,362	Tone	Oct. 29, 1918
1,435,314	La Vercombe	Nov. 14, 1922
1,973,333	Craemer	Sept. 11, 1934
2,130,269	Dietert	Sept. 13. 1938
2,338,537	Podesta	Jan. 4, 1944