Nov. 10, 1931. H. H. LA VERCOMBE 1,830,842

HARDNESS TESTING MACHINE

Filed Aug. 28, 1925 2 Sheets-Sheet 1

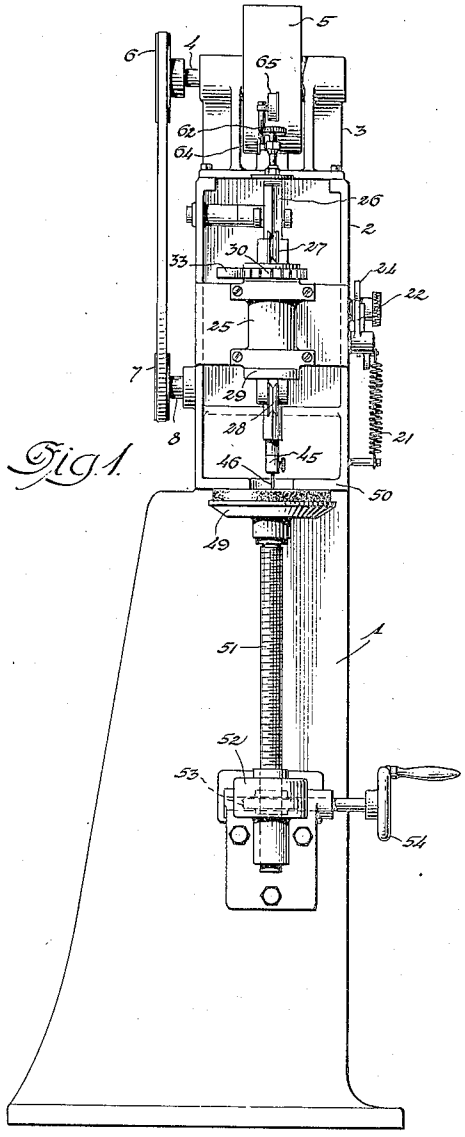


Fig. 1.

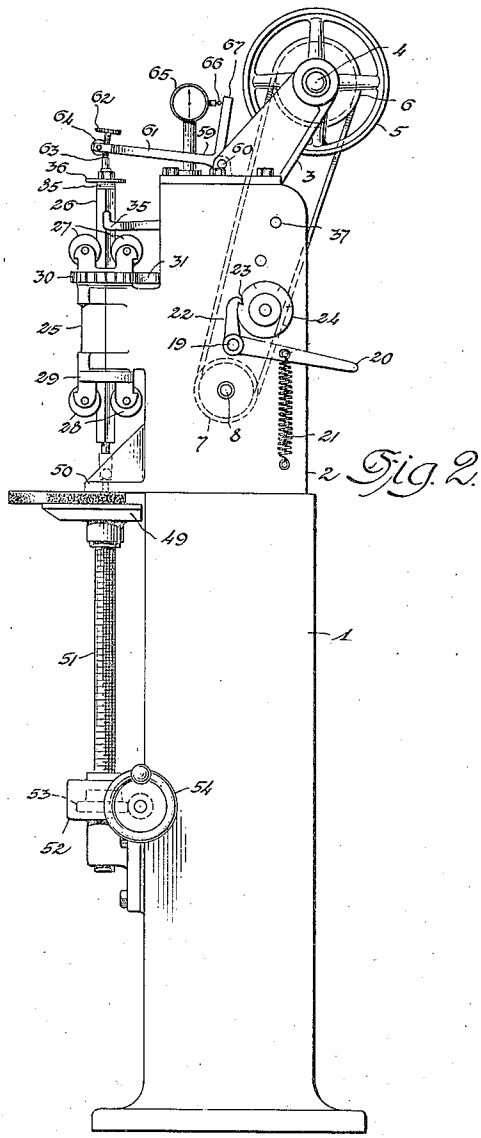


Fig. 2.

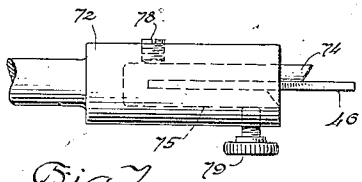


Fig. 7.

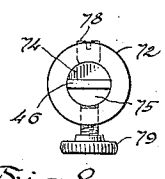


Fig. 8.

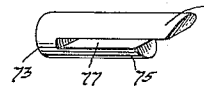


Fig. 9.

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Fig. 3.

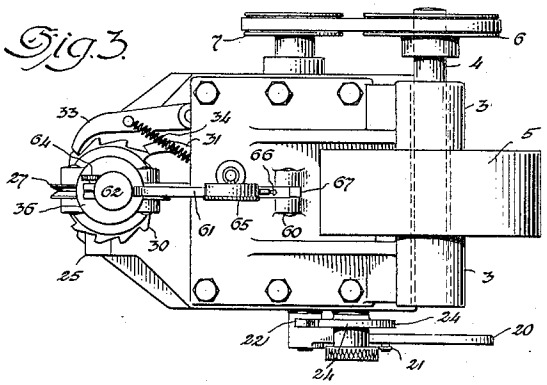


Fig. 4.

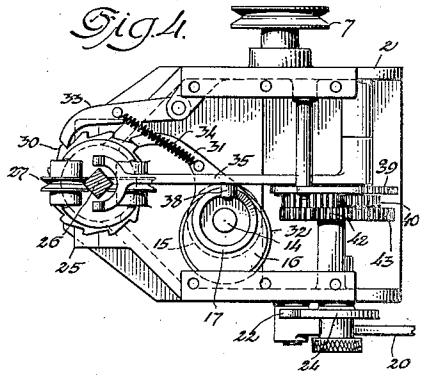
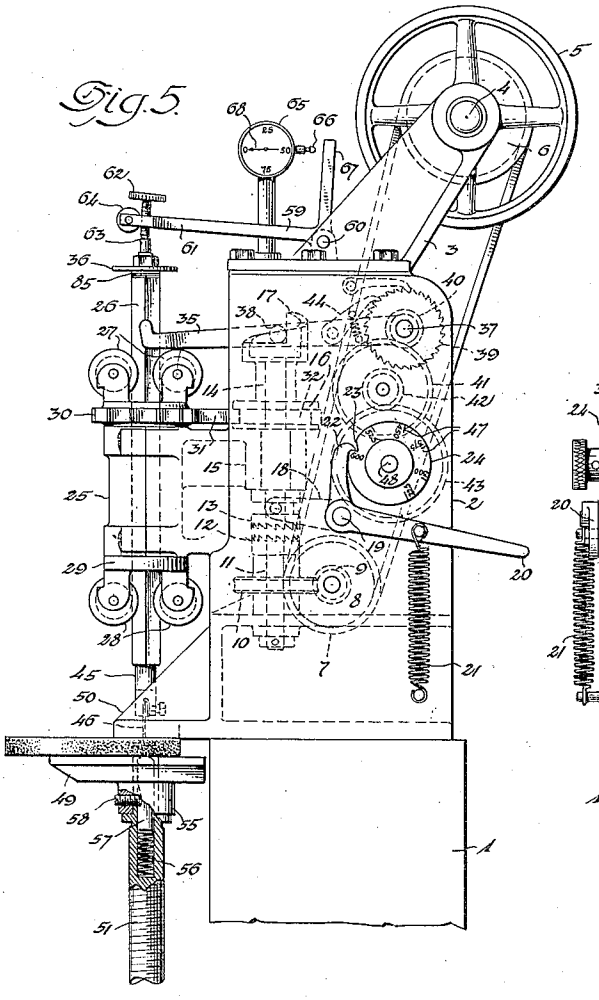


Fig. 5.



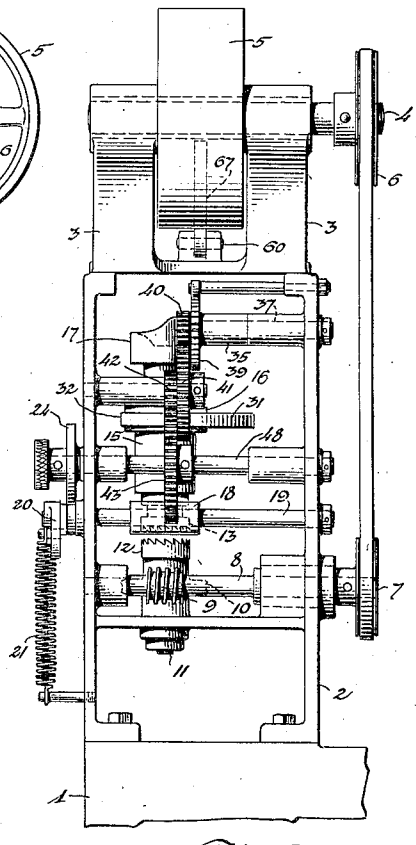


Fig. 6.

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UNITED STATES PATENT OFFICE

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HARDNESS TESTING MACHINE

Application filed August 28, 1925. Serial No. 52,975.

This invention relates to means for testing the hardness of grinding wheels, stones and similar material and articles which it is desirable to grade according to set standards so that uniformity in such grading may be secured and the relative hardness of different grinding wheels or stones ascertained in order to determine their suitability for different uses, and to that end it has heretofore been proposed to submit the article to be tested as to hardness to the frequent impact of a drill, and to compare different stones or wheels after similar treatment to ascertain the relative extent to which they have been affected by such impacts.

The hardness which it is desired to ascertain is that which results from the nature of the material forming the grinding wheel or stone as a composition or structure and is not necessarily governed by the size or nature of the grains of the abrasive material. For instance it may be governed by the nature of the matrix in which the abrasive material is embedded.

The success of comparative hardness tests must necessarily depend upon identical or definitely related circumstances governing the treatment of different stones which are to be so compared, otherwise the conclusions arrived at would be unreliable, and it is the object of this invention to provide, in a hardness testing machine, for the ensuring of the carrying out of such tests under practically identical conditions as to duration of operation, frequency of impacts, power expended in such impacts, and the manner of their delivery and reception so that proper comparison as to results of the tests on different wheels or stones may be made.

The invention also is intended to provide for variation of the length of stroke of the impact drill and also variation of the power expended in such impacting stroke; a further object of the invention being to provide for the determining of the number of blows to be delivered by the drill in an operation, and the duration of such operation.

Further objects of the said invention are to provide for the mounting of the grading drill on a spindle which delivers its blows preferably by gravity alone, thereby eliminating the lack of uniformity which is liable to result from the use of springs, and to further facilitate such gravital operation by the mounting of the said spindle in roller guides.

It is also an object to provide for the rotation of the spindle by the rotation of said rollers around the axis of said spindle between each impact, whereby a flat drill may be caused to produce a round hole or depression in the surface of a wheel or stone submitted to the impact of the said drill throughout a period of operation.

The invention also contemplates the provision of durable indexing and ratchet mechanism controlling and effecting the duration and frequency of the impact and the rotation of the grading spindle, and also the provision of an indicator giving a direct reading of the depths of penetration without necessitating the removal of the wheel or stone from the machine, or such interference with the setting of the machine as might preclude or complicate the further continuance of the test if so desired.

Further objects are to provide means associated with the grading table upon which the wheel rests during a test, particularly intended to effect the local supporting of the wheel or stone directly beneath the drill; and to provide a simple form of chuck eminently adapted to use in a machine of this type.

Still further objects subsidiary to or resulting from the aforesaid objects, or from the construction or operation of the invention as it may be carried into effect, will become apparent as the said invention is hereinafter further disclosed.

In carrying the said invention into effect, I may provide, in a hardness testing machine for facilitating the grading of articles such as grinding wheels, a grading table for the support of a grinding wheel, and a drill spindle vertically reciprocal above said table by means of a mechanically actuated lifting member which releases the said spindle and permits it to fall by gravity, a drill or impact tool mounted in the lower end of said spindle which strikes the surface of the grindstone each time the spindle falls, and

ratchet means synchronized in operation with the lifting member, partially rotating the said drill between each blow delivered to the said grindstone.

An adjustable dial device controls the duration of the operation of the lifting and rotating mechanism, and stop means, set by the said dial, ensure the cessation of the operations when they have been effected to the predetermined extent; and an indicator is adapted to be brought into operation at any stage in the test to indicate the penetration of the grindstone effected by the drill and to give a direct reading of such penetration, means being provided for the setting of such indicating mechanism to provide for different thicknesses or dispositions of the grinding wheels relative to the drill or for different lengths of drills which may be utilized. The said grading spindle reciprocates between friction reducing rollers which rotate therewith and about the axis thereof and are mounted in a suitable housing adapted to ratchet rotation whereby the aforesaid rotation of the spindle is effected. An adjustable member is adapted to be brought to bear on the grindstone directly beneath the drill.

All of which is more particularly described and ascertained hereinafter, by way of example, having reference to the accompanying drawings, in which—

Figure 1 is an elevation of a machine embodying my improvement;

Figure 2 is a side elevation of the same;

Figure 3 is a plan of the same;

Figure 4 is a similar view to Figure 3, with the upper cover plate removed;

Figure 5 is a detail side elevation of the upper part of the machine;

Figure 6 is a rear elevation of the same;

Figure 7 is a detail side elevation of a suitable form of chuck and drill for use with the improved machine;

Figure 8 is an end elevation of the same, and

Figure 9 is a detail perspective view of the compressible jaw member of the chuck.

Similar characters of reference indicate similar parts in the several figures of the drawings.

Mounted on a pedestal 1 is a gear casing 2, from the upper end of which extend arms 3 carrying the drive shaft 4 which is provided with a drive pulley 5 and a V-pulley 6 belted to a similar pulley 7 on the end of a worm gear shaft 8 journaled in the lower part of the said gear casing. This shaft 8 through a worm 9, worm gear 10 and its spindle 11 effects the rotation of the lower part 12 of a dog clutch, the upper part 13 of which is mounted on the lower end of a vertical spindle 14 journaled in a member 15 of the gear casing and carrying an eccentric 16 and a cam 17 at the upper end thereof.

It will be seen that the upper part 13 of the dog clutch is vertically movable on its spindle by a clutch fork 18 mounted on a shaft 19 extending transversely of the gear casing and operable by a clutch lever 20 exterior to the said casing, which lever is subjected to the influence of a tension spring 21 which tends to retain it in a depressed position and therefore tends to effect the disengagement of the clutch 12, 13. The said clutch lever is, however, provided with a dial latch 22 adapted to ride over the periphery or engage in a peripheral notch 23 of a rotary dial 24, according to the position of the said dial relative to the latch 22, for purposes which will be hereinafter further explained.

Extending forwardly of the said gear casing is a head 25 through which vertically passes a reciprocal and rotatable spindle 26 mounted between upper and lower pairs of rollers 27 and 28, whereby its very free vertical movement is permitted. The said spindle is not rotatable with respect to the said rollers, but these rollers are mounted at the upper and lower ends of a sleeve 29 in the head 25, which sleeve is provided with a ratchet 30. The rotation of the said sleeve is accompanied by the rotation of the said spindle 26 and such rotation of the sleeve is effected by the movement of a pawl 31 extending from a strap 32 mounted upon the said eccentric 16, which pawl engages the teeth of the said ratchet successively with each revolution of the said eccentric 16.

33 is a dog locking the ratchet against reverse rotation, the said pawl 31 and dog 33 being held in operative relation to the ratchet by a tension spring 34.

Reciprocation of the said spindle is effected through a lever 35 by the cam 17 which in each revolution raises the said lever and causes it to strike the underside of a plate or weight 36 on the upper end of the said spindle, the said lever being swingably mounted on a shaft 37 in the gear casing and provided with a roller 38 beneath which the said cam 17 passes. The weight 36 may be replaced by different weights to suit circumstances of operation.

On the inner end of the shaft 37 is a ratchet wheel 39 and a gear pinion 40 which, through a train of gears 41, 42 and 43, effects the rotation of the dial 24 upon the actuation of the ratchet wheel 39 by a pawl 44 carried by the said lever 35.

From the foregoing description it will be understood that one revolution of the cam 17 and eccentric 16 is accompanied by the lifting of the spindle, a partial revolution thereof while raised, the release of the spindle so that it may fall by gravity, and the partial rotation of the dial 24; a ratio of gearing which I have found useful in this device resulting in one complete revolution of the dial 24 to six hundred revolutions of the said

cam 17 and consequently to six hundred strokes of the spindle 26.

The lower end of the said spindle 26 is provided with a chuck 45, a preferred form of which will be hereinafter referred to, and 46 is a drill or impact tool which comprises a flat steel member preferably of known hardness and having a blunt striking end of an appreciable area as shown in Fig. 8. This drill is intended to be brought into impact with the surface of an abrasive stone or wheel for the purpose of determining the hardness of the said stone, and the frequency and force of the impact is determined by the number of revolutions per minute of the cam 17 and the stroke and weight of the spindle 26.

Furthermore, the duration of the operation, in other words the number of strokes required of the spindle 26, may be determined by rotating the dial 24 so as to vary the relative position of the notch 23 thereof to the latch 22 and thereby determine the extent of rotation of the said dial required to permit the latch to engage in the said notch 23 which determines the number of revolutions of the cam 17 which will be required to permit such engagement of the latch with the said notch. The said dial may be indexed as at 47 to facilitate its proper setting for any desired number of revolutions of the said cam 17 and also may be frictionally mounted upon its shaft 48 to permit of its adjustment.

For the support of the grinding wheel or abrasive material, a table 49 is provided beneath the said spindle 26 and also beneath a jaw 50 extending from the lower part of the said gear casing, this table being vertically adjustable by means of a threaded support 51 mounted in a housing 52 which is secured to the pedestal 1 and encloses an elevating gear 53 operable by a hand wheel 54 so that grinding wheels or material of different thicknesses may be clamped between the said table 49 and the jaw 50. It will also be noted that the length of the stroke of the spindle 26 may be varied by raising or lowering the position of the weight on the spindle such as by the use of shims 85.

It is preferable that adequate support be given, especially in the testing of comparatively thin wheels or material, to the underside of the material immediately beneath the impacting drill, and as sometimes there are depressions in such underside which would not be properly supported by a flat table of any considerable area it is proposed to provide the table and its support with a bore 55 in the lower end of which a compression spring 56 is accommodated and from the upper end of which projects a plunger 57 supported by the said spring. Consequently, if the grinding wheel be placed upon the said table 49 and clamped thereby beneath the jaw 50, this plunger will be pressed by its spring into engagement with that part of the underside of the grinding wheel immediately beneath the drill 46, even though there may be a depression at this point, and the said plunger is then clamped firmly into such engagement with the grindstone by means of a set screw 58.

When the machine is operated the spindle is successively raised to a definite height, turned while the tool 46 is out of contact with the material being tested, and allowed to fall with a definite impact for a number of times determined by the setting of the dial 24, as explained, the partial rotation of said spindle and its drill between impacts forming a round hole or depression in the surface of the grindstone; and since the force of impact is equal with each blow (excepting insofar as the stroke is slightly increased by the depth of the depression formed, which is negligible) a very definite force is expended in any determined number of impacts.

Therefore, two wheels of equal hardness, as it is understood in a test of this nature, will show resultant depressions by the drill of equal depth if tested under identical conditions. The depth will be greater in the case of a wheel of lesser hardness and less in a wheel of greater hardness. Thus a series of wheels may be so tested and graded as to their hardness by relatively measuring the depth of depressions formed in them by an equal number of impacts in each case, or, on the other hand, by comparing the number of impacts required in each case to produce depressions of equal depth.

I facilitate the ready reading or determining of such hardness by the provision of means which will visually indicate the result of a test in a very simple manner, such means consisting of a bell crank 59 fulcrumed at 60 to the gear casing, the horizontal arm 61 of the said bell crank being provided with an adjusting screw 62, the end of which rests upon a projection 63 on the upper end of the spindle 26, 64 being a locking screw for securing the set screw in adjusted positions. Also mounted upon the upper part of the gear casing is an indicator 65 having an operating pin 66 projecting therefrom in the direction of the vertical arm 67 of the said bell crank lever; and before commencing a test upon a grinding wheel or other piece of abrasive material, the spindle is permitted to descend until the drill fully rests upon the surface of the said grinding wheel after which the adjusting screw 62 is adjusted until the vertical arm 67 of the bell crank engages the pin 66 of the indicator in such manner as to bring the indicator pointer 68 to zero. After this has been done and the set screw 62 firmly locked against displacement from its adjusted position, the bell crank may be swung upwardly out of opera-

tive position and the test proceeded with, the dial 24 being first set with the index showing the number of impacts of the drill upon the grindstone to be made.

The machine now being set in operation by the driving of the pulley 5 by any suitable means, the drilling takes place and the dial 24 gradually revolves until the latch 22 is coincident with the notch 23 of the said dial, whereupon the tension of the spring 21 causes the latch to enter the said notch which is accompanied by the disengaging of the upper part 13 from the lower part 12 of the clutch due to the depression of the clutch lever 20 by the said spring 21. This results in the cessation of the operation of the machine.

After the operation of the machine has ceased, the bell crank is again brought into operative position relative to the spindle which is in a position of rest with the drill bottoming the depression formed thereby in the grindstone, and consequently the vertical arm 67 of the bell crank will actuate the pin of the indicator to an extent relative to the depth of such depression so that the indicator will be operated to show such depth.

Upon the insertion of another wheel or stone in the machine for testing, the adjusting screw of the bell crank is again reset, if required, to insure the proper zero setting of the vertical arm of the said bell crank relative to the indicator and the test again proceeded with as before, and if with the same setting of the dial 24 as used in the previous test the same reading is secured on the indicator when the bell crank is brought into operation as was secured in the previous test, the two wheels or stones so tested may be graded as of equal hardness, but if a greater depression be indicated the stone so tested would be graded as of lesser hardness, or vice versa.

I prefer to use a chuck such as that shown in Figures 7, 8 and 9, wherein a tubular head 72 receives a jaw 73, one arm 74 of which jaw is longer than the other arm 75. The longer arm 74 projects beyond the end of the head 72 to facilitate the insertion of the drill into the groove 77, as the flat side of the drill may be simply engaged with the inner side of the projecting end of the arm 74 which guides the drill into the groove. 78 is a set screw securing the jaw in the head and 79 is another set screw in the head by means of which the drill is clamped between the arms of the jaw. Where a considerable amount of testing is to be done it is usually advisable to frequently change the drill as it becomes worn and the provision of a chuck such as that described greatly facilitates this changing operation.

A machine of this type if properly constructed is very positive in its operation and indications, and affords a means of readily obtaining comparisons of the hardness of different grinding wheels, stones or abrasive materials, irrespective of other qualities which are often confounded with true hardness as properly understood in this art and which very often lead to improper rating of abrasive materials.

This invention may be developed within the scope of the following claims without departing from the essential features of the said invention, and it is desired that the specification and drawings be read as merely illustrative and not in a limiting sense, except as necessitated by the prior art.

What I claim is:—

1. In a machine for testing the hardness of abrasive and similar materials, a reciprocal drill member, a drill carried thereby, means for supporting material to be tested in opposition to said drill, means effecting the reciprocal movement of said member whereby said drill is caused to frequently strike the presented surface of said material, and means for measuring the depth of the hole formed by said drill.

2. In a machine for testing the hardness of abrasive and similar materials, a reciprocal drill member, a drill carried thereby, means for supporting material to be tested in opposition to said drill, means effecting the reciprocal movement of said member whereby said drill is caused to frequently strike the presented surface of said material, timing means determining the number of reciprocations of said member, and stop mechanism controlled by said timing means, said stop mechanism rendering said member inoperative when such number of reciprocations has taken place.

3. In a device of the class described, means for supporting the material to be tested as to hardness, impacting means adapted to be brought into frequent contact with a localized area of said material on said supporting means, and a member adapted to be projected from the surface of said support for the local supporting of said material directly beneath the impacting means.

4. A device according to claim 3, wherein the main supporting means for said material is in the form of a table and said supplementary supporting means in the form of a spring pressed plunger extending beyond the surface of said table, whereby it may enter depressions in a material supported on said table and a lock securing said plunger rigidly in its engagement with said material.

5. In a device of the class described, in combination, a reciprocal drill member, a cam mechanism effecting the reciprocation of said member, said mechanism including a clutch, declutching means, and timing means operating said declutching means upon the completion of a predetermined number of reciprocations of said member.

6. In a device of the class described, in combination, a reciprocal drill member, a cam

mechanism effecting the reciprocation of said member, said mechanism including a clutch, declutching means, and timing means operating said declutching means upon the completion of a predetermined number of reciprocations of said member, said timing means being actuated by said member.

7. In a device of the class described, in combination, a reciprocal drill member, a cam effecting the reciprocation of said member, cam operating means, means for disconnecting said cam from said operating means, said disconnecting means being geared to said operating means and adjustable for disconnecting the cam upon the completion of a predetermined number of reciprocations of said member.

8. In a device of the class described, in combination, an impacting device, means for operating said device, a clutch in said means, declutching means, and timing means operated by said operating means and operable on said declutching means, said timing means being adjustable to operate said declutching means on the completion of a predetermined number of movements of said impact member.

9. A method of testing the hardness of abrasive and similar materials consisting in applying to said material a known number of impacts with a straight-edged drill, turning said drill through a small angle between impacts and while out of contact with the material whereby a round hole is formed in said material, and measuring the depth of said hole after a known number of impacts has been applied.

10. A method of testing the hardness of abrasive and similar materials consisting in applying to said material a known number of impacts with a straight-edged tool with a striking end of an appreciable area, turning said tool through a small angle between impacts and while out of contact with the material, whereby a round hole is formed in said material, and measuring the depth of said hole after a known number of impacts has been applied.

11. In a machine for testing the hardness of abrasive and similar materials, a reciprocable spindle, a straight-edged impact tool carried thereby and having a striking end of an appreciable area, means for supporting material to be tested in opposition to said tool, said means engaging the material over an area directly beneath that struck by said tool, means for raising said spindle and tool, means for turning said spindle while raised, and means for withdrawing support from said spindle while raised, whereby said spindle falls and said tool strikes the material to be tested.

In testimony whereof I affix my signature.

HARLEY H. LA VERCOMBE.