April 14, 1925.

1,534,015

K. O. SWENSON

GRADING MACHINE

Filed March 18, 1920

FIG. 1.

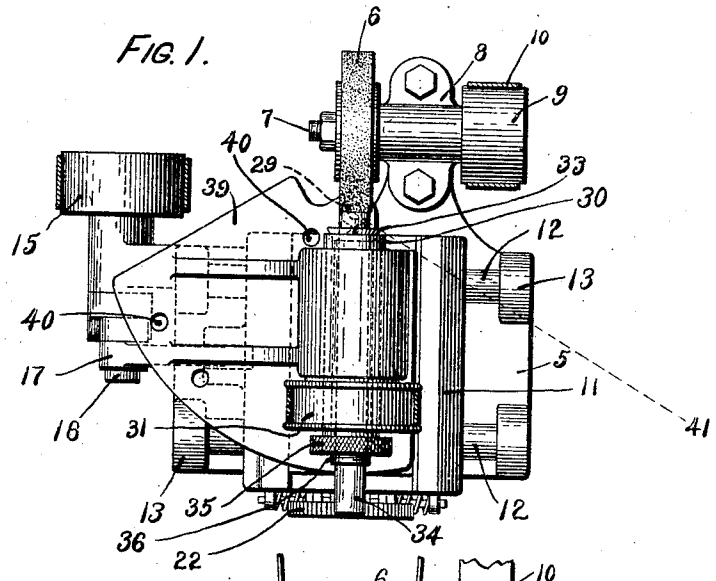


FIG. 2.

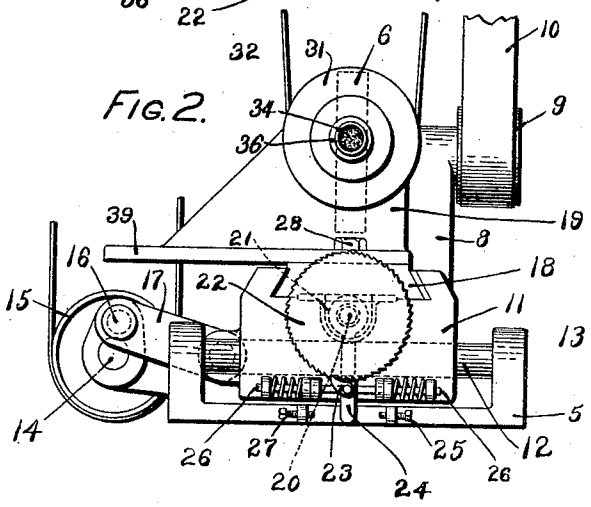
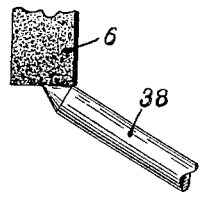


FIG. 3.



WITNESS

Ronald F. Hatch

INVENTOR

Kaspar O. Swenson

BY Clayton R. Jenks

ATTORNEY

Patented Apr. 14, 1925. 1,534,015

UNITED STATES PATENT OFFICE.

KASPER O. SWENSON, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO NORTON COMPANY, OF WORCESTER, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

GRADING MACHINE.

Application filed March 18, 1920. Serial No. 367,005.

To all whom it may concern:

Be it known that I, KASPER O. SWENSON, a citizen of the United States of America, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented certain new and useful Improvements in Grading Machines, of which the following is a full, clear, and exact specification.

This invention relates to the art of grading or classifying abrasive articles and more particularly to an improved method of and a machine for such grading or classifying.

The purpose of grading a grinding wheel or other abrasive article is to foretell its cutting ability, so that a user can call for a wheel of a certain grade with the knowledge that such wheel will be an exact duplicate of others of that grade which he has found to be suited to his work. It is impractical to test each wheel, when made, by an actual grinding test for the reason that such a test would require a prohibitive amount of time and moreover, it is not known on what material and under what conditions the wheel may be used. Various grading machines have been made for the purpose of quickly determining the cutting ability of a wheel by comparing certain characteristics of the new wheel with others of known cutting ability. For example, the hardness of the bond uniting the abrasive particles is sometimes the characteristic compared. It has been found, however, that while the hardness of the bond exerts a large effect in determining the grade, the cutting ability of the wheel does not vary directly with this or any other single characteristic, so that wheels which indicate exactly duplicate cutting ability by this method, may vary widely when put into use.

It is the object of this invention to provide a method and a machine for carrying the method into practical effect, by which the cutting ability of a wheel may be quickly and accurately determined by comparing certain functions or characteristics of the wheel, which vary directly with its cutting ability and which may be quickly ascertained, with those of a wheel of known grinding ability.

To the accomplishment of this object I have produced a grading machine employing a tool which has a destructive action on the wheel, crushing and disintegrating the wheel body in a manner heretofore employed only for the purpose of dressing or truing the surface of the wheel. This tool is preferably positively forced into the wheel while one or the other of the parts is being moved to present a relative abrading action there-between.

It will be obvious that if the tool is of a practically unwearable material, such as a diamond, the amount removed from a wheel will be substantially identical, whatever may be the degree of hardness of the wheel body. Therefore, another object of the invention is to provide a tool and method of using the same, for use in grading machines, which will show a marked distinction between different grades of wheels, as indicated by the material removed from the wheel body by engagement with the tool. For this purpose I provide a rotary tool in the form of a rod which, in order to increase its destructive action on the wheel body, may be made hollow in the form of a tube or pipe. I have discovered that the greatest distinctions between successive grades of wheels, as indicated by the material removed by such a tool, will be observed when the wear on the tool and on the wheel, both being measured in linear units, are about equal. Therefore, I vary the form and material of the tool in accordance with the hardness of the wheel being graded until a condition of approximately balanced wheel and tool wear are observed. Under these conditions slight variation in cutting ability is indicated by appreciable variation in the amount of material removed by the tool.

A further object of the invention is to determine the grade of abrasive bodies, particularly wheels, without defacing or injuring the strength or appearance of the wheel. To the accomplishment of this object I have provided a grading machine in which the grading tool is traversed back and forth across a face of the wheel, at the same time that it is moved into the body of the wheel, so that it not only determines the grade but also leaves a true surface thereon which is in good condition to start subsequent grinding operations.

The various features employed to the accomplishment of these objects and others that may hereinafter appear will best be

understood from the following description taken in connection with the accompanying drawings of the preferred embodiment of the invention, in which:—

Fig. 1 is a plan view of the grating machine;

Fig. 2 is a front elevation; and

Fig. 3 is a detail view showing the use of a solid tool instead of a tube.

In order to secure a relative abrading action between the abrasive article and the tool, it is most convenient, when the article is a wheel, to mount it for rotation and to present the tool thereto. As illustrated, the machine is provided with a base 5 adapted to be attached to a bench, and the wheel to be graded, indicated at 6, is mounted on a spindle 7 carried in a standard 8. The spindle is provided with a pulley 9 which may be connected with a source of power by a belt 10 to rotate the wheel. The speed of rotation of the wheel may be varied as may seem desirable but I have found that the best results on wheels of hard and medium grades are obtained by running the wheel at a slower speed than that which would be employed in normal grinding with the same wheel. Therefore, all except very soft wheels are run at a surface speed of about 3000 to 3500 feet per minute. Very soft wheels are run at a higher speed in order that the effect may be that of a harder wheel, in accordance with a well known law of grinding, as will be more fully explained. The standard 8 is preferably interchangeable or adjustable on the base 5 in order that wheels of various diameters may be approximately positioned without moving the tool.

I have found that it is possible to true the face of the wheel at the same time it is graded by causing the tool to traverse across the face, thus leaving a parallel, well-dressed surface ready for future use in a grinding machine. For this purpose the tool is carried on a table 11 mounted to slide on a pair of rods 12 fixed in suitable lugs 13 formed on the base 5. The table may be reciprocated parallel with the face of the wheel by any suitable mechanism, such, for example, as a shaft 14 which is provided with a driving pulley 15 on one end and a crank pin 16 on the other connected by a link 17 with the table 11. The throw of the crank pin 16 is considerably greater than the face of the wheel 6 in order that the tool may traverse beyond each side of the wheel and in order that the working stroke of the tool may be at a more nearly uniform rate.

In order that the tool may be fed or moved toward the wheel, the table 11 is provided with ways embracing a slide 18 on which a head 19 is mounted. An automatic feed mechanism is provided to move the tool toward the wheel, and in order that the tool may always work at a uniform depth into the wheel, the feed is arranged to take place near the end of the traverse when the tool is off the wheel. As illustrated, the feed is produced by a screw 20 rotatably secured in the table 11 and engaging a threaded nut 21 fixed on the slide 18. The screw is turned through a slight angle near each end of the stroke by a ratchet wheel 22 in operative relation with a pawl 23 mounted on an arm 24 loosely pivoted on the projecting end of the screw. As the table 11 nears the right end of its stroke, the arm 24 is engaged by a stop screw 25 fixed on the base, which turns the ratchet wheel 22 through an angle dependent on the adjustment of the stop screw. On the return stroke of the table, the arm 24 is brought to central position by one of a pair of spring pressed plungers 26. When the table approaches the end of its stroke to the left, the arm 24 is swung idly by a stop screw 27 and when the table starts in the opposite direction, the other spring plunger 26 moves the arm to central position and moves the ratchet wheel with the arm.

The head 19 is secured to the slide 18 by screws 28 and 29. The head may be modified to hold various forms of tools, either rotatable or non-rotatable, but I have found it expedient to employ a positively rotated tube as a tool on all wheels except the very soft, in order that the wear on the wheel may be great enough to show a marked degree of differentiation between wheels having but slight difference in cutting ability. As shown in the drawings, the head is bored to receive a hollow shaft 30 one end of which carries a pulley 31 which may be driven from any suitable source of power by a belt 32. The hollow shaft 30 carries a draw-in chuck 33 which grips the tube or pipe 34 employed in the present instance as a tool. The chuck is operated to grip and release the tool to permit the tool to be pulled out as worn away by a hand wheel 35 threaded onto the projecting end of the chuck sleeve 36. It will be observed from Fig. 2 that the bottom of the tube 34 is approximately in the plane of the axis of the wheel 6, which position produces greater wheel wear than if the axes of the tube and wheel intersected one another.

I have determined by careful experiments that it is advantageous to use certain speed ratios which amplify the difference in grade between wheels of nearly equal cutting ability. Thus I have determined that wheels of medium hardness will most closely indicate their true cutting ability if the wheel is run at a speed of from 3000 to 3500 surface feet per minute, whereas the normal grinding speed of the wheel would usually be between 5000 and 6000 surface feet per minute; that

the speed of rotation of the pipe or tool 34 should be about 300 R. P. M.; that the feed of the tool toward the work at the end of each pass should be from .002″ to .004″; and that the number of passes or traversing movements of the tool should be about 50 in order that the wear on the wheel shall be of easily measurable volume. I have also discovered that the greatest distinction between wheels will be indicated when the linear wear on the tool is approximately equal to the wear or decrease in diameter of the wheel. For example, the relative speeds should be adjusted so that when the pipe shows a decrease in length of .100″ for a certain wheel, the diameter of the wheel should also be decreased by about .100″. It is to be understood that all the figures given are solely for the purpose of making a complete disclosure of the best method at present known to me of carrying the invention into practical effect and these figures and ratios are not to be considered as limiting the invention in any way.

With the object of keeping the tool wear and wheel wear about equal for the reasons stated, I change the material and size of the pipe for use on softer wheels and on hard and fine wheels I find it desirable to replace the tubular tool with a solid rod preferably of smaller diameter. For medium grade wheels I obtain more satisfactory results with a tool of Shelby steel tubing, one inch outside diameter and $\frac{1}{16}$ of an inch thick. On softer wheels the diameter and wall thickness may be reduced and the tube material may be changed to a softer metal such as brass.

I have determined that the greatest distinction between wheels of nearly equal cutting ability, when the wheels are quite hard or of a very fine grain, may be observed by the use of a solid round rod of soft steel of a diameter of about ½″. In the use of the tubular tool I have found it desirable to mount the tool substantially radial to the wheel but in the use of a solid tool I have found it more expedient to position the tool at an angle other than normal to the surface of the wheel being acted upon. In Fig. 3 the wheel is shown as being acted upon by a solid tool 38, the axis of which extends at an angle of 30 degrees to the axis of the wheel. I find it most desirable to rotate the rod as has been described in connection with the tubular tool so that the end of the tool is ground to a conical shape as is illustrated.

In order that all types of wheels may be tested on the machine shown in Figs. 1 and 2, I have made provisions for turning the tool carrying head into various angular positions for use particularly with the solid tool as has been described. For this purpose the head 19 is provided with an extended surface 39 provided with a hole 40, so that the head may be turned to position the axis of the tool on the line 41 (Fig. 1) and secured in this position by the screws 28. A series of holes similar to the hole 40 may be provided so that the head may be held in various angular positions if desired.

In order that the head and tool carried thereby may be swung about an axis coincident with the surface of the wheel, as obviously would be most desirable, I prefer to provide a pivotal connection between the head 40 and the slide 18 in vertical alignment with the surface of the wheel being graded. The screw 29 may be conveniently employed as the pivotal connection between the head 19 and the slide 18.

It is clearly apparent that the machine shown may be used with a tubular tool as illustrated, and by substituting a solid rod of the proper diameter and swinging the head, it may equally well be used for grading very fine or hard wheels. In the practice of this method and use of the machine the grade or so-called hardness of a wheel is preferably determined by comparing the loss of wheel material when subject to the standard test, with tables showing the loss of material by this test on wheels of known cutting ability. It is possible, as will be readily observed, to make further comparison by the use of this machine, such, for example, as determining the loss of tool material during a standard test. I do not, however, consider this to be necessary. The wheel material removed may be determined by measuring the diameter of the wheel or by weighing the wheel, the exact method of measuring the material removed being unimportant except that similar units shall always be compared.

It is to be understood that while I have described the preferred sequence of steps in the method of carrying our invention into practical effect and the preferred embodiment of the machine for practicing the method, such disclosure is for the purpose of illustration only and I do not wish to be limited to the exact sequence of steps or form and arrangement of the parts of the machine set forth except in so far as is specified in the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. That improvement in the method of grading abrasive articles which includes the steps of relatively moving a tool and the article to produce an abrading action, forcing the tool into the article for a definite period and at a constant rate faster than that at which the article can wear away the tool and comparing the amount of material removed from the article with similar tests on other abrasive articles of known cutting ability.

2. The method of grading abrasive wheels

comprising the steps of rotating the wheel, forcing a wearable tool into the wheel to a definite distance at a constant rate which is greater than that at which the wheel can wear away the tool, and comparing the material removed from the tool and the material removed from the wheel with similar tests on other abrasive wheels of known cutting ability.

3. The method of grading abrasive wheels comprising the steps of rotating the wheel, traversing a wearable tool across the face of the wheel while forcing the tool into the wheel at a predetermined rate faster than the wheel can abrade the tool for a definite period, and comparing the quantity of material removed from one of these members with similar tests made with abrasive wheels of known cutting ability.

4. The method of grading abrasive wheels which includes the steps of rotating the wheel, positively rotating a tool in contact with the wheel in such a manner as to have a destructive effect upon the wheel in excess of the normal grinding wear, forcing the tool into the work at a predetermined rate and for a definite period, and comparing the amount of material removed from one of these members with similar tests on wheels of known cutting ability.

5. A machine for grading abrasive articles comprising a support for the article, a cutting tool, means for rotating the article relative to the tool to grind the latter, and means to force the relatively moving tool and article together at a rate faster than that at which the article can abrade the tool and thereby disrupt the surface of the article, said cutting tool being of wearable material adapted to be ground away by a measurable amount during the period of operation.

6. A machine for grading abrasive wheels having in combination means for rotating the wheel, a wearable tool, automatic means for traversing the tool across the face of the wheel and means for forcing the tool into the wheel at a constant rate faster than that at which the wheel can abrade the tool.

7. A machine for grading abrasive wheels having in combination means for rotating the wheel, a wearable tool, means for rotating the tool while in contact with the wheel, means for traversing the tool across the face of the wheel and means for forcing the tool into the wheel at a rate faster than the wheel can abrade the tool.

8. A machine for grading abrasive wheels having in combination means for rotating the wheel at less than normal grinding rate, a wearable tool, automatically operated means for rotating the tool while in contact with the wheel, means for repeatedly traversing the tool across the face of the wheel and means for positively feeding the tool into the wheel at the end of a traversing stroke to a greater depth than the wheel can abrade the tool during the traverse, thereby disrupting the wheel in excess of the normal grinding wear.

Signed at Worcester, Massachusetts, this 12 day of March 1920.

KASPER O. SWENSON.