Dec. 9, 1958 S. M. BOOTH 2,863,750

METHOD, COMPOSITION AND APPARATUS FOR MECHANICALLY SETTING OR RESETTING DIAMOND PARTICLES IN A WORKING SURFACE

Filed Oct. 18, 1954 2 Sheets-Sheet 1

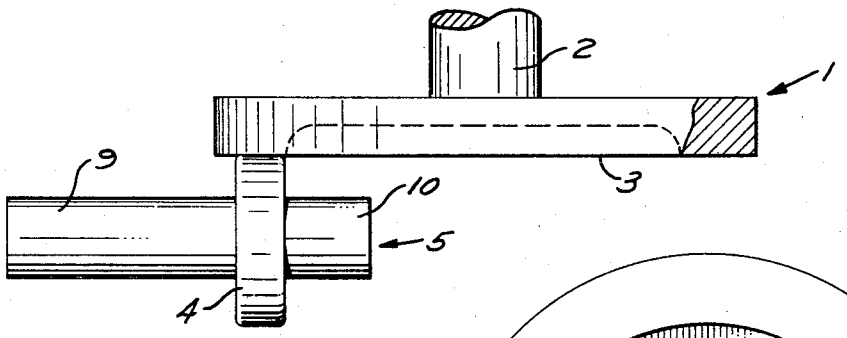

fig. 1

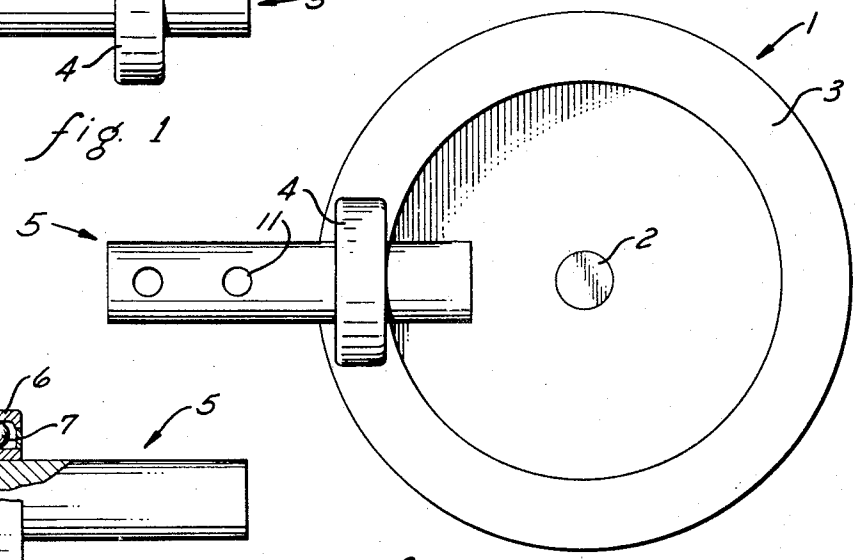

fig. 2

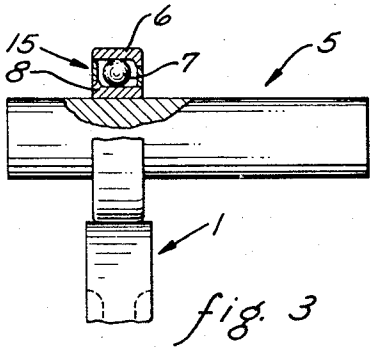

fig. 3

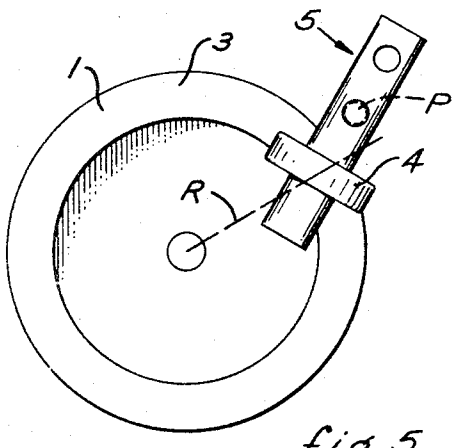

fig. 5

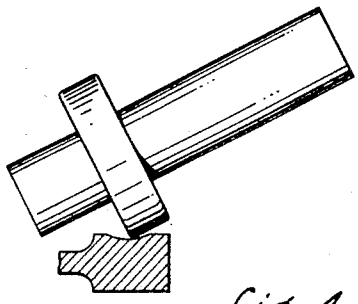

fig. 4

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METHOD, COMPOSITION AND APPARATUS FOR MECHANICALLY SETTING OR RESETTING DIAMOND PARTICLES IN A WORKING SURFACE

Filed Oct. 18, 1954 2 Sheets-Sheet 2

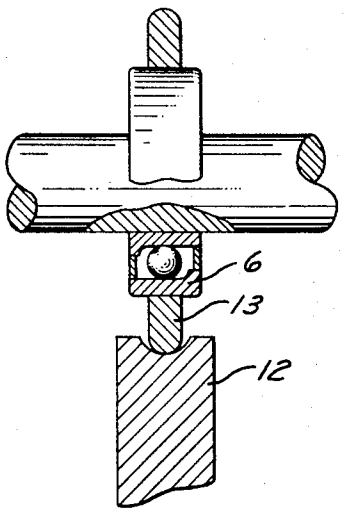

fig. 6

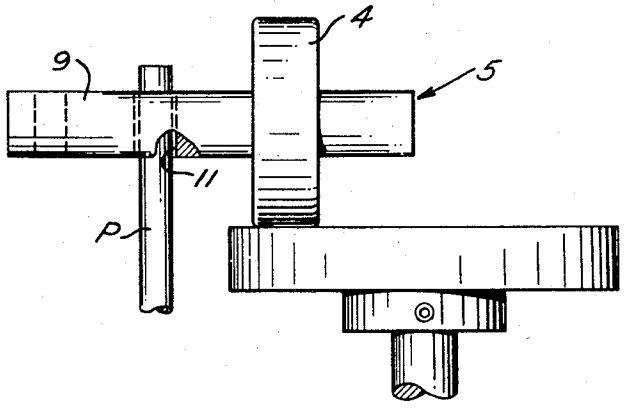

fig. 7

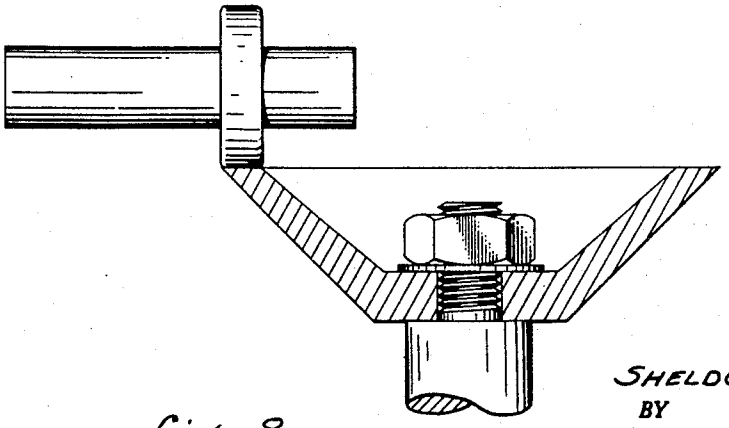

fig. 8

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METHOD, COMPOSITION AND APPARATUS FOR MECHANICALLY SETTING OR RESETTING DIAMOND PARTICLES IN A WORKING SURFACE

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7 Claims. (Cl. 51—293)

This invention relates to a method for making and maintaining a sharp cutting surface on a grinding wheel or lapping device and particularly relates to such a method applicable to a cutting surface utilizing diamond particles as its primary cutting material. The invention also relates to the provision of a composition including diamond particles useful for application to the surface of such a wheel or lapping device without loss of diamond in any phase of the operation.

It is well known that the use of diamond abrasive wheels is normally associated with grinding and cutting of a type meeting high precision requirements and, accordingly, that the wheels used for this purpose must be kept constantly in good condition to carry out the service required of them. For example, the operation of sharpening carbide tipped tools is frequently carried out in two steps of which the second often involves the use of a diamond wheel. The first, or rough, grind for sharpening or resharpening carbide tips is accomplished by use of a loose bond abrasive grinding wheel which wears away rapidly (a so-called green wheel) thereby presenting a new surface to the face of the tool being ground. This primary grind is not done with a diamond wheel due to great cost arising from loss of diamond. But the finish grind or lap, the second operation, must be perform on a wheel containing a diamond surface as this is the only way possible to obtain a keen edge finish on the carbide tool.

The method of manufacture of diamond wheels up to this time embodies three classes, namely, the ceramic bonded, the bakelite bonded, and the metal bonded. All three of these depend upon a certain amount of diamond mixed with the top 1/16 inch or 1/8 inch layer of the bonding material and cast or baked in special ovens thereby becoming a part of the remaining part of the wheel or lap structure. The three classes of diamond wheels thus made usually perform effectively when new and first used. During use the imbedded diamond supply carried by these three types is utilized in ways characteristic of the types of wheels. The ceramic bonded wheel loses a portion of its diamond surface thereby causing a diamond loss. The bakelite bonded wheel loses a larger portion of its diamond surface content and more rapidly, thereby maintaining a sharp cutting surface, but at great diamond loss-cost. The metal bonded wheel outlasts both the other two but becomes dull and remains dull unless surface dressed by some abrasive stick which knocks off the dull diamond surface exposing some new cutting diamond edges underneath the worn dull ones. All three of the above methods are wasteful of the diamond used and, as each diamond particle has several sharp cutting edges or points, my new method of impregnating a surface with diamond crystals and thereafter by mechanical means resetting said impregnated diamond particles has been proved to effect a great saving in diamond and to maintain a sharp diamond surface on the wheel or lap.

Accordingly, a major object of the invention has been to provide a method for renewing a partially worn grinding wheel of the type utilizing diamond particles as its principal cutting material.

A further object of the invention has been to provide a composition including appropriate diamond particles capable of being applied to the wheel for renewing same without loss of diamond during the application or use thereof.

A further object of the invention has been to provide a process and composition, as aforesaid, which can be utilized by the user of the wheel and without moving the wheel from its normal position of operation.

A further object of the invention has been to provide a process and tools, as aforesaid, which can be practiced and used by relatively unskilled labor with only a minor amount of instruction.

A further object of the invention has been to provide a process which could be carried out with relatively simple equipment.

A further object of the invention is to provide a method which is applicable to a wheel which has worn to a concave profile without destroying said concavity.

A further object is to provide a composition that carries its own surface lubricant and even when used dry on a grinder allays its own dust.

A further object is to provide a composition that when used on a grinder can be used with a water spray or fog or it can be used dry.

A further object of this invention is a method enabling an inexpensive cast iron wheel to perform a diamond finish grind operation by addition of only a small investment in diamond on the wheels.

A further object of the invention is to provide a method and apparatus, as aforesaid, which are applicable without modification to a wide variety of specific grinding or lapping wheel designs.

Other objects and purposes of this invention will become apparent to persons familiar with equipment of this general type upon reading the following specification and inspection of the accompanying drawings.

In the drawings:

Figure 1 shows a typical grinding wheel and an applicator used in the practice of the process of the invention with a possible mounting structure indicated in broken lines.

Figure 2 is a top view of the grinding wheel of Figure 1 together with said applicator.

Figure 3 is a fragmentary view of a wheel of different type from that shown in Figure 1 and illustrating the process of the invention as applied to the peripheral surface of the wheel.

Figure 4 shows the method of the invention applied to a wheel which has been worn to a concave profile, the wheel being illustrated in a diametric cross-section.

Figure 5 is a view of the wheel and applicator illustrating the operation of resetting diamonds previously applied to a wheel surface.

Figure 6 is a fragmentary view in partial diametric section of a modification.

Figure 7 illustrates the application of the invention utilizing a fixed support for the applicator.

Figure 8 illustrates the application of my method and applicator to a wheel of still different design.

In general my invention consists of preparing a mixture of a diamond dust and powdered glass in a suitable plastic carrier, as petroleum jelly, spreading the mixture onto the surface of the wheel requiring renewal, as a conventional cast iron wheel, and then forcing the solid portions of said mixture into the interstices of the wheel by any suitable pressure mechanically applied, as by a roller.

Turning first to the material used with this process, I prepare a quantity of diamond dust, a quantity of powdered glass, and a quantity of zinc stearate intimately

together and then mix said components evenly through a relatively small quantity of a plastic, non-hardening, material, such as petroleum jelly or a heavy grease.

The petroleum jelly is first heated in a water bath to a temperature of about 210 degrees F. which, since its melting point is between 100 degrees F. and 140 degrees F., primarily at about 115 degrees, insures the complete liquification of all thereof.

The powders are then introduced gradually into the petroleum jelly with continuous and vigorous agitation and the entire mixture is vigorously and continuously agitated while cooling to a creamy consistency and sufficiently to insure an even distribution of all materials throughout the mixture. It is then permitted to cool further with continuing and vigorous agitation to a point, namely, about 125 degrees F., where the solid materials will remain in suspension and evenly distributed without agitation but the mixture is capable of being poured. At such point it is then poured into suitable containers and allowed to further cool, thereby forming a plastic, non-hardening paste-like material having its components permanently and evenly distributed throughout the mass. More specific examples of such a mixture are the following:

Example 1

600 carats of 180–200 screen diamond dust, 800 carats of 80–120 screen powdered glass and 400 carats of zinc stearate were mixed evenly together and then stirred into 16 fluid ounces of white petroleum jelly. When used in the manner described following this material effectively renewed a worn cast iron base grinding wheel.

Example 2

The same formulation set forth above was repeated using 800 carats of 100–120 screen diamond dust. Good results were obtained.

Example 3

The same formulation above set forth in Example 1 was repeated with the diamond dust being 80–100 screen size and fair results were obtained.

Example 4

The same formulation above set forth in Example 1 was repeated with the diamond dust being of 280–300 screen size and good results were obtained.

Example 5

The same formulation above set forth in Example 1 was repeated with a clean heavy grease of approximately the same consistency as petroleum jelly replacing the petroleum jelly and good results were obtained.

Other screen sizes of diamond dust have been used successfully and the size will be chosen according to the use desired. For example, a "microfinish" will be obtained by using diamond dust of up to 1500 screen size. The composition can by variation of screen size of diamond be adjusted to finish grind carbide steels to a fine razor edge or by coarser size to a comparative coarser faster cutting edge.

The mixture is then spread onto a new or partially worn cast iron or other metal receiving base and is mechanically worked into the surface thereof by a surface harder than the surface of the receiving base and under a force greater than the force at which the wheel will be used. Said base may be a wheel, a block or other desired shape. The zinc stearate raises the melting point and tends to hold fast in the mixture the diamond particles on the surface of the wheel.

The powdered glass being of larger screened size scours and works to open up any clogged pores of the wheel to loose and hold for resetting any previously set diamond. It will then crush down and permit the setting of any new diamonds applied in the paste mixture to the wheel.

Referring to the drawings, the wheel 1 is indicated as rotatably mounted on the shaft 2 and having a working surface 3. A roller 4 is supported on a bar 5 and has an outer ring 6 (Figure 3) rotatable on a plurality of balls, of which one appears at 7, on and with respect to an inner ring 8. The rings and balls are held in operative position by any convenient means, such as a conventional ball bearing cage structure 15. The peripheral surface of the outer ring 6 is hardened and the lateral edges of said peripheral surface are both rounded and hardened, said hardening in each case being to a degree sufficient to provide a surface harder than the surface of the abrasive wheel being treated. Said inner ring 8 is non-rotatably fixed to the bar 5, as by a press fit. The bar 5 is relatively heavy, within the limits of convenient handling, for purposes appearing hereinafter, one typical small applicator having a total weight of nearly three pounds. The ends 9 and 10 of the bar 5 may be manually grasped for controlling the position of the roller 4 or one end, as the end 9, may have one or more openings 11 (Figure 7) therein for receiving any supporting fixture, as the post P. Where said post P is used, the bar 5 will normally be held within close tolerances to a plane determined by the angle, normally a right angle, between the axis of the opening 11 and the axis of the bar 5 but will be free to swing pivotally on said post across the surface of the wheel 1 (Figure 5).

The diamond carrying paste is first spread thinly onto the surface of the wheel while the wheel is stationary or being rotated slowly by hand. Paste is applied in any way convenient as by a small flat wooden paddle. Thereafter, and without unnecessary delay, with the wheel rotating at a more rapid speed, usually its normal speed of operation, such as from 300 to 3400 R. P. M. depending on the machine, the roller 4 is applied to said working surface and held manually thereagainst while the paste is worked thereby, due in part to the extreme hardness of the roller, into the interstices of the receiving wheel. The applicator is held against the wheel at a pressure materially greater than the pressure at which a tool being sharpened or other work will be held against the wheel. For example, since 4 pounds applied to the tool is normal grind condition, the applicator may effectively be held against the wheel at from 12 to 15 pounds of force in most cases. The quantity to be applied will be largely a matter of judgment and will depend upon the size, style and type of wheel concerned, but in a wheel of 6 inch diameter having a working surface 3 of ¾ inch radial width, I have found that it is effective to utilize from 1/50 to 1/80 ounce of the composition above described in Example 1.

Where the peripheral surface of the wheel is the working surface, then the composition is applied to such surface while the wheel is rotated by hand and the roller then applied to said surface while the wheel is rotating more rapidly, in the manner indicated in Figure 3.

Where it is desired to renew a surface previously worn into a concave profile, as illustrated in Figure 4, the same operation is repeated but here the roller will be tilted sharply and worked, preferably manually, radially back and forth to place the curved corner of the roller against the full width of the concave surface.

If desired, and particularly where a specially shaped wheel is involved, such as the peripherally grooved wheel 12 (Figure 6) used for rounding the edge of glass panels, an external ring 13 may be applied, as by pressing, to the outer ring 6. The periphery of the external ring 13 may be shaped as required to conform to the peripheral shape of the grinding wheel to be renewed, here semi-circularly in its diametric section.

Figure 8 illustrated the application of the invention to a conical wheel. The procedure follows that already described.

In this manner and with selected ones of the applicators described, I have been able in five minutes to renew a diamond type grinding wheel in a manner rendering it indistinguishable, insofar as its cutting ability was

concerned, from a new wheel and I have been able to do so without removing said wheel from its normal position of use.

It will be recognized that the materials will be applied to machines having a wide range of wheel speeds. Generally speaking, it may be said that the composition of the formula is made such that there is no loss of diamond by throwing the material off the wheel at grinding speed, if the paste is thinly and evenly spread to the wheel surface before the wheel is started. Also there is no throwing off of the paste during the setting operation.

The powdered glass indicated as used in the composition functions to cut, and later remove, the skin of metal or metallic particles which forms on the surface of the grinding wheel during its normal use. The particles of powdered glass are larger than the particles of diamond and hence they act on this skin prior to the exertion of any material pressure by the roller on the diamond particles. However, during the working of the paste by the roller at approximately 12–15 pounds pressure, the glass particles are eventually crushed to a size smaller than the diamond particles but by this time the metallic skin will have been substantially removed and the roller will then be able to push the diamond particles into the interstices without difficulty. Thereafter the usual sharpening of tools is at a pressure of approximately only 4 pounds against the wheel surface.

In Figure 5 there is illustrated a modification of the above process in which a grinding wheel can be substantially renewed within certain limits but without in all cases the application of any new material thereto. With the wheel rotating at a normal speed, the applicator 4 is applied to the working surface 3 of the wheel at a pressure in excess of the pressure at which the diamond particles were originally set and with the axis of the shaft 5 positioned at a rather substantial angle to a radius R of the wheel. This moves, rearranges and resets previously set diamond particles in such a manner as to expose new cutting edges on said diamond particles and has the effect of resharpening each of, or substantially all of, the particles in the wheel. Thus, where previous use of a wheel has not worn the wheel to a depth beyond that at which diamond particles are present, so that there still remains at the abrasive surface a substantial quantity of diamond particles, this method will often effect a sufficient improvement of the cutting qualities of the wheel to make unnecessary the application of further diamond particles thereto as described above.

The foregoing description has assumed throughout for illustrative purposes that the abrasive device to which the diamonds are applied is a wheel. It will be evident in view of the above that the process may also be applied to a cast iron block, or block of other suitable metal, having a properly smooth surface by manual or mechanical rolling of the applicator back and forth across its surface.

One great advantage, among others, of the present invention is its applicability to a wide variety of grinding or lapping wheels or blocks without any modification and its ease of modifications, as illustrated in Figure 6 for example, to meet still further requirements.

A further advantage of this method is that the reserve stock of the diamond conditioning paste can be retained in the tool room and dispensed in quantities as needed by the machine operator thereby preventing loss and enabling an operational cost record. The composition will not harden under normal conditions either in the jar or on the wheel surface.

Due to the substantial weight of the applicator, this method will tend to smooth and true a partially worn wheel during either a setting or a resetting operation and thus further attain the broad objective of renewing the grinding wheel.

The method is adaptable to any metal grinding or lapping wheel utilizing diamonds as a primary grit, and since it can be performed rapidly and easily by workmen in the shop where the grinding wheel is used, it can greatly improve the quality of work obtained therein.

While I have utilized a preferred series of steps and in certain preferred compositions and applicators for illustrating the invention, it will be apparent that many variations may be made from the specific details here shown without departing from the scope of the invention and the hereinafter appended claims are to be interpreted as including such variations unless said claims by their own terms specifically provide otherwise.

I claim:

1. A method of mechanically setting diamond particles in and renewing the solid working surface of a metal diamond-abrasive wheel, consisting essentially of the steps: applying a mixture comprising diamond particles, glass particles of larger size than said diamond particles and a carrier selected from the group consisting of petroleum jelly and a heavy grease, to the working surface of said wheel; rotating said wheel at a speed in excess of about 300 R. P. M.; urging a freely rotatable roller against said working surface while said wheel is rotating under a pressure sufficient to cause said glass particles to cut said working surface of said wheel and to loosen previously set diamond particles in said working surface; and thereafter urging said roller against said working surface while the wheel is rotating under a pressure sufficient to crush said glass particles to a size smaller than said diamond particles and to force said diamond particles into the interstices of said working surface.

2. A method of mechanically setting diamond particles in the solid working surface of a metal diamond-abrasive wheel, consisting essentially of the steps: applying to the working surface of said wheel a thin layer of a uniform mixture comprising diamond particles, glass particles of larger size than said diamond particles and a carrier selected from the group consisting of petroleum jelly and a heavy grease; rotating said wheel at a speed in excess of about 300 R. P. M.; urging a freely rotatable roller against said working surface while said wheel is rotating under a pressure sufficient to force said glass particles to cut said working surface of said wheel and to loosen previously set diamond particles in said working surface; thereafter urging said roller against said surface while said wheel is rotating with a force of between about 12 and 15 pounds force to thereby crush said glass particles to a size smaller than said diamond particles and to force said diamond particles into the interstices in said working surface.

3. A method of mechanically setting diamond particles in and renewing, the solid working surface of a metal diamond-abrasive wheel consisting essentially of the steps: applying a mixture, comprising diamond particles, glass particles of a size larger than said diamond particles and being from about 80 screen to about 120 screen and a carrier selected from the group consisting of petroleum jelly and a heavy grease, to the working surface of said wheel; rotating said wheel at a speed in excess of about 300 R. P. M.; urging a freely rotatable roller against said working surface while said wheel is rotating under a pressure sufficient to cause said glass particles to cut said working surface of said wheel and to loosen previously set diamond particles in said working surface; and thereafter urging said roller against said working surface while the wheel is rotating under a pressure sufficient to crush said glass particles to a size smaller than said diamond particles and to force said diamond particles into the interstices of said working surface.

4. The method described in claim 3 wherein the diamond particles are of a size 180 screen to about 200 screen.

5. The method described in claim 3 wherein the diamond particles are of a size 100 screen to about 120 screen.

6. The process described in claim 3 wherein the diamond particles are of a size 80 screen to about 100 screen.

7. The process described in claim 3 wherein the diamond particles are of a size about 280 screen to about 300 screen.

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