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ART OF DRESSING GRINDING WHEELS

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Fig. 1.

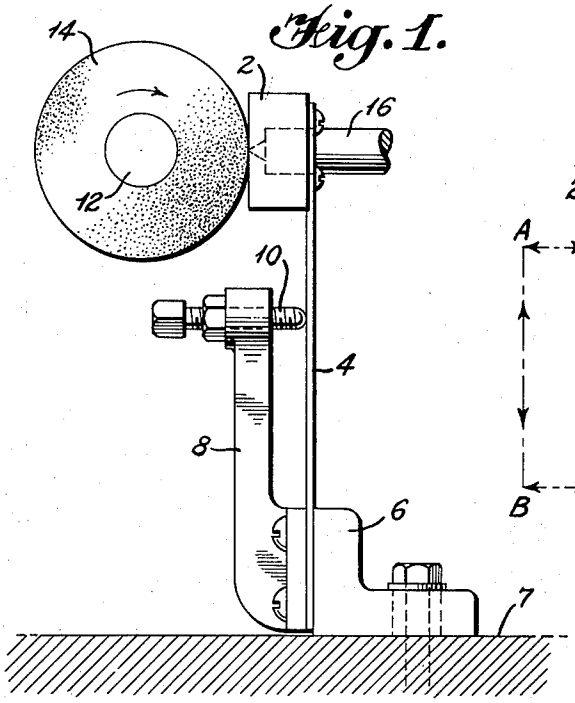
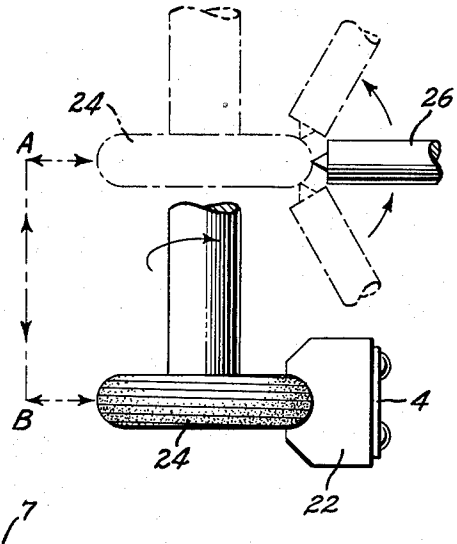


Fig. 3.



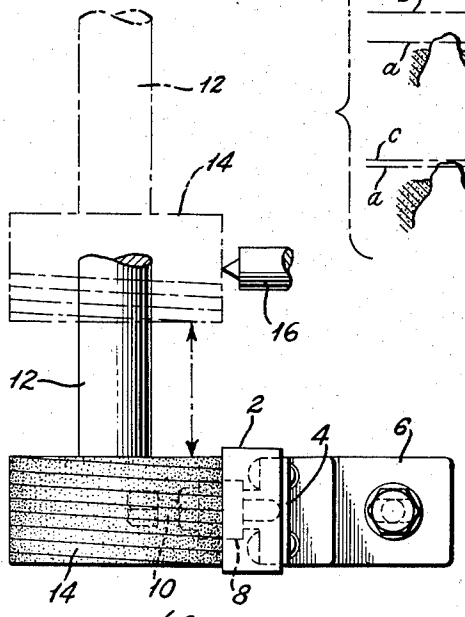


Fig. 2.

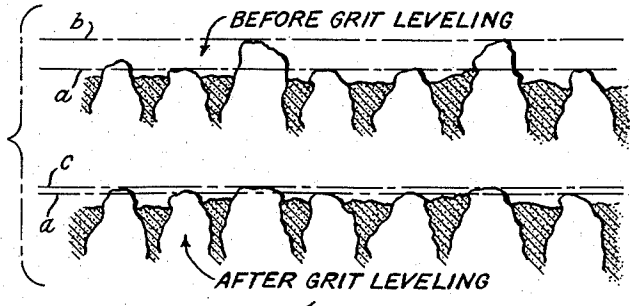


Fig. 4.

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ART OF DRESSING GRINDING WHEELS

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3 Claims. (Cl. 125—11)

This invention relates to the art of dressing the tool, i.e., the grinding wheel, of a grinding machine in order to obtain the optimum condition in a grinding process. More particularly, this invention relates to dressing a grinding wheel by a conventional dressing method and then introducing a supplementary novel step to obtain this optimum condition.

The purpose of dressing a grinding wheel is to condition the grinding wheel's cutting surface so that it, when presented to the work, will remove material at a rapid rate and at the same time produce a good surface finish. The operations of removing material and at the same time producing a fine finish are rarely compatible without the sacrifice of time; therefore, this is unduly expensive. To attempt to alleviate this condition sundry remedies have been suggested and/or used, e.g., adding a subsequent polishing operation after the grinding operation. These remedies are, however, economically unfavorable and often technologically undesirable. It is therefore an object of this invention to introduce a method of conditioning the cutting surface of a grinding wheel in a manner that is able to both rapidly remove material and produce a fine finish.

Another object is to condition the grinding wheel by relatively simple means which can be utilized and adapted to modern grinding machines with a minimum of personal attention.

The following detailed description will describe the method of the invention and a preferred mode of adapting the method is illustrated in the accompanying drawings to which reference may be had, and wherein:

Fig. 1 shows an elevation of a simplified illustration of a device, in relationship to a grinding wheel, wherein the method iis applied;

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

Fig. 3 is a top plan view of a modification for application of the method to a contour formed grinding wheel;

Fig. 4 is an enlarged schematic showing of the surface of the grinding wheel before and after grit leveling.

Normally, grinding wheel dressing is executed by a traverse motion of the wheel past a fixed diamond dressing tool as in the case of Fig. 1 and Fig. 2, or, as in the case of Fig. 3, the diamond is moved to generate the desired contour on the fixedly positioned wheel. These relative movements between the dresser and the rotating wheel will produce a more or less coarse helix, depending on the rate of these motions, consequently affording the wheel a relatively fast cutting ability. The coarser the helix, the faster the cutting action, but also the rougher the finish produced on the work piece; and vice versa, with a finer helix the cutting action will be slower and the finish on the workpiece will be finer; however, there is the added risk of "burning" the surface which is ground.

It is known that conventional dressing with a diamond will leave a random scatter of grits projecting above the true cylinder generated by the diamond point, and these grits are one of the main causes of poor surface finish. To overcome this detrimental condition deliberately dulling the cutting face of the wheel after dressing by mechanical means has been suggested. This, however, is usually unsatisfactory and is at best a delicate operation requiring a skilled man's judgment, and it is practically impossible to control as a phase of operation in an automatic machine. Therefore, this invention introduces a novel method of removing the grits that are still projecting above the cylindrical surface generated on the grinding wheel by the normal dressing tool, and this method includes the improvement of easy controllability without introducing undue forces acting on the grinding wheel. This is accomplished by treating the grinding wheel's cutting surface, after the conventional dressing or at any other phase of the machining cycle, with a material or substance that either reacts chemically with the components of the abrasive grits or is mutually soluble therewith.

Fig. 1 is a schematic showing of a device for practicing the invention wherein a member **2** containing the treating substance or material is secured to one end of a flexible reed **4** having its other end attached to a bracket **6** which is fixed in an adjusted position on a machine bed or equivalent machine element indicated at **7**. Bracket **6** has an upstanding portion **8** with a stop screw **10** threaded therein with its pointed end directed toward the reed **4**. A rotatable spindle **12** supports a grinding wheel of the cylindrical type **14**. This spindle is mounted for longitudinal reciprocatory movement (Fig. 2) and it may have a movement transverse to its axis imparted to it in a manner well known in the art. A conventional diamond dressing tool **16** is located with its dressing point a predetermined distance from the spindle axis, and when the grinding wheel is compelled to describe a path past this point the normal dressing phase is executed.

The bracket **6** is adjusted and fixed to place a surface portion of member **2** in a tangential plane in the proximity of the surface of the cylinder generated by the diamond, at a longitudinal position away from the diamond point. The set screw **10** provides a means for fine adjustment of the position of the member **2** relative to the axis of the spindle **12**. This set screw may be further used to vary the amount of bias on the reed **4**, as different conditions may demand that the force by which member **2** is pressed against the wheel be varied at the radial contact point defined by the position of the diamond on the grinding wheel surface. The member **2**, as stated above, contains the material or substance for treating the grinding wheel according to the method of this invention. Of several materials investigated titanium was found to be the most acceptable, both as to availability as well as economy and predictability of results. It has been found that it is not necessary to use pure or even "commercially-pure" titanium because tests have shown that completely satisfactory results have been achieved with regular titanium base alloys, e.g., type 150 manufactured by Titanium Metals Corp., which alloy contains approximately 10 percent residual materials.

The steps and results of utilizing the method of the invention are as follows: With the grinding wheel **14** rotating at normal speed it is longitudinally traversed with its periphery in a path defined by the position of the point of the diamond tool **16**, and this accomplishes a conventional dressing operation. The diamond point will generate a cylindrical form on the wheel but will leave a scatter of grits projecting above the diameter of the cylindrical form defined by the position of the point of the diamond tool **16**. The member **2** is positioned in the path of the wheel **14** so that during an extension of the traverse motion of the wheel it will contact a face of

the member 2 adjusted to a position in the proximity of the path (Fig. 2).

In this position the reed 4 should act on member 2 with a total spring force preferably close to zero. In other words, the set screw 10 should be adjusted such that the reed will exert little or no force to move member 2 into the periphery of the grinding wheel 14. During the extended traverse the residual projecting grits will push the member 2 against the spring force of the reed 4 away from its adjusted position of rest with the result that only the extremes of these grits will intially make contact with the member 2. Even with a relatively small total force acting between the grinding wheel and the member, the unit force acting at the minute contact areas of the grits will be considerable and the friction between the grits and the member 2 will result in an instantaneous temperature rise at the contact points sufficiently to permit or allow a desired reaction. This reaction, as a result of the interaction between the grits and the material of member 2, at present defies a detailed theoretical explanation. Since the material in the preferred embodiment is principally titanium, the characteristic of titanium to react with known refractories at elevated temperature, particularly in the molten stage, is believed to be a major factor. That such high temperatures are present under the conditions described above is a well established fact known in the art of grinding. By the interaction of the member 2 and the grinding wheel the projecitng grits will be "dubbed off" and as member 2, as a result thereof, returns to its adjusted rest position the spring force of the reed 4 will decay to the preset value. The results of the conventional dressing and treating are shown in Fig. 4 wherein the projecting grits are greatly exaggerated for the sake of clarity. It will be obvious that the application of the substance or material to the grinding wheel may be varied as to time and speed to suit various conditions.

Tests have positively shown the effectiveness of this method, e.g., in plunge grinding a bore after a conventional diamond dressing operation a finish of 17 microinch R.M.S. resulted, and using the same conditions and procedure while dressing by the applicant's process resulted in a finish of 3.5 microinch R.M.S.

In Fig. 3 there is illustrated another modification of applying the method. A grinding wheel 24 in a fixed transverse and longitudinal position A has been preformed by an oscillating diamond tool 26 in a manner normally used for plunge grinding a form, e.g., a race way of a ball bearing. After the wheel 24 is moved from position A to position B along a path indicated by dash dot lines, it is now treated by a member 22 attached to reed 4. The member 22 has a preformed surface complementary to the profile of the desired wheel perimeter profile and the treatment is applied when the wheel is transversely moved to the predetermined position B where the member 22 under influence of the spring force of reed 4 will move towards the center of the wheel in a manner described above for Figs. 1 and 2. Alternately the member 2 could be substituted for 22 to make tangential contact with the profile of wheel 24 while the member 2 is made to oscillate in the manner of diamond tool 26.

Fig. 4 is an enlarged exaggerated showing of the grits, set in their bonding matrix, before and after grit leveling. While diamond dressing may leave an estimated 10 to 20% of the grits projecting above line *a*, toward line *b*, after grit leveling these grits will project only to line *c* which is extremely close to line *a*, hence the grits have been "dubbed off" to the desired surface level.

Applicant has disclosed a novel method of dressing grinding wheels and a preferred embodiment to enable one skilled in the art to practice his invention. The disclosure of the preferred emobdiment is intended to be illustrative only and not limiting as the scope of the invention is limited only by the spirit and scope of the appended claims wherein applicant is entitled to a reasonable range of equivalents.

I claim:

1. A method of dressing a grinding wheel having refractory grits in order to condition the grinding surface thereof so that when it is presented to the work it will remove material at a rapid rate and at the same time produce a good surface finish, the method comprising; first dressing the wheel by conventional dressing means such as a diamond dressing tool down to a desired surface level, the conventional dressing inherently leaving residual projetcing refractory grits above this surface level, subsequently frictionally contacting the same portions of the so-dressed wheel with a solid substance, the solid substance being a metal which thermochemically reacts with the refractory grits of the grinding wheel at temperatures approaching the melting point of the solid substance, creating an extremely high tmeperature at the point of contact between the solid substance and the wheel, the creation of the high temperature accomplished by allowing the solid substance and the wheel relative tangential motion while applying a light force and moving the solid substance against the projecting grits down to the proximity of the desired surface level, such that the thermochemical reaction between the solid substance and the refractory grits at the high temperatures occurs at the contact between the solid substance and grinding wheel to dub off the residual projecting grits on the wheel to the proximity of the desired surface level.

2. The method of dressing a grinding wheel as defined in claim 1 further comprising biasing the solid substance toward said support to accomplish moving the solid substance against the projecting grits and positively stopping the movement of the solid substance in the proximity of the desired surface level by reducing the biasing force to zero when a predetermined position in the proximity of the desired surface level is reached by the solid substance.

3. A method of dressing a grinding wheel having refractory grits in order to condition the grinding surface thereof so that when it is presented to the work it will remove material at a rapid rate and at the same time produce a good surface finish, the method comprising; first dressing the wheel by conventional dressing means such as a diamond dressing tool down to a desired surface level, the conventional dressing inherently leaving residual projecting refractory grits above this surface level, subsequentially frictionally contacting the same portions of the so-dressed wheel with a solid metal containing principally titanium which thermochemically reacts with the refractory grits of the grinding wheel at temperatures approaching the melting point of the titanium, creating an extremely high temperature at the point of contact between the solid titanium and the wheel, the creation of the high temperature accomplished by allowing the titanium and the wheel relative tangential motion while applying a light force and moving the solid substance against the projecting grits down to the proximity of the desired surface level such that the thermochemical reaction between the titanium and refractory grits at elevated temperatures occurs at the contact between the titanium and the grinding wheel to dub off the residual projecting grits on the wheel to the proximity of the desired surface level.

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