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(54) Diamond tool.

(57) A diamond scaife which comprises an iron-based working surface (12) having a bonding paste of an organic binder uniformly spread across it, the paste containing a plurality of particles (14) of single and polycrystalline diamond which are partially embedded in the iron-based working surface (12).

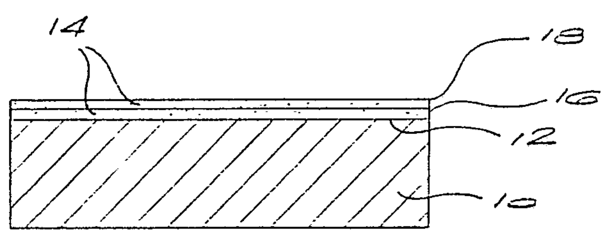

FIG 2

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Description

DIAMOND TOOL

BACKGROUND OF THE INVENTION

This invention relates to diamond tools, particularly diamond scaifes.

A diamond scaife is a tool which comprises a cast iron plate, one surface of which has a paste containing a plurality of small diamond particles uniformly spread across it. The paste is rubbed on to the surface and then worked in with a piece of low quality diamond. A diamond scaife is a tool used for polishing diamond.

SUMMARY OF THE INVENTION

A diamond tool comprises an iron-based working surface having a bonding paste of an organic binder uniformly spread across it, the paste containing a plurality of particles of single crystal and polycrystalline diamond which are partially embedded in the iron-based working surface.

According to another aspect of the invention, there is provided a method of making a diamond tool as described above which includes the steps of providing an iron-based working surface, depositing a layer of a bonding paste of an organic binder on the surface, the bonding paste containing a plurality of single crystal and polycrystalline diamond particles, and causing the diamond particles to become partially embedded in the working surface.

DESCRIPTION OF THE DRAWING

Figure 1 illustrates a perspective view of a diamond tool of the invention; and

Figure 2 illustrates a section through the diamond tool during the course of its manufacture.

DESCRIPTION OF EMBODIMENTS

The abrasive elements for the diamond tool will be constituted by a mixture of single crystal and polycrystalline diamond. The paste will constitute a thin film across the iron-based working surface and is believed, in use, to perform some lubricating function. The paste will contain the diamond particles which will also be partially embedded in the iron-based working surface. It has been found that use of this tool results in polishing being achieved without the metal surface coming into contact with the diamond or other material being polished.

The diamond tool is preferably a diamond scaife.

The working surface may be made of any suitable iron-based material, but is preferably cast iron.

The paste will have a coherency sufficient to allow it to remain on the working surface without flowing off it. It will act, at least in part, to locate the diamond particles on the working surface and also as a lubricant. The paste is constituted by an organic binder which may be any known in the art. Examples of suitable binders include cellulose ethers and esters, phenolic resins, dextrin and other similar materials. One preferred organic binder is methyl cellulose.

The diamond particles will be fine, i.e. they will generally have a particle size of 40 microns or less. When the diamond tool is to be used for a relatively rough polishing operation, the diamond particles will typically have a size of 10 to 40 microns. For smoothing operations, finer diamond particles of the order of 2 to 10 microns will be used.

The diamond particles will be made up of a combination of single crystal diamond and polycrystalline diamond. The polycrystalline diamond particles will generally be produced by crushing a diamond compact. The diamond compact may be one which contains a solvent second phase such as that described in United States Patent No. 3,745,623 and British Patent No. 1,489,130. The polycrystalline diamond may also be produced from a thermally stable diamond compact, that is a diamond compact which can withstand a temperature of 1200°C in a vacuum, inert or non-oxidising atmosphere without any significant graphitisation of the diamond occurring. Examples of such compacts are described in United States Patents Nos. 4,224,380, 4,534,773 and British Patent No. 2,158,086. It is preferred that the polycrystalline diamond is thermally stable, particularly of the type described in British Patent No. 2,158,086.

The diamond tool may be made by a method which forms another aspect of the invention. As described above, this method involves providing an iron-based working surface, depositing a layer of a bonding paste of an organic binder on the surface, the bonding paste containing a plurality of single crystal and polycrystalline diamond particles, and causing the diamond particles to become partially embedded in the working surface. Generally, the diamond particles will be caused to become partially embedded in the working surface by rotating that surface and bringing the rotating surface into contact with a diamond surface which is generally a piece of low quality diamond.

The bonding paste will preferably be deposited on the working surface in the form of a liquid which contains a solvent and the solvent then allowed to evaporate at least partially, to produce the coherent paste. The solvent will vary according to the nature of the organic binder. Preferably the organic binder will be such that the solvent is water.

Generally, two layers of the bonding paste will be deposited on the surface one on top of the other, the layer adjacent the working surface containing the polycrystalline diamond particles and the other layer containing the single crystal diamond particles. In this form of the invention, the single crystal diamond particles may be smaller than the polycrystalline diamond particles so that when the particles are caused to become partially embedded in the working surface, the fine single crystal diamond particles tend to locate in spaces between the polycrystalline diamond particles.

An embodiment of the invention will now be described with reference to the accompanying drawings. Referring to Figure 1 of this drawing, there is shown a cast-iron disc 10 of a diamond scaife which has an upper working surface 12. This working surface 12 has a uniform layer of bonding paste of an organic binder uniformly spread across it. This bonding paste includes a plurality of diamond particles 14 evenly distributed through it and partially embedded in the working surface 12 of the disc 10.

The diamond scaife may be made by depositing a first layer 16 on the working surface 12 of the disc 10 - see Figure 2. This layer 16 will consist of an organic binder containing a plurality of the polycrystalline diamond particles. On the layer 16 there is deposited a second layer 18 of an organic binder containing a plurality of the single crystal diamond particles. The layers 16 and 18 are each deposited by providing a liquid mixture of the organic binder, a suitable solvent and the diamond particles, applying that liquid mixture to the relevant surface and allowing the solvent to evaporate leaving a coherent paste layer. The diamonds of the two layers are worked into the surface 12 by rotating the disc 10, for example at a speed of about 2000rpm, and bringing that rotating surface into contact with a diamond surface such as that provided by a low quality diamond. The resulting product is that illustrated by Figure 1.

In a particular example of the invention, one carat of crushed thermally stable diamond compact containing a silicon second phase (as described in British Patent No. 2,158,086) and of particle size less than 40 microns was rubbed on the cast iron working surface of a scaife with a binder such as dextrin or phenolic resin in a solvent. The solvent was allowed to evaporate leaving a coherent paste. A paste of fine single crystal diamond particles in water containing methyl cellulose was then applied to the coated surface. The water was allowed to evaporate leaving a thin film or layer of coherent methyl cellulose paste containing the diamond particles. The coated working surface was then rotated at a speed of 2000rpm and brought into contact with a low quality diamond. This contact was maintained for 75 minutes to work the polycrystalline diamond particles and the single crystal diamond particles into the working surface. It was found that diamond polishing could be achieved with this scaife without the metal surface coming into contact with the diamond being polished. Further, improved cutting performance was experienced in relation to diamond of 2 carats or larger. This makes the diamond scaife ideally suited for working stressed diamonds.

Claims

1. A diamond tool comprises an iron-based working surface (12) having a bonding paste of an organic binder uniformly spread across it, the paste containing a plurality of particles (14) of single crystal and polycrystalline diamond which are partially embedded in the iron-based working surface (12).

2. A diamond tool according to claim 1 wherein the organic binder is selected from phenolic resins, cellulose ethers and esters and mixtures thereof.

3. A diamond tool according to claim 1 or claim 2 wherein the working surface (12) is a cast iron working surface.

4. A diamond tool according to any one of the preceding claims wherein the polycrystalline diamond particles (14) are thermally stable polycrystalline diamond particles.

5. A diamond tool according to any one of the preceding claims wherein the diamond particles (14) have a size of 40 microns or less.

6. A method of making a diamond tool according to any one of the preceding claims including the steps of providing an iron-based working surface (12), depositing a layer of a bonding paste of an organic binder on the surface, the bonding paste containing a plurality of single crystal and polycrystalline diamond particles (14), and causing the diamond particles to become partially embedded in the working surface (12).

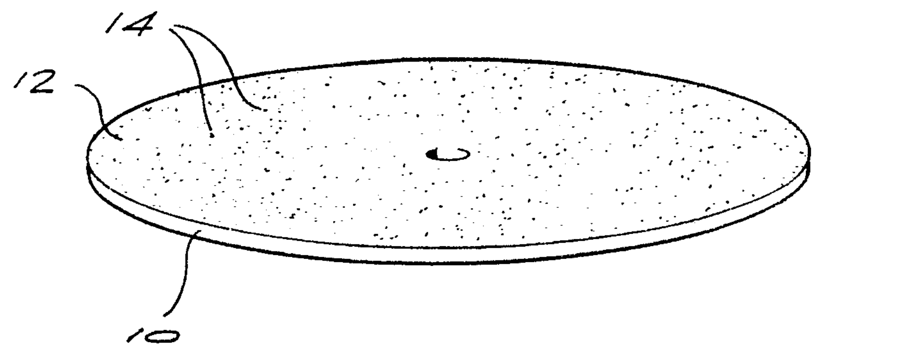
7. A method according to claim 6 wherein the bonding paste is deposited in the form of a liquid containing a solvent and the solvent is allowed to evaporate, at least partially, to produce the paste.

8. A method according to claim 7 wherein the solvent is water.

9. A method according to claim 7 or claim 8 wherein two layers of bonding paste are applied to the surface (12), one on top of the other, the layer (16) adjacent the working surface containing the polycrystalline diamond particles and the other layer (18) containing the single crystal diamond particles.

10. A method according to any one of claims 6 to 9 wherein the diamond particles are caused to become partially embedded in the working surface (12) by rotating that surface (12) and bringing the rotating surface (12) into contact with a diamond surface.

FIG 1



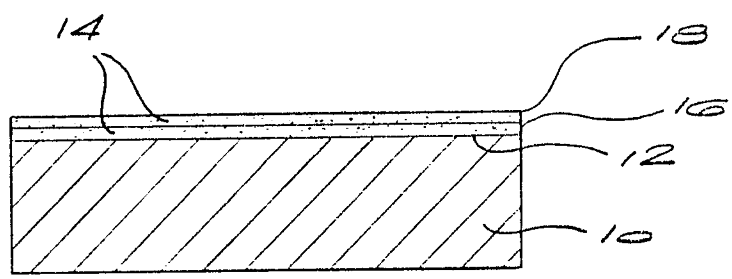


FIG 2