Jan. 30, 1945. G. F. KEELERIC 2,368,473

METHOD OF MAKING ABRASIVE ARTICLES

Filed Nov. 10, 1942

Fig. 1,

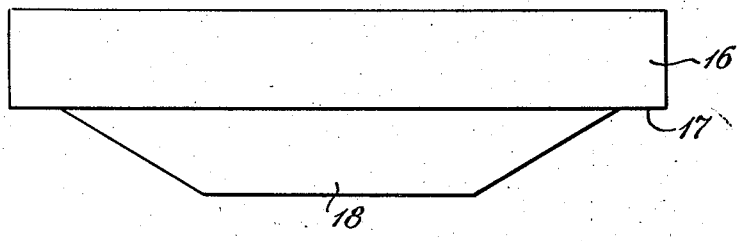


Fig. 2

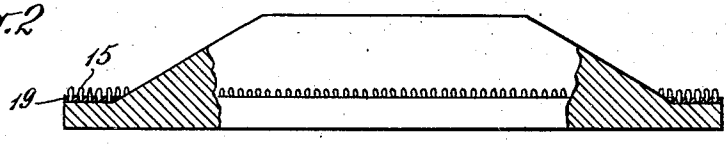


Fig. 3,

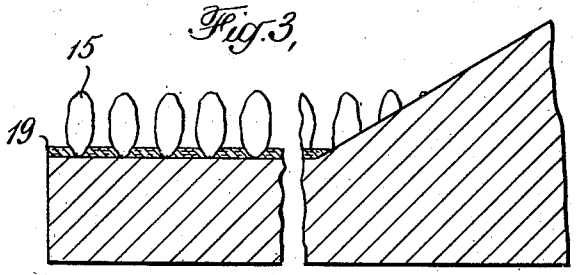


Fig. 4,

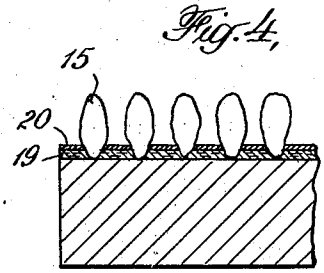


Fig. 5,

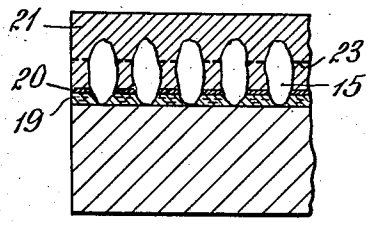


Fig. 6,

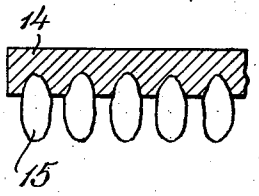


Fig. 7,

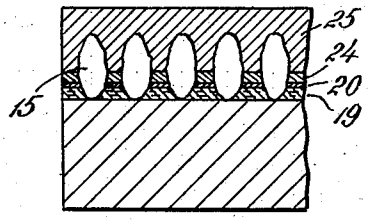
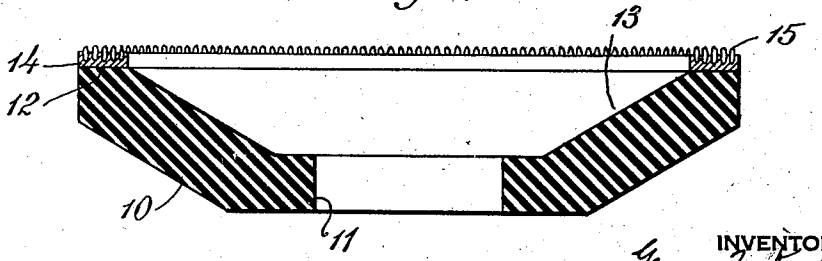


Fig. 8.



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METHOD OF MAKING ABRASIVE ARTICLES

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Application November 10, 1942, Serial No. 465,131

8 Claims. (Cl. 51—309)

This invention relates to the manufacture of abrasive articles or tools employed for grinding or cutting purposes and including a base or body having a working surface formed of particles of an abrasive material, such as diamond dust, bound in place by a layer of metal in which the particles are embedded. More particularly, the invention is concerned with a novel method for making such articles, the new method insuring anchoring of the particles in the working surface of the article in such manner that the article cuts cleanly, the particles are not dislodged during use, and the surface does not become clogged.

In my co-pending application Serial No. 491,827, filed June 22, 1943, I have disclosed and claimed a method of making such abrasive tools, in the practice of which I prepare a blank having a surface of the same shape and size as the working surface of the tool to be produced. A layer of soft metal is applied to that surface of the blank in any suitable way but preferably by electrodeposition and ordinarily, the layer has a thickness equal to the desired maximum projection of the particles from the working surface of the tool. The particles are then distributed on the surface of the layer and forced into the layer until they strike the surface of the blank. The particles employed are preferably equidimensional, and, since the layer is substantially thinner than the greatest dimension of any particle, substantial portions of the particles will remain exposed above the layer, after the particles have thus been forced through the layer into contact with the blank. A hard bonding metal is next applied to the surface of the layer, for example, by electrodeposition, to enclose the portions of the particles exposed above the layer and to build up a body of the desired thickness.

In the practice of the method of the co-pending application, the blank employed is preferably made of metal and best results are obtained by the use of substantially equidimensional particles, since, regardless of the positions of such particles when they are forced into the metal layer to make contact with the blank, they will not be wholly embedded in the layer and portions will remain exposed for enclosure in the bonding metal. Although such equidimensional particles are available, they are somewhat more expensive than particles that the non-equidimensional and their use adds somewhat to the cost of manufacture. Also, in some instances, it may be desirable for convenience or to save expense to employ a blank of non-metallic material in forming the tool.

The present invention is, accordingly, directed to the provision of a method by which satisfactory tools may be made by the use of non-equidimensional particles and a blank of non-conductive material, although it will be apparent that the utility of the method is not restricted to the use of particles of any particular shape or of a blank of any particular material.

In the practice of the new method, a blank of a suitable material, which may be non-conductive, is prepared, the blank having a surface corresponding to the working surface of the tool to be produced. That surface of the blank is coated with an adhesive and while the latter is in tacky condition, particles of the abrasive, such as diamond dust, are distributed on the adhesive coating in the desired concentration. If the particles employed are non-equidimensional, they are applied to the coating electrostatically, so that they will be oriented and lie with their long axes normal to the coated surface. After the adhesive coating has set, metal is applied to the coating and particles to enclose the particles and build up a body of substantial thickness. The body, with the particles in place, is then removed from the blank and part of the metal deposited may be removed from around the particles, if desired. After suitable finishing operations, the body will ordinarily be attached to a support or backing to complete the tool.

For a better understanding of the invention, reference may be had to the accompanying drawing in which

Fig. 1 is a view in side elevation of a blank which may be used in the practice of the new method;

Fig. 2 is a view partly in side elevation and partly in section of the blank at one stage in the practice of the method;

Figs. 3, 4, and 5 are fragmentary sectional views of the blank illustrating different steps in the method;

Fig. 6 is a fragmentary sectional view through the abrasive member of a tool being made in accordance with the invention;

Fig. 7 is a view similar to Fig. 5 showing an alternative operation; and

Fig. 8 is a sectional view through a completed tool made in accordance with the invention.

The new method may be employed in the production of tools of various kinds and, for purposes of explanation, the employment of the method in the production of the tool shown in Fig. 8, will be described in detail. This tool is

of the rotary type and it includes a base 10 of dish formation formed with an opening 11 for receiving a shaft and a flat circular surface 12 around the edge of a concavity 13. On the surface 12 is mounted an abrasive member consisting of a body of hard bonding metal 14 in which are embedded particles 15 of abrasive material. If desired, the abrasive member may include a metal lining for the concavity 13 of base 10, this lining being formed integrally with the body 14.

The blank 16 employed in the formation of the tool shown may be made of any suitable material, which may be conductive or non-conductive, and it is provided with a flat circular surface 17 corresponding to the surface 12 of the tool. The blank is also preferably formed with a frusto-conical extension 18 which is of the same shape as the concavity 13.

In practicing the new method, the blank is placed on a surface with its extension 18 projecting upward and a coating of adhesive material 19 is applied to the surface 17. The particles 15 of abrasive material, such as diamond dust, are then distributed over the adhesive coating while the latter is still tacky. The distribution of the particles may be effected in any suitable way with the particles applied in any desired concentration. When the particles are non-equidimensional, they are applied to the coating electrostatically, that is, by being thrown against the coating by the action of an electrostatic field. When this method is used, the particles will be oriented and lie with their long axes normal to the coated surface. As the adhesive coating is quite thin, only small portions of the particles are embedded therein, although, as illustrated, the particles all extend through the coating and have portions which make contact with the surface of the blank. The adhesive is then allowed to set and the setting may be accelerated, if desired, by the application of heat. The portions of the particles exposed above the coating are then enclosed in a body of hard bonding metal which may be applied by spraying or by electrodeposition. When electrodeposition is used, the surface of the coating is rendered electroconductive in any suitable way, as by the application of graphite or powdered metal, to form the thin conductive film 20.

In the completed tool, the particles are held in place by the portions thereof which are anchored in the body 21 of bonding metal, which may be iron, nickel, or chromium, for example. The body is of substantial thickness and the particles are completely enclosed within the body, except for such portions as lie within the thin films of adhesive and conductive material, when the latter is employed. After completion of the body, it is removed from the blank and carries the particles with it. At this stage, the particles have an insufficient exposure from the working surface of the body and some of the bonding material must be removed from around the particles in order to increase the exposure of the particles to the desired extent. For this purpose, such portions of the adhesive and conductive coatings as have remained in place during the separation of the body from the blank are removed to expose the hard metal between the particles. That metal may then be conveniently removed by deplating, that is, by mounting the body in an electrolytic cell with the body connected as the anode. The deplating is continued to produce such exposure of the particles as may be appropriate with reference to the use to which the tool is to be put and, for example, in the production of a tool to be used on ceramics, the metal of the body may be removed to the plane indicated by the line 23, so that the particles have about a two-thirds exposure from the surface of the completed body 14. In tools to be used in metal operations, an exposure of the particles of about one-third of their length is satisfactory and, in that event, the deplating will be carried on for a shorter period of time.

In Fig. 7, there is illustrated a stage in an alternative method, according to which a thin layer 24 of metal, which is different from the hard bonding metal, is first applied to the adhesive coating to form a layer after which the bonding metal is applied over the layer to build up a body of the desired thickness. The layer 24 is preferably made of copper and it may be applied by electrodeposition or by spraying. When the layer is applied by electrodeposition, the adhesive coating is first provided with a conductive layer 20. The layer 24 does not entirely enclose the particles and when it is completed, portions of the particles project above it. The hard bonding metal is applied over layer 24 by spraying or electrodeposition to enclose the exposed portions of the particles and build up a body 24 of the desired thickness. The body 25 with layer 24 in place is then separated from the blank and the layer may be removed, as by dissolving it in acid, by deplating, or by melting it out by heat, to cause the particles to project from the body 25 to the extent desired in the final tool. It is not necessary, although preferred, to remove the layer 24 before the tool is put in use, since the layer will be worn away during grinding operations. If the layer is not to be preliminarily removed, it is preferably made of metal which is relatively brittle and will be worn away rapidly in service.

When the abrasive member has been produced as described, it will ordinarily be mounted on a base 10 which may conveniently be made by molding a suitable plastic to the abrasive member. If the base is thus formed by molding the blank 16 can be used as a part of the mold and the base 10 can be formed while the abrasive member is still mounted on the blank. This will insure the formation of a tool which will run true.

If it is desired to provide the concavity 13 of the base 10 with a liner, the entire surface of the frusto-conical extension 18 of the base will be rendered conductive at the appropriate stage in the operations and bonding metal will be deposited thereon to form a lining of the desired thickness. Alternatively, bonding metal may be sprayed over the surface of extension 18 at the time the body 14 is built up. In either case, the lining will be integral with the body of bonding metal.

I claim:

1. A method of making an abrasive tool which comprises applying a layer of adhesive to the surface of a blank, embedding abrasive particles in said adhesive layer, applying metal to the layer to enclose the particles and to build up a body of substantial thickness, applying a tool base to the body while said body, the abrasive particles and the layer of adhesive still are on the blank, and thereafter removing the base and the body with the particles embedded therein from the adhesive layer.

2. A method of making an abrasive tool which comprises applying a layer of adhesive to the surface of a blank, embedding abrasive particles

in said adhesive layer, applying metal to the layer to enclose the particles and to build up a body of substantial thickness, applying a tool base to the body while said body, the abrasive particles and the layer of adhesive still are on the blank, thereafter removing the base and the body with the particles embedded therein from the adhesive layer, and removing metal from around the particles to give them the desired maximum exposure.

3. A method of making an abrasive tool which comprises applying a layer of adhesive of the size and shape of the working surface of the tool to be made to the surface of a blank, embedding abrasive particles in said adhesive layer, applying metal to the adhesive coating and to the exposed portion of the particles embedded therein to enclose the particles and to build up a body of substantial thickness, affixing a tool base to the body while the body, the abrasive particles and the adhesive layer still are on the blank, and thereafter removing the base and the body with the particles embedded therein from the blank.

4. A method of making an abrasive tool which comprises applying a layer of adhesive of the same size and shape as the working surface of the tool to be made to the surface of a blank, embedding abrasive particles in said adhesive coating, applying metal to the particles to form a layer enclosing a portion of the particles, applying another and harder metal to the surface of the layer of the first-applied metal to enclose the portions of the particles projecting therethrough and to build up a body of substantial thickness, affixing a tool base to the body while the adhesive layer, the particles and the applied layers of metal still are on the blank, and thereafter separating the base, the body with the particles embedded therein and the first-applied metal layer from the blank.

5. A method of making an abrasive tool which comprises applying a layer of adhesive of the same size and shape as the working surface of the tool to be made to the surface of a blank, embedding abrasive particles in said adhesive coating, applying metal to the particles to form a layer enclosing a portion of the particles, applying another and harder metal to the surface of the layer of the first-applied metal to enclose the portions of the particles projecting therethrough and to build up a body of substantial thickness, affixing a tool base to the body while the adhesive layer, the particles and the applied layers of metal still are on the blank, thereafter separating the base, the body with the particles embedded therein and the first-applied metal layer from the blank, and thereafter removing the layer of first applied metal.

6. A method of making an abrasive tool which comprises applying a layer of adhesive to the surface of a blank, embedding abrasive particles in said adhesive layer, electrodepositing metal onto the layer to enclose the particles and to build up a body of substantial thickness, applying a tool base to the body while said body, the abrasive particles and the layer of adhesive still are on the blank, and thereafter removing the base and the body with the particles embedded therein from the adhesive layer.

7. A method of making an abrasive tool which comprises applying a layer of adhesive of the size and shape of the working surface of the tool to be made to the surface of a blank, embedding abrasive particles in said adhesive layer, electrodepositing metal onto the adhesive coating and to the exposed portion of the particles embedded therein to enclose the particles and to build up a body of substantial thickness, affixing a tool base to the body while the body, the abrasive particles and the adhesive layer still are on the blank, and thereafter removing the base and the body with the particles embedded therein from the blank.

8. A method of making an abrasive tool which comprises applying a layer of adhesive of the same size and shape as the working surface of the tool to be made to the surface of a blank, embedding abrasive particles in said adhesive coating, applying metal to the particles to form a layer enclosing a portion of the particles, electrodepositing another and harder metal onto the surface of the layer of the first-applied metal to enclose the portions of the particles projecting therethrough and to build up a body of substantial thickness, affixing a tool base to the body while the adhesive layer, the particles and the applied layers of metal still are on the blank, and thereafter separating the base, the body with the particles embedded therein and the first-applied metal layer from the blank.

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