Patented May 27, 1941 2,243,105

UNITED STATES PATENT OFFICE

2,243,105

ABRASIVE TOOL

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No Drawing. Application July 28, 1939, Serial No. 287,003

5 Claims. (Cl. 51—298)

My invention relates to abrasive tools comprising a bonded mixture of metal particles, abrasive particles and a non-metallic bond.

Among the objects of my invention, but without regard to the order of their importance, are:

1. The production of an abrasive tool which is highly heat resistant and which conducts frictional heat rapidly away from its working face because of its high metallic content.

2. The production of an abrasive tool the porosity of which can be readily controlled, which taken with the ductility of the metal employed in making the tool provides a tool capable of absorbing loosened abrasive particles.

3. The production of an abrasive tool requiring but low pressures and low temperatures in its manufacture, thus eliminating the danger of fracturing and of oxidizing the expensive abrasive during the process of manufacture of the tool.

4. The production of an abrasive tool in the manufacture of which, if desired, a small percentage of lead, tin or other very ductile metal can be added to impart a greasy or lubricating effect, thus increasing the ease and speed of cut, and by the same token loosened abrasive particles easily become absorbed, thereby realizing more work out of a given amount of abrasive.

5. The production of an abrasive tool which in the course of its manufacture may be readily molded to a metallic support, as my improved tool possesses excellent heat conducting properties. By reason of this fact frictional heat developed at the working face flows therefrom through the tool structure to its support, where it is readily dissipated.

6. The production of an abrasive tool capable of producing better finishes than possible with prior tools, owing to the high metal content of my improved tool.

7. The production of abrasive tools the hardness of which may be varied by varying the type of metal employed in their construction.

More specifically my invention is directed to abrasive tools suitable for grinding, lapping, polishing and finishing metals, my improved tool comprising particles of one or more metals, such as one or more metal powders, abrasive granules such as diamond, boron carbide, etc., and a strong non-metallic bond of which a resinoid bond is an example. Such phenol-formaldehyde preparations known commercially as "Durite #278," "Bakelite #BR2417" and "Durez #9540" have proven very successful in the practice of my invention.

The metals usable in the production of my improved tools may vary depending upon the characteristics desired in the finished product. For example, in some instances I may employ powdered copper alone, but where circumstances demand I may add powdered tin, powdered iron, powdered nickel or other powdered metal.

The amount of abrasive employed is variable, but in all cases the metal, by weight, exceeds the abrasive.

The amount of bonding material employed may be varied also, but on the average the bond percentage ranges from 10% to 30% by weight. I might mention that the bond percentage may at times be higher or lower than the range just mentioned. For example, where aluminum powder is used which has a specific gravity of 2.56 as compared with 8.82 for copper, it will be apparent that the bond percentage will be high, it may even be as high as 50% by weight. On the other hand, when coarse metal powders are employed, the percentage of bonding material is low, because these coarse metal particles approach the specific gravity of solid metal thus having less volume by weight than fine particles, even in some instances as low as 4.50% by weight.

In making up my improved tool the metal powder, abrasive and binder are molded under pressure. The binder is heat cured, the temperature used being below the fusing point of the metal powder in all cases. The pressure employed in most instances is relatively low, from 1000 to 4000 pounds per square inch, thereby effectively avoiding injury to the abrasive particles. The temperature necessary for curing the binder is also low, as above indicated, around 320° F. which effectively eliminates oxidation of the abrasive and is well below the fusing point of the metals, so that the mixture in the finished tool will be metal particles, abrasive particles and a strong non-metallic binder.

As above mentioned, the mesh size of the metal particles employed may be varied, the metal particles increasing in size as one approaches or wishes to approach the action of a pure metal lap. I wish it to be understood that it is within the contemplation of this invention to employ metal particles ranging from as low as 40 mesh to as high or fine as 350 mesh, and in some instances even higher. For the purposes of this application metal powders of 200 mesh and upwards are fine powders, while powders below 200 mesh are to be considered coarse powders.

It has been mentioned above that the porosity of my abrasive tool is controlled. This may be realized by employing a "closing" type of mold

and regulating the amount of material employed in both pressing and curing. For example, I may in one instance obtain a density of approximately 65 grams per cubic inch, adding more material to the mold if a denser structure is desired.

Porosity may further be controlled by varying the mesh size of the metal particles. A low pressure and coarse particles gives a mass containing many voids as compared with the results obtained when using finer powder. A very porous structure is sometimes desirable where clearance is desired for the grinding chips or for carrying more lubricant to the work and freer cutting qualities.

I have obtained excellent results employing the following formulae:

Example A

	Per cent by weight
Resin bond	10.73
Fine copper powder (200 mesh and upwards)	32.13
Fine tin powder (200 mesh and upwards)	32.14
#2 diamond powder (240–300 mesh)	25.00

Example B

	Per cent by weight
Resin bond	9.90
Fine copper powder (200 mesh and upwards)	29.65
Fine tin powder (200 mesh and upwards)	29.65
#2 diamond powder (240–300 mesh)	30.80

Example C

	Per cent by weight
Resin bond	4.41
350 mesh copper powder	4.41
60–120 mesh copper powder	66.14
240–300 mesh diamond powder	24.99

The curing cycles normally run from 5 to 10 minutes at 330° F. when curing under pressure and employing resin bond in a dry state. I may use a plasticizer, however, and press cold in which event a different curing cycle is employed. In such case, after pressing an oven is used, employing stepped heating, starting at around 175° F., the temperature being raised by steps to around 350° F. The duration of each step depends upon the compactness desired and size of the article. A heat of 24 hours duration is suitable for small abrasive tools.

I have found that the resinoid bond hereinbefore referred to may be substituted by a plastic rubber bond, which gives a strong integral body. This plastic rubber may be mixed with the metal powder and abrasive particles in a dough type mixer until well blended, then spread in a mold and cured in a hot press. The proportions of ingredients employed may be the same as when using a resinoid bond. This plastic rubber bond must not be confused with the common roll-mixed rubber which is unsuitable for this work.

Where a plastic rubber bond is used a hot press heat of 15 minutes at 250° F. and 45 minutes at 330° F. gives excellent results. This is the procedure when pressing and curing simultaneously. When pressing cold and curing in multiples a longer heat is used, approximately 12 hours at 330° F.

It will be noted that in the examples set out above the amount of metal employed is high. I have found by many experiments and tests that I must employ a minimum of 40% by weight of metal in making up my improved tool, substantially less than this amount defeating my purpose. I find also that an extremely high percentage of abrasive is detrimental, inasmuch as it spreads the bond or matrix to such an extent that the tool loses many of the advantages it otherwise possesses.

It is to be understood that changes may be made in the details of construction above described within the purview of my invention.

This application is a continuation-in-part of my copending application Serial No. 253,741, filed January 31, 1939.

What I claim is:

1. An abrasive tool comprising finely divided particles of a plurality of metals of different degrees of hardness, abrasive granules, and a non-metallic binder, molded into an integral body, the metal particles, by weight, exceeding the abrasive granules.

2. An abrasive tool comprising finely divided particles of a plurality of metals of different degrees of hardness, abrasive granules and a resinoid binder.

3. An abrasive tool comprising copper powder, tin powder, diamond powder and a resinoid bond, substantially in the following proportions by weight:

	Per cent
Copper powder	29.65 to 32.13
Tin powder	29.65 to 32.14
Diamond powder	30.80 to 25.00
Resinoid bond	9.90 to 10.73

4. An abrasive tool comprising copper powder varying from 60–120 mesh, 350 mesh copper powder, 240–300 mesh diamond powder and a resinoid bond, substantially in the following proportions by weight.

	Per cent
60–120 mesh copper powder	66.14
350 mesh copper powder	4.41
240–300 mesh diamond powder	24.99
Resinoid bond	4.41

5. An abrasive tool comprising metal particles and abrasive particles bonded by a plastic rubber heat cured bond, the metal particles by weight exceeding the abrasive particles.

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