United States Patent Office 3,547,609 Patented Dec. 15, 1970

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3,547,609

ELECTRICALLY CONDUCTIVE THERMOSET RESIN-BONDED GRINDING WHEEL CONTAINING SILVER PARTICLES

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No Drawing. Filed Oct. 31, 1967, Ser. No. 679,533
Int. Cl. C08g 51/12; B24b 7/08
U.S. Cl. 51—298 4 Claims

ABSTRACT OF THE DISCLOSURE

A conductive phenolic resin-bonded grinding wheel contains conventional abrasive grits bonded by a resin including from 10 to 25% by volume of finely divided silver. Lower percentages of silver produce essentially non-conductive wheels.

BACKGROUND OF THE INVENTION

This invention relates to electrically conductive resin-bonded grinding wheels.

The prior art (see, for example, Thompson U.S. Pat. No. 3,283,448, and Turner British Pat. No. 991,143) teaches the use of metal powder in phenol-aldehyde type resins as a bond for producing electrically conductive grinding wheels for use in "electrolytic" or, more properly, electrochemical, grinding. In the Thompson patent the minimum metal content taught in the bond (converting the data to a volume percent basis) is 38%. The range of metal content taught is from 38% to 59% by volume, or a ratio of bond volume to metal volume of about 0.7 to 1.7. The Turner patent teaches a bond to metal volume ratio of about 0.33 to 1.67 (40% to 75% by volume of metal).

SUMMARY OF THE INVENTION

These prior art ratios of metal to bond are higher than desirable and, since the metal detracts from physical characteristics of the bond, making the wheels difficult to dress or form to a close tolerance, reduction of the metal content would be desirable. According to the present invention, it has been discovered that by the use of a silver powder for the metal, a reduction in metal content to ⅕ of what has previously been required may be achieved without sacrifice in the electrical properties of the wheels for electrochemical grinding. This discovery is surprising in view of the fact that the prior art makes no distinction between copper and silver powders and in view of the fact that the resistivity of silver is only about 6% lower than that of copper (1.6×10^{-6} ohm-centimeters vs. 1.7×10^{-6}). Amounts of silver in the wheel should, it has been found, be from 10% to 25% of the total volume of the bond. The abrasive content of the wheel, which may be any conventional abrasive, may vary between wide limits since in the purely electrochemical grinding the abrasive grits do little, their main function being to bring the work to the final desired tolerance or surface finish by mechanical action. The maximum practical abrasive content is about 70% by volume and, in an abrasive wheel, the practical minimum would be around 12%.

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DESCRIPTION OF PREFERRED EMBODIMENTS

Wheel mixes having the following formula were prepared:

	Alumina 46 grit wheel mix	Silicon carbide 46 grit wheel mix
Wt. percent abrasive	68.5	63.8
Wt. percent bond	31.5	36.2

The bond formula was as follows:

	Wt. percent
Phenolic resin powder (BRP–5417, Union Carbide) (including 10% hexamethylene tetramine)	38.6
Silver powder (Metz Refining Company, Type C–18, 0.9 to 1.4 microns)	57.8
Lime	3.6

In making the mix, the silver and resin powder are intimately blended to insure a uniform mix. The grain and bond are mixed, the grain being wet with furfural in the amount of 15 cc. per pound of resin mix. After mixing, the material is weighed to the exact weight of the wheel to be molded. The mix is then hot pressed at 2½ tons per square inch for 30 minutes to one hour, depending upon the thickness of the wheel, at a temperature of from 150 to 160° C.

The same formula, given above, was used to prepare wheels with 100 grit abrasive.

Diamond containing tools can be similarly produced.

The bonds in the above examples contained about 15% by volume of silver, and the finished wheels, about 8% by volume, or about 18% by weight.

In grinding tests, the wheels made in accordance with the above performed satisfactorily and 1 x 4" test bars showed a conductivity of 230 amperes with an applied voltage of 2 volts. A similar wheel with 11% by volume of silver in the bond, showed a conductivity of 100 amperes at 3 volts, which is suitable. At 9% by volume of silver in the bond, the conductivity was essentially nil (less than 10 amps at 1 to 4 volts).

While other resins than the standard phenolic may be employed, these are conventional and inexpensive and thus are preferred. However, thermosetting moldable resins may be employed so long as they do not attack the contained silver.

The surprisingly high conductivity of wheels made according to this invention cannot be explained by assuming a completely homogeneous dispersion of silver in the bond. Microscopic examination of the finished wheels shows that the silver, although originally homogeneously mixed, segregates into conducting paths during the processing of the mix, when included in the range of 10 to 25% by volume of the organic bond, and when the particle size of the silver is less than 10 microns.

What is claimed is:

1. An organic bonded electrically conductive grinding wheel for electrochemical grinding, consisting of abrasive grains and silver particles in a thermoset resin matrix, wherein the conductivity is imparted by the inclusion of from 10 to 25% by volume of finely divided silver particles, 10 microns and smaller, in the resin matrix in the

form of conducting paths consisting solely of silver dispersed in the resin matrix.

2. A grinding wheel as in claim 1 in which the bond is a phenolformaldehyde resin.

3. A grinding wheel as in claim 1 in which the abrasive content is between 12 and 70% by volume.

4. A grinding wheel as in claim 1 in which the abrasive is selected from the group consisting of diamond, aluminum oxide, and silicon carbide.

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U.S. Cl. X.R.

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