April 25, 1950 J. C. MAYS 2,505,196

METHOD FOR MAKING ABRASIVE ARTICLES

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Fig. 1.

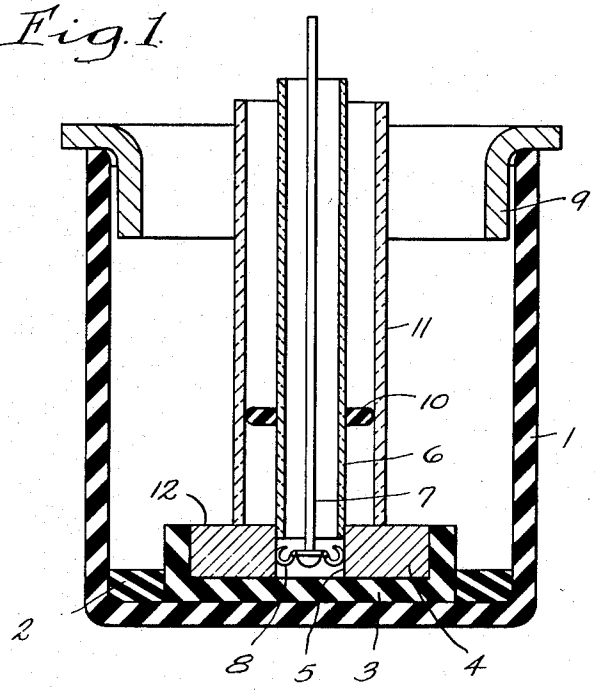
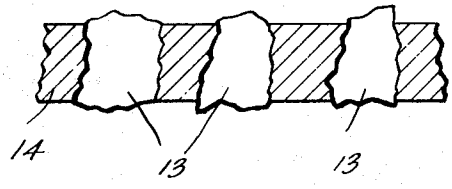


Fig. 2.



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METHOD FOR MAKING ABRASIVE ARTICLES

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9 Claims. (Cl. 51—309)

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This invention relates to methods of manufacturing metal-bonded abrasive articles, and to apparatus for use in such manufacture. More particularly, this invention relates to the manufacture of metal-bonded abrasive articles by electrodeposition of metal and to apparatus especially adapted for such manufacture.

This application is a continuation-in-part of application Serial No. 385,407, filed March 27, 1941 now Patent No. 2,347,920, issued May 2, 1944.

One of the objects of this invention is to provide means whereby strong and uniform electrodeposited metal coatings may be produced for the purpose of bonding abrasive grain. Other objects of my invention are to provide methods by which electrodeposited metal may be used in forming abrasive articles of novel characteristics.

The employment of electrodeposition as a device for the bonding of abrasives has previously been suggested, but the difficulties encountered in producing abrasive articles by that means have not been overcome prior to the present invention.

In making abrasive articles of certain types such as metal bonded wheels, the use of very hard abrasive such as diamond is desirable. Diamond abrasive is, however, so extremely expensive that, while the ordinary commercial abrasives are sold for about five cents per pound, diamond abrasive sells for around two thousand dollars per pound. It will be obvious, therefore, that in commercial practice when using diamond abrasive in the manufacture of abrasive articles the quantity of abrasive which can economically be used will be very small. Indeed it is desirable in many types of abrasive articles to have only a single layer of diamond abrasive. When diamond particles firmly held on the surface of a tool are moved into contact with a workpiece, the tool acts like a milling cutter, the many small exposed points of the diamonds each functioning as a cutting tool.

The use of a single layer of abrasive, however, raises problems which are very difficult to overcome since the tearing out or loss of any considerable amount of abrasive from the surface will render the abrasive articles useless. Accordingly, it is necessary that the single layer of abrasive be firmly and permanently held. By means of the present invention this may be done in an economical, satisfactory way; consequently, the commercial production of abrasive articles, more particularly thin wheels such as

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cut-off wheels having only a single layer of abrasive, is rendered commercially possible.

The accompanying drawing illustrates an embodiment of my invention. In the drawings, Figure 1 is a sectional view of apparatus adapted for the making of thin abrasive wheels such as those used for cutting hard materials or as dental separating discs, and Figure 2 is an enlarged fragmentary sectional view of a cut-off wheel of the type produced by the apparatus shown in Figure 1.

The apparatus illustrated in Figure 1 is designed for the manufacture of abrasive wheels by electrodeposition of metal around abrasive particles. Such wheels may be thin, consisting essentially of one layer of abrasive particles, or they may have any desired thickness. By the use of this apparatus, a cut-off wheel, for example, can be made which is the approximate thickness of the diameter of the largest abrasive particles in the wheel. In Figure 1 a vessel 1 of non-conducting material such, for example, as glass, is used. Supported on the bottom of vessel 1 and centered by ring 2 is a plate 3 also of insulating material, such as a phenolic resin, in which is embedded a circular disc 4 of metal, such as copper, having a centrally located hole 5 therethrough. Extending partially into hole 5 is an insulating tube 6 within which is a wire 7 by which an electrical connection may be made to disc 4 through spring contact 8 attached to wire 7 and pressing against the sides of hole 5 in disc 4. Suspended from the upper edge of vessel 1 is an anode 9 of circular cross-section.

In the use of the apparatus shown, the upper surface of disc 4 is so treated that it is deactivated, that is, in such condition that the electrodeposited metal will not adhere to it. Such treatment may consist of putting a very thin coating of grease on the upper surface of the disc. Alternatively, the upper surface of disc 4 may be deactivated by forming a metal oxide layer thereon. This may be done, for instance, when the disc is made of nickel or has a nickel plated surface, by making it anodic for a short time in a dilute nickel sulfate solution.

After disc 4 is treated to deactivate its upper surface, it is then placed in cell 1 and assembled with tube 6 and electrical connections 7 and 8. Since in making abrasive wheels, in this instance a cut-off wheel, it is usually unnecessary and when using costly abrasives such as diamond it is undesirable to have abrasive throughout the wheel, only the wheel rim contains abrasive. This is provided for in my invention by sliding

over spacing washer 10 on tube 6 a cylindrical, non-conducting tube 11 which is allowed to rest on disc 4 thus leaving exposed a peripheral ring 12 of disc 4 of the desired size, the cell 1 having already been filled with plating solution. Abrasive particles are then introduced at the surface of the electrolyte in cell 1 around tube 11 and allowed to fall on the exposed portion 12 of disc 4, care being taken to obtain a uniformly distributed deposit of abrasive. Tube 11 is then removed and plating carried out until the abrasive particles are covered with metal. Plating is then discontinued and the apparatus disassembled. The abrasive containing layer may be readily peeled off because of the parting layer previously placed on disc 4. After flattening, if necessary, the metal disc may be treated with acid to dissolve from the wheel sufficient metal to leave abrasive particles exposed on both side faces. Alternatively, the disc may be made the anode in an electroplating cell and metal removed from it to expose the grain on the side faces by allowing current to flow for a desired length of time.

By the above-described method cut-off wheels much thinner than those obtainable by other methods may be produced. This is because of the fact that the electrodeposited metal bond is much stronger than bonds obtained by such methods as sintering. When suitable abrasive is used they are capable of use in cutting costly material such as gems, quartz crystals, hard metal carbides and the like.

It will be obvious that thicker articles such as wheels may be produced by supplying additional abrasive either continuously or intermittently as the plate is continued so that the wheels may be of any desired thickness. When the abrasive is introduced continuously, as by being allowed to settle through the electrolyte onto the cathode, the metal bonded abrasive article so produced has the abrasive distributed throughout it in a substantially uniform manner. Alternatively, the abrasive may be placed on the cathode in essentially a single layer in the same manner as when a cut-off wheel is produced. Following deposition of sufficient metal to secure the abrasive particles together strongly, such metal extending upwardly anywhere from a substantial part of the diameter of the abrasive particles to such height as completely to cover such abrasive particles, an additional layer of abrasive is placed on top of the electrodeposited metal and/or the initial abrasive layer, and additional metal electrodeposited upon the second abrasive layer. Such process may be continued as long as desired, thereby building up an article of the desired thickness wherein the abrasive particles are distributed in a desired predetermined manner. Tubular means 11 may be replaced after deposition of each metal layer in order to exclude abrasive particles from the center of the wheel. Following deposition of the layer of abrasive particles, means 11 is again removed.

In Figure 2, which is a fragmentary sectional view, is shown a cut-off wheel of the type produced by the apparatus shown in Figure 1. Abrasive grains 13 are firmly held in a matrix 14 of electrodeposited metal but with points exposed on opposite sides of the matrix.

Any desired abrasive may be used in the manufacture of abrasive wheels by the methods disclosed herein, but these methods are particularly adapted for use with diamond abrasive, the high cost of which necessitates a very firm bonding of

the abrasive particles so that the valuable abrasive is not pulled out nor dislodged. Moreover, various metals and alloys such as copper, brass, silver may be electrodeposited as a bond for the abrasive, though, in general, it may be desirable to use harder metals and alloys, such as nickel or chromium.

It will be obvious that many modifications may be made in the illustrated apparatus and the described process, and I do not wish to be limited to the precise apparatus and methods described but only by the scope of the appended claims.

I claim:

1. The process of making thin abrasive articles such as cut-off wheels which comprises providing a conductive parting layer on a conducting surface, depositing abrasive grain on said parting layer, and electrodepositing a metal stratum on said conductive parting layer and around said abrasive particles.

2. The process of forming thin abrasive articles such as cut-off wheels which comprises providing a layer of abrasive particles on a conductive surface, electrodepositing metal on said surface and around the abrasive particles, and thereafter stripping off from the conductive surface said electrodeposited metal stratum with included abrasive particles.

3. The process of forming thin abrasive articles such as cut-off wheels which comprises providing a conductive parting layer on a conducting surface, depositing abrasive grain on said parting layer, electrodepositing a metal stratum on said conductive parting layer and around said abrasive particles to a thickness approximating that of the diameter of the larger abrasive particles, whereby said abrasive particles are firmly bonded together, thereafter stripping off from the conducting surface said electrodeposited metal stratum, and removing outer portions from such electrodeposited metal stratum to expose portions of the abrasive grain at the surfaces of said stratum.

4. The process as set forth in claim 3 in which the abrasive particles include diamond particles and the electrodeposited metal is nickel.

5. The process as set forth in claim 3 in which the abrasive particles include diamond particles and the electrodeposited metal is chromium.

6. The process as set forth in claim 3 in which the abrasive particles include diamond particles and the electrodeposited metal is copper.

7. The process of forming thin abrasive articles such as cut-off wheels which comprises providing a conductive parting layer on a conducting surface, depositing abrasive grain on said parting layer, electrodepositing a metal stratum on said conducting parting layer and around said abrasive particles to a thickness approximating that of the diameter of the larger abrasive particles whereby said abrasive particles are firmly bonded together, thereafter stripping off said electrodeposited metal stratum, and removing outer portions of such metal by causing it to form ions in a liquid bath to expose portions of the abrasive grain at the surface of said stratum.

8. The process of making metal bonded abrasive articles such as wheels which comprises providing a conductive parting layer on a conducting surface, depositing abrasive grain on said parting layer, electrodepositing metal on said conductive parting layer and around said abrasive particles to a thickness which is at least a substantial part of the diameter of the larger abrasive particles,

thereafter depositing a second layer of abrasive grain on said electrodeposited metal layer, and continuing the electrodeposition of additional metal.

9. The process of forming metal bonded abrasive articles such as wheels which comprises providing a conductive parting layer on a conducting surface, depositing abrasive grain on said parting layer, electrodepositing a metal stratum on said conductive parting layer and around said abrasive particles of such thickness as to bond the particles strongly together, depositing a second layer of abrasive particles on the electrodeposited layer of metal and depositing additional electrodeposited metal around such second added layer of abrasive, the process being continued until the wheel has been built up to the desired thickness, thereafter stripping off the product which consists of electrodeposited metal with interspersed abrasive particles.

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