

- [54] **PROCESS FOR METAL COATING DIAMONDS**
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- [56] **References Cited**
UNITED STATES PATENTS
 521,991 6/1894 Sachs et al..... 204/9

1,789,443	1/1931	Levin.....	204/20
3,577,324	5/1971	Patterson.....	204/222
3,498,890	3/1970	Divecha et al.....	204/16
3,654,098	4/1972	Backhurst.....	204/20

FOREIGN PATENTS OR APPLICATIONS

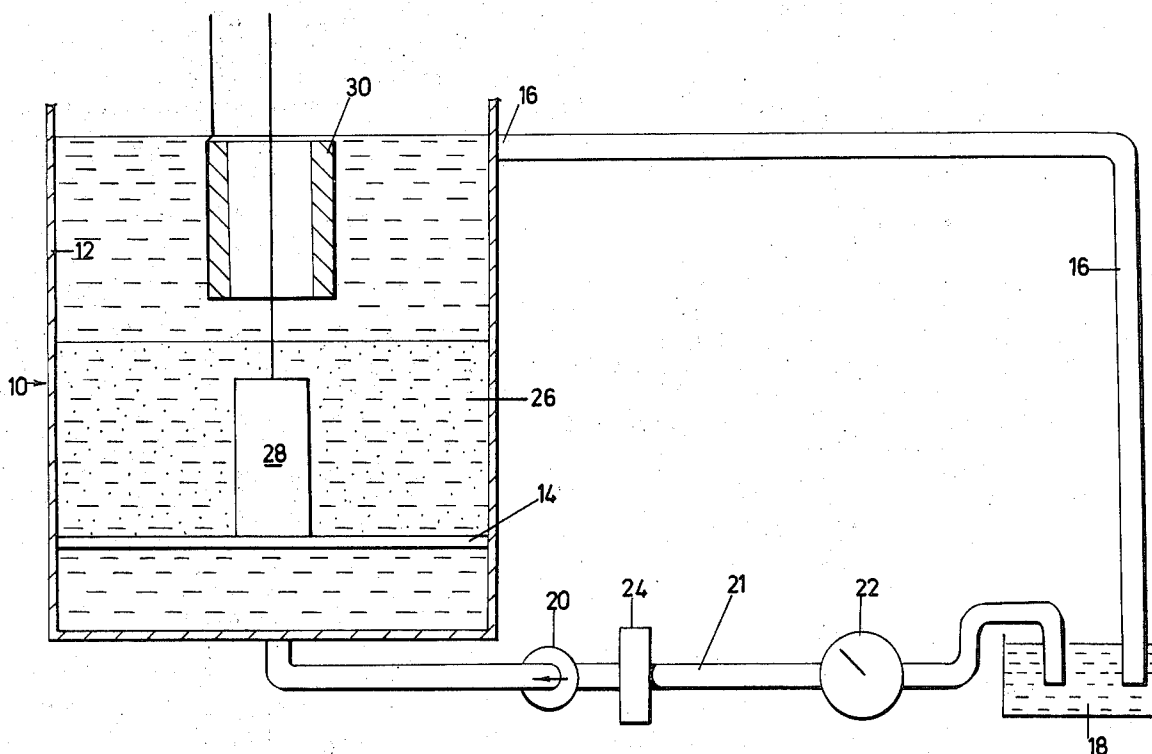
1,537,301	7/1968	France.....	204/23
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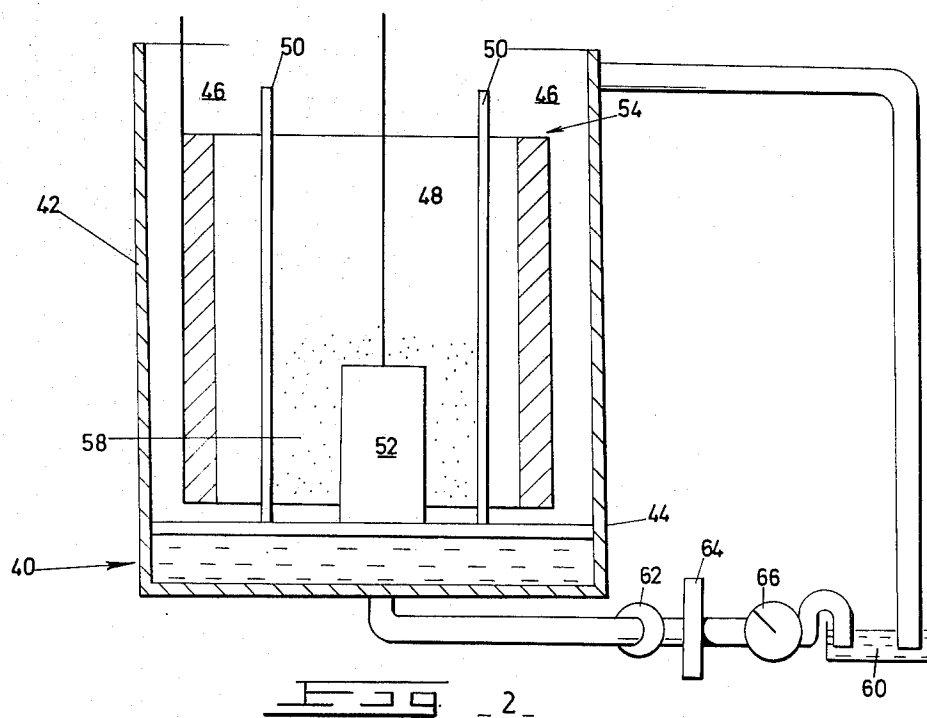
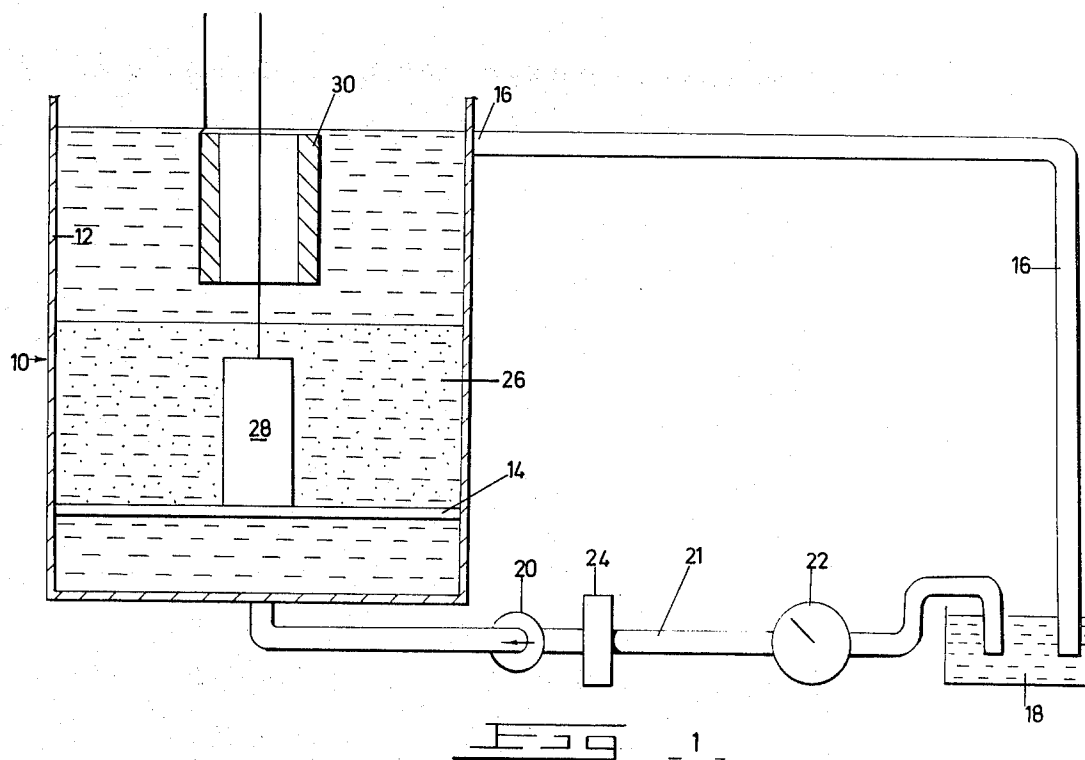
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[57] ABSTRACT

A method of metal coating, particularly electrolytically, particulate material such as diamond, cubic boron nitride or the like which includes the steps of forming a bed of the material, fluidising the bed by passing a metal coating solution through it, and causing the metal to deposit on to the material.

2 Claims, 2 Drawing Figures





PROCESS FOR METAL COATING DIAMONDS

The invention further relates to apparatus for use in metal coating particulate material including a vessel for accomadating a bed of the material, an inlet for introducing coating solution into the bed and pumping means for delivering coating solution to the inlet at a sufficient rate to cause fluidisation of the bed. When the apparatus is used for electrolytic coating, it includes a spaced anode and cathode, the anode being in contact with the coating solution, but not the fluidised bed, and the cathode being in contact with the fluidised bed.

This invention relates to a method of coating diamonds electrolytically with a metal.

The electrolytic plating of the diamond particles has in the past been carried out in a barrel system. The barrel is made of an inert material and two metal rings are set through the wall of the barrel. These rings are close to, but insulated from each other and they transfer the necessary current to the inside of the barrel. One of these rings, the current feeder, is divided into three sections and the design of the electrical circuit enables these sections to be alternately positively and negatively charged. The term "current feeder" is used in place of "cathode" as the cathode for a particulate plating system is the total surface area of all the particles in contact with the negative electrode. The second ring conveys the anodic current to the anode which is a metal rod inserted on the axis of the barrel. The diamonds to be electrolytically coated (i.e. those which already have an electroless metal coat on them) are poured into the barrel which is then filled with the electrolytic plating solution. The barrel is then rotated on rollers. Brushes situated in appropriate positions carry the necessary current to the two metal rings set through the barrel wall. On rotation of the barrel the diamonds roll to the bottom where they are negatively charged on contacting the current feeder, positive metal ions are reduced on to these particles and in this way electrolytic plating takes place.

A particular problem encountered with this system is the coherence of the diamonds being plated to form clusters. This phenomenon is termed agglomeration.

Adherence to the current feeder presents a second major problem of this system. The current feeder on rotating free of the diamonds is positively charged. This change in polarity is necessitated by the fact that diamonds adhere to the current feeder and the positive charge forces most of these particles to break away from the electrode.

To prevent excess agglomeration and adherence low current densities have to be used which results in low plating rates. Also it has been found that batches below 50 gm of diamond grit are very difficult to coat. Between 50 gm and 600 gm prove to be the most workable loads but it has been found that barrels of varying dimensions have to be used to accommodate this range.

It is an object of the present invention to provide an improved method of metal coating diamonds.

According to this invention, there is provided a method of metal coating diamonds including the steps of forming a bed of diamonds, fluidizing the bed by passing a metal coating solution through it, and causing the metal to deposit on to the diamonds.

Deposition is achieved by passing a current through the coating solution.

The flow rate required to cause fluidization will vary according to the material to be coated and the bed weight.

The bed is caused to pulsate by passing a pulsating flow of coating solution through it. The pulsations have the effect of minimising the residence time of any diamonds in the cathode area, thereby minimising the possibility of the diamonds coating on to the cathode. The bed is preferably caused to pulsate at a rate of from 1 to 3.5 pulses per second, with 2.5 pulses per second being the most preferred rate.

The roughness of the coat can be controlled by controlling the extent to which the bed is expanded during fluidisation. As the degree of expansion increases, so the smoothness of the coat increases. It is preferred to have the bed volume expand from 5 to 20 percent during fluidisation.

The coating solution will vary according to the metal to be coated, but the preparation of any coating solution for a particular application is well within the knowledge of one skilled in the art, as are the conditions suitable for effecting deposition of the metal on to the material.

Two embodiments of the invention will now be described by way of example with reference to the accompanying diagrammatic drawings.

In the drawings:

FIG. 1 is a section through one form of apparatus for practicing the method of the invention, and

FIG. 2 is a similar section through another form of the apparatus for practicing the method of the invention.

Referring now to FIG. 1, there is shown apparatus 10 for coating particulate material, particularly abrasive metal particles. The apparatus 10 comprises an open-topped glass vessel 12 having near its lower end a perforated plate 14. At its upper end, the vessel 12 has an outlet 16 through which liquid can flow to a reservoir 18. A peristaltic pump 20 draws liquid from the reservoir 18 and feeds it to the lower end of the vessel 12 below the plate 14. In the inlet line 21 to the pump 20 is a flowmeter 22 and a throttling device 24. The throttling device 24 consists of a clamp which can pinch the flexible inlet line 21 to varying degrees and in this manner vary the flow rate of the solution.

The flow can be caused to pulsate by means of the pump 20.

A bed 26 of diamonds is located on the plate 14. An electrolytic coating solution is circulated through the apparatus 10 by the pump 20. The flow rate is such that the solution passing through the plate 14 will cause the bed 26 of particles to fluidise. Furthermore, the pump is operated to cause the flow of coating solution to pulsate and this causes the bed to pulsate.

Resting centrally on the plate 14 is the lower end of a cathode 28 in the form of a carbon rod. This carbon rod 28 is of such a height that its upper end will always be below the upper surface of the bed 26. Co-axially arranged above the rod 28 is the anode 30 which is in the form of a metal tube and which is located about one to two centimetres above the maximum height of the fluidised bed.

The apparatus described above was used to coat diamond particles with copper and for this purpose a coating solution containing 200 grams/litre copper sulphate, 50 grams/litre sulphuric acid and 2 grams/litre of gelatin was used.

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In order to make the diamonds electrically conductive, a nickel flashing consistency of about 3 to 5 percent by weight of the uncoated diamond, was applied to the particles using a well-known electroless coating method.

Seventeen Grams of the diamonds coated with a nickel flashing were placed on the plate 14 to form a bed. The coating solution was then passed through this bed at a flow rate of between 0.1 and 0.9 litres/minute to fluidise the bed and the pump was operated so that it caused the flow rate to pulsate at a rate of 2.5 pulses/second thereby causing the bed to pulsate at the same rate.

Copper was coated on to the diamond particles by applying a potential difference of 15 volts across the anode and cathode to induce a current of 0.19 amps per gram of diamond particle. In this manner, a copper coating comprising 50 percent by weight of the nickel-coated diamond was applied to the diamond particles after four and a half hours. It was found that the copper coating had a density of about 8.5 which is considerably higher than the density of copper coatings achieved using the conventional barrel method described above where densities of the order of 7.8 to 8.0 are achieved. The significance of the higher density is that the bonding of the coating to the diamond is better and this results in better retention properties of the diamonds in abrasive tools such as resin or metal bond wheels, saws and compacts.

Further, it was observed that there was no agglomerations of the diamonds and no diamonds were plated on to the cathode.

The above-described method and apparatus has been described with reference to copper coatings. It is to be understood that these examples are given solely by way

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of example as other metal such as nickel, gold, iron and cobalt may be coated on to the diamonds.

Referring now to FIG. 2 there is shown a modified apparatus 40 which includes a glass vessel 42 having a plate 44, which is similar to plate 14, at its lower end. The space above the plate 44 is divided into inner and outer compartments 46 and 48, which are located coaxially one within the other, by means of a porous membrane 50. A carbon cathode 52 projects into the inner chamber 48 and a metal anode 54 projects into the outer chamber 46. The diamonds are set in a bed 58 in the inner chamber 48 on the plate 44. The apparatus 40 also comprises a reservoir 60, pump 62, throttle 64 and flowmeter 66 which are identical with the equivalent parts in the first described embodiment.

The operation of the apparatus 40 is the same as the operation of the apparatus 10. This apparatus, however, has the advantage that the electric field created between the anode and cathode is more uniform and hence better plating of the metal on to the diamonds results.

I claim:

1. A process of metal coating diamonds including the steps of forming a bed of the diamonds, fluidizing the bed by passing a flow of a metal coating solution through it in a predetermined direction to cause the bed volume to expand by from 5 to 20 percent, causing the metal to deposit on the diamonds electrolytically with an electrode immersed in said bed, and pulsating said flow of solution in said predetermined direction at a rate from 1 to 3.5 pulses per second to reduce the tendency of said diamonds to plate onto said electrode.

2. A process as claimed in claim 1, in which said rate is 2.5 pulses per second.

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