

1

2,912,804

METHOD FOR POLISHING ARTICLES

Luther G. Simjian, Greenwich, Conn.

No Drawing. Application June 16, 1958
Serial No. 742,052

5 Claims. (Cl. 51—281)

This invention generally refers to a method for polishing articles and more particularly has reference to a method for applying a superfine finish to articles having irregular surfaces.

It is well-known that applying a superfine finish to articles by automatic means is quite difficult but can be accomplished in most instances by means of lapping or burnishing, provided that the articles are flat or can be run on centers. The applying of a fine finish however, to articles with irregular surfaces is a great deal more difficult if not impossible, in view of the fact that conventional abrading and polishing means do not reach into hidden recesses, re-entrant cavities, undercuts, etc. In connection with the manufacture of analog computers, fire control systems, and other high precision computing devices, it is necessary frequently to apply a very high finish to spur gears, worm gears, worms, helical gears, shafts and other parts, in order to maintain the precision and accuracy required and to achieve substantially noiseless operation.

In U.S. Patents 2,735,231, entitled "Sharpening or Polishing Device," issued February 21, 1956, and 2,735,232, entitled "Polishing Device," issued February 21, 1956, I have disclosed method and means for sharpening and/or polishing articles which embody irregular surfaces. The instant invention describes a further method of accomplishing the general aims of abrading such articles whereby the procedure described hereafter generally will be useful as the last and final step in producing the superfine finish desired.

As used in the conventional sense, the word "sonic energy" shall denote the use of acoustic waves within the audible and inaudible frequency range. Since for certain applications, particularly large scale industrial processing, energy within the audible frequency range causes some discomfort unless acoustic shielding is provided, usually an inaudible frequency of 20 kilocycles per second or higher is used. Units in this frequency range are known commercially as "ultrasonic" devices. It will be understood, however, that the process described hereinafter is useful regardless whether the frequency is audible or inaudible and the term "sonic" shall embody the entire frequency spectrum. The agitation necessary for the present process is produced by sonic energy which in fluids causes cavitation and shock waves emanating from the cavitation centers.

In its broad concept the instant invention provides that the surface of the article to be polished is prepared with a coating of abrasive particles. The article is then subjected to sonic energy in such a manner that shock waves impinge upon the abrasive coating, causing the abrasive particles to become displaced relative to the article surface and abrade this surface as they become displaced therefrom.

The process, for instance, may be carried out conveniently by employing, as a part of this process, ultrasonic cleaning devices which provide the desired ultra-

2

sonic power and shock waves. The method described hereafter in greater detail will be found helpful for abrading and providing a superfine finish to articles which may be either magnetic or nonmagnetic.

One object of this invention is the provision of a method for applying a superfine finish to articles for precision instruments.

Another object of this invention is the provision of a method which permits abrading of articles which embody irregular surfaces and cavities.

Another object of this invention is to provide an automatic method for abrading articles which are neither flat nor can be run on centers.

Another and further object of this invention is the combination of an abrasive coating and the energy derived from sonic energy to effect abrading of articles.

Another and still further object of this invention is the provision of an improved method for effecting a superfine finish on small and delicate parts combined with cleaning these objects.

Other and further objects of this invention will be apparent by reference to the following detailed description:

The article to be abraded, such as a gear, a microwave cavity, or other suitable article, is coated as a first step, with a layer of discrete abrasive particles. When this coating has hardened and adheres to the surface of the article to be treated, the article is exposed to sonic energy which causes repetitive impact of shock waves on the abrasive particles thereby consecutively vibrating, loosening and displacing the discrete abrasive particles from the surface of the article. As the particles become displaced, under the impact of the shock waves, the particles will scrape and abrade against the surface of the article so as to cause a superfine finish.

A practical step by step procedure comprises for instance, the following individual steps:

A mixture of abrasive particles, such as carborundum, emery, garnet, diamond grit, etc., is suspended in an adhesive medium such as clear lacquer and sprayed onto the article to be abraded. The article is then immersed into an ultrasonic cleaning bath which provides the ultrasonic energy and the coupling medium between the ultrasonic energy source and the article, thus causing shock waves to impinge upon the article. The shock waves will "clean" the article but in attempting to accomplish this cleaning process, the abrasive particles become progressively vibrated, loosened and displaced from the location at the surface and while becoming displaced therefrom, will abrade the area surrounding each particle.

It will be apparent that many different abrasive materials may be employed for this type of operation, that various binders may be used for holding the abrasive coating on the article and that the binder may either be of the air drying or oven drying type without deviation from the principle described hereinbefore. Moreover, instead of spraying the coating, brush application or a dip method may be substituted without deviating from the principle described.

When polishing articles which are paramagnetic or which can be magnetized, the use of a binder material may be deleted inasmuch as iron particles, magnetic particles such as "Alnico," or ferrite particles may be employed which adhere to the article surface by means of magnetic attraction.

The ultrasonic shock waves impinging on the article surface will, after a brief period, displace the abrasive particles and when circulating the liquid through a filtering system, the abrasive particles may be trapped and settled out so that the finished product is an abraded and cleaned article exhibiting a superfine finish. The liquid employed may comprise ordinary water, water with a

3

detergent or water with a wetting agent or other suitable cleaning solution as are well-known in the art. It will be advantageous, however, to select a liquid which will not immediately dissolve the binder, if a binder is employed. However, a solution which slowly attacks the binder may be found advantageous in many instances.

It is believed that most satisfactory results can be achieved by employing for the sonic energy an ultrasonic cleaning device operating in the 10 to 50 kc. range although transducers may be employed which operate at either lower or higher frequencies. Depending on the frequency, transducers may comprise either magnetostriction transducers, piezoelectric transducers, acoustic transducers or other materials and types without deviating from the principle described hereinbefore. In most instance an ultrasonic exposure of a few minutes will be sufficient not only to abrade the article but also to free the surface of the abrasive particles and any other foreign substance and objects. The instant method therefore will provide a very effective means for abrading, cleaning and leaving a superfine finish on an object.

While there have been described specific embodiments of the invention, it will be obvious that various changes and modifications may be made therein without departing from the field of the invention which should be limited only by the scope of the appended claims.

What is claimed is:

1. A method for polishing an article comprising: coating the surface of the article to be polished with an adhering layer of abrasive particles; exposing the coated surface to sonic energy to free the surface of said particles thereby causing the particles to abrade the surface as they become displaced therefrom.

2. A method for polishing an article comprising the steps of coating the surface of the article to be polished

4

with an adhering layer of discrete abrasive particles; immersing the coated surface in a liquid and exposing the surface while in said liquid to sonic energy to cause loosening of the particles from the surface and produce abrading motion between the particles and said surface.

3. A method for polishing an article comprising the steps of coating the surface of the article to be polished with an adhering layer which comprises discrete abrasive particles and a binder, immersing the coated surface in a liquid and applying sonic energy to said liquid to cause abrading motion between the particles and the surface to which they adhere as the particles are loosened from adhesion to the surface.

4. A method for polishing a magnetic article comprising the steps of coating the surface of the article to be polished with an adhering layer of magnetic abrasive particles; exposing the article to sonic energy to break the magnetic adhesion between said surface and said particles thereby causing abrading motion therebetween.

5. A method for polishing an article comprising the steps of coating the surface of the article to be polished with an adhering layer of discrete abrasive particles; immersing the coated surface in a liquid, applying sonic energy to said liquid to cause loosening of the particles from the surface and produce abrading motion between the particles and said surface, and circulating the liquid to separate the particles from the influence of sonic energy subsequent to the abrading action.

References Cited in the file of this patent

UNITED STATES PATENTS

2,460,918	Bodine	Feb. 8, 1949
2,554,701	Hackett	May 29, 1951
2,736,148	Thatcher	Feb. 28, 1956