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VIBRATORY FINISHING METHOD

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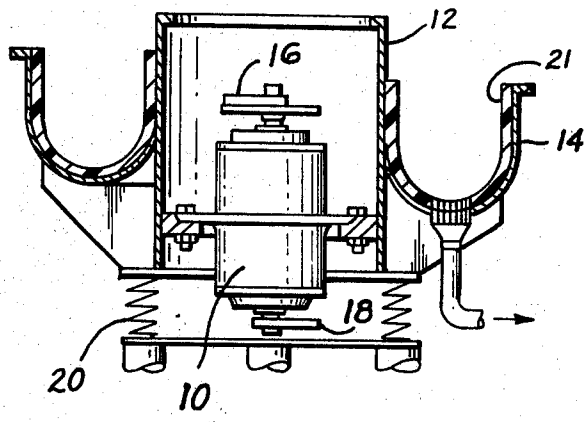


FIG. 1

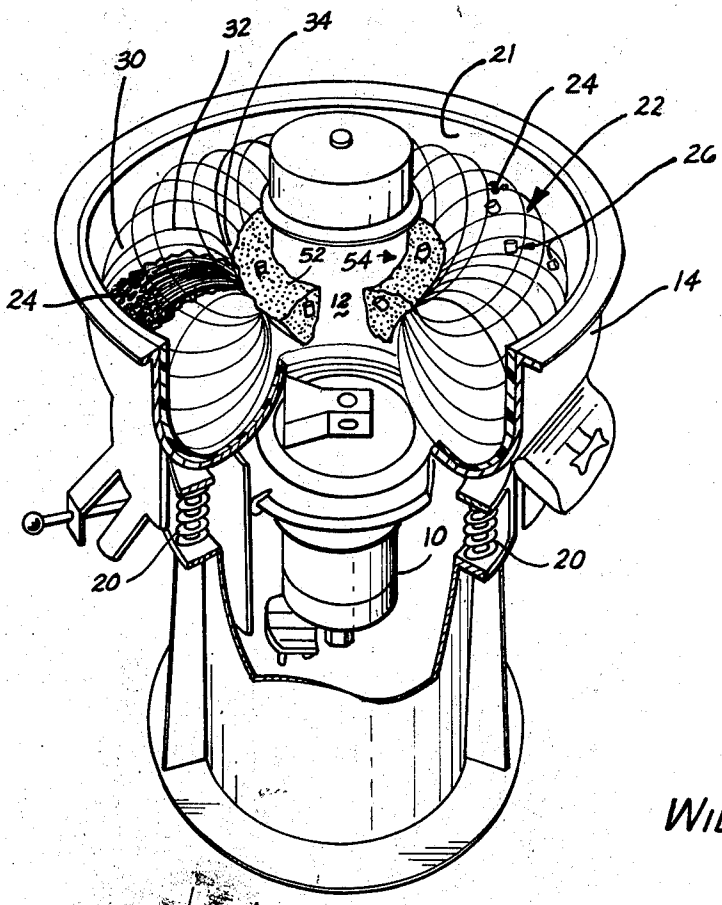


FIG. 2

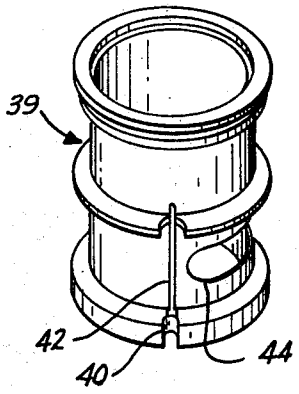


FIG. 3

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VIBRATORY FINISHING METHOD

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ABSTRACT OF THE DISCLOSURE

This invention relates to an improved method for finishing relatively delicate parts by conventional vibratory machines which method includes the steps of combining the parts with suitable abrasive materials to form a work load, and forming gas bubbles within the work load for the purpose of creating a cellular layer which acts as a cushioning agent for the protection of the parts during the vibration cycle.

BACKGROUND OF THE INVENTION

During motion finishing operations such as deburring, descaling or burnishing, practically millions of microscopic particles need be removed from the work piece. If these particles are not removed from the work piece or are allowed to redeposit thereon during the finishing operation, the work piece must be frequently rejected because it is neither chemically nor physically clean.

Various finishing methods are known ranging from hand operations to semi-automatic and fully automatic operations. In the past to achieve the highest degree of finish on relatively delicate parts, especially made of nonferrous or plastic materials, hand operations were almost exclusively employed. For example, in the manufacture of certain geophysical transducers such as geophones and hydrophones, thin-walled aluminum parts are employed which need be thoroughly deburred.

Prior to my method, it was necessary that these machined aluminum parts be sandblasted and each individually hand buffed with a nylon rotary brush. The buffed parts were subsequently rinsed in one or more detergent solutions. These hand finishing manipulations were relatively expensive and considerably raised the price of the products requiring such high finish.

Yet for other parts various techniques and machines are known which are used to perform the necessary finishing operations such as deburring. One such well-known method employs a vibratory machine having a processing tub mounted on suitable vibration imparting means as on a vertically mounted vibratory motor. Eccentric weights may be mounted on both top and bottom of the motor's shaft. Adjusting both the position and size of the weights varies the impact force delivered by the vibratory motor.

The use of such vibratory machines requires that the parts be combined with suitable "media" and chemical compounds to form a "workload." The efficiency of the finishing method depends on the combined efficiency of the employed media, compounds and finishing machine. The latter are selected on the basis of the desired finishing operation to be performed for example, deburring, descaling, radiusing, cleaning, etc.

The finishing machines include tumbling machines, vibratory machines and others. For best results with the method of this invention it is preferred to employ vibratory machines. Vibratory machines produce the greatest relative motion between the parts to be finished and the media. In such machines the work load consisting of media, chemical compounds and parts moves in circular paths and individual particles have motions relative to each other. As a result, media lying within a hole in the

part move within the confined area of the hole and perform internal finishing. Similar action takes place in machined or recessed areas throughout the part.

Various factors contributing to successful finishing operations are known. These depend on the amount of material to be removed, the size and weight of the parts, and the final micro-inch finish desired. Nevertheless even by controlling these factors the vibratory machines were found unsuitable for finishing lightweight, relatively small parts, especially parts having relatively confined recessed areas thereon. Such parts when placed in a vibrating machine cannot withstand the rough handling to which they become subjected during the vibrating cycle. Such parts often collide against each other or against the center post of the vibrating machine. These collisions cause some of the parts to become damaged and others to receive a poor finish.

Accordingly, it is a broad object of this invention to provide a new and improved method for use with conventional vibratory machines, which method allows the mechanical processing of relatively fragile and lightweight parts in conventional vibratory machines.

FIG. 1 shows in cross-section a typical vibratory machine;

FIG. 2 is a view of the work load within the vibratory machine; and

FIG. 3 shows typical parts which can be processed by the method of this invention.

Referring to the figures there is shown a typical vibratory machine. One such machine may be purchased from the Roto Finish Company in Kalamazoo, Mich. An electric motor **10** is directly bolted to a cylindrical center post **12** supporting a process tub **14**. Eccentric weights **16** and **18** are mounted on the upper and lower ends of the motor shaft, respectively. Cylinder **12** is mounted on coil springs **20** to allow the tub **14** to vibrate thereon. A suitable plastic lining made of Adiprene (trademark of Du Pont) covers the walls of the process tub, as shown. The lining is abrasion resistant, relatively resilient and exhibits excellent resistance to oils, water, and many chemicals. Vibratory action is transmitted to the processing tub by motor **10**. Means (not shown) are provided to easily adjust the weights **16** and **18**, thereby varying the impact force of the vibratory motor and controlling the moving rate of the parts in the machine.

The work load **22** in tub **14** consists of abrasive media **24**, chemical compound additives, water and parts **26** to be finished. Vibratory action takes place throughout the work load and all parts are processed uniformly and simultaneously. Such a vibratory machine can be operated as a continuous automatic finishing machine or as a batch, automatic-finishing machine, as is well known in the art. It is important that the proper motion be imparted to the parts. This motion causes the work load **22** to become propelled in a spiral orbital path around the tub with tridimensional vibration. The parts move in orbital paths, such as path **30**. When they reach the summit **32** on path **30** they "break away" from the media **24** and "fall" into "valley" **34** between the center post **12** and the vibrating work load **22**.

There are six principal operating parameters controlling the vibratory finishing operation:

(1) Media are selected by size or shape since it is not desired that they lodge in holes, projecting parts or recesses. Media are also selected on the basis of the desired finish. It is advantageously with relatively complicated parts to combine both large and small media.

(2) The proportion of media-to-parts is selected depending on the size and fragility of the parts to be finished.

(3) Water is added to the medium to control the cutting speed and the final luster and finish of the parts. The cutting action of abrasive media is reduced as the amount

of water is increased. It is also recognized that the amount of water added to the work load has an effect in controlling damage to the parts. For that reason operators usually add relatively large quantities of water both to reduce the abrasive action of the media **24** and to act as a cushioning agent for the parts **26**.

(4) Chemical compounds are added to the media and the water. Several high-quality compounds are commercially available and allow great versatility in finishing procedures. These compounds can be both abrasive and non-abrasive, depending on the final finish desired. They are available in both coarse and fine-grit sizes for most efficient finishing operations.

(5) The amplitude, frequency, and speed of the vibrating tub have an important effect on the success of the finishing operation. When these are properly selected the work load **22** receives proper motion which causes the work load to move in an elliptical path for maximum relative motion between media and parts. For fragile parts or those requiring a micro-inch finish, relatively low speeds are preferred.

(6) The processing time in the tub is an important parameter and normaly ranges from about 5 minutes to 2 hours.

While vibratory machines differ in design, they operate in substantially similar fashion. Another machine found acceptable to carry out the method of this invention is manufactured by the Southwestern Engineering Company of Los Angeles, Calif., and is sold under the trademark of SWECO.

As previously mentioned, in spite of controlling the above and other parameters, it was not possible, to my knowledge, to use such vibrating machines for the finishing of relatively delicate parts **39** such as are shown in FIG. 3. These aluminum parts are machined and are characterized by recesses such as **40**, **42** and **44**. When parts **39** would reach the summit **32** on orbital path **30**, they would fall into the valley, collide against each other and against the center post **12**. As a result parts **39** would become damaged. Also, the relative motion between the parts and the media would frequently cease, thereby preventing the parts from receiving a proper finishing action.

In accordance with my invention, a cushion or layer of gas bubbles **52** is formed especially around the center post **12**. Bubbles **52** form a relatively thick foam **54**. Foam **54** causes the parts **39** to fall itno the valley **34** gently, keeps the parts properly separated, prevents them from colliding against each other and against the center post, and allows the parts to move in their orbital paths in a three dimensional vibration.

In one application the work load **22** was made of 150 pounds of Norton No. 8 silicon carbide natural, 150 pounds Norton No. 10 silicon carbide, 8 ounces of 3M Honit 300 micro-cut, and 8 ounces of water. The water combines with the micro-cut to form a viscous layer of foam around the center post to protect the parts. Since

micro-cut is also an abrasive detergent, it cleans the parts as they vibrate.

While soap detergents and other abrasive chemical compounds were previously employed, they were usually employed with such relatively high quantities of water that no substantial layer of foam was created. As a matter of fact, steps were generally taken to avoid the formation of a layer of foam.

While applicant has suggested a suitable work load, it will be apparent to those skilled in the art that other media and other compounds can be combined to achieve optimum finishing results on relatively fragile and lightweight parts. It is important however that the quantity of water added, or other equivalent liquid for mixing with the chemical compounds, be controlled to obtain a continuous and consistent viscous layer of foam to properly cushion the parts in the vibratory load and against the sidewalls of the tub.

It will also be recognized that while the layer of foam was obtained by chemically combining compounds and water, other methods may be employed to produce gas bubbles to achieve similar results. The invention therefore is to be interpreted by the scope of the attached claims.

What I claim is:

1. The method for finishing relatively delicate articles of manufacture which includes the steps of:

placing said articles in a vibrating machine,

combining said articles in said vibrating machine with at least suitable abrasive materials to form a work load,

vibrating said machine to vibrate said work load thereby causing relative movements between said articles and said abrasive materials, and

establishing in at least a portion of the vibrating work load a substantial cushion of air bubbles, said cushion acting to prevent said articles from damaging collisions between themselves and against the inner walls of said machine thereby allowing said articles to become properly finished.

2. The method of claim **1** wherein said vibrating machine includes a process tub and an upright center post, and wherein said cushion of air bubbles is established primarily around said center post.

3. The method of claim **1** wherein said cushion of air bubbles is established by introducing into said vibrating machine a detergent compound and a limited quantity of liquid just sufficient to create a relatively thick cushion of air bubbles.

4. The method of claim **3** wherein said abrasive materials are of different dimensions.

References Cited

UNITED STATES PATENTS

2,548,264	4/1951	Howe	51—316 X
3,161,997	12/1964	Balz	51—316

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