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J. H. MAKER ETAL
MECHANICAL PLATING METHOD

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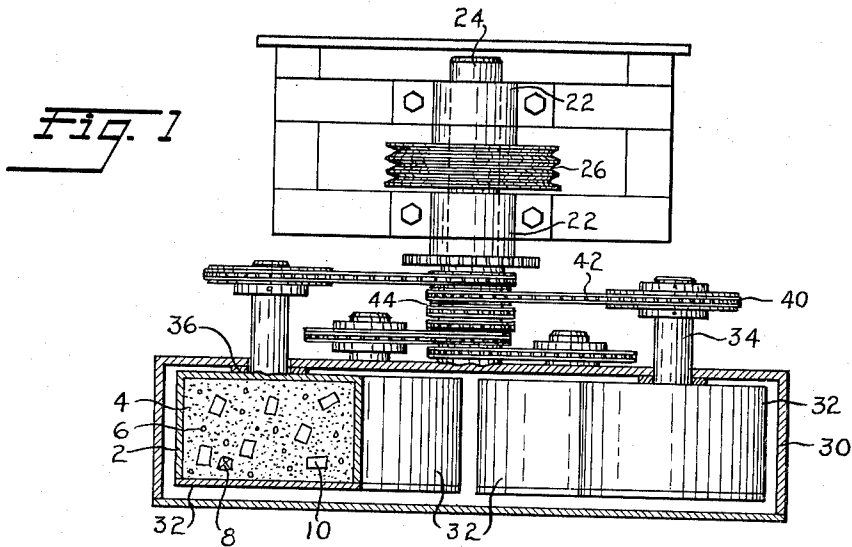
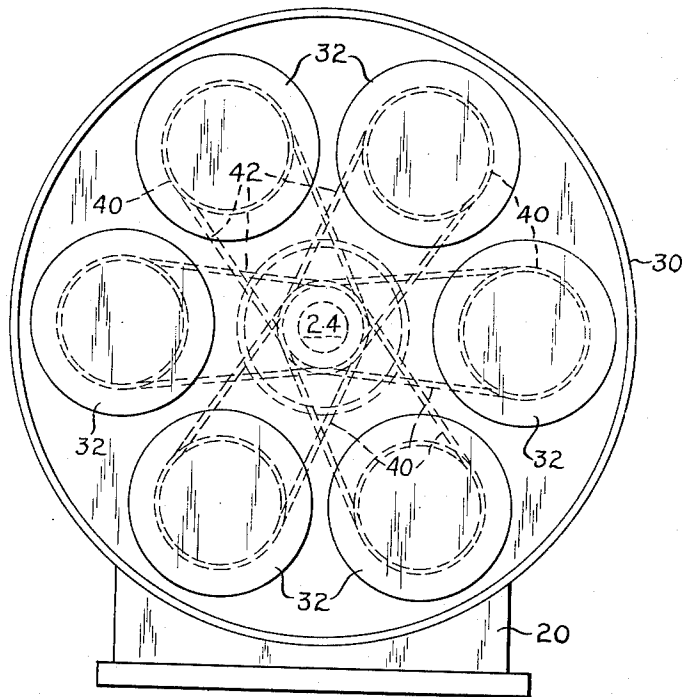


Fig. 2

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MECHANICAL PLATING METHOD

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This invention relates broadly to the plating of metal articles to produce a continuous protective or decorative surface thereon and, more particularly, to methods for producing such surfaces by mechanical action.

There are now commercially available apparatus and plating media for mechanically plating metal parts by impacting powdered metal particles onto the surface of such articles, one of such apparatus and the media to be used therein being disclosed in United States Letters Patent to Songas, No. 3,013,892 for Impact Media for Mechanical Plating and Method of Using Same. The apparatus and media disclosed in this patent are very useful but have certain disadvantages, notably the long time required to complete the usual plating operation, which is approximately one hour, resulting in increased cost. It has been the principal object of this invention to provide new and improved plating means which will maintain the advantages of plating by the use of known apparatus and media while at the same time reducing by at least one-half, and in some cases to one-twentieth, the required plating time, with consequent considerable cost reduction.

The invention is described in the following specification and is illustrated in the accompanying drawing, in which:

FIG. 1 is a top plan view, partly in section, of the apparatus useful with the invention, showing the media to be used therewith, and

FIG. 2 is a front elevation view of the apparatus shown in FIG. 1.

In FIG. 1 there is shown the interior of a tumbling barrel 2 loaded for beginning a tumbling operation to plate metal powder onto the surfaces of articles within the barrel. To facilitate illustration, the barrel is displayed as containing a carrier liquid 4 (having promoter chemicals dissolved therein to facilitate the plating action of the metal powder) with a metal powder 6 to be plated, and an impact media 8 to aid in plating. The parts to be plated are designated by the numeral 10 and may be of any desired shape. The powder 6 and impact media 8 in the carrier liquid are shown in suspension, rather than settled in the bottom of the drum as they would be with the drum at rest, for simplicity of illustration. It is to be understood that these ingredients would probably be mixed in more random fashion within the tumbling barrel than is illustrated and no attempt has been made to draw the ingredients to scale.

The impact media comprises graded sizes of spherical impacting particles intermingled with graded sizes of non-spherical particles. It is to be understood that these particle shapes are not all-inclusive of the almost infinite variety of nonspherical shapes possible.

Non-spheroidal particles having a major dimension larger than about $\frac{3}{4}$ of an inch (the longest dimension of the particle is measured by passage through a square mesh screen or by simply measuring the longest dimension with a ruler or scale) have been found to be generally ineffective to provide the improved results of this invention as there is a tendency for the powdered metal of the plating operation to plate out on these particles whereby they detract from the plating efficiency of the system and consequently, as an economic matter, while a little of this may be tolerable, the net result is to change

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particles of such large sizes from impact media to coated parts.

When the non-spheroidal vitreous particle size falls below about 0.03 inch, the abrasive action of the particles is too great on the plated parts and the luster, in fact even the coating continuity, becomes detrimentally affected. Here again, however, minor amounts of non-spheroidal particles smaller than about 0.03 inch can be tolerated to some degree without serious detrimental effect on the system.

The percentage of non-spheroidal particles to total impact media mixture of spheroidal and non-spheroidal particles in parts by volume may be varied from about 5 to about 80% to provide mechanically plated parts with visibly superior lusters, and in the case of screw threaded and other parts having intricate surface geometry, more uniform coating thicknesses and continuity, and in the case of threaded parts, greater thread root coverage.

In the selection of spheroidal particles in the impact media mixture, those having a size range of from about 0.006 inch to about 0.35 inch have been found suitable. For convenience, the spheroidal particles may be divided basically into groups of "fines," which are those spheroidal particles from about 0.006 inch to about 0.014 inch, intermediate fines from 0.014 inch to about 0.035 inch, and "large," namely those of a size larger than about 0.035 inch. It is only in the case of very intricate surface geometry, e.g., small screw threaded parts, etc., that large quantities of the fines (up to 30% by volume of the impact media mixture) are used as on flat parts they may contribute to roughness of plated surfaces.

The large spheroidal particles are limited in their gross size primarily because of the tendency of the powdered metal in the mechanical plating mixture to plate out onto them as well as on the parts it is actually desired to plate and further because when such particles are used, as for example on parts made of metal stampings with sharply angled sections, a "halo" effect is sometimes apparent wherein the area of the part immediately at the juncture of the sides to the angle (inside) is relatively dull as compared with the flatter surfaces on both sides thereof. However, oftentimes larger spheroidal particles may be added to the plating system to space parts from one another and prevent them from unduly scratching one another, as for example to separate from one another loud speaker frames which tend to nest with one another and radio chassis with sharp corners.

The selection of any particular combination of sizes of spheroidal and non-spheroidal particles in any given impact media mixture is of course somewhat dependent on the type, size, and shape of the part to be plated. The usual parts to be plated are of ferrous metals, in many instances overcoated with flash immersion coatings of copper or the like to promote plating adherence, and are predominantly hardware items such as nuts, bolts, screws of all sizes, serrated washers and similar items having relatively intricate surface geometry as well as parts stamped and formed from flat sheet stock, and including flat washers, hinges, rods, bars, small plates, and various stamped frames such as brackets, holders, and similar items.

While plating can be formed of almost any powdered metal or powdered metal alloy of a particle size about 44 microns and smaller, which will adhere to the article being plated, zinc, cadmium and tin are the more common plating powders as well as alloys of zinc, cadmium and tin among themselves and with other metals. As exemplary of other metal powders which may be utilized, brass, bronze, silver and gold may be considered.

Selection of the size ranges of the spheroidal and non-

spheroidal particles comprising the impact media mixture to be used in the mechanical plating of articles will vary with the article to be plated for optimum results. Thus, with relatively flat parts as for example small leaf springs, washers, hinge plates and the like, impact media mixtures may contain only the larger spheroidal particles and little or no spheroidal particle fines, and only the larger, non-spheroidal particles of from about 0.2 to about 0.75 inch.

On the other hand, with small parts having very intricate surface geometry such as that found in small springs, screws, nuts, etc., a significant percentage of spheroidal "fines" of the smaller sizes, from about 0.006 to about 0.014 inch will be present as a percentage of the spheroidal particles in the mixture and the non-spheroidal particles present will probably not exceed a size over about $\frac{1}{10}$ of an inch, the non-spheroidal size range possibly being from 0.03 to about 0.09 inch.

Between the two extremes noted in the preceding paragraphs are obviously many size range and percentage range combinations of the spheroidal and non-spheroidal particles which may be found to be optimum for any particular type of part being coated or plated.

With respect to simple flat parts such as washers, hinge plates, etc., preferred impact media mixtures are those containing from about 50 to about 70% non-spheroidal particles as a volume percentage of the total mixture of spheroidal and non-spheroidal particles. With respect to parts having intricate surface geometry such as the screws and the like noted in the preceding paragraph, mixtures containing from about 15 to about 70% non-spheroidal particles have been found to provide plated articles having visibly improved surface finishes, e.g., better luster and more uniform coating thicknesses; preferred mixtures for such parts have been found to be those containing from about 30 to about 60 volume percent non-spheroidal particles.

In accordance with the invention the plating is carried out in tumbling apparatus such as that shown in the drawings in order to achieve the new and improved results produced by the invention. This apparatus comprises a base 20 which provides support for two spaced bearings 22 in which a shaft 24 is journaled for rotation by any suitable means, such as the drive pulley 26. A cylindrical casing 30 is mounted at its center on shaft 24 for rotation therewith and is provided with any suitable access means, not shown. Within this casing a plurality of drums 32 are mounted on individual shafts 34 which are equally spaced about shaft 24 and each of which is journaled in a bearing 36 in the rear wall of casing 30 and extends through such wall.

Six drums are shown but any other number of drums may be provided. The size of the drums will depend on the size of the work pieces that are to be finished, but it has been found that a wide variety of sizes and shapes of work pieces can be polished in the same drum. While the drums are illustrated as circular in cross-section it has been found that various polygonal cross-sections are also suitable and sometimes preferable.

The drums may be lined with layers of rubber or other relatively soft material which has a high friction coefficient that prevents sliding and imparts a smooth, flowing caterpillar treadlike movement to the abrasive media in the drums.

Outside of casing 30 a sprocket 40 is secured to each stub shaft 34, and these six sprockets are driven by individual chains 42 from a six-step drive sprocket 44 mounted on shaft 24. In accordance with the invention the sprocket 44 is driven at a speed selected to rotate the drums 32 with the stub shafts 34 while the casing 30 and all of the drums are rotated as a group about the main shaft 24.

As shown in FIG. 1, each drum contains the impact media and work pieces of a character and structure which have been described more fully hereinafter. One or more work pieces are placed loosely in each drum 30 and the top of each drum is sealed by a cover, not shown, fastened thereto, the impact media also having been introduced into the drum. The casing 30 is rotated at a speed which is selected to produce a centrifugal force on the material in the drums in a range of from a few to several hundred g's. A force of approximately fifty g's has successfully plated and polished a multitude of articles of widely different shapes and formed of different metal and plastic materials. At the same time the sprocket 44 is driven so as to cause rotation of each individual drum 30 and thereby cause the contents of the drums to shift and the work pieces to move through and against the compacted coating and abrasive material under pressure and thereby be plated, cut and finished. The two centrifugal forces acting on the work pieces and the material cooperate to effect a particularly satisfactory finishing action on the work surfaces. It is desirable to achieve relatively slow movement of the work pieces through the highly centrifugally compacted polishing media.

It has been found that the use of the described impact media in tumbling apparatus producing the dual centrifugal action of that described herein, causes improved mechanical plating of articles and reduces very greatly over prior processes the time required for such plating, thereby affording considerable savings in cost.

From the foregoing description it is believed that the invention and the practice thereof will be apparent to those skilled in the art. Since minor modifications and changes in the impact media mixture not specifically described hereinbefore will obviously be occasioned in the practice of the invention, it is to be understood that the invention is to be limited only to the extent required by the appended claim.

What is claimed is:

The method of mechanically plating the surface of articles, which comprises rotating the articles together with a mass of loosely particulated material in a drum about a first axis while concurrently rotating the drum about a second axis spaced from the first axis, the loosely particulated material comprising a mixture of spheroidal and non-spheroidal vitreous particles, a liquid carrier medium, a metallic plating powder and a promoter chemical, the spheroidal particles having a size range of 0.006 to 0.35 inch, the non-spheroidal particles having a size range of 0.03 inch to 0.75 inch, and the non-spheroidal particles comprising from about 5% to about 80% by volume of the mixture of spheroidal and non-spheroidal particles.

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