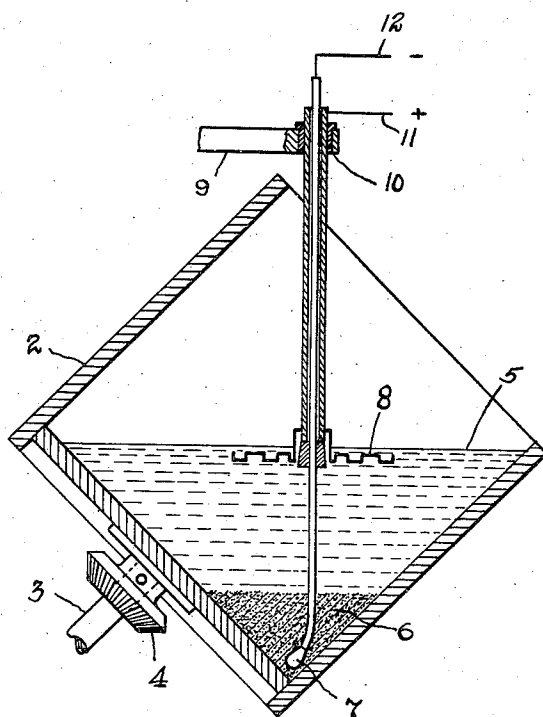


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METALLIC COMPOSITION
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METALLIC COMPOSITION

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The compression of metal powders, usually followed by heat, with or without mechanical working, in order to form rigid aggregates having definite size and shape, has been practiced for many years, the rigid bodies so formed generally having in greater or less degree the properties of cast or forged metal of the same chemical composition. For example, the manufacture of tungsten filaments for use in electric light bulbs is generally carried out by compressing powdered metallic tungsten in a mold to give the shape of a bar. This bar is then heated in a non-oxidizing or reducing atmosphere and is then swedged or forged to develop the desired physical properties. The metal is then drawn through dies to form wire. Another example of the consolidation of powdered metal has been known in the manufacture of bronze bearings and bushings. In this, powdered copper and tin in a desired proportion are mixed together, and the mixture is formed to shape a die under high pressure. Suitable heat is then applied to further the action. In this process the extent to which strength of product is attained is limited by the fact that interaction between adjacent metal particles occurs only where such particles contact, and with irregular particles the points of contact are inherently quite limited, notwithstanding the utmost practical pressure that can be applied. Such products then are lacking in a desired mechanical strength. In accordance with the present invention however, it now becomes possible to work up powdered metals to the production of novel metallic products, and the attainment of physical properties available for a wide range of usage.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain embodiments of the invention, these being indicative however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

The sole figure is a vertical sectional view of an apparatus applicable in carrying out the invention.

For the purposes of the present invention, I employ metals in powdered form, that is, finely divided condition, the particular size depending somewhat upon the products desired. In general, the particle size need not go larger than that which will pass an 80 mesh screen, although this is not limitative. The lower limits of size may be

again of considerable range, although in practice it is sometimes advantageous to remove such exceedingly fine particles as are almost impalpable in size. For optimum conditions, particles that will pass a 180 mesh screen and be retained on approximately a 400 mesh screen, are satisfactory. These metal powders can be produced in various ways, such as by reduction of metallic compounds, oxides, formates, oxalates, etc.; also by spray atomization of molten metal, or by electrolytic deposit from solutions by using higher current densities than are normal to obtain smooth deposits. Grinding, stamping, sawing, etc. are other possible means for the production of the metal powder to be employed.

With a suitably finely divided metal, I now coat the particles with another metal. For this, I may deposit a metallic coating on the particles by immersing them in a suitable solution of a metallic salt. For example, I may coat particles of nickel, iron, etc. by immersion in a solution of copper sulphate. Another and quite generally applicable procedure which I prefer is electro-deposition or plating onto the particles. For this, I may place the metal powder to be coated in a container, which may conveniently take the form of a rotatable chamber 2 mounted in any suitable way, as by shaft 3 on an incline, and having a driving gear 4 for suitable rotation. The plating solution 5 covers the powdered metal 6 in the bottom of the container, and a cathode 7 and an anode 8 are suitably arranged and supported, for instance as suspended from a support 9 with suitable insulation 10, the cathode extending well into the mass of powdered metal, while the anode is supported at a working distance up in the bath. Leads 11, 12, from a source of direct current supply the power requirements.

The amount of metal deposited, by whatsoever means, on the metal particles, can be controlled as desired and percentage compositions can be prepared in wide range. Again, and particularly where employing the plating type of deposit, a wide range of combinations may be had. For instance tin can be plated onto copper particles using tin anode and a tin plating-electrolyte the particular composition of which need not be detailed here, or vice versa, copper can be plated on tin powder, by employing a copper anode and a copper plating bath. Similarly, nickel may be deposited on copper, or copper on nickel, and so on. Among metals particularly desirable for base-particles I may mention metals such as copper, iron, manganese, nickel, tungsten, molybdenum, antimony, etc., and among metals which

may be advantageously employed for coating the particles I may mention metals such as tin, cadmium, zinc, lead, copper, nickel, chromium, cobalt, silver, gold, the platinum group, etc. Desirable combinations for instance, are copper particles having tin plated thereon to the amount of 8-12 per cent, or copper having nickel deposited thereon to the extent of 0-60 per cent. That is, a combination of copper 92-98 per cent and tin 8-12 per cent may thus readily be had, or for instance, copper 30-40 per cent and nickel 70-60 per cent. More than one metal coating may be applied, and various complex combinations may thus be built up. For instance, a combination of copper 88-90 per cent, with tin 10-8 per cent and lead 2 per cent. Again, such combinations as iron and nickel, iron, nickel and chromium, copper and zinc, copper, zinc and tin, copper, zinc, tin and antimony, etc. may all readily be made.

The metal-coated metallic particles so prepared may be employed as such for some uses. For instance, metal particles for "bronzing" liquids having special utilities and advantages may be thus prepared, it being possible to apply coats of even the noble metals in such an economical manner on a base-particle as to attain a wide range of results.

By compressing a mass of the coated metal particles, articles of desired form may readily be had, whether blanks to be further worked up or final forms for finishing. For instance, copper particles coated with zinc or tin or both may be compressed to form articles having the characteristics of bronzes, and in various desired utilitarian or ornamental forms. Again, metal particles in suitable coated combination may be compressed to form bearings, and here a degree of porosity may be preserved if desired, making it possible to further the oil take-up. By vacuum impregnation an oil absorption for instance practically up to 100 per cent by volume may be readily attained.

With the pressing, or subsequently, I, in most instances, also apply heat, the temperature being such as generally to bring about fusion of at least the lower melting component. By reason of the very intimate contact of the coated-on metal with the basal particle, interaction or alloying proceeds readily and may be carried through as thoroughly as desired. A structure of particular strength may thus be had, as contrasted with the more or less partitive and superficial action attainable where only dissimilar metal particles are compressed.

With this process, it also now becomes feasible to build up more composite articles, whether a relatively thin surfacing, or a body-to-body consolidation be involved. For instance, metal-coated particles of one kind may be compressed to a desired shape, and metal coated particles of another kind may be separately compressed to desired form, and these two blanks may then be compressed together, furthering the action. A blank or article of one combination of coated metal particles may be pressed up, and a facing or surfacing of another combination of coated metal particles may be pressed thereagainst, and so on variously.

The amount of pressure may vary somewhat in accordance with the metals being operated with. For instance, where dealing with rather soft metals, or where great density of final product is not desired, pressures of 10,000 pounds per square inch or less may be employed, and up to 100,000 pounds per square inch. With hard metals, or where great density of product is desired, pressures on the order of 50,000-150,000 pounds or more per square inch may be employed.

As an example: Copper powder coated with tin to the extent of about 8-9 per cent is compressed in a mold under a pressure of about 25,000 pounds per square inch, and is heated to a temperature of 700° C. for an hour. On microscopic examination, the material is found substantially entirely homogeneous in alloy formation.

Other modes of applying the principle of my invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. A process of the character described, which comprises electro-depositing metal upon particles of another metal, compacting and heating such particles into a body to form an alloy of said metals.

2. A process of the character described, which comprises electro-depositing one metal upon particles of a second metal, compressing and heating a mass of such metal coated metallic particles to form an alloy, separately electro-depositing a third metal upon particles of a fourth metal, compressing and heating a mass of such metal-coated particles to form an alloy, bringing said two masses together, and finally compressing.

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