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METHOD OF MANUFACTURING METAL SPHERES

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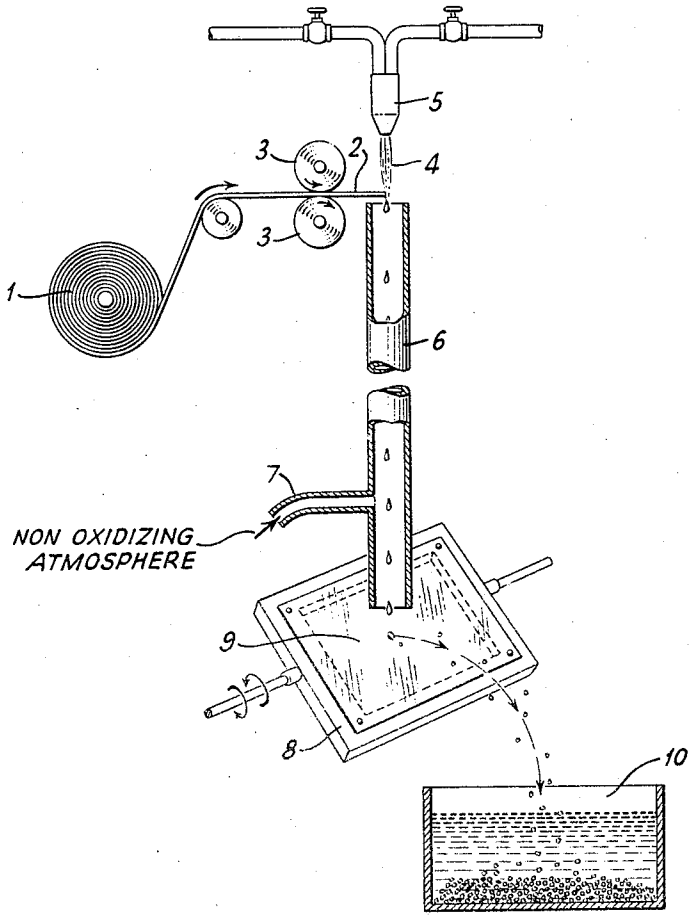


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## METHOD OF MANUFACTURING METAL SPHERES

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3 Claims. (Cl. 83—91)

My invention relates to a method of manufacturing small metal spheres and particularly to a method of making metal spheres of uniform size and shape.

In my U. S. Patent No. 2,175,689 I have disclosed an electrode of the mosaic type suitable for use in television transmitting tubes. The electrode of the type described includes sintered metal particles or plugs mutually separated and insulated from a conducting foundation by an intermediate insulator. I have found that it is desirable to provide denser metal plugs than those obtained by sintering metal powers. It is desirable that these metal plugs be uniform in size and shape but various methods of manufacturing such small particles, which usually range in size from .01" to .005", have been found unsatisfactory. Small metal spheres are particularly suited to this use, but attempts to make small metal spheres by spraying the metal from a spray gun of the Schoop type or passing molten metal through a fine mesh screen as in the shot-tower process do not meet with success. In the first method the particles produced are of non-uniform shape and size so that less than 4% of the product is usable. In the latter process the molten metal will not pass through a fine wire mesh screen but rather collects in large drops on the under side of the screen, the drops bearing no apparent relationship to the size of the openings in the screen.

It is an object of my invention to provide a method of manufacturing small metal particles or spheres of uniform size and shape. It is a further object of my invention to provide equipment for and a method of manufacturing metal spheres in which the percentage yield of the desired size range is increased. In accordance with my invention, I melt a metal which it is desired to make into small particles, allow the molten metal to fall a considerable distance through space and interrupt the fall on an inclined plane of resilient material to break the melted metal into small metal particles which are solidified and cooled. These and other objects, features and advantages of my invention will become apparent when taken in connection with the accompanying drawing in which the single figure represents one form of equipment suitable for practicing my invention.

Referring to the drawing, I provide a quantity of metal 1, preferably in wire form as shown at 2, which is passed between rollers 3 into a melting region such as the flame 4 provided by the burner 5. The burner 5 is preferably supplied with gas and air, although oxygen and hydrogen may be used when melting certain metals highly refractory in character. The rollers 3 preferably feed the wire 2 into the melting region or flame 4 at a uniform rate, the capacity of the flame being such that the wire is melted at the rate at which it is fed. After the wire is melted in the flame 4 the molten metal is allowed to fall through space for a distance determined by the size of the metal particles desired, as will be referred to later. If the metal is of such a material as to be readily oxidized, the path of the falling molten metal may be surrounded by a tube 6 containing a non-oxidizing atmosphere which may enter the tube 6 such as through the inlet 7, although I have found this to be unnecessary when making metal particles of such metals as silver, copper, zinc, nickel or nickel chrome alloys.

In accordance with my invention, I interrupt the fall of the molten metal by a resilient base. Referring to the drawing, the platform 8 is arranged in the path of the falling metal and also arranged to be rotated so that the angle of incidence of the falling metal with respect to the plane of the platform may be varied. The platform 8 supports a sheet 9 of resilient material such as at its four corners so that the molten metal, when interrupted in its fall, will bounce from the resilient sheet 9, whereupon it may be collected and cooled such as by a water bath 10.

I have found the size of the particles made of any given metal to be dependent upon a number of variables. Thus I have found that the hotter the melting region, such as the flame 4, the smaller will be the particles size. Likewise I have found that the greater the distance that the molten metal is allowed to fall before interruption, the smaller the particle size. This distance may vary from 6 inches to 8 feet when making silver particles, the only requirement being that the metal should be molten at the time it is interrupted by the resilient sheet 9. The particle size may be further controlled by varying the angle of incidence between the path of the falling metal and the plane of the resilient sheet 9. Thus for grazing incidence I have found the particles to be considerably larger than for angles nearer the perpendicular, although I have obtained the best results, both with respect to the uniformity of particle size and the maximum yield of spherical particles, when this angle of incidence is approximately 45°. I have tried a number of materials for the purpose of interrupting the fall of the molten metal and have

found that a sheet of paper or thin cardboard or other resilient heat insulating material is greatly preferred. Materials such as metal, wood, glass or silica have proven unsatisfactory, which I attribute to their lack of resilience. It appears, however, that the material of the sheet 9 should have a relatively smooth surface, and while I have obtained satisfactory results with a platform co-extensive and in contact with the sheet 9, I prefer to support the sheet from its four corners, whereupon the central section of the platform 8 may be cut away as shown in the drawing.

The resultant product made in accordance with my invention are particles of metal which are substantially spherical, the size of the particles being quite uniform. In addition, my equipment and method are particularly suited for making metal particles of other metals than silver, such as copper, zinc, nickel and nickel chrome alloys. For metals which have a tendency to oxidize while being melted, I prefer to use a reducing type flame to prevent the formation of oxide, but for metals such as zinc I have found that the use of an oxidizing flame is advantageous.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particlular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

I claim:

1. Apparatus for manufacturing small metal particles comprising a source of metal to be melted, means to melt the metal into relatively large particles, said means being elevated so that upon melting the particles of metal immediately drop through space, means to intercept the particles which drop through space while the particles are still in a molten state, said means comprising an inclined base of heat insulating non-metallic resilient material of sufficient thinness as to be flexible under the impinging particles causing the particles to rebound and subdivide into smaller particles.

2. Apparatus for manufacturing small metal particles comprising means to melt a quantity of metal, said means being elevated so that the metal falls through space immediately upon becoming molten, a thin base of resilient material of sufficient thinness as to be flexible under impact of said molten metal and positioned to intercept the falling molten metal and cause the metal to be subdivided into small particles, the base being supported from its sides so that the impinged area of the base is free to flex under the impact of said particles.

3. Apparatus for manufacturing small metal particles comprising a resilient non-metallic base capable of deformation by small molten particles impinging thereon, said base being inclined at an angle to the vertical and supported from the edges thereof, means directly above an unsupported area of said base to melt a quantity of metal which when molten falls on the said area of said base and means to collect and cool said metal following the impingement of said metal on said base causing a flexure thereof.

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