

Feb. 12, 1946.

G. F. TAYLOR

2,394,727

METHOD FOR MAKING SMALL METALLIC SPHERES

Filed Dec. 27, 1944

Fig. 1.

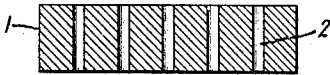


Fig. 2.

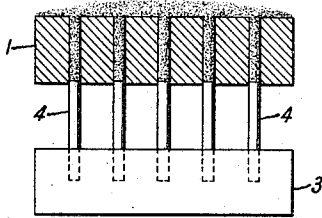


Fig. 3.

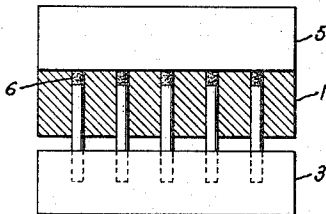


Fig. 4.

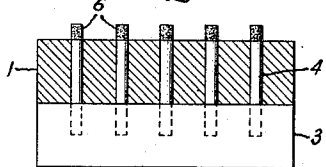


Fig. 5.

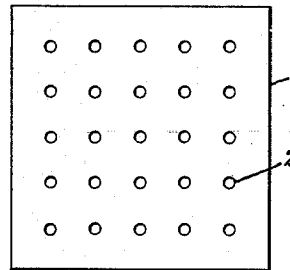


Fig. 6.

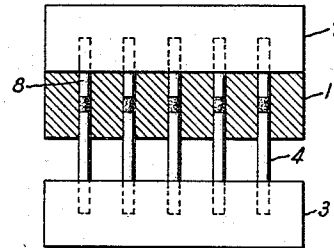


Fig. 8.

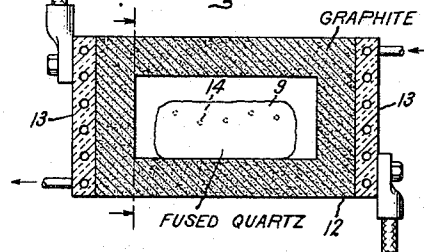


Fig. 7.

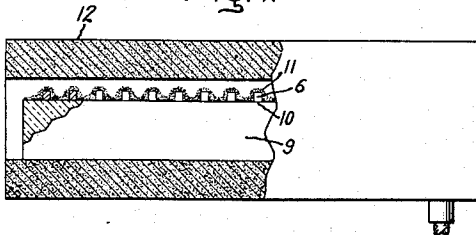
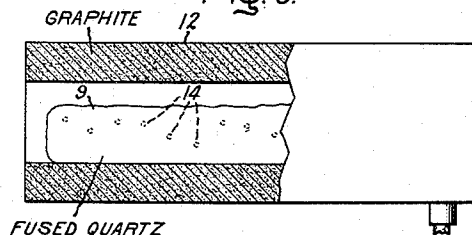


Fig. 9.



Inventor:
George F. Taylor,
by *Harry E. Dunkham*
His Attorney.

UNITED STATES PATENT OFFICE

2,394,727

METHOD FOR MAKING SMALL METALLIC SPHERES

George F. Taylor, Grosse Pointe Woods, Mich., assignor to Carboloy Company, Inc., Detroit, Mich., a corporation of New York

Application December 27, 1944, Serial No. 569,967

7 Claims. (Cl. 22-200)

The present invention is a method for making small metallic spheres from pressed powder compacts and more particularly a method for making refractory metal spheres adapted for use in the manufacture of pen points.

One of the objects of the present invention is the provision of a method adapted for quantity production of small metallic spheres. A further object is the provision of a process for making very small spheres of iridium or platinum-iridium alloys and the like adapted for use in tipping pen points, making jewelry, ornaments, bearings, etc. A further object of the invention is the provision of a process for producing small metallic spheres all of equal size and perfectly spherical. Other objects will appear hereinafter.

The novel features which are characteristic of my invention are set forth with particularity in the appended claims. The invention itself however will best be understood from reference to the following specification when considered in connection with the accompanying drawing in which Fig. 1 is a cross-sectional view of a molding plate which may be employed in carrying out my invention; Figs. 2, 3 and 4 are views partly in section and partly in elevation illustrating successive steps employed in my process; Fig. 5 is a plan view of the mold plate illustrated in Fig. 1; Fig. 6 is a view, partly in section and partly in elevation, of a modified apparatus for carrying out my invention; Fig. 7 is a view, partly in section and partly in elevation, of a loaded graphite muffle for fusing the pressed powder compacts and the support therefor; Fig. 8 is a cross-sectional view of the muffle disclosed in Fig. 7 and illustrating the position of the metallic spheres after fusion has taken place; while Fig. 9 is a longitudinal view partly in section and partly in elevation of the graphite muffle and load shown in Fig. 7.

My improved process, in general, comprises placing a number of pressed powdered metal compacts on a plate composed of material such as glass or quartz which becomes plastic or semi-fluid at and somewhat above the melting temperature of the metal or alloy to be formed into globules. When the plate is softened by heat and the metal has fused forming globules, the latter will slowly sink into the plate. By lowering the temperature at this point causing the plate to become rigid, the globules can be caught in the act of falling through the plate. The plate can then be dissolved by hydrofluoric acid or other suitable solvent and the metal recovered as perfect spheres.

The type of glass employed will depend upon the melting point of the metal to be made into spheres. If one of the softer metals such as lead, zinc, tin, thallium, cadmium, etc., is employed, borax glass, for example sodium or lithium borate glass or any one of a number of borate glasses may be employed. On the other hand, if the metal is employed which has an intermediate melting point such as gold, silver, copper, one of the softer boro-silicate glasses, for example a glass commonly known in the trade as "Gena 59-3," may be employed as well as other lime or lead glasses. For higher melting point metals such as nickel, iron, cobalt and manganese, a hard, arsenated, high temperature glass such as Pyrex may be employed, while for the most refractory metals such as platinum, iridium, ruthenium and rhodium, it is preferable to employ pure fused quartz.

Referring more particularly to the drawing, I have indicated at 1 a stainless steel multiple mold plate which may be about 2" x 2" x 1/2" thick. Although the plate illustrated contains twenty-five holes 2, a plate having the dimensions indicated may contain about one hundred holes each about .050" in diameter and drilled through the plate 1. In order to apply pressure to the material in the plate 1, I employ a metal plate 3 to which a series of steel plungers 4 are secured in any suitable manner. These plungers are equal in number to the holes in the plate 1, and have an exposed length equal to the length of the holes 2, and a diameter only slightly less than the diameter of the holes 2 so as to fit slidingly therein.

The metal powder to be formed into spheres, for example iridium powder, is mixed with starch and a water glycerine solution or any one of numerous other suitable binder or plasticizing mediums to form a paste. However, starch should not be employed with those metal which readily form carbides since a small quantity of residual carbon usually remains when the starch burns. Furthermore, if very fine metal powder such as iridium black is employed no binder is necessary although a trace of paraffine may be found to be desirable.

In case the pellets or compacts are formed from dry powder, the lower ends of the holes 2 are closed by plungers 4 as shown in Fig. 2. The powder is poured on top of plate 1 and vibrated or otherwise agitated until the powder fills all the holes. The excess is then raked off and a plate 5 is placed on the plate 1 so as to cover all the openings 2 therein. Pressure is then applied

to plates 3 and 5 until each column of powder has been compressed to a pellet 6 as shown in Figs. 3 and 4. In case it is desired to form pellets 6 from a paste mixture of metal powder in a plastic binder, the operation is substantially the same, as hereinbefore set forth, except that the paste is forced into the holes 2 by applying pressure at the top. After the powder has been compressed to the desired extent the plate 5 is removed and the compacts pushed out of the holes 2 by further movement of the plungers 4 therein as indicated in Fig. 4 of the drawing.

Instead of forming the compacts as indicated in Figs. 2, 3 and 4, I may employ the apparatus shown in Fig. 6 of the drawing. In this arrangement the plate 1 is employed with two sets of oppositely disposed plates 3 and 7 with attached plungers 4 and 8 respectively so that pressure may be applied simultaneously to the metal in the holes 2 at both ends thereof.

In order to form metal spheres the pressed powder compacts 6 are placed on a glass-like supporting plate 9 which has a layer of powdered glass 10 sprinkled thereon having the same composition as the plate 9. After the compacts have been positioned in the loosely sprinkled powder layer and out of contact with one another, they are entirely covered with more of the same powder as indicated at 11 in Fig. 7 of the drawing and thereby held in position on the plate during the subsequent heating operation and until they have fused and start sinking into the fused plate 9.

The plate 9 with the compacts or pellets 6 positioned thereon is placed in a graphite muffle 12 of suitable size which is clamped between water cooled electrodes 13 which are adapted to be connected to a suitable source of electric current to thereby heat the muffle or tube 12. Since the plate 9 is heated almost entirely by radiation the tube 12 will be heated to a temperature considerably higher than that required to fuse the iridium and the glass-like support 9. If the temperature of the muffle 12 is too high or applied too long the metal beads or pellets will sink all the way through the support 9 and rest on the base of the graphite muffle thereby causing a slight flattening on one side of the finished beads. Under such conditions the metal in some cases will chemically combine with a portion of the graphite to form a carbide. The proper temperature and time to be employed may be ascertained without great difficulty by starting out with a minimum temperature and minimum time, and observing after each run whether or not fusion has taken place, this procedure being continued until the metal beads have melted and fallen about mid-way into the fused glass plate 9 after which the temperature is lowered to permit the plate to become rigid. By noting the time and current flow at the moment when the pellets have fallen about mid-way into the plate 9, the operation may be repeated easily and without likelihood of failure.

After the metallic beads 14 have sunk into the fused plate 9, the latter is removed from the graphite tube 12 and pulverized or cracked up in a mortar or other suitable device so that the time for dissolving the glass-like support in acid may be reduced. After the glass has been broken up, it is placed in a lead pot and covered with acid, for example a 48% hydrofluoric or other suitable acid and the covered pot left in a hood for several hours. When the glass particles have been dissolved, the metal beads 14, all of which

will be found to be of the same size and perfectly spherical, may be recovered. Any glass, excepting quartz, may be broken by dropping the hot glass into water. When forming spheres of soft metal, glasses having a high coefficient of expansion are preferable since they break up into finer fragments when the hot glass is plunged into water.

The present process is particularly suitable for producing very small spheres of iridium or platinum-iridium alloys for tipping pen points since the spheres made in accordance with my improved process all have the same diameter and are perfectly spherical and highly polished. Any metal can be made into spheres by my process except metals which have very high melting points such as molybdenum or tungsten, or metals which have a specific gravity lower than the glass employed, for example lithium, magnesium or aluminum, or metals that combine with glass to form silicides such as aluminum, zinc and magnesium. Although chromium reacts with fused silica at its melting point, it forms therewith only a thin film of silicide if not exposed above its melting point for too long a period of time. After cooling, this silicide film shells off very easily leaving a perfect chromium sphere having a brilliant mirror surface.

Although I have illustrated my process in connection with a particular mold arrangement, it will be obvious that the apparatus disclosed in Figures 1 to 4 inclusive is not essential for the performance of my process and that the compacts or pellets formed therein could be made by other means such as a pill press.

It should be understood that where the expressions "glass" or "glass-like material" are employed in the specification, such expressions include quartz, porcelain, or other vitreous material.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method for making metallic spheres which comprises compressing powdered metal into a compact mass, placing the compacted mass on a glass-like support and heating the support and compacted mass at a temperature at which the compacted material will fuse and sink into but not all the way through the glass-like support.

2. The method for making metallic spheres which comprises compressing powdered metal into compacts, placing them on a glass-like support having a layer of powdered glass thereon, said powdered glass having the same composition as said support, and thereafter heating said support and compacts to a temperature at which the compacts will fuse and sink into the glass support.

3. The method for making metallic spheres which comprises pressing powdered metal into a series of cylindrical compacts, placing the compacts on a glass support and heating the support and compacts to a temperature high enough to fuse each of them whereby each of said compacts will sink into said support and assume a spherical form.

4. The method for making metallic spheres which comprises pressing powdered metal into cylindrical compacts of predetermined size, placing the compacts on a glass support and out of contact with one another, and fusing said support and compacts to thereby cause each of said compacts to sink into said support and assume

a spherical form therein, and thereafter separating the glass from said sphere.

5. The method of forming metal spheres which comprises forming a series of pressed powder compacts each containing the same quantity of powdered metal, positioning the compacts on a glass-like support, heating said compacts and support to thereby cause said compacts to sink into said support and assume the form of spheres therein and thereafter separating the spheres from said support.

6. The method for forming a metal sphere suitable for attachment to a pen point which comprises compressing a predetermined quantity of powdered iridium metal, placing the compressed powder on a quartz support and fusing the compressed powder and quartz to thereby cause the

compressed powder to sink into the quartz support and assume a spherical shape therein and thereafter separating the quartz from said sphere.

7. The method of simultaneously forming a series of metal spheres suitable for attachment to a pen point which comprises compressing a series of powdered cylindrical masses of metal each containing the same quantity of metal, spacing the compressed masses apart on a glass-like support, fusing the compressed powder masses and support to thereby cause each of the compressed powder masses to sink into said support and to assume a spherical shape therein and thereafter separating the spheres from said glass-like support.

GEORGE F. TAYLOR.

Certificate of Correction

Patent No. 2,394,727.

February 12, 1946.

GEORGE F. TAYLOR

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 41, for "metal" read *metals*; page 2, second column, line 71, strike out the words "of predetermined size"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of October, A. D. 1946.

[SEAL]

LESLIE FRAZER,

First Assistant Commissioner of Patents.