Sept. 15, 1931. G. F. TAYLOR 1,823,709

METHOD OF PRODUCING OPENINGS THROUGH HARD METAL COMPOSITIONS

Filed Jan. 22, 1931

Fig. 1.

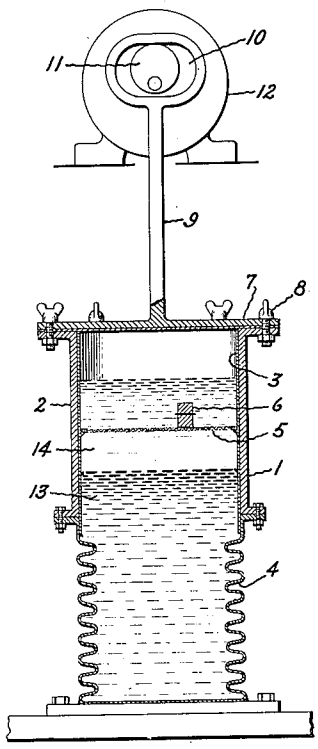


Fig. 2.

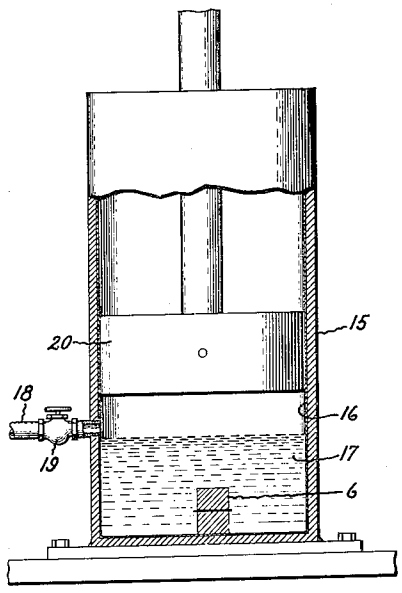


Fig. 3.

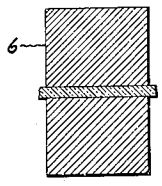
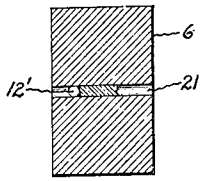


Fig. 4.



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UNITED STATES PATENT OFFICE

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METHOD OF PRODUCING OPENINGS THROUGH HARD METAL COMPOSITIONS

Application filed January 22, 1931. Serial No. 510,505.

The present invention relates to hard metal compositions and more particularly to a method for producing openings through sintered hard metal compositions.

In my copending application, Serial No. 480,330, filed September 8, 1930, I have disclosed a method for manufacturing thin hard metal discs having an opening therethrough. While the method described in my prior application is particularly adapted for use in the manufacture of very thin discs, it is not limited to such articles but may be employed in the manufacture of discs of considerable thickness, for example wire drawing dies and the like.

The method disclosed in the prior application comprises, briefly, heating powdered compositions, such as a mixture of a refractory carbide, for example tungsten carbide, with a binder metal having a lower melting point than the carbide, for example cobalt, and simultaneously pressing the powdered mixture in an electrically non-conducting mold. In order to produce an opening through the pressed material, I employ in the prior disclosure a quartz or carbon stem or rod centrally disposed in the mold. A pair of oppositely disposed plungers are employed to compress the powdered materials and each plunger has a centrally disposed longitudinal opening adapted to engage the central quartz or carbon stem.

When very thin discs are produced in the manner disclosed in the prior application, it is ordinarily a simple matter to remove either the quartz or carbon stem from the pressed material. The carbon may be removed by simply drilling it out of the opening in any desired manner. When a quartz stem is employed and it cannot be pushed out of the thin disk of pressed material but is broken so that a small portion of the quartz remains in the pressed material, that portion of the quartz stem may be removed by immersing the pressed material in hydrofluoric acid which will quickly dissolve the quartz.

When employing the process disclosed in my prior application, it is preferable to employ quartz instead of a carbon stem if a smooth, straight opening is desired, as for example in a wire drawing die. If a carbon stem is employed there is always a tendency for the hole through the die to assume a spherical shape. For example, as pressure is applied to the opposite surfaces of the powdered materials, the upper and lower portions thereof are pressed into the central carbon plug so that the surface of the hole or opening produced in the die is concave in shape and must be ground or lapped to form a straight smooth opening through the die. If the die has an appreciable length and has a very small opening therethrough, for example an opening of 40 mils or less, there is a further difficulty in removing the carbon stem. Carbon cannot be dissolved and with a long capillary opening it is impossible to press or drill the carbon out of the opening. A steel needle, for example, used for such a purpose would not have sufficient strength to accomplish this result.

I have found that when powdered materials are pressed and sintered around a quartz stem or plug as in the process disclosed in my prior copending application, the opening through the die or other pressed article is entirely smooth and straight when the quartz stem is removed and does not require any grinding. However, if the opening through the die or other article is relatively long and small, it has been substantially impossible heretofore to remove the quartz stem or plug. For example, if the pressed material containing the small diameter quartz stem is immersed in hydrofluoric acid, the acid will dissolve the exposed portions of the quartz rod that extend beyond the die. However, as the acid works into the opening filled by the quartz, gas bubbles are formed as the quartz is dissolved and as the gas bubbles remain in the capillary opening they very soon stop or greatly retard any action of the acid on the quartz.

According to the present invention, I have discovered that if the pressed and sintered powdered material with the central quartz stem embedded therein is immersed in acid and the acid subjected to pressure and then to a reduced pressure so as to produce a partial vacuum above the acid and these steps

slowly alternated, the gas bubbles are removed from the central opening as they form, the acid is forced into the opening, and the quartz plug dissolved in a short period of time.

The novel features which are characteristic of the present 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 drawings in which Fig. 1 is a view partly in section and partly in elevation illustrating diagrammatically an apparatus which may be employed in carrying my invention into effect; Fig. 2 is a view partly in elevation and partly in section of a modified form of apparatus which may be employed in carrying out my invention; Fig. 3 is a cross sectional view on an enlarged scale of a die with a central quartz stem therein; while Fig. 4 is a cross-sectional view on an enlarged scale of a die with the central quartz stem partly removed.

Referring more particularly to the drawings, I have indicated at 1 a receptacle the upper portion of which comprises a hollow steel cylinder 2 with flanged end portions and lined with a suitable acid-resisting material 3, for example lead. The lower portion of the receptacle 1 comprises a thin steel sylphon bellows 4 having a flange at its upper end which is bolted to a cooperating flange on the lower end of the cylinder 2. A perforated lead shelf 5 is positioned within the cylinder 2 and is adapted to retain thereon a die 6 or other articles to be treated. The receptacle 1 is provided with a cover 7 which is bolted to the upper end of the cylinder 2 as indicated at 8. An upwardly extending rod 9 which may be secured in any desired manner to the cover 7 is provided at its upper end with an opening 10 adapted to be engaged by a cam 11 driven by a motor 12.

The lower portion of the receptacle 1 is filled with mercury 13 which completely fills the sylphon bellows 4 and extends up into the cylinder 2. The mercury is employed to protect the sylphon bellows from the action of the hydrofluoric acid 14 which is placed on top of the mercury and in which the articles to be treated are immersed.

When a die 6 or other material containing a capillary quartz stem embedded therein is placed on the shelf 5 in the hydrofluoric acid solution, the acid first dissolves the exposed portions of the quartz rod. The acid then enters into the opening through the die forming gas bubbles which tend to prevent any further action of the acid on the quartz. If the motor 12 is now operated slowly to reduce the pressure in the receptacle 1, the gas bubbles 12' are removed from the die. As the motor revolves, pressure is again applied to the liquid in the receptacle 1 and the acid in the receptacle forced into the capillary opening in the die. By subjecting the acid to alternate pressure and partial vacuum the quartz stem embedded in the die is removed in a short period of time without causing any appreciable injury to the die.

If the opening through the die is appreciably larger than 15 mils, for example about 40 mils or greater, it might be possible to dissolve the quartz by simply immersing it in hydrofluoric acid. Under such circumstances however the time required to dissolve the quartz would be so long that the acid would increase the opening through the die to an undesired extent.

In Fig. 2, I have illustrated a modified apparatus for carrying out my invention. In this figure I employ a steel container 15 lined with lead or other acid-resisting material 16. The lower portion of the receptacle 15 is filled with hydrofluoric acid solution 17 in which a die 6 or other material to be treated may be immersed. The receptacle 15 is provided with an outlet pipe 18 and a valve 19. A piston 20 is mounted in the receptacle and adapted to be reciprocated therein by any well known means. The pipe 18 provides an outlet for the air in the container 15 when the piston 20 is first inserted in the receptacle and moved downwardly. The level of the acid employed will usually extend up to a point adjacent the pipe 18. The action of the apparatus disclosed in Fig. 2 is substantially identical with that disclosed in Fig. 1.

Although I have illustrated my invention in connection with a die having a single central opening therethrough, it will be clear that the invention is not restricted to the production of a wire drawing die with a single opening therethrough. If desired, the pressed material might contain a plurality of openings therethrough which might be produced in identically the same manner as the central opening 21 in die 6. Such devices might be employed for example as spinnerets in the manufacture of rayon fibres.

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

1. The method of removing a plug embedded in a metallic article, which comprises immersing said article in a reagent capable of dissolving said plug, subjecting said reagent to pressure and then reducing said pressure to form a partial vacuum above said reagent and alternating the two last mentioned steps.

2. The method of removing a plug embedded for an appreciable distance in a capillary opening in a metal structure which comprises immersing said structure in a reagent capable of dissolving said plug then slowly and alternately subjecting said reagent to a partial vacuum and pressure.

3. The method of removing a quartz plug embedded for an appreciable distance in a

capillary opening in a hard metal composition, which comprises immersing said hard metal composition in a solution of hydrofluoric acid, applying pressure to the surface of said solution, then reducing the pressure applied to said solution to produce a partial vacuum above said acid and slowly alternating the two last mentioned steps.

4. The method of forming an opening through a sintered metallic structure made from powdered materials, which comprises forming the powdered materials around a quartz stem, applying pressure and heat to the powdered materials to form them into a hard, dense mass, immersing said mass in a reagent capable of dissolving said quartz stem, applying pressure to said reagent, reducing said pressure to form a partial vacuum above said reagent and slowly alternating the two last mentioned steps until the quartz stem is dissolved.

In witness whereof, I have hereunto set my hand this 21st day of January, 1931.

GEORGE F. TAYLOR.