April 22, 1941. L. C. JACOBSON 2,239,425

METHOD OF MAKING DRAWING DIES

Filed Dec. 16, 1937

Fig. 1

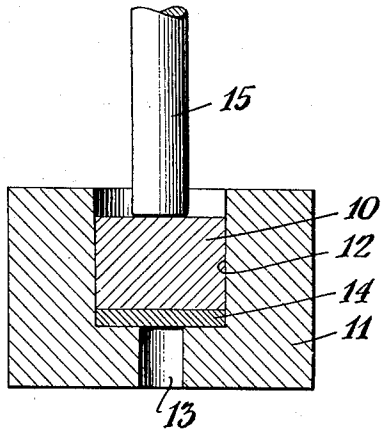


Fig. 2

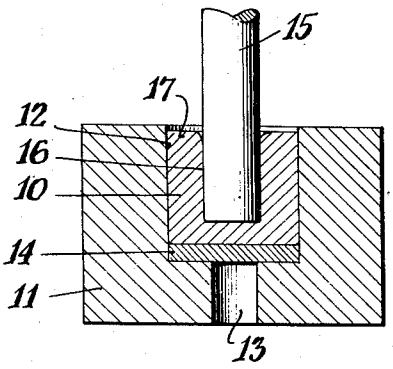


Fig. 3

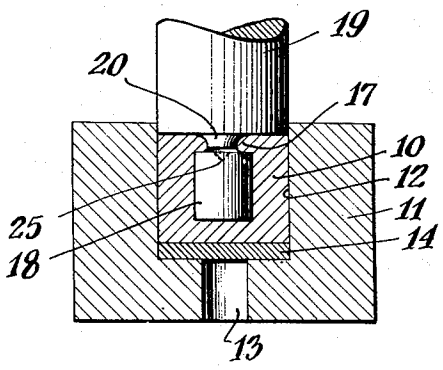
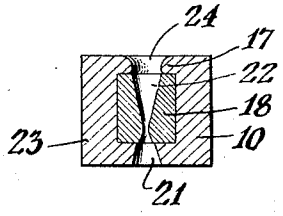


Fig. 4



INVENTOR
Leslie C. Jacobson
BY
Watson, Bristol, Johnson & Leavenworth
ATTORNEYS

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METHOD OF MAKING DRAWING DIES

Leslie C. Jacobson, Darien, Conn., assignor to Carboloy Company, Inc., Detroit, Mich., a corporation of New York

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8 Claims. (Cl. 76—107)

The present invention relates to a method of making drawing dies utilizing the class of materials known in the trade as cemented hard metal carbides, such, for example, as the material described and claimed in the Schroter Patent No. 1,549,615, issued August 11, 1925, consisting of minute particles of extremely hard tungsten carbide cemented together with a small amount of cobalt. Such materials are characterized by very great hardness, compressive strength and resistance to abrasion, but do not possess sufficient tensile strength to withstand the enormous forces set up in metal drawing operations such as the drawing of wire, rod, tubing and the like.

Drawing dies have heretofore been made by securing nibs of cemented carbide in casings of materials such as steel or bronze which possess high tensile strength and are so designed and made as to reinforce the cemented carbide nib. In prior practice it has been necessary to prepare the casing by accurate machining and the nib by grinding and then to secure the latter within the former by brazing, or by shrink fitting, or by a forging operation as disclosed, for example, in the patent to Morris Simons 1,952,388, issued March 27, 1934.

A general object of the present invention is the provision of an effective method for making such dies which may be readily and cheaply practiced in a minimum amount of time with a minimum amount of labor and material and which results in an efficient production of reinforced dies which are of simple construction and excellent quality, are capable of withstanding the enormous forces set up in drawing operations, and have long lives.

A more specific object of the invention is the provision of an efficient method of providing such nibs with metal casing which grip the nibs and place them under unusually high compression, eliminating the necessity of using supplemental drawing die holders, which method eliminates the necessity of preliminary annealing of casing material and many machining operations and reduces to a minimum waste of material.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others thereof, which will be exemplified in the method hereinafter disclosed, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

Fig. 1 is a vertical sectional view of a forging die holder, associated structure and a blank or slug of casing material showing a forging plunger in position prior to a forging operation of the present invention;

Fig. 2 is a sectional view similar to Fig. 1 showing a nib-receiving recess being forged into the casing blank or slug;

Fig. 3 is a similar sectional view showing the upper portion of the casing blank or slug being forged over the upper end of a nib seated in the casing recess; and

Fig. 4 is a vertical sectional view of a completed reinforced die.

By the present invention a recess adapted to receive a cemented hard metal carbide nib is forged into a slug or flat blank of tool steel or other suitable material of high tensile strength to form a cup-shaped casing and a nib is then placed into the cup-shaped casing and secured therein by forging, producing a drawing die of superior strength and eliminating to a large extent the machining and grinding operations and waste of high priced material which is characteristic of the practices heretofore followed.

The application of the present invention will be described with particular reference to the production of a wire drawing die having a nib of cemented tungsten carbide provided with a circular metal drawing passageway and surrounded by a casing of tool steel containing about .80% to 1.05% carbon, about .20% to .45% vanadium and, if desired, up to about .5% chromium, though it is to be understood that the invention is applicable to the production of drawing dies of other designs, with nibs of other materials of the same class, and with casings of other materials having the necessary properties of high elastic strength and thermal expansion.

Cylindrical bar stock of the selected tool steel in unannealed condition is cut by means of an abrasive wheel cutting machine into sections of predetermined length, with substantially flat end faces. Each of these sections constitutes a casing slug or blank **10**. Without further manipulation of any kind, each slug **10** is heated to a suitable forging temperature between about 1850° F. and 2000° F. to make it plastic. It is then transferred quickly to a cup-shaped forging die **11**, formed of hot forging steel such as chromium-tungsten steel or other suitable material, in a

press of the type adapted to deliver percussive compression or a relatively slow hammer blow effect, such as a percussion, hydraulic or compression screw press. The forging die 11 preferably has the walls of the socket 12 therein tapered slightly and is provided with an ejection passage 13 in the bottom thereof to permit ready removal of a completed die assembly. A bottom plate 14, preferably formed of similar metallic material, is seated in the bottom of the socket 12.

A press plunger 15 is centered on top of the hot slug 10 and the press is operated to drive or force the plunger into the slug 10 to the desired depth displacing slug material to form a recess 16 as shown in Fig. 2. The plunger 15 is driven or forced into the hot slug 10 preferably to an extent so that a portion 17 of the top of the resultant cup-shaped casing projects above the upper end of a nib when placed in the recess.

The casing may then be permitted to cool, placed in stock and subsequently reheated to forging temperature and a nib 18 seated in the recess 16 after reheating, or a nib may be placed into the recess immediately after formation of the latter before the casing has cooled below a forging temperature, and another press plunger 19 having a centrally located stud 20 on the end thereof may be operated to cause the portion 17 of casing material to flow over the outer portion of the upper end of the nib 18 as shown in Fig. 3. During this second forging operation which is similar to that described in the identified Simons patent the stud 20 limits the inward flow of the casing material. The nib is thus "positioned" in the recess with the walls thereof snugly engaging the nib when the casing is hot either by the seating of the nib when the casing is reheated or by the placement of the nib immediately after formation of the casing before it has cooled.

The encased nib is then ejected from the forging die 11 and allowed to cool to and is heat treated at about 800° F. to permit contraction of the casing so that it will place the nib under great compression. Thereafter the casing is tempered at about 900° F. to 1250° F., preferably about 1150° F., to develop the proper properties in the casing steel. After the tempering is complete, the casing material at the center of the bottom of the die is removed by a simple trepanning tool to form an opening 21. All that is necessary to finish the tool is to make and/or finish a wire-drawing hole 22 in the nib 18, to machine the outer surface 23 of the casing to insure concentricity with the hole 22 and, if desired, machine out opening 24 in the casing communicating with the wire-drawing hole.

If desired, although not necessary, the nib may have its surfaces ground and/or sand blasted to remove surface defects or adhesions prior to being placed in the casing and may be preheated. The nib may be a blank nib or a cored nib, i. e. a nib provided with a wire-drawing hole. If a blank nib is used, it is preferably provided with a center 25 prior to being positioned in the casing to permit ready machining of the circumferential face of the casing concentric with the axis of the nib and to facilitate opening up the bottom of the casing.

The plunger 15 may be centered on the hot slug 10 in any suitable manner. This may be done by placing a centering ring within the socket 12 on the top of the hot slug 10 with the outer surface of the ring snugly fitting within the socket 12, and a centered hole in the ring receiving and guiding the plunger 15.

Obviously such centering ring will not be necessary if provision is made for accurate placement of the forging die 11 beneath a plunger fitted into the head of the press with the axis of the casing slug 10 coinciding with that of the plunger. If the plunger 15 is a punch fitted into the head of the press it will accomplish the first forging operation, that of forming the recess 16, as shown in Fig. 2, when the press head is moved on the downstroke. On the upstroke the punch may be retracted from the recess 16 into which a die nib can then be placed. A second plunger 19 which may be fitted into the head of the press can then be moved into position and the second forging operation shown in Fig. 3 can be accomplished when the press head is moved on the succeeding downstroke. Both forging operations can thus be easily and rapidly performed before the casing material has cooled below a forging temperature. The structure of the press may be such that the two plungers 15 and 19 may be shifted automatically so that they are successively centered over the casing being forged.

Materials other than tool steel may be used for the casing. Such materials should have high tensile strength and higher coefficient of thermal expansion than the nib material. Various types of bronze, such as aluminum bronze known as "Avialite," satisfy these requirements. A suitable forging temperature for bronze is about 1500° F.

The casing slug may be heated to the forging temperature in a period of minutes. The slug 10 at the forging temperature should fit easily into the socket 12 of the forging die 11 which preferably is cold when the heated slug is placed therein. Consequent chilling of the surface of the slug eliminates any tendency for it to weld to the socket face of the forging die.

By the present invention the manufacture of cemented carbide drawing dies is greatly simplified and the expense materially reduced. For example, the steel bar stock can be used in the unannealed condition, thus eliminating the expense of annealing which has heretofore been necessary. Preliminary machining of the casing material is entirely eliminated. Waste of steel is eliminated with the exception of a very small amount which is trimmed from the casing after the forging operation is completed. The amount of final grinding of the casing to insure its concentricity with the hole in the nib is reduced to a minimum.

In addition to the elimination of machining and grinding operations heretofore necessary and the elimination of waste, the present invention makes possible the production of drawing dies of superior strength and decreased liability to breakage in service.

In the claims the use of the terms "hard metallic nib" and "slug of casing material" are used respectively to identify hard metallic material having low tensile strength, great hardness, high melting point and low coefficient of thermal expansion, such as a cemented hard metal carbide; and metallic casing material which is deformable and has high tensile strength and a higher coefficient of thermal expansion than the nib material, thus high shrinkage characteristics.

It will thus be seen that the objects set forth above are attained by the present invention in an efficient manner. Since certain changes may be made in carrying out the above method with-

out departing from the scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The method of making a drawing die, comprising heating a slug of casing material to a forging temperature, hot-forging a recess therein to form a cup-shaped casing while limiting lateral expansion of the casing material, positioning a hard metallic nib in said recess and cooling the cup-shaped casing about said nib to thereby place the nib under high compression.

2. The method of making a drawing die, comprising heating a slug of casing material to a forging temperature, hot-forging a recess therein to form a cup-shaped casing while limiting lateral expansion thereof, positioning a hard metallic nib in the recess with the walls thereof snugly engaging the nib when the casing is hot, hot-forging a portion of said casing over the upper end of said nib and heat treating the resulting assembly.

3. The method of making a drawing die, comprising heating a slug of casing material to a forging temperature, hot-forging a recess therein to form a cup-shaped casing, positioning a hard metallic nib in said recess so that a portion of said casing projects above the upper end of said nib, hot-forging the portion of said casing projecting above the upper end of said nib over the upper end of said nib, and limiting lateral expansion of the casing material during forging.

4. The method of making a drawing die, comprising heating a slug of casing material to a forging temperature, hot-forging a recess therein while limiting lateral expansion to form a cup-shaped casing, seating a hard metallic nib in the recess before the casing has cooled below a forging temperature, and hot-forging a portion of said casing over the upper end of said nib.

5. The method of making a drawing die, comprising heating a slug of casing material to a forging temperature, hot-forging a recess therein while limiting lateral expansion to form a cup-shaped casing, seating a hard metallic nib in the recess with the casing at a forging temperature, hot-forging over the upper end of said nib a portion of said casing projecting thereabove, and heat treating the resulting assembly.

6. The method of making a drawing die, comprising heating a slug of steel of high compressive strength to a forging temperature, hot-forging a recess therein while limiting lateral expansion to form a cup-shaped casing, positioning a hard metal carbide nib in the recess with the casing at a forging temperature, hot-forging a portion of said casing over the upper end of said nib and cooling the steel casing to cause it to place said nib under high compression.

7. The method of making a drawing die which comprises heating a slug of casing material to a forging temperature, placing said heated slug in a forging die, hot-forging a recess in said slug to form a cup-shaped casing that is wholly within said forging die, positioning a die nib in said recess so that the cup-shaped casing extends above said nib, and hot-forging a portion of said casing over the upper end of said nib.

8. The method of making a drawing die which comprises heating a slug of casing material to a forging temperature, placing said heated slug in a forging die, hot-forging a recess in said slug to form a cup-shaped casing, thereafter positioning a cored die nib in said recess so that the cup-shaped casing extends above said nib, hot-forging a portion of said casing over the upper end of said nib and heat treating the resulting assembly.

LESLIE C. JACOBSON.