UNITED STATES PATENT OFFICE

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METHOD OF MAKING DRAWING DIES

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For drawing dies, it is advantageous to use a hard wear resisting element or nib consisting mainly of tungsten carbide. A suitable composition for such a nib is one known in the trade as "widia" metal, and comprising approximately 85% tungsten carbide, 10% cobalt, and 5% carbon. Such a product is extremely hard and very efficient for cutting purposes, but lacks tensile strength.

Hitherto, difficulties have been encountered in the use of dies of this character due to the cracking or breaking of the nib, but the cause of the cracking has not been understood, and no method of manufacture has been known which would produce a die free from these difficulties.

One method which has been proposed and tried, is to mount the nib in a metal taper plug, and force the plug into a tapered passage in a plate or holder heated to a high temperature, so as to force the metal of the plug into snug engagement with the periphery of the nib to firmly support the latter, and resist expanding stresses caused by the wire during the wire drawing operation. In spite of this firm gripping of the nib, experience proves that the nibs break under the strain of operation. I have noted that during this assembling operation, the distance between the outside cylindrical surface of the nib and the tapered wall of the passage in the holding plate decreases and the wall of the plug becomes slightly thinner, thus causing the metal of the plug to be drawn lengthwise of the nib. I believe that as the plug becomes gripped to the nib, the elongation of said plug will cause a corresponding tendency towards elongation of the nib, thereby subjecting it to tension stresses which it can not effectively withstand. The nib thus becomes weakened by this endwise flow of the metal toward the ends of the nib during thinning of the plug wall, and therefore is very liable to crack or break in use.

Whether or not this theory of the cause of cracking is correct, I have discovered that by avoiding this thinning of the plug wall and flow of metal toward the nib's ends, I can produce a die having a nib of comparatively low tensile strength, which is far more durable in use.

In carrying out my invention, the nib is placed in a metal plug which may be inserted in a passage of a holding plate without the application of any substantial force. Compression force is then applied to both ends of the plug in a wire drawing direction, while holding said plug in a substantially fixed position. During this operation, the plug is subjected to endwise compression to thicken rather than thin the plug wall, and to cause its metal to flow transversely to the direction of the forces, and from the end portions towards the middle. The plug is thus firmly secured in the passage by its increase in external diameter and firmly grips the nib and supports it against internal expanding strains by a decrease in the internal diameter of the plug. The thickening of the plug wall is preferably accomplished by applying the pressure when the parts are cold, rather than hot, so that the development of stresses and shape changes during cooling after assembly, are avoided.

Although the invention will be described with particular adaptation to the setting of a tungsten carbide nib, as far as the broader aspects of the invention are concerned, the method can be adapted for setting in a die of any wear resisting element or nib of a composition having low resistance to tensile stresses.

In the accompanying drawing, there are shown for purposes of illustration, three forms embodying the invention, in which Figs. 1, 2 and 3 are central longitudinal sections showing three different forms prior to the final assembling operations, and Figs. 4, 5 and 6 are sections corresponding to Figs. 1, 2 and 3 respectively, but showing the dies in final form after being subjected to swaging action, and also showing the swaging or deforming tools which may be used.

In the construction shown in Figs. 1 and 4, there is employed a nib 10 constructed of tungsten carbide metal such as widia metal, and of a shape suitable for wire drawing. It is set within a recess 11 of a hollow cylin-
drical plug or sleeve 12, and seated against an inwardly extending flange 13 presenting a shoulder at one end of the plug. This plug 12 is disposed in a passage 14 formed in a holding plate or die holder 15. The size of the plug 12 in respect to the passage 14 is such that the plug 12 may be inserted without any substantial force, until the end surface 16 of the flange 13 is in the same plane with the under surface 17 of the die holder 15.

The passage 14 may be slightly tapered with the upper end the larger, so as to permit the easy reception of the plug in the passage before the swaging action, and to firmly hold said plug against relative axial movement after the final assembling operation as will be hereinafter described.

After the elements of the die have been assembled as shown in Fig. 1, they are subjected to a swaging operation by tools shown in Fig. 4 to permanently grip the nib in position. For that purpose, the elements of the die are disposed on an anvil or bed plate 18. On the top of the holder 15 is placed a guide plate 20 having an aperture for the passage therethrough of a swaging tool 21 which acts on top of the plug 12 and subjects the wall thereof to compression forces. This causes the metal of the wall to flow axially downward and to increase in thickness to completely fill the space between said nib and said holder. This operation also serves to fill the tapered passage 14, and to thereby hold the plug against axial movement with respect to the holder 15 during the wire drawing operation. Furthermore, this swaging action also serves to upset the end portion of the plug wall, and causes it to engage the end of the nib to form a shoulder 22. The assembling operation is preferably done while the elements are cold so as to eliminate unequal expansion and contraction during temperature changes.

In Fig. 2 is shown a different construction in which the method may be carried out. The annular nib 25 of tungsten carbide or similar material is set within the recess of a cylindrical plug 26 which is disposed in the passage of a die holder 27. Instead of the plug having a flange for the nib, the holder has a flange 28 presenting a shoulder or seat for both the plug and the nib. After the elements have been assembled in the position shown in Fig. 2, they are subjected to a final metal cam pressing operation as shown in Fig. 5. The assembled elements are positioned on an anvil 18, and the top of the plug 26 forced down by a punch die 30 which compresses the plug wall and thickens it as well as causing a flow of metal from the upper end of the nib toward the middle or lower end. The compression also forces the metal to flow into gripping relationship with both the die holder 27 and the nib 25, and serves to form a shoulder 31 overhanging one end of the nib.

In Fig. 3 is shown still another form similar to Fig. 2, but particularly adapted to the setting of a larger and longer nib. The size of a nib depends upon the size of its opening, so that a nib with a larger opening has a correspondingly larger diameter and a greater length. The plug for holding such a nib must be correspondingly larger and longer. The result is that the metal of a plug wall of such length must flow endwise for an undesirable distance if the flow be all from one end. If a long nib be assembled as shown in Fig. 2, the upper portion of the plug wall might be the first portion to increase in thickness and would grip on the sides of the die holder and the nib before the bottom portion had started to thicken. The result might be that too great pressure would be required to get a uniform thickening, gripping, and supporting action throughout the length, and some parts, particularly at the lower end, might not be properly deformed.

Therefore, in the form shown in Fig. 3, means are provided for permitting the axial flow of the metal from both ends of the plug during swaging operation. For that purpose, the plug 26 is provided with one or more very small radially extending lugs 35 which are spaced from the lower end of said plug, and upon which the nib 25 may seat. The plug is subjected to a swaging action as shown in Fig. 6 by a suitable tool 36 having a center portion 37 extending into the plug for a short distance. The pressure on the plug causes the metal to flow up from the bottom as well as down from the top, to provide the thickening of the wall around the nib, instead of all the flow being in one direction. The lugs 35 are so small that they are upset, and the nib in final position rests on the flange 28. The center portion 37 of the tool prevents excessive thickening of the top portion of the plug, and forms the retaining flange 38.

After the parts shown in the various figures have been assembled in the manner above described, the inner surface of the nib may be finished to the desired diameter and smoothness in accordance with the size and the material of the wire to be drawn. A nib of this character is particularly useful in the drawing of steel and other material. However, the device may be also used for drawing wire tubing, rods or the like.

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

1. The method of forming a drawing die, including the steps of positioning a nib in a hollow plug, disposing said plug in a die holder, and applying compression force to said plug in wire drawing direction to thereby increase the thickness of the wall of the plug and firmly secure the parts together.
2. The method of forming a drawing die, including positioning a nib having low tensile strength in a metal sleeve in a die holder, and applying compression force to said sleeve axially thereof to thereby reduce the length of said sleeve and firmly embed said nib in said sleeve, and firmly secure said sleeve in said die holder.

3. The method of forming a drawing die, including the steps of positioning a nib of tungsten carbide comparatively loosely in a fixed position in a hollow plug, disposing said plug in a fixed position in a die holder without the application of substantial force, and applying compression force to both ends of said plug lengthwise thereof while holding said plug in said fixed position, whereby said nib is firmly embedded in said plug and said plug is firmly secured in said die holder.

4. The method of making a wire drawing die, including the steps of positioning a nib in a hollow metal plug, disposing said plug in a passage in a die holder, said passage being large enough to permit one end surface of said plug to substantially align with one end surface of said holder, without the application of substantial force, and applying compression force to the other end surface of said plug, and holding said surfaces in alignment, whereby said nib, plug and holder are firmly connected by the thickening of the wall of the plug.

5. The method of forming a wire drawing die, including the steps of positioning a nib in a metal sleeve, disposing said sleeve in a passage in a die holder, said holder having a shoulder at one end of the passage for seating said sleeve, and said passage being large enough to permit one end of said sleeve to seat upon said shoulder without the application of substantial force, and applying compression force to the other end of said sleeve to increase the thickness of the wall of said sleeve and cause it to grip both the nib and the surface of said passage.

6. The method of forming a wire drawing die, including the steps of positioning a nib in a metal sleeve so that one end of said nib is spaced from the corresponding end of said sleeve, disposing said sleeve in a fixed position in a die holder, and applying compression force to both ends lengthwise of said sleeve while held against axial movement with respect to said holder, whereby said nib is firmly embedded in said sleeve and said sleeve is firmly embedded in said die holder.

7. The method of forming a wire drawing die, including the steps of positioning a nib in a metal sleeve and spaced from each end thereof, disposing said sleeve in a fixed position in a die holder, and applying axially acting compression force to both ends of said sleeve to shorten and thicken the wall thereof until one end of said nib is flush with one end of said sleeve, and the other end of said sleeve is swaged on to the end of said nib.

Signed at New York in the county of New York and State of New York this 24th day of February A. D. 1931.

AARON SIMONS.
DISCLAIMER

1,904,698.—Aaron Simons, Bronx, N. Y. Method of Making Drawing Dies

Hereby enters this disclaimer, limiting claim 1 of said Letters Patent as follows:
By restricting the term "nib" to a substantially cylindrical block containing tungsten or other carbide.

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