April 12, 1927. F. VOLLMER 1,624,027

WIRE DRAWING DIE

Filed Jan. 16, 1926

Fig. 1.

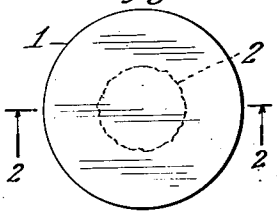


Fig. 2.

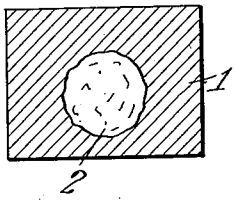


Fig. 3.

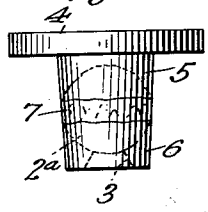


Fig. 4.

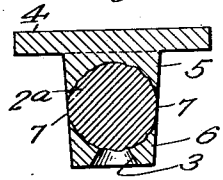


Fig. 5.

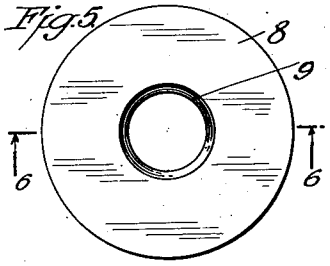


Fig. 6.

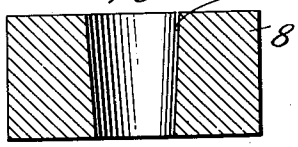
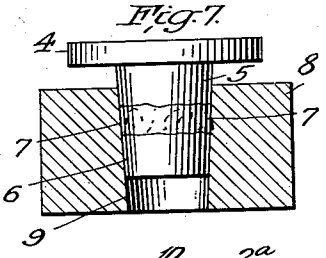


Fig. 7.



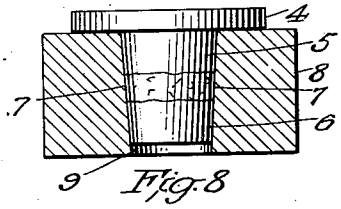


Fig. 8.

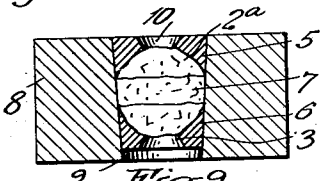


Fig. 9.

Fig. 10.

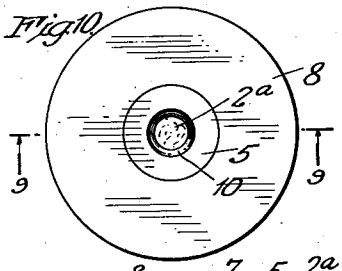


Fig. 14.

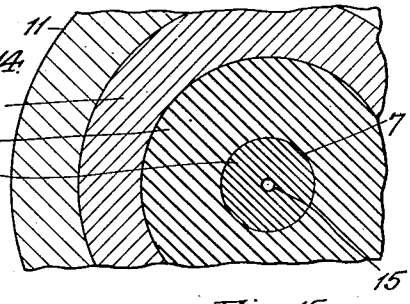


Fig. 11.

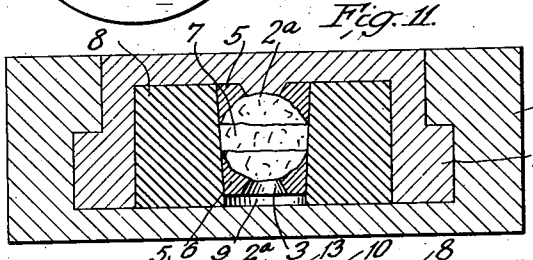


Fig. 12.



Fig. 13.

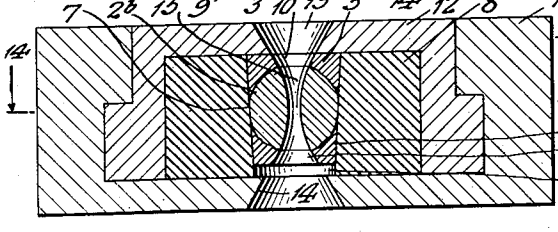
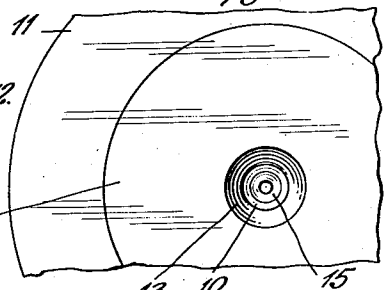


Fig. 15.



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Patented Apr. 12, 1927. 1,624,027

UNITED STATES PATENT OFFICE.

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WIRE-DRAWING DIE.

Application filed January 16, 1926. Serial No. 81,676.

According to the common practice heretofore, in drawing wire through diamond dies, as a general rule the diamonds break long before they wear out. The settings heretofore commonly employed afford an inadequate amount of reinforcement to the diamond, and the strain on the diamond produced by drawing the wire through its perforation, which is largely an outward pressure or bursting strain, is borne mostly by the diamond itself, and the strength of the diamond being insufficient to withstand this strain, eventually the diamond breaks, usually splitting into two parts and then breaking into smaller fragments. Also commonly, under the pulling strain of the wire, diamonds become slightly loose in their settings and then the diamond will soon break. In order to reduce the breakage, commonly heretofore larger diamonds have been used than otherwise would be necessary for drawing wires of given sizes, these diamonds, to obtain the greatest strength for a given size, usually being of oblate or flattened shape. The high price of such large diamonds of good quality is prohibitive, hence the diamonds commonly used have many flaws and defects, which cause them to wear more rapidly; also when these imperfect diamonds are rebored for drawing wire of a larger size, a flaw is likely to be encountered which renders the diamond worthless. Various kinds of settings have been employed, but, with a somewhat extensive knowledge of the dies in use, I do not know of any which are free from the above noted objections.

An object of the invention is to prevent the breaking of the wire-drawing member, and especially to prevent the breaking of a wire-drawing diamond in a diamond die. Other objects of the invention are to enable the use of smaller diamonds, diamonds of globular shape, and more nearly perfect diamonds, which wear much longer and which may be rebored without developing defects. Another object is to provide a permanent reinforcement for the diamond which will prevent the possibility of the diamond ever becoming loose in the die. Thus a general object of the invention is to produce a better die than heretofore has been made and at a less cost of production.

According to this invention, the wire-drawing member, more particularly a wire-drawing diamond, is provided with a reinforcement which takes the wire-drawing strain. More particularly, in carrying out the invention, the originally rough diamond is provided with a smooth conically tapered peripheral surface, and the reinforcement for the diamond comprises a metal block having therein a smooth, round conically tapering hole of the same taper as the taper on the diamond and in which the diamond is tightly gripped at its smooth periphery. This reinforcing block may be a small cylindrical block or nib and the metal of which it is composed should be sufficiently hard and have sufficient tensile strength to provide the desired reinforcement. By making the gripping or inward pressure of this block or nib on the diamond fully as great or greater than the radial or outward pressure of the wire being drawn through the hole in the diamond, this outward pressure or strain will be borne entirely by the nib and not by the diamond. Also, because of the taper, the pull of the wire on the diamond tends to keep the diamond tight in its reinforcement and to make it even tighter, so that the diamond cannot become loose under the wire-drawing strain.

The accompanying drawings show a wire-drawing diamond die constituting one embodiment of the invention, and also illustrate a process or method involved in carrying out the invention, the drawings being made to an enlarged scale. The invention, which is pointed out in the appended claims, will now be described with reference to the drawings, in which:

Fig. 1 is a plan view of a blank formed by casting metal around a rough diamond.

Fig. 2 is an axially central section on the line 2—2 of Fig. 1 with the diamond in elevation.

Fig. 3 is an elevation or side view, and

Fig. 4 is a central vertical section of a headed conically tapering plug formed by turning down the blank shown in Figs. 1 and 2 to form a conical taper on the metal and on the diamond, the lower end of the plug having been opened to expose the diamond.

Fig. 5 is a plan view of a metallic reinforcing block for the diamond having therein a round conically tapering hole of the

same taper as the plug but of slightly less diameter at corresponding points along their length.

Fig. 6 is an axially central section on the line 6—6 of Fig. 5.

Fig. 7 is a similar section with the plug in elevation and dropped into the hole in the block approximately as far as it will freely enter when the block is heated.

Fig. 8 is a similar view with the plug forced into the hole in the block as far as its head will let it go, so that the block tightly grips the diamond at all points on its smoothed periphery.

Fig. 9 is a similar view and is an axially central section on the line 9—9 of Fig. 10, showing the plug with its head removed and as opened at its upper end to expose the diamond, the metal parts of the plug being shown in section and the diamond in elevation.

Fig. 10 is a plan view of Fig. 9.

Fig. 11 is a central axial section similar to Fig. 9, showing the diamond reinforcing block or nib as centrally set in a metallic cup or casing by means of a suitable metallic filling which surrounds and covers the nib.

Fig. 12 is a similar view with the filling removed at the top and the metal of the casing removed at the bottom to provide central flaring openings exposing the diamond.

Fig. 13 is a view similar to Fig. 12 and is a central axial section of the completed die, and shows the wire-drawing perforation which has been provided in the diamond.

Fig. 14 is a partial horizontal section on the line 14—14 of Fig. 13.

Fig. 15 is a partial plan view of Fig. 13.

The manner of carrying out the invention as illustrated in the drawings to produce the wire-drawing diamond die shown in Figs. 13, 14 and 15 as an embodiment of the invention will now be described.

By means of a suitable mold (not shown) a metal envelope 1 is cast around a rough diamond 2 of globular shape so as entirely to cover the diamond or bury it therein thereby to form the cylindrical blank shown in Figs. 1 and 2, in which the center of the diamond is located on the axis of the cylindrical blank but nearer to the bottom than to the top of the blank.

The diamond 2 is not shown as having a wire-drawing hole or perforation therein, however, so far as the present invention is concerned the diamond could have such perforation formed therein before it is cast into the metal envelope 1. So far as this invention is concerned it is immaterial at what stage the diamond is perforated in the manufacture of the die.

Any one of a large variety of metals, or alloys, may be employed to form the metallic envelope 1. For example, brass may be used; or a harder metal, provided its temperature when in a molten condition is not so high as to be harmful to the diamond; and molten metal produced from the mixture well known as thermit is suitable for the purpose, as such metal, when it has solidified and cooled, strongly adheres to the diamond.

The diamond-containing blank is now fixed at its upper end (as viewed in Fig. 2) in a chuck on a lathe, and, by means of a suitable tool, a small flaring opening 3 (Figs. 3, 4 et seq.) is made in the metal at the center of the free end of the blank, to expose the diamond, thereby to make sure that the diamond is centered in the blank and also more readily to determine if the chucking is true; and the opening 3, being a necessity in the completed die, may as well be made at this stage.

By means of an ordinary suitable tool, the projecting portion of the blank is now turned down along tapering lines until the diamond 2 is reached, after which a diamond-pointed tool is used to turn down both the diamond and the metal to form the conically tapering headed plug shown in Figs. 3 and 4. This plug has a head or flange 4 (which was held in the lathe chuck) and a gradually and smoothly conically tapering shank or stem which comprises (as viewed in Figs. 3 and 4) an upper metal part 5, a lower metal part 6 and a middle part formed by the diamond 2^a, which has formed thereon a smooth annular conically tapering peripheral girdle 7, the smooth surface of which forms a continuously smooth taper with the smooth surfaces of the tapering metallic end parts 5 and 6. The unsmoothed or rough portions of the diamond 2^a are embedded in the metal end parts 5 and 6, which firmly adhere thereto. The diameter of the conically tapering plug may vary, depending upon the size of the diamond, and because diamonds of different sizes are employed according to the size of wire to be drawn through the die.

Occasionally the rough diamond may have such an uneven surface that a depression or cavity therein will leave at some point a small bridge of metal connecting the end parts 5 and 6 of the plug, the metal then filling the cavity or depression in the diamond, but in most instances a complete smooth annular surface is formed on the periphery of the diamond.

A metallic reinforcement is now formed for the tapered diamond. First a disc-like cylindrical blank (not shown) may be formed in any suitable way, for example it may be cast, or it may be cut and shaped from a piece of metal, and this original blank may or may not have a hole through its center. When it has no hole it has been found convenient first to bore a small hole

through the blank axially thereof. By means of a suitable tapering boring tool the original aperture is now enlarged and given a tapering form, thereby to produce the nib or reinforcing block 8 shown in Figs. 5 and 6 et seq., which has through its center a round conically tapering hole 9. This hole 9 is made to fit the tapering plug, the taper of the plug and the hole being made the same and the size of the hole being made such that the plug will have a tight fit therein. The hole 9 is made of slightly less diameter than the plug at corresponding points, for example, the top of the hole is of less diameter than the upper end of the upper metal part 5 of the plug, i. e., adjacent the lower surface of its head 4, and a difference in diameter which has proved satisfactory is from .003 to .004 of an inch. The taper of the plug and the hole 9 may be anything desired that proves suitable, and a taper of three degrees on the side, that is, six degrees for both sides at diametrical points, has proved satisfactory, and that is approximately the taper shown in the drawings.

The diamond-reinforcing block or nib 8 is now moderately heated in any convenient way, for example, by means of an ordinary blow torch, to expand the nib and slightly enlarge the hole 9. The conically tapering plug is now dropped into the expanded conically tapering hole 9 in the hot nib 8, which it will freely enter about to the extent shown in Fig. 7. The conically tapering plug, of which the peripherally smoothed diamond 2^a forms a part, is now gradually forced into the heated nib to the desired extent by means of a suitable press, so that the plug and particularly the diamond 2^a at all points on its smooth peripheral taper 7, is tightly wedged in the tapering aperture 9. The head or flange 4 on the plug has been found to form a convenient gauge for correctly limiting the extent to which the tapering plug, and therefore the tapered diamond, should be inserted into the tapering hole 9 in the nib, as is shown in Fig. 8. The heated nib is now permitted to cool, so that it shrinks upon and grips the diamond 2^a firmly at all points on its smooth conical taper 7.

The head 4 on the plug has now served its double purpose as a means for chucking and as a means for limiting the extent to which the diamond is wedged into the nib hole 9, and henceforth would only be objectionable. Accordingly, the head 4 is now cut off flush with the upper surface of the nib 8, and at the same time, if desired, the top of the nib may be dressed down. A small flaring opening 10 is now made in the upper metal part 5 at the center thereof, down to the diamond 2^a, as shown in Figs. 9 and 10. It is to be noted that the lower metal end part 6 does not extend all of the way through the nib, a small space being left between its lower end and the lower face of the nib, the purpose of which will hereinafter appear.

As shown in Figs. 9 and 10 the nib part of the die is now complete with the, as yet, unperforated diamond 2^a gripped therein to be reinforced thereby in the completed die. The small size of the nib ring 8, that shown in the drawings being about one-half inch in diameter and about one-fourth of an inch thick, requires that the nib be set in an outer casing 11, as shown in Fig. 11 et seq., in order that the completed die may be held in a wire-drawing machine, but the mounting of the nib in the casing forms no part of the invention, other than that it is the means shown as employed to produce the complete die. The casing 11 shown is about one inch in diameter (or it may be one and one-eighth) by three-eighths of an inch thick, and is of cup shape, undercut at the inside as shown. This casing may be of brass, or other metal.

The diamond-carrying nib shown in Figs. 9 and 10 is now centered in the casing 11, the upper central opening 10 being of substantial aid in centering the nib. To secure the nib in the casing 11 a suitable metallic filling 12 is placed in the casing around and covering the nib, as shown in Fig. 11. This filling 12 may be a hard solder such as brass solder.

As shown in Fig. 12, a flaring entrance opening 13 is formed in the filler 12 down to the diamond, the filling metal being removed from the opening 10 in the upper metal part 5 of the plug, and a similar flaring exit opening 14 is made in the bottom of the cup 11, thereby completing the casing structure. The only thing remaining to be done to complete the die is to provide a wire drawing perforation in the diamond 2^a, assuming, and as is shown in the drawings, that the diamond has not been previously perforated, which, as hereinbefore mentioned, could as well be the case.

In the completed die shown in Figs. 13, 14 and 15 the diamond has had a hole 15 drilled through it and this hole has been shaped and polished, thereby to produce the perforated wire-drawing diamond 2^b. The present invention is not concerned with the shape of the wire-drawing hole through the diamond, and the shape of the perforation 15 shown in the drawings may be considered as conventional. Also it is not necessary that the perforation or drilling of the diamond shall be the last thing done, and the invention has been carried out by beginning with a perforated diamond, but more care is then required in order to have the wire-drawing hole true in the completed die.

It is necessary that the metal or alloy of

which the reinforcement 8 is composed shall be sufficiently hard to hold the diamond securely, as if it were too soft it would yield to such an extent under the wire-drawing strain that the diamond would not be adequately reinforced. Also this reinforcement 8 should have sufficient tensile strength that it will not break under the wire-drawing strain transmitted or transferred to it by the wire-drawing diamond 2^b. There are a number of suitable metals and alloys which may be used to form the diamond-reinforcing block or nib ring 8, and a metal or alloy of any kind that answers the requirements may be used. For example, steel may be used. Another example is a copper alloy well known as Monel metal.

The casing 11 is not essential to the carrying out of the present invention and, if so desired, may be omitted by making the diamond-reinforcing nib 8 of larger external diameter, and also somewhat thicker so as to have a suitable entrance opening.

The hereinbefore described shrinking of the hard and strong metallic reinforcing block upon the diamond after the latter has been tightly wedged therein results in the perforated wire-drawing diamond 2^b being strongly gripped with an inward pressure at all points on its smooth peripheral surface and thus securely and permanently reinforced against breakage under the wire-drawing strain. It has been found in carrying out the invention that the inward pressure of the reinforcement 8 upon the diamond 2^b is greater than the outward pressure in its perforation 15 due to the drawing of the wire so that the perforated wire-drawing diamond 2^b is subjected only to opposed compression strains and there is no bursting strain upon it and a margin of safety against the diamond splitting under the wire-drawing strain is thus provided. This has been proved in tests by, in one instance splitting the diamond into two parts and in another instance into four parts longitudinally through its perforation, and when the parts of these purposely broken diamonds were assembled and reinforced in a die according to the present invention, the dies withstood the test of drawing wire the same as if the diamonds had been whole.

The pulling strain of the wire being drawn through the diamond has a tendency not only to keep the smoothly tapered diamond 2^b tight but to make it tighter in its taperingly apertured reinforcement 8. While movement of the diamond toward the back of the die, if such movement takes place, is imperceptible, yet the diamond is free thus to move should the pulling strain of the wire be sufficiently great. The slight space provided between the end of the metal plug part 6 and the rear face of the nib 8 provides for such movement without obtrusion of the end of the part 6. In one instance in which the tapering plug, including the taper on the diamond, was made slightly undersize, the diamond shifted perceptibly so as to become tighter in its reinforcement, but did not break. In extensive and severe tests and in actual practice in commercial wire-drawing use, no diamond has yet broken when reinforced according to the present invention, although for a given size of wire a smaller diamond is employed than in any other dies in use, so far as I am aware.

While all of the features of the invention have distinct utility in combination, it is to be understood that some of these features might be modified or even omitted from the combination and advantageous results still be obtained. It is obvious that various modifications may be made in the construction illustrated in the drawings and above particularly described, within the principle and scope of the invention as defined in the appended claims.

I claim:

1. A diamond die for drawing wire having, in combination, a perforated wire-drawing diamond provided with a smooth taper on its periphery, and a block of hard and strong metal having therein a tapering hole which fits the taper on the diamond and into which the tapered diamond has been wedged to reinforce the diamond.

2. A diamond die for drawing wire having, in combination, a perforated wire-drawing diamond provided with a smooth taper on its periphery, and a block of hard and strong metal provided with a tapering hole to fit the taper on the diamond and shrunk upon the diamond at its taper to reinforce the diamond.

3. A diamond die for drawing wire having, in combination, a perforated wire-drawing diamond provided on its periphery with a smooth conical taper, and a block of hard and strong metal provided with a conically tapered hole which fits the conical taper on the diamond and in which the diamond has been wedged at its conical taper to reinforce the diamond.

4. A diamond die for drawing wire having, in combination, a perforated wire-drawing diamond provided on its periphery with a smooth conical taper, and a block of hard and strong metal provided with a conically tapered hole which fits the conical taper on the diamond and shrunk upon the diamond at its conical taper to reinforce the diamond.

5. A diamond die for drawing wire having, in combination, a longitudinally apertured plug comprising a perforated wire-drawing diamond embedded in metal and provided with an exposed smooth circular peripheral surface flush with the adjacent surface on the metal, and a diamond-rein-

forcing block of suitably hard and strong metal provided with a hole for the plug and in which the diamond tightly fits at its smooth periphery, whereby the block grips the diamond and reinforces it.

6. A diamond die for drawing wire having, in combination, a diamond-reinforcing block of suitably hard and strong metal having therein a conically tapering hole, and a longitudinally apertured conically tapering plug tightly fitted in said hole, said plug comprising a middle part consisting of a perforated wire-drawing diamond which is peripherally conically tapered, and apertured metal end parts having a peripheral conical taper substantially flush with the taper on the diamond whereby, the block grips the diamond and reinforces it.

7. A wire-drawing die comprising, in combination, an apertured wire-drawing stone having a smooth circumferential substantially circular surface band in a plane at right angles to the axis of the aperture, and a metal block having a hole therein with a wall corresponding to the said band and tightly gripping the stone about said band.

In testimony whereof I affix my signature.

FREDERICK VOLLMER.