June 30, 1925.

1,543,683

A. SIMONS

DIAMOND DIE

Filed March 5, 1924

Fig. 1.

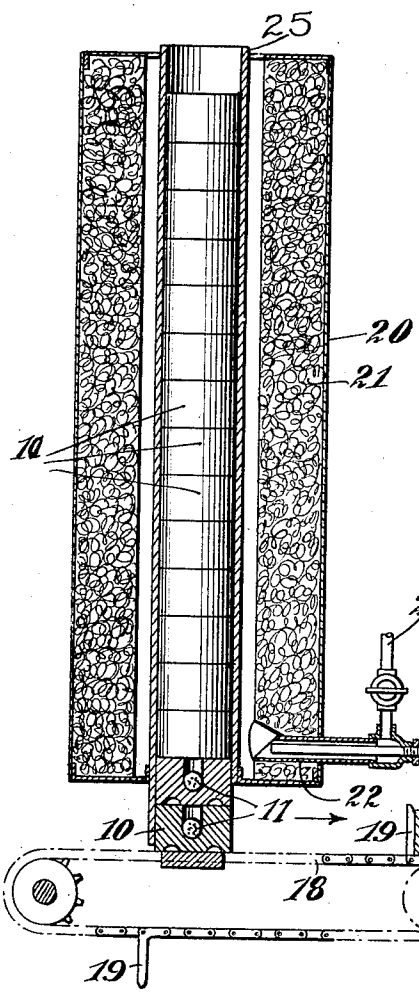


Fig. 4.

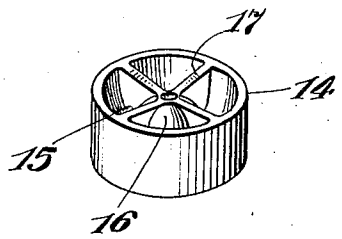


Fig. 2.

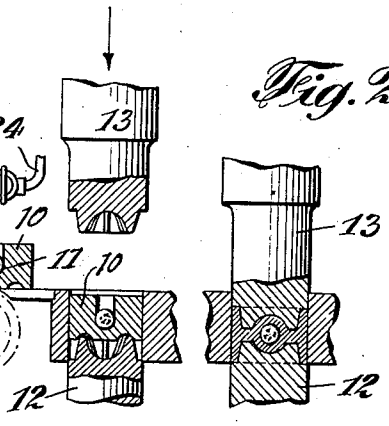
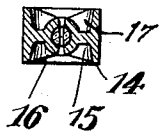


Fig. 3.



INVENTOR

Aaron Simons

BY

Dean Frankenberg Albright & Breech

his ATTORNEYS

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UNITED STATES PATENT OFFICE.

AARON SIMONS, OF NEW YORK, N. Y.

DIAMOND DIE.

Application filed March 5, 1924. Serial No. 697,059.

To all whom it may concern:

Be it known that I, AARON SIMONS, a citizen of Russia, and resident of New York, in the county of Bronx and State of New York, have invented certain new and useful Improvements in Diamond Dies, of which the following is a specification.

This invention relates to the diamond dies, particularly for use in wire drawing. In order that long life and efficient operation of a diamond die may be secured, it is essential that every portion of the outer surface of the diamond shall be firmly supported or backed up, and that the holder exert uniform pressure on all portions of the surface. A clearance of even one ten-thousandths (0.0001) of an inch between any small portion of the diamond surface and the surface of the support or holder is sufficient to cause the diamond to crack, due to the very high internal pressure to which the diamond is subjected during the wire drawing operation.

It has been proposed to embed the diamond in a mass of metal by forcing the metal around the diamond while heated and quite plastic, and thereafter applying compressive force in a line at an angle to the axis of the bore of the diamond. Such compressive force is applied because the metal in cooling shrinks away from the diamond to leave a very slight clearance, but the compressive force cannot be applied radially to the diamond and equally at every point of its surface. Irregularity in the surface causes unequal pressures, and compression around the circumference of the diamond tends to force the metal away from the poles. At points spaced even but a short distance away from the circumference, the compressive force is not radially of the diamond and may cause minute voids due to the tendency of the metal to move toward the ends under the compressive force applied at the circumference.

The main object of my invention is to prevent the metal from shrinking away from the diamond in cooling, and to utilize the cooling action to cause the metal to contract radially and equally in all directions, and thus firmly and uniformly support every portion of the surface of the diamond.

A further object of my invention is to reduce the cost of manufacture by reducing the number and simplifying the character of the steps required.

A further object is to so construct the die that liability of loosening of the diamond by heating and expanding of the holder during operation is reduced to a minimum.

Other objects, advantages and important features of my invention will be pointed out hereinafter, or will be apparent from a consideration of the preferred embodiment hereinafter described.

In the accompanying drawings:

Fig. 1 is a central vertical section through an apparatus for use in making dies embodying my invention, certain of the parts being somewhat conventionally illustrated.

Fig. 2 is a view similar to a portion of Fig. 1, but showing the shell or holder for the diamond closed up around the latter by the coacting dies.

Fig. 3 is a section through the completed article, and

Fig. 4 is a perspective view of the completed article.

In the form illustrated the metal shell 10 is provided with a hole or chamber for the diamond 11 and is heated to such a temperature that the metal becomes rather soft and easily molded or pressed to shape. The holder with the diamond therein is then brought into position between a pair of dies which serve to close up the open end of the holder 10 and force the metal snugly and firmly around the diamond. As shown, the die members include a lower die 12 and an upper die 13 which have substantially semi-cylindrical cavities and peripheral grooves therein. The lower die 12 serves to receive the heated holder or shell 10 and support the latter, while the upper die engages the open upper end of the holder and forces inwardly the metal around the open top, so as to close up the holder and completely enclose the diamond within the shell.

In Fig. 1 the holder is shown in the lower die member ready for the operation of the upper die member, while in Fig. 2 the parts are shown in the position which they occupy at the end of this step in the operation. The die members 12 and 13 serve not only to close up the metal shell around the diamond, but they are comparatively large in respect to the holder and serve to rapidly extract heat from the holder. The dies are held in firm contact with the holder, and the holder is held under compression for a brief interval after the dies are brought together, so as to subject the holder to external pressure during the initial cooling operation.

Thus the engagement of the holder with the diamond results first from the force applied by the dies, second by the abstracting of heat by the die, and third by the application of pressure to the holder during the cooling action.

In its preferred form the shell is so pressed or molded as to form a circumferential band portion 14 connected by a web 15 to a central body portion 16 and there may be radial webs or flanges 17. The body portion 16 is of a diameter equal to twice that of the diamond, and the band portion is of a diameter equal to four times that of the diamond.

By forming the cavities or recesses in the upper and lower surfaces of the shell, the thickness of the shell, measured in a direction parallel to the bore of the diamond, is very materially reduced along the annular section between the outermost periphery and the portion directly contacting with the diamond. Thus the outer or peripheral wall, the body portion engaging with the diamond and the connecting web portion, may be made of approximately the same thickness, whereby heat is radiated uniformly from all portions during the compressing action of the forming dies. There is therefore the maximum drop in temperature during forming, and the minimum amount of change in dimensions due to cooling after removal from the forming dies.

The web and flanges which are formed by the die members 12 and 13 serve primarily as heat radiating members. They operate not only to rapidly radiate the heat from the hot shell during the closing up of the latter by the dies 12 and 13, but after the die has been completed and is in operation they serve to radiate heat and prevent the shell from getting hot and expanding to loosen the diamond during the use of the diamond in wire drawing. In some constructions the peripheral band portion may be omitted.

After the shell or holder has been closed up and contracted as hereinbefore described, it will be understood that a suitable hole is bored through the shell and diamond, and through which the wire passes during the wire drawing operation. My present invention does not involve the details of the steps employed in forming this hole. It is preferably formed in a direction at right angles to the circumferential flange or web 15.

To facilitate the rapid manufacture of the dies I provide an apparatus including a vertical tube or guide 25 adapted to receive a stack or column of the open topped shells 10, each with the diamond therein. These may be fed into the upper end of the tube in any suitable manner, and may be removed in succession from the lower end by a suitable form of conveyor, such as an endless carrier 18 having spaced lugs 19 thereon. The tube 25 is mounted in a casing 20 having a lining 21 of insulation material spaced from the exterior of the tube 25. Closely adjacent to the bottom of the casing there is means for heating the tube with the holders or carriers therein. As shown this includes a burner 22 having gas and air supply pipes 23 and 24 for projecting a flame into the annular space between the tube 25 and the lining 21. The hot gasses of combustion pass upwardly in this space and around the tube, and the parts are so proportioned and so operated that each holder 10 is of the proper temperature when it reaches the bottom of the tube 25, and is delivered therefrom by the conveyor 18 to the dies 12 and 13.

In the foregoing description and in the claims I refer to the apparatus as a diamond die, and designate the member 11 which is placed in the holder, as a diamond. It will of course be understood that my invention is not dependent upon the specific character of this element, as other extremely hard substance such as carborundum might be used in place of the diamond. I wish all such equivalent substances to be considered within the scope of the word "diamond" as employed herein. The shell may be of Monel metal, phosphor-bronze or other hard non-rusting metal or alloy.

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

1. A diamond die including a diamond and a shell having a thickness less than the diameter of the diamond, and having a cooling flange formed thereon.

2. A diamond die including a diamond and a shell having a thickness less than the diameter of the diamond, and having an annular supporting flange.

3. A diamond die including a diamond and a shell having a thickness less than the diameter of the diamond, and having a supporting projection extending at an angle to the axis of the die.

4. A diamond die including a diamond embedded in a metal shell having heat radiating projections facilitating the rapid cooling of the shell and the firm gripping of the diamond during manufacture, and facilitating radiation of heat and maintenance of the firm gripping condition during use.

5. A diamond die including a diamond and a substantially spherical shell having the wall thereof of a thickness approximately equal to one-half the diameter of the diamond, the shell having a circumferential flange in a plane at right angles to the axis of the die, and having heat radiating flanges.

6. A diamond die including a diamond and a shell having a substantially spherical

body portion, the wall thereof being of a thickness approximately equal to one-half the diameter of the diamond, a circumferential band of a diameter approximately equal to twice that of the body portion, and a connecting web.

7. A diamond die including a diamond and a shell having a substantially spherical body portion, the wall thereof being of a thickness approximately equal to one-half the diameter of the diamond, and the shell having a heat radiating projection formed thereon.

8. A diamond die including a bored diamond and a shell having a substantially spherical body portion and an annular flange integral with said body portion and encircling the latter in a plane substantially at right angles to the bore of the diamond.

9. A diamond die including a bored diamond and a shell having an inner diamond enclosing and supporting portion, a peripheral portion and a connecting portion, the shell having a recess in the face thereof between said inner portion and said peripheral portion, whereby the thickness of said connecting portion is reduced.

Signed at New York in the county of New York and State of New York this 15th day of February A. D. 1924.

AARON SIMONS.