Dec. 31, 1957 A. E. LONG 2,817,885

MEANS FOR ORIENTING DIAMONDS IN HARD VECTOR DIRECTIONS IN DIAMOND BITS AND TOOLS

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Fig. 3.

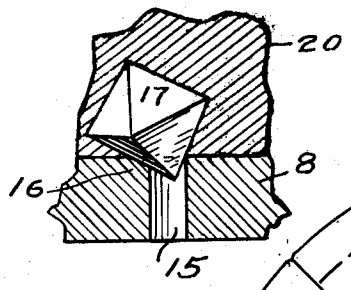


Fig. 1.

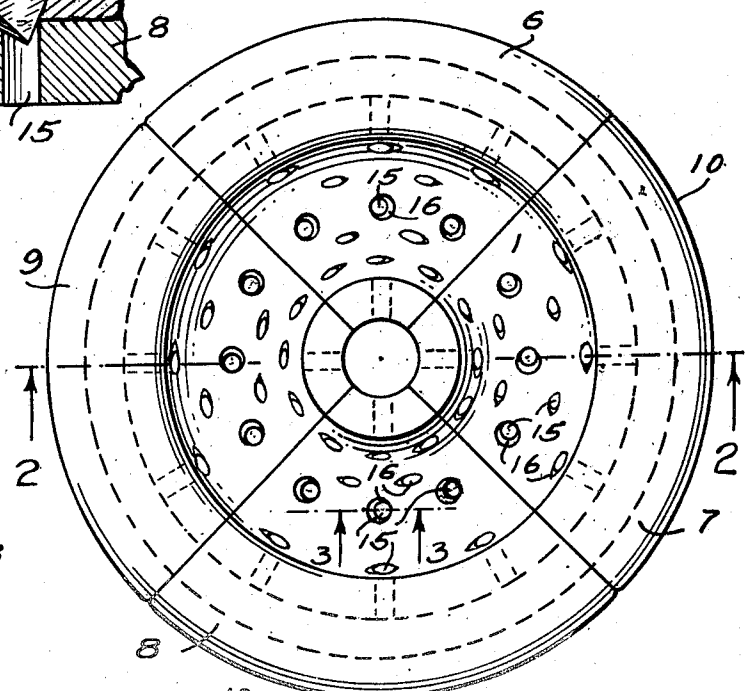
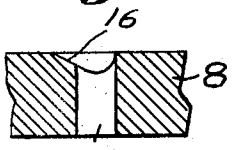


Fig. 4.



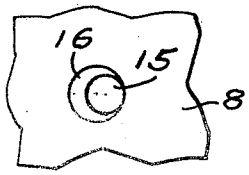


Fig. 5.

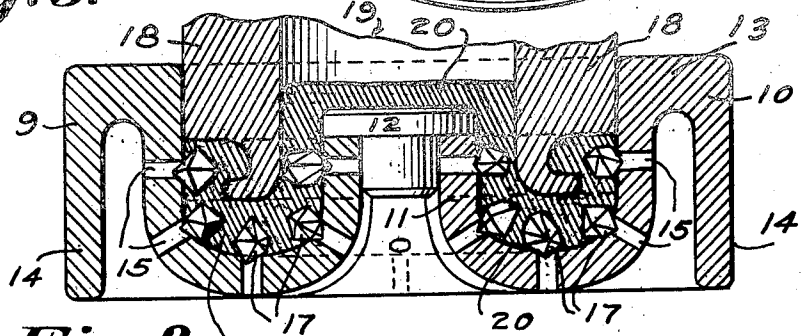


Fig. 2.

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MEANS FOR ORIENTING DIAMONDS IN HARD VECTOR DIRECTIONS IN DIAMOND BITS AND TOOLS

Albert E. Long, Berryville, Va., assignor to the United States of America as represented by the Secretary of the Interior

Application November 10, 1953, Serial No. 391,397

1 Claim. (Cl. 22—122)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to me of any royalty thereon in accordance with the provisions of the act of April 30, 1928 (ch. 460, 45 Stat. L. 467), 33 U. S. C. 266.

This invention relates to the making of diamond grinding bits for industrial and similar uses and is particularly concerned with the setting of the diamonds in the bits.

An object of the invention is to provide means for setting diamonds in bits with the hardest portions of their points presented to the work for the grinding operation, thereby increasing the efficiency and the useful life of the bits.

Another object is to provide means for setting diamonds in the manner described without employing highly-skilled individuals for that purpose.

Another object is to provide such means in which the proper setting of the diamonds, as described, for incorporation in the bit is substantially automatic.

Another object is to provide such means which are quite simple in construction and which require no changes in existing machines used in making diamond bits and with which the means of this invention are adapted to be employed.

These and other objects are attained by the means described herein and disclosed in the accompanying drawing in which—

Figure 1 is a top plan view of a mold of the present invention.

Figure 2 is a cross-sectional view on the line 2—2 of Figure 1 and showing in addition a central plug for the mold, and the end portion of a grinding tool projected into the mold as during the formation of the grinding tool, this view also showing a charge of the metallic matrix associated with the tool and incorporating the diamonds.

Figure 3 is an enlarged, fragmentary cross-sectional view on the line 3—3 of Figure 1 and showing in addition a diamond applied to the perforation or aperture and metallic matrix associated therewith.

Figure 4 is a view similar to Figure 3 but showing a part of the mold only, without the diamonds or matrix applied thereto.

Figure 5 is a top plan view of the mold portion seen in Figure 4.

The device of this invention is adapted to be employed with apparatus for making diamond tools such as that disclosed in the patent to R. H. Taylor, No. 2,256,062. In view of the disclosure therein it is unnecessary to elaborate the apparatus beyond explaining that the mold of the present invention is held in operative position thereby for the application of the diamond securing matrix to the end of a diamond tool presented to the mold and held in operative position by the said apparatus for that purpose.

It should be initially explained that it is necessary in manufacturing diamond cutting tools to orient the diamonds in their mold apertures or perforations in hard vector directions so that the hardest portions of the diamond points will be presented to the work, thereby improving the quality of the work and increasing the useful life of the diamonds and, accordingly, of the tool. Such orientation of the diamonds has heretofore necessitated the employment of individuals trained in the science of crystallography. Only such skilled persons have been able to consistently orient a sufficient number of diamonds to significantly improve the efficiency of the bit or tool produced. Manufacturers of these tools are aware that there is only a limited number of such trained individuals and that their salaries are necessarily at such level as to represent a considerable factor of cost in production.

It is the principal purpose of the present invention to provide means for orienting the diamonds in their molds in a substantially automatic fashion, that is to say, so that the diamonds when placed in their apertures or openings in the mold, automatically assume the desired position, with the hardest portions of their points disposed at a drag angle relative to the work to be performed by the tool or bit. Thus highly-skilled workers are not required.

Briefly this desirable result is accomplished by forming the diamond receiving opening of the mold with an eccentric bevel against which the diamonds are supported and by reason of which the diamonds project from their openings at a non-vertical angle relative to the adjacent portions of the mold.

The molecular layers of a diamond are so arranged that the hardest planes intersect all or any one of the three axial planes of the diamond crystal at an angle of 35 degrees 16 minutes. Thus the hard vector planes of a diamond are parallel to the crystal face of an octahedral diamond. The various crystal faces and edges along which the crystal faces of a diamond abut are so arranged that when those faces or edges rest on and are parallel to the planes of an eccentrically-shaped indentation, pip or beveled opening, the axial planes of the diamond are tilted off vertical and this orients the diamond so that the hard vector or hardest planes of the molecular layers of the diamond meet the surface to be abraded or cut at a negative rake or drag angle.

Therefore, when the beveled openings in the face of a tool mold are eccentrically shaped the setter need only to place a diamond in the opening in such manner that a crystal face or inter-face edge of a diamond rests firmly on and parallel to the eccentric bevel to successfully orient the diamond in a hard vector direction. Thus the setter need not have a knowledge of diamond crystallography, as no specific crystal face or interfacial edges of a diamond need be selected as the plane or edge to be aligned parallel the angled face of the beveled opening. In this manner, the hard vector orientation of the diamond is achieved instantly and automatically and the time consuming- and skill-requiring methods based on determining the axial planes through visual examination of each individual diamond, are eliminated.

In greater detail and with reference to the drawings the mold contemplated in the present invention is of a well-known type and as shown in Figure 1 is formed of four similar sections indicated at 6, 7, 8 and 9. When these quarter sections are placed together in assembled relation by the means disclosed in the patent above-mentioned or by similar suitable means, they together form a circular mold 10 comprising an annular channel extending around a raised central portion 11 which is apertured and provided, during use of the mold, with a removable plug 12, Figure 2. The enlarged annular channel is bounded on its outer sides by the rim portions 13 of the

mold, the outer walls **14** of which are down turned as indicated in Figure 2.

Each of the mold sections **6**, **7**, **8** and **9** is provided with a plurality of openings or apertures **15**. Each of these openings is adapted to receive a commercial diamond, which collectively are known as drill bort. It is these diamonds which, as explained above, must be disposed in hard vector directions in order to achieve the greatest efficiency of the work to be performed and the longest useful life for the diamonds.

In order to orient the diamonds in the desired manner, each of the openings **15** is provided at its inner edge with an eccentric bevel **16** which together in the assembled mold, project in similar directions, as indicated in Figure 1.

The drag angle or negative rake is determined by the angle of the plane of the eccentrically beveled opening. This is an acute angle and substantially as shown at **16** in Figs. 3 and 4. The maximum eccentricity should be placed on the leading side of the opening and aligned parallel to the direction of the tool travel, thus tilting the axial planes of the diamond toward the leading side of the diamond parallel to the line of travel.

When the mold has been assembled and placed in the tool manufacturing machine according to such means as disclosed in the patent mentioned, the diamonds **17** are positioned in the apertures by means which include air pressure for temporarily holding the diamonds in place until the molten matrix has been poured into the mold. This placement of the diamonds is the critical point in the use of the present invention. Due to the eccentric bevels **16** associated with the apertures **15**, the diamonds when initially placed in the apertures with their working points projecting therefrom as seen in Figures 2 and 3, automatically assume an off-vertical position relative to the adjacent portions of the mold, that is to say, the crystal axes of the diamonds are disposed in this off-vertical position or, expressed in another manner, the axes are by virtue of the eccentric bevel, disposed in non-parallel relation with the walls of the associated openings **15**.

Thereafter, in accordance with known practice, the plug **12** is placed in the aperture and the tool or bit-holding part of the tool manufacturing machine is actuated so as to dispose the head **18** of the tool **19** in an inwardly projecting position relative to the annular channel **10** of the mold as seen in Figure 2. The molten matrix **20** is then poured into the mold and incorporates the portions of the diamonds projecting from the apertures **15**, leaving the working points thereof exposed for performing the grinding operations for which the tool is intended. Inasmuch as the eccentric bevels **16** of the diamond openings **15** all extend in concurrent directions, the diamonds are, as a result, disposed in a concentric pattern and in use of the tool, the points of the diamonds are disposed at a drag angle relative to the work being performed.

It is clear from the foregoing description that the device of this invention is simple in manufacture and operation and can be associated with existing tool manufacturing machines without any changes whatever.

Modifications will be suggested by the means herein disclosed but these are believed to be comprised within the spirit and scope of the present invention.

What is claimed is:

A mold for holding diamonds to be incorporated into the matrix of a grinding bit, the mold being provided with openings each adapted to have a diamond placed therein and projecting therefrom, the edge of the opening being formed with an eccentric bevel against which the diamond is supported whereby the latter is tilted to a non-aligned relation with its mold-opening for disposing the working point of the diamond at a drag angle relative to the work to be performed by the completed bit.

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