Nov. 26, 1940. R. S. McCLINTOCK 2,223,220

METHOD AND MOLD FOR SETTING DIAMONDS

Original Filed June 16, 1936 2 Sheets-Sheet 1

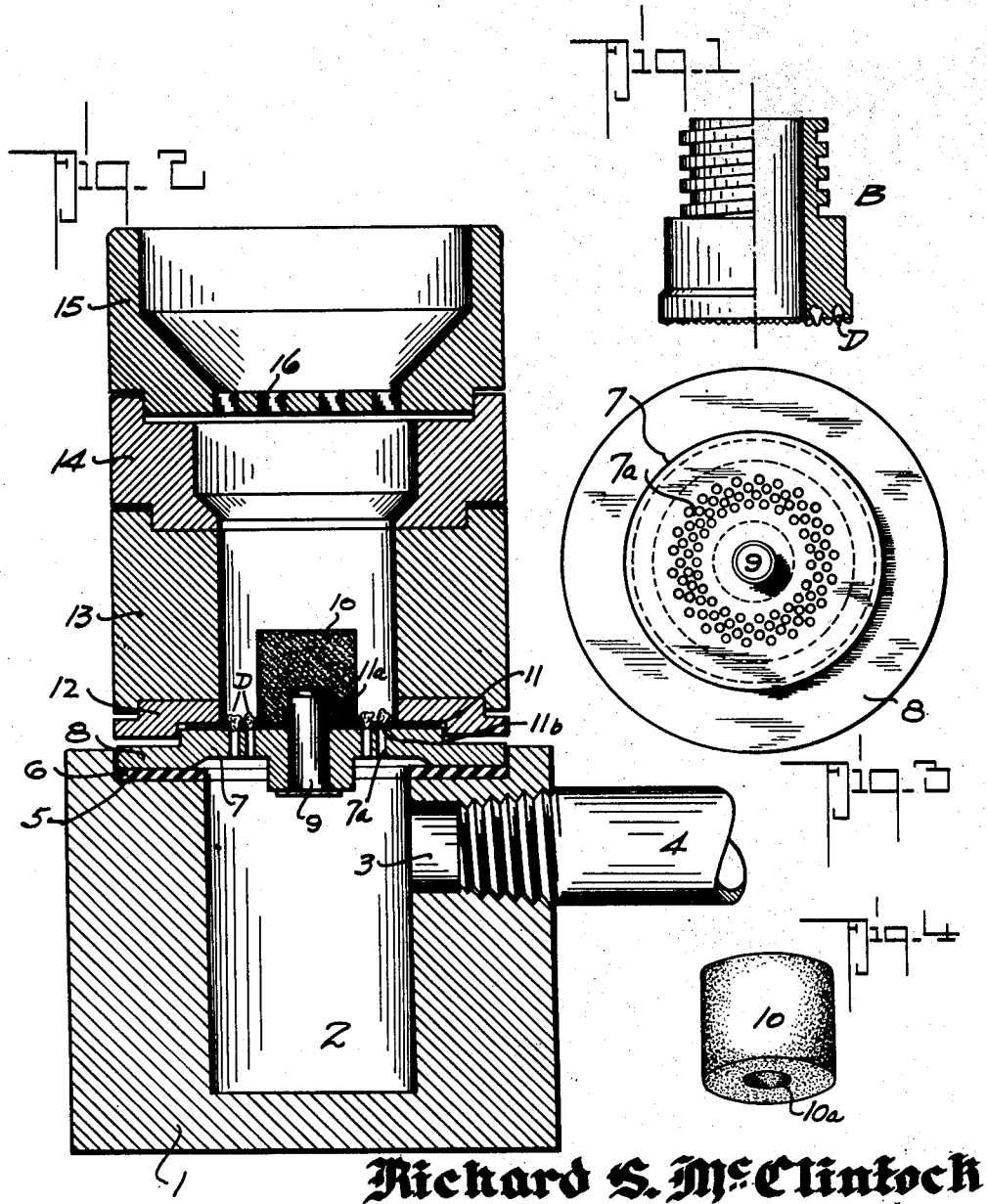


Fig. 1

Fig. 2

Fig. 3

Fig. 4

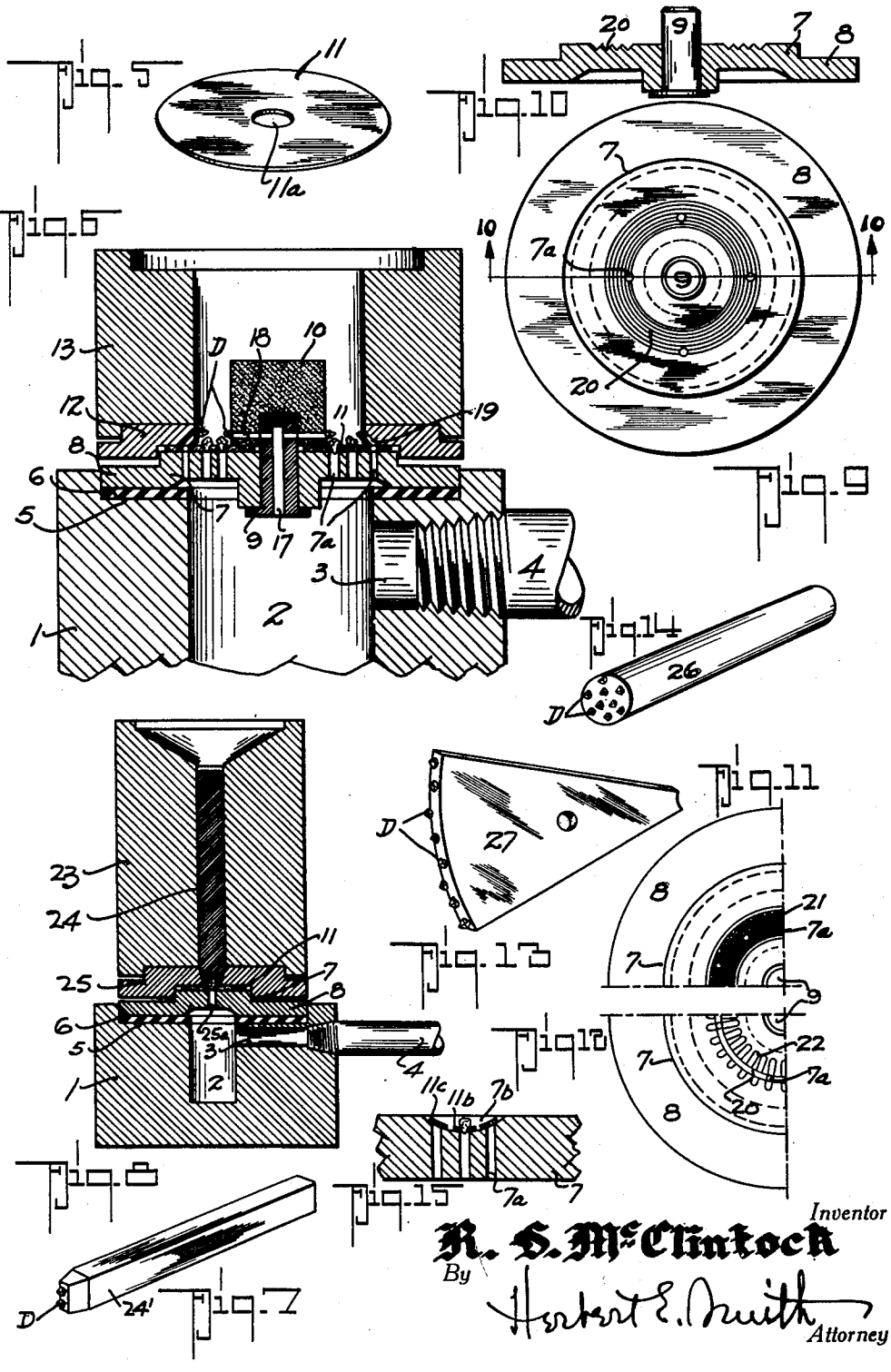
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Patented Nov. 26, 1940

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UNITED STATES PATENT OFFICE

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METHOD AND MOLD FOR SETTING DIAMONDS

Richard S. McClintock, Spokane, Wash.

Application June 16, 1936, Serial No. 85,515
Renewed March 7, 1939

9 Claims. (Cl. 22—122)

My present invention relates to an improved method and mold for setting diamonds, which, while applicable for use in a variety of industries, is especially designed for setting diamond-cutters in tools and devices, as for instance in rotary drill-bits for earth boring. Heretofore the common practice for setting diamonds, as cutters, in industrial tools, has centered around the comparatively difficult, tedious, and therefore extremely expensive method of first drilling depressions in the face of the tool and then setting the diamonds in the depressions and forming facets from the surrounding material by means of punches and mauls, to retain the diamonds. This old method of hand setting permits the selection of desired faces to be exposed, after the diamonds are set, but it is expensive and inefficient and necessitates the use of comparatively large and more expensive stones.

Various other methods have been employed for setting the diamonds in the tools, which use plastics for temporarily holding the diamonds in proper position in a mold, and then, through the application of heat and pressure upon a powdered metal confined within the limits of the mold, a cutting tool is produced. An obvious disadvantage of this method is that the diamonds are not firmly held in their seats, and therefore a high percentage in loss of diamonds occurs when the bit is used.

In some instances, attempts have previously been made by casting diamonds in a slug, but because the specific gravity of the diamonds is considerably less than the molten metal or alloy used in such methods, extreme difficulties have been encountered in holding the diamonds in their proper places during the process of pouring the molten metal. This objectionable dislodgment of the diamonds from their proper seats preparatory to setting, is termed "floating," which has heretofore presented a problem that could not be solved, except through the tedious and expensive method of hand-setting the diamonds.

In carrying out my invention, I employ a pattern-holder for the diamonds in which they are initially seated, and after the pattern-holder has been located in the mold, I utilize a vacuum chamber in the mold and air-suction to retain the diamonds in their respective seats in the holder during the process of arranging the diamonds in the best chosen pattern and during the pouring of the molten metal for the formation of the tool. In this manner the diamonds are retained in their proper positions against dislodgment during arranging period and against "floating" and they are set with accuracy and firmly retained against loss during subsequent use.

The invention consists in certain novel steps in the process or method of setting the diamonds, and in certain novel combinations and arrangements of parts in the mold by means of which the steps of the process are carried out. In the accompanying drawings I have illustrated several modes I have so far devised for the practical application of the principles of my invention but it will be understood that changes and alterations may be made in these exemplifying structures, within the scope of my claims, without departing from the principles of the invention.

Figure 1 is a view partly in elevation and partly in section illustrating a core bit-drill with the diamonds set in the annular cutting face of the bit.

Figure 2 is a vertical sectional view of a mold equipped to cast the boring bit of Figure 1 and set the diamonds in its cutting face.

Figure 3 is a plan view of the template or base-plate employed in the mold of Figure 2.

Figure 4 is a perspective view of the carbon core employed in the mold of Figure 2 for casting the earth boring tool of Figure 1, which tool is a core bit, having an annular cutting face and a large interior passage for the core that is formed during the drilling operation.

Figure 5 is a perspective view of the disk of mica from which the pattern-holder for the diamonds is made.

Figure 6 is a detail sectional view of part of a mold, slightly modified, in order that the bit, in addition to the cutters set in its annular cutting face, may have interior and exterior, laterally projecting reaming diamond cutters set therein.

Figure 7 is a perspective view of another type of tool in which the diamonds are set by my improved method, and Figure 8 is a sectional view of a mold in which the tool of Figure 7 may be cast.

Figure 9 is a plan view of a modified base-plate or template, and Figure 10 is a cross section thereof at line 10—10.

Figures 11 and 12 are plan views of fragments of base-plates or templates having modified faces.

Figure 13 illustrates a portion of a rotary saw having the diamonds set in its periphery according to my invention.

Figure 14 is a perspective view of a multi-set tool having the diamonds set according to my invention.

Figure 15 is a detail sectional view of another modification of the base-plate or template.

For convenience of illustration and description, reference should be made to the sectional view of the mold in Figure 2 in which the diamonds D are set in the bit B of the core drilling tool. In carrying out my invention I employ a base 1 for the mold in which an interior vacuum chamber 2 is provided, and an air port 3 in a side wall of the mold-base connects with an air-suction pipe 4 which leads to a suitable air pump that tends to create a vacuum in the vacuum chamber 2 of the mold-base.

The upper, open face of the mold base is countersunk at 5 to form an annular seat for the annular gasket or ring 6 which insures an air tight joint in the top of the mold base. A circular base-plate 7 is fashioned with an annular flange 8 which rests on top of the gasket, and this base plate, which forms the top of the vacuum chamber is provided with an annular series of ports 7*a* extending transversely through the thickness of the plate and opening at their lower ends to the vacuum chamber.

A centering pin 9 is rigidly mounted in the center of the base plate and this pin projects above the base plate to support the carbon core 10 which has a bottom recess 10*a* to fit over the upper end of the centering pin. This core 10 forms the interior passage of the bit B when the molten metal is run into the mold.

The suction pump (not shown) is started to create a vacuum condition in the pipe line 4 and in the vacuum chamber 2, with the result that air pressure is withdrawn through ports 7*a* of the base plate 7. On top of the perforated base plate is placed a pattern holder 11 having a central opening 11*a* to fit over the centering pin 9 and this pattern holder which is preferably a mica disk as shown in Figure 5 is secured thereon by means of the suction upon its lower face through holes or ports 7*a*.

On top of the base plate and the pattern holder support thereon is placed a base ring 12 which forms the lower annular portion of the cylindrical flask 13 and serves to indicate the outside limits of the slug to be cast and aids the diamond setter in determining his clearances. The base ring is countersunk and flanged for co-action with the base plate 1 and flask 13 to center the parts and to provide closed joints in the mold appliance.

The pattern holder is first perforated or holes are punched therein by means of a suitable tool, the pricked or punched holes being arranged in any desired or suitable pattern to form sets 11*b* for the diamonds in the pattern holder. The punched holes may be regular in shape and of a size to permit the insertion therein of portions of the diamonds D and as the inserted portions are usually of irregular shape the diamonds may be forced into the holes 11*b* and retained securely therein by reason of atmospheric pressure on top of the pattern holder and the seated diamonds (which seal their seats). Those portions of the diamonds which project into and through the pattern holes or seats 11*b* after casting of the slug become the projecting cutters on the face of the bit B. The diamonds thus seated in the pattern holder present the exact form and pattern of the diamonds on the annular cutting face of the drill bit B which may be subsequently cut or machined from a slug formed by casting.

On top of the flask is mounted a cup 14, and on top of this cup is mounted the feed cup 15 which is fashioned with a perforated bottom forming distributing holes 16 to uniformly distribute the molten metal, as it is run into the feed cup, and from these holes the molten metal flows down through the flask and is deposited on top of the pattern-holder supported on the base plate of the mold.

The molten metal which surrounds the core also surrounds those portions of the diamonds which project from their seats above the top face of the pattern holder, and as indicated the diamonds are usually seated, each with its major irregular portion projecting above the pattern holder. This arrangement of the diamonds permits the molten metal to penetrate under, around, and over the projecting parts of the diamonds, above the pattern plate or pattern-holder, thereby firmly imbedding a major portion of a diamond in its setting in the face of the bit. The flat upper face of the mica pattern-holder forms a flat cutting face of the bit, and the portions of the diamonds that project into or through the seats of the pattern holder form the cutters on this annular, flat face of the bit.

If more of the stones or cutters D is to be exposed the cutting face may be sandblasted until sufficient metal has been eroded to give proper clearance and adequate cutting projections. During the casting operation a vacuum is maintained in the chamber 2 and securely holds or retains the seated diamonds in the pattern holder 11 against displacement or floating and the diamonds are thus firmly held in their proper positions until they have been surrounded in the molten metal and fixed or set in the face of the bit.

After removal of the cast bit (or slug) from the mold, and removal of the mica pattern holder, the cast bit is "finished" in a suitable machine tool, as a lathe, to proper shape and size, and the completed bit is ready for use.

In Figure 6, in addition to setting the diamonds D in the annular cutting face of the bit, this mold is designed to set reaming cutters (diamonds) to project laterally from the faces of the interior and exterior walls of the tubular or core drill-bit, and the diamonds which are to be thus set, are also held in their seats by air-suction. For this purpose the centering pin is made tubular with a central suction duct 17 opening into the vacuum chamber 2, and the pin also has laterally extending ducts that communicate with complementary radially extending but diagonal ducts 18 in the core. The diamonds which are to provide the reamers in the interior of the core drill-bit are seated in the open outer ends of these ducts 18 and are retailed therein by air-suction.

In addition, the base ring is fashioned with air ducts 19, the inner ends of which form the seats for the diamonds which are to become the reamers on the exterior face of the drill-bit, and these ducts 19 open through ports in the pattern-holder to the airports or suction ports 7*a*, to provide suction to hold the diamonds in their seats.

Various changes and alterations may be made in the setting pattern of the diamond holder, and in the upper face of the base plate, as for instance in Figures 9 and 10 the base plate is fashioned with an annular series of grooves 20, and in Figure 11 the base plate has a knurled, annular

pattern 21, on which the pattern-holder is to be placed. These irregular or uneven faces of the base plate, beneath the pattern-holder enhance the suction beneath the holder with the result that the holder is more firmly held to its seat and the diamonds are more held to their seats in the holder.

In Figure 12, in addition to the single annular groove 20 in the face of the circular base plate, radially extending grooves 22 may be provided, and in all cases, the air ports or suction ports 7a provide the suction which tends to create a vacuum condition beneath the pattern holder.

In Figure 15 the base plate is illustrated as having a depression 7b which may be an annular depression about the central pin 9 (not shown in this view) and having the suction ports 7a. Bits of mica 11c in this instance serve as pattern holders and they are placed over the upper end of the ports 7a and retained there through atmospheric pressure. The hole 11b is pricked and the diamond securely seated therein by suitable instruments. In this manner round nosed slugs may be cast for the subsequent shaping of "bull-nosed" bits such as are popular under certain conditions.

In Figure 8 where a modified mold is shown in which tools of the type illustrated in Figures 7 and 14 may be cast, the flask 23 has a central bore 24 into which the metal is run, and the base ring 25 provides the bottom of the bore, the pattern-holder being located between the base ring and the base plate, and the latter being provided with a suction duct as 25a that opens into the vacuum chamber 2. Such a tool may be cast rectangular in cross section as 24' in Figure 7, with two diamond cutters in its face; or the tool may be a solid cylinder 26 in Figure 14 with a number of diamonds set in its face.

By my process, and with slight variations in the mold, other tools may have diamonds set in the proper places, as for instance, the portion 27 of a rotary saw in Figure 13 may have the diamonds D set in the periphery of the saw to form a cutting edge.

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

1. In a diamond setting mold, the combination with a base forming a vacuum chamber and a ported base-plate, of a pattern holder having diamonds seated therein and supported on the base-plate, a flask mounted on the base plate to receive molten metal, and means tending to form a vacuum in the vacuum chamber to hold the diamonds in their seats and thereby prevent "floating" of the diamonds.

2. In a diamond-setting mold, the combination with a base-plate having ports, and means for applying air-suction through said ports, of a pattern-holder having openings therein and supported on said base plate, and said openings being closed by diamonds seated therein.

3. The method of setting diamonds in a molded casting which consists in fashioning seats in a diamond holder to form a pattern holder, seating diamonds in said seats, supporting said pattern holder in a mold on a ported base plate, and applying air suction to the diamonds thru said ported base-plate before and during the process of molding the casting.

4. In a mold for setting diamonds in a drill bit, the combination with a base having ports and a ported diamond support forming diamond seats, and means for applying air-suction through said ports, of a centering pin mounted in said base and having a suction duct, means for supporting the base and centering pin, and a central core rigid with the pin, said core having lateral suction seats communicating with said duct.

5. In a diamond setting mold, the combination with a base having a countersunk face and having a port forming a vacuum chamber, a ported base plate covering said chamber and having a flange mounted in said countersunk face, and means for supplying air suction through said ports, of a diamond support having openings therein and supported by said base plate, and said openings being closed by diamonds seated therein.

6. In a diamond setting mold, the combination of a base forming a vacuum chamber, a ported base-plate supported on the base and overlying the vacuum chamber therein, with a port of the base-plate in communication with the vacuum chamber, a diamond support on the base-plate and having ports forming diamond seats in communication with the vacuum chamber through the ported base-plate, a flask adapted to be mounted on the base-plate to receive molten metal, and means tending to form a vacuum in the vacuum chamber to hold the diamonds in their seats during the positioning of the diamonds.

7. Apparatus for use in molding a tool having diamond cutting elements, including a ported mold wall, a diamond seating element overlying said ported wall, the seating element having a surface presented to the interior of the mold cavity and having ports therein in communication with ports in said wall and adapted to seat diamonds, and air suction means cooperating with the ports in said wall and tending to withdraw air from the interior of the mold through the ports in said wall and said element and thereby retain diamonds seated in the ports of said element during the positioning thereof.

8. The method of setting diamonds in a molded casting which consists in fashioning seats in a diamond holder to form a pattern holder, seating diamonds in said seats, supporting said pattern holder in a mold on a ported base-plate, and applying air suction to the diamonds through said ported base-plate during the seating of the diamonds.

9. The method of setting diamonds in a molded casting which consists in fashioning seats in a diamond holder to form a pattern holder, seating diamonds in said seats, supporting said pattern holder in a mold on a ported base-plate, and applying air suction to the diamonds through said ported base-plate during the process of molding the casting.

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