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(54) Mounting of cutters on cutting tools

(57) A support 44 for holding a synthetic polycrystalline diamond cutter 36 on a drill bit is forged or arc cast from molybdenum.

FIG. 2

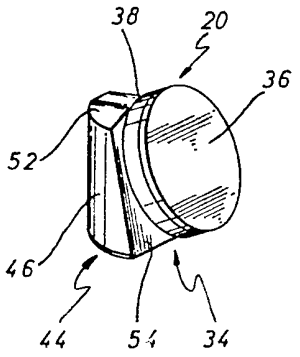

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FIG. 1

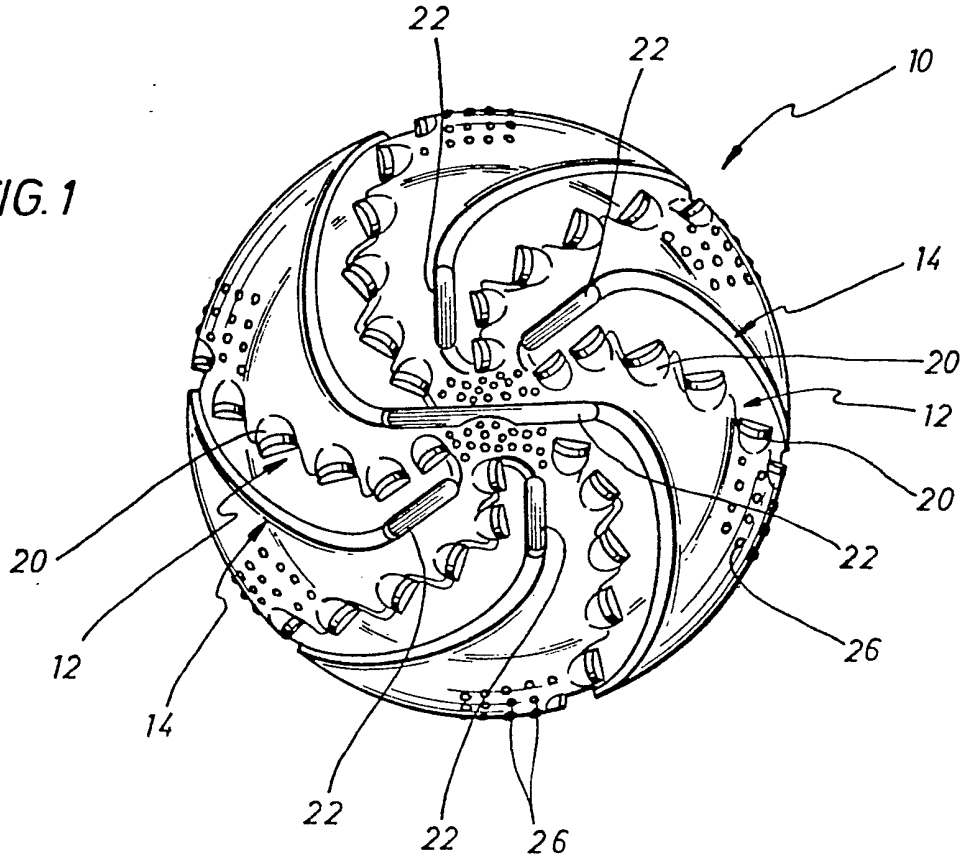


FIG. 2

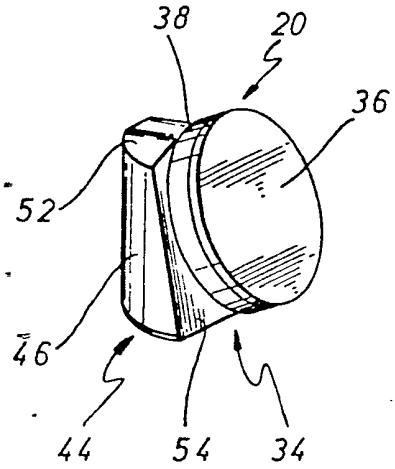
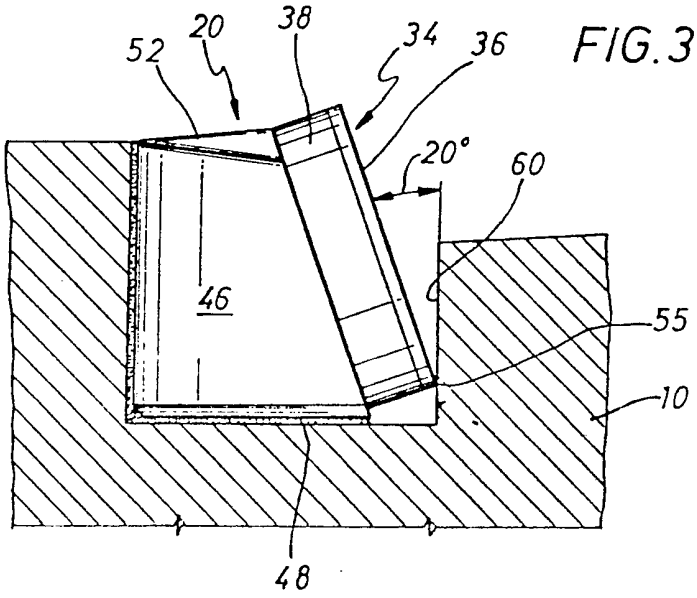


FIG. 3



SPECIFICATION

Mounting of cutters on cutting tools

The invention relates to cutting tools and, more particularly, to means for supporting the cutting elements of such tools.

It is well known that many types of cutting tools comprise hard cutting elements fixedly mounted on the body of the tool. A common example is a drill bit of the type having cutting elements positioned within sockets in the bit body so as to present hard cutting faces of tungsten carbide or similar material above the body. Such bits are disclosed, for example, in U.S. Patent Nos. 2,578,351; 3,077,798; 3,191,700; 3,749,190 and 4,047,583.

A new type of cutter for drill bits comprising a synthetic polycrystalline diamond face is now being used for drilling relatively soft formations. The synthetic diamond has been manufactured by General Electric Corporation under the trademarks COMPAX and STRATAPAX. The synthetic diamond material is generally available in discs, with a typical size being a cylinder with a 0.5 inch diameter and having a STRATAPAX brand polycrystalline diamond face of 0.5mm secured to a 2.5mm tungsten carbide backing. The use of synthetic diamond discs as cutting elements is disclosed, for example, in U.S. Patent No. 4,066,788.

As noted in U.S. Patent No. 4,066,788, significant problems have been encountered in the use of the synthetic diamond cutters in that the cutters tend to break when the drilling conditions suddenly change. The cutters appear to be particularly susceptible to breakage because the synthetic diamon material cannot bend appreciably without breaking.

Prior attempts to mount synthetic polycrystalline diamond cutter discs on drill bits are exemplified in U.S. Patent No. 4,006,788. According to the teachings of this patent, the diamond cutter is bonded to a tungsten carbide support which is inserted into the bit body to expose a selected portion of the cutter above the body. Other forms of cemented carbide supports have been used. However, all cemented carbide supports are believed to have the common disadvantage of being subject to thermal cracking, thereby causing premature failure of the support and resultant breakage of the diamond material. Furthermore, it is costly to manufacture cemented carbide supports having the requisite rigidity, i.e., a rigidity defined by an elastic modulus above 50,000,000 psi, and preferably of the order of 70,000,000 psi.

Other supports for diamond disc cutters have been manufactured from steel. However, all known uses of steel have failed due to the low elastic modulus of suitable steels which caused the diamond cutters to bend and break.

Consequently, there is a well recognized problem mounting synthetic polycrystalline diamond cutters on drill bits so that the cutters will remain in place and not be subjected to breakage.

In accordance with the present invention, there is provided novel means for supporting cutters on the body of cutting tools, and particularly, for supporting synthetic polycrystalline cutters on downhole tools such as drill bits. In application of the invention to the securement of synthetic polycrystalline diamond discs to drill bit bodies, the discs may be secured to the bit body at the desired locations by means of mounting the discs on a support formed from molybdenum and securing the support to the bit body. It have been found that using molybdenum as the support material overcomes the disadvantage of thermal cracking associated with conventional carbide supports because of the high temperature strength of molybdenum. Furthermore, molybdenum has the advantage of having a sufficient rigidity to prevent breakage of the diamond disc cutters.

In one aspect, the invention comprises a support for mounting a cutter on a cutting tool wherein such support is made from molybdenum. The cutter may comprise a synthetic polycrystalline diamond cutting face and the cutting tool may be a drill bit, for example, a drag type drill bit. The support may be force fit and brazed into a mating pocket in the body of the drill bit.

In another aspect, the invention comprises a drill bit having a bit body which provides a plurality of locations for attachment of cutters thereto, a cutter being provided for each location and a molybdenum support secured to each cutter, with each support being mounted on the bit body at a selected one of the locations. The bit body may be formed by powder metallurgy with pockets at each location for receiving the supports, with the supports being force fit and brazed into the pockets. The molybdenum support may be forged, arc cast, or otherwise formed in the desired shape.

Accordingly, it is a principal advantage of the present invention that it makes it possible to provide a rigid support for holding cutters to a cutting tool, for example, a drill bit, whereby the cutter will not be subject to breakage due to bending.

It is a further advantage of the present invention that it makes it possible to provide a drill bit having cutter supports formed from molybdenum to positively locate the cutters on the bit body with a reduced likelihood of cutter breakage.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Figure 1 is a bottom view of a drag type drill bit constructed in accordance with the present invention;

Figure 2 is a perspective view of a cutter assembly utilized in the bit of Fig. 1;

Figure 3 is a side view of the cutter assembly and pocket uitilized with the drill bit illustrated in Fig. 1;

A preferred embodiment of the present invention will now be described with reference to Figs. 1–3. Fig. 1 is a bottom view of a drag type drill bit 10 constructed in accordance with the present invention. Bit 10 is a six-way drag bit with six curved or helical blades 12. Associated with each blade 12 is a waterway of field course 14 for directing the drilling mud emerging from the center of the drill bit along the face of the bit so as to cool the cutters and sweep away the cuttings. Each blade 12 includes six cutter assemblies 20 which are force fit and brazed into pockets in bit head 10. Bit 10 includes a plurality of centrally disposed openings 22 through which the drilling mud emerges for flow along fluid courses 14. Each fluid course 14 terminates at the periphery of the drill bit in a recessed area for transmission of the drilling mud and entrained cuttings back up the borehole in the manner well known in the art. The periphery of bit 10 also includes a plurality of recessed gauge diamonds 26 which are used to maintain the diameter of the borehole. The gauge diamonds are recessed into the matrix, as opposed to the face cutter assemblies 20 which have portions protruding from the matrix.

The bit head may be formed by powder metallurgy techniques whereby a graphite mold is made to the shape of the bit. A plurality of flats are machined into the mold at positions corresponding to the cutter-receiving pockets to be formed in the bit head. At each flat, a protruding mold portion is secured to the graphite mold for forming the pocket. The protruding portion is shaped such that within the pocket there will be no negative relief. In accordance with known techniques, the mold is first filled with a tungsten carbide powder with the steel shank in place. The mold is then vibrated to compact the powder and a copper alloy binder is placed upon the powder. The filled mold is then furnaced so that the copper melts and infiltrates the powder. The protruding pocket-forming portion of the mold is sized so as to have external dimensions slightly in excess of the finished pocket to allow for shrinkage during the furnacing of the drill bit head.

A typical cutter assembly 20 associated with drill bit 10 will now be described with reference to Figs. 2 and 3. Cutter assembly 20 includes a drill blank 34 which comprises a synthetic polycrystalline diamond face 36 secured to a tungsten carbide backing plate 38. A drill blank adapted for use in accordance with the present invention is a drill blank manufactured by General Electric Corporation having a synthetic STRATAPAX brand polycrystalline diamond face of 0.5mm secured to a 2.5mm thick tungsten carbide backing plate. In one application, the drill blank had a circular cross-section with a 0.5 inch diameter, but it will be appreciated that other sizes of blanks and configurations other than circular may be utilized. Although not illustrated, the cutting face of the cutter assembly need not be planar, but rather may be curved, multifaced, or the like.

Referring back to Figs. 2 and 3, the backing plate 38 of the drill blank is secured to the front face of a contoured support 44. Support 44 includes a curved back 46, a flat base 48, a top 52 and a flat front 54 to which the backing plate of the drill blank is secured. It will be appreciated that the curved back portion 46 subtends an arc in excess of 180°, preferably on the order of 240°, and that substantially the entire curved portion 46 is brazed to the mating wall of the pocket formed in the drill bit head.

According to the present invention, support 44 is formed from molybdenum which has a rigidity defined by an elastic modulus on the order of 50,000,000 psi. The molybdenum may be initially formed to the shape of the support by arc casting, forging or other suitable means. It has been found that the molybdenum may be formed into the support, including final machining, at a cost no greater than that required to form conventional cemented carbide supports.

While the present invention has been disclosed in connection with illustrated embodiments, it will be apparent to those skilled in the art that numerous modifications may be made without departing from the spirit or scope of the instant invention. For example, supports made from molybdenum may be used to mount cutters other than synthetic diamonds to drill bits or other cutting tools. The molybdenum may be combined with other materials according to known metallurgical practices to enhance the properties of molybdenum for the given application. The shape and means of attaching the support may vary according to the application. Furthermore, while the upper surface of the support is shown as being substantially flush with the face of the bit, it will be appreciated that the support may extend beyond the bit face to provide greater engagement of the cutter with the material being drilled. Such an extended support will be subjected to greater stresses, thereby requiring a stong and reliable support as taught by the instant invention. These and other variations are within the spirit and scope of the present invention.

CLAIMS

1. A molybdenum support for mounting a

cutter on a cutting tool.

2. A support as claimed in claim 1 including means for securement of the support to a cutter comprising a synthetic polycrystalline diamond.

3. A support as claimed in claim 2 including means for securement of the support to a cutting tool comprising a drill bit.

4. A support as claimed in claim 3 wherein said support is adapted for force fitting and brazing into a mating pocket in the body of the drill bit.

5. A drill bit comprising:

a bit body providing a plurality of locations for attachment of cutters thereto;

a cutter provided for each of said locations; and

a molybdenum support secured to each said cutter, each said support being mounted on said bit body at one of said locations.

6. A drill bit as claimed in claim 5 wherein said bit body is formed by powder metallurgy with pockets at each location for receiving said supports.

7. A drill bit as claimed in claim 6 wherein said supports are force fit and brazed into the pockets.

8. A drill bit as claimed in any of claims 5 to 7 wherein at least some of said cutters have synthetic polycrystalline diamond cutting faces.

9. A drill bit as claimd in any of claims 5 to 8 wherein said molybdenum support is forged.

10. A drill bit as claimed in any of claims 5 ot 8 wherein said molybdenum support is arc cast.

11. A support for mounting a cutter on a cutting tool, substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

12. A drill bit substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

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