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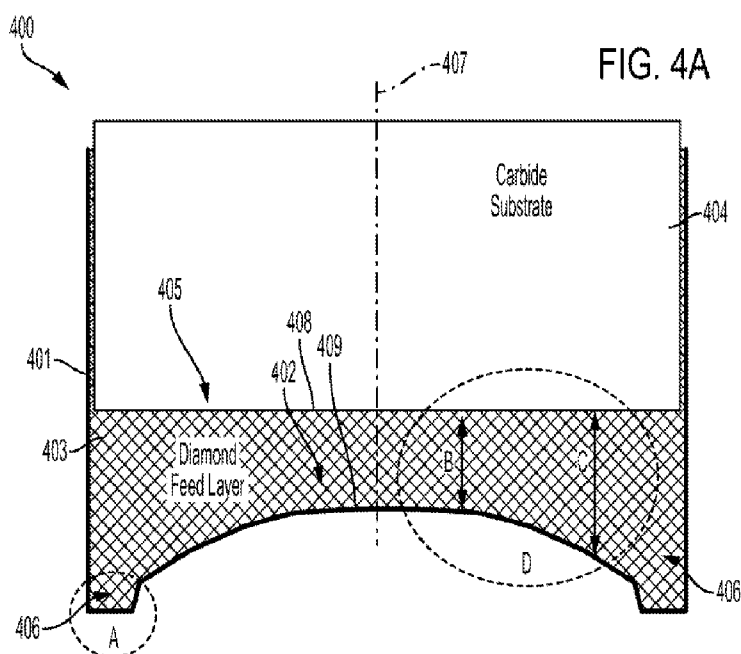
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(54) Title: NEAR NET SHAPE POLYCRYSTALLINE DIAMOND CUTTERS AND METHODS OF MAKING THEREOF



(57) Abstract: Polycrystal line diamond cutters (600, 650) and methods of making thereof are described, the cutters (600, 650) including a substrate (601, 654) and a diamond body (602, 652), the diamond body (602, 652) having at least one side including a concave portion and at least a portion of the surface of the concave portion (603, 680) on the second side of the diamond body (602, 652) includes a plurality of exposed sintered diamond particles that retain a physical structure of as-sintered diamond particles.

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:

30 July 2020 (30.07.2020)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/064871

A. CLASSIFICATION OF SUBJECT MATTER

INV. C04B35/528 B01J3/06 C04B35/645 C04B37/02 E21B10/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C04B E21B B01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2015/069967 A1 (SMITH INTERNATIONAL [US]) 14 May 2015 (2015-05-14)	1,3-9, 12,15-21
Y	paragraph [0026] - paragraph [0042]; figures 1,4	2,10,11, 13,14
A	US 8 784 517 B1 (GONZALEZ JAIR J [US] ET AL) 22 July 2014 (2014-07-22) page 3, line 53 - line 57; figure 1d column 4, line 6 - line 33	1-21
X	WO 2016/099798 A1 (SMITH INTERNATIONAL [US]) 23 June 2016 (2016-06-23) paragraph [0031] - paragraph [0057]; figures 7,11	1,3,6-8, 12,15-21
Y	US 8 080 071 B1 (VAIL MICHAEL A [US]) 20 December 2011 (2011-12-20) column 5, lines 44-51	2,10,11, 13,14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

11 February 2020

Date of mailing of the international search report

29/06/2020

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/064871

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of Item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-21

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-21

A method of making a near net shape polycrystalline diamond cutter, comprising a substrate and a diamond body, the method comprising:

forming an assembly comprising along an axis of the assembly a refractory container, a diamond feed layer, and a substrate, the forming comprising: a) providing the refractory container comprising an inner bottom side, an outer bottom side, and an inner edge side; b) depositing the layer of diamond feed in the refractory container in contact with the inner bottom side; c) positioning the substrate over the diamond feed layer, the substrate comprising a first side and a second side opposite the first side; and d) optionally, positioning a cap over the contents of the refractory container, and e) sealing the diamond feed layer and substrate in the refractory container to form the assembly; and

processing the assembly under high pressure high temperature sintering conditions (HPHT) from 5 GPa to 8 GPa, and from 1300 °C to 1600 °C, to sinter the diamond feed into a diamond body affixed to the substrate;

wherein the second side of the substrate is positioned over the diamond feed layer; and

wherein at least one of the inner bottom side of the refractory container and the second side of the substrate comprises a convex portion,

2. claims: 22-41

A polycrystalline diamond cutter comprising:

a substrate comprising a first side, a second side opposite the first side, and an edge side connecting the first side to the second side, wherein a periphery of the first side intersects with the edge side, and a portion of the first side is included in a diamond cutter mounting surface; and a diamond body comprising a first side, a second side opposite the first side, and an edge side connecting the first side to the second side, wherein a periphery of the second side intersects with the edge side and a portion of the second side is included in a diamond body working surface;

wherein the first side of the diamond body is attached to the second side of the substrate,

wherein the edge side of the diamond body is substantially aligned with the edge side of the substrate along an axis of the cutter;

wherein the second side of the diamond body comprises a concave portion, and

wherein at least a portion of the surface of the concave portion on the second side of the diamond body includes a

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

plurality of exposed sintered diamond particles that retain
a physical structure of as-sintered diamond particle.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/064871

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2015069967 A1	14-05-2015	CN 105899751 A EP 3066289 A1 US 2015129322 A1 US 2019136636 A1 WO 2015069967 A1	24-08-2016 14-09-2016 14-05-2015 09-05-2019 14-05-2015
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