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[Continued on next page]

(54) Title: ROTARY METAL-CUTTING INSERT AND MOUNTING CARTRIDGE THEREFOR

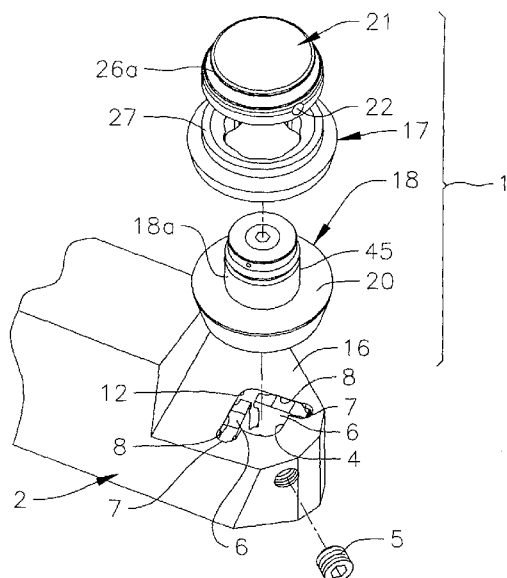


FIG. 1

(57) Abstract: The flow of heat energy from the cutting edge rim of a self-propelled round annular rotary cutting element ('insert') to axial-load and radial-load bearings in a cartridge which rotatably supports the insert on a machine tool body is reduced by defining heat flow paths from the insert rim to cartridge components which engages the bearings to have low thermal conductance relative to heat flow paths from the insert rim to other parts of the cartridge. Control over heat flow path thermal conductance is obtained by selection of materials used between the insert rim and the mentioned cartridge components, by reductions in the cross-sectional areas of the critical heat flow paths, and by combinations of those two techniques. Protection of the bearings from heat enables the insert and the cartridge to be reduced in size. Improved mountings of insert-supportive cartridges to tool bodies are disclosed. The insert and the cartridge preferably are shaped to enable the insert to be positioned on a tool body so that the insert's rake face can have a positive rake orientation relative to a workpiece. Arrangements for controlling cuttings chip formation and for handling cuttings chips also are disclosed.



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14 January 2010

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/30360

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B23B 29/02 (2009.01); B23B 51/00 (2009.01)

USPC - 408/146; 407/7

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)

IPC(8): B23B 29/02 (2009.01); B23B 51/00 (2009.01)

USPC: 408/146; 407/7

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

USPC: 408/86; 407/30, 64; 408/; 407/; 409/

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

PubWEST (USPT, PGPB, EPAB, JPAB); Google/Patents; Google/Scholar

Search terms: cutter, cutting, bit, machine, tool, rotary, rotation, spin, thermal, heat, temperature, conduction, coefficient, edge, transfer, spread, transmit, resistance, impedance, insert, ceramic, material, stainless, control, reduce, reduction, rotor, etc

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---	US 4,477,211 A (BRIESE) 16 October 1984 (16.10.1984), entire document especially Fig. 1, 2	37 -----
Y		29-36, 38-49
Y	US 4,378,184 A (BRIESE) 29 March 1983 (29.03.1983), col 1, lns 17-55; col 3, lns 23-28; Fig. 1, 2	1-23
Y	US 2,944,323 A (STADLER) 12 July 1960 (12.07.1960), col 1, lns 15-18; col 3, lns 31-42; col 4, lns 34-40; Fig. 6, 6a	1-23, 44, 49
Y	US 7,156,006 B2 (HYATT et al.) 02 January 2007 (02.01.2007), col 1, lns 8-13; col 8, lns 30-37; col 9, lns 4-10	29-36, 47-49
Y	US 3,845,336 A (MOORES, JR. et al.) 29 October 1974 (29.10.1974), col 1, lns 4-8	38-44
Y	US 4,552,491 A (PARKER) 12 November 1985 (12.11.1985), col 1, lns 8-10; Fig. 1, 2, 4	45, 46
Y	US 4,507,023 A (SHIKATA) 26 March 1985 (26.03.1985), col 1, lns 6-8; col 10, lns 62-66; Fig. 15, 28	10-12, 14, 21-23

☒ Further documents are listed in the continuation of Box C.



* 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)

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"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

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/30360

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:

Group 1 (claims 1-23)
Group 2 (claims 24-25)
Group 3 (claims 26-28)
Group 4 (claims 29-36)
Group 5 (claim 37)
Group 6 (claim 38-44)
Group 7 (claim 45-46)
Group 8 (claim 47-49)

---details on extra 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 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.:
1-23 and 29-49
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.:

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.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/30360

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,606,248 A (SHIKATA) 19 August 1986 (19.08.1986), col 1, lns 8-10; Fig. 1, 2, 36, 37	15-20
Y	US 2007/0140803 A1 (FILHO) 21 June 2007 (21.06.2007), para [0004] and [0013]; Fig. 1, 2	32, 33, 41-43, 48
Y	US 6,926,472 B2 (ARVIDSSON) 09 August 2005 (09.08.2005), col 1, lns 55-58; col 3, lns 23-24; col 4, lns 13-15; col 6, lns 6-11; Fig. 1, 3, 4	39

---Box III continued---

Group 1: claims 1-23 directed to a self-propelled rotary metal-cutting insert.

Group 2: claims 24-25 directed to a self-propelled annular, essentially axisymmetric, metal cutting element.

Group 3: claims 26-28, directed to a self-propelled annular axisymmetric metal cutting element.

Group 4: claims 29-36, directed to a In a cartridge for rotatably supporting on a tool body a self-propelled annular round metal cutting element.

Group 5: claim 37 directed to a cartridge assembly for rotatably mounting a self-propelled annular metal cutting element to a tool body.

Group 6: claim 38-44 directed to the combination of a self-propelled annular rotary metal cutting element with a cartridge which is mountable to a tool body and which supports the cutting element for rotation concentrically about a cartridge axis.

Group 7: claim 45-46 directed to the combination of a self-propelled annular rotary metal cutting element with a cartridge which is mountable to a tool body and which supports the cutting element for rotation concentrically about a cartridge axis.

Group 8: claim 47-49 directed to directed to a method for limiting the amount of heat transferred to bearings within a cartridge.

The inventions listed as Groups 1-8 do not relate to a single general inventive concept under PCT Rule 13.1 because under PCT Rule 13.2 they lack the same or corresponding technical features for the following reasons:

Groups 2-8 do not include the inventive concept of a body having a central axial hole extending between opposite ends of the body and by which the body can be mounted for rotation about its axis during and in response to cutting engagement of the insert with a workpiece, the body having an exterior surface which extends between the body ends and is defined as a surface of revolution concentric to the body axis, the exterior surface defining a circular cutting edge concentric to the body axis, the body being defined to impede the transfer of heat generated at the cutting edge across the surface of the central hole of the body of Group 1.

Groups 1 and 3-8 do not include the inventive concept of a self-propelled annular, essentially axisymmetric, metal cutting element adapted to be mounted via a central hole axially through the element for rotation in response to forces applied to the element when the element is engaged at a circumferential cutting edge of the element with a workpiece moving relative to the element, the cutting edge being located intermediate top and bottom ends of the element, the element having an exterior surface which includes the cutting edge and an element rake face which is open toward the element top end and which extends from the cutting edge toward the axis, the element defining a central riser which extends above the cutting edge plane to the element top end, the exterior surface of the element including a circumferential surface of the riser which at a lower end thereof merges into the rake face inwardly from the cutting edge and then extends upwardly at a selected angle relative to the axis, the value and direction of the selected angle being related to the composition of the workpiece and being defined to control cutting chips reated when the element operates to cut the workpiece of Group 2.

Groups 1-2 and 4-8 do not include the inventive concept of the rake face and the exterior surface of the riser being components of an element exterior surface which is a surface of revolution concentric to the axis except for the presence in the rake face and optionally in the riser exterior surface of circumferentially substantially regularly spaced surface features present in the element exterior surface inwardly from the cutting edge to interact with cutting chips in the use of the element. of Group 3.

Groups 1-3 and 5-8 do not include the inventive concept of in a cartridge for rotatably supporting on a tool body a self-propelled annular round metal cutting element which rotates in response to forces applied to the element when a circumferential cutting edge of the element engages a workpiece moving relative to the element, the cartridge including a stator mountable to the tool body, a rotor rotatably mounted to the stator via axial-load and radial-load bearings, the rotor having a cutting element support platform for engaging a bottom end of the element and an axial sleeve engageable with the inner diameter of the element, the improvement in which the rotor is defined compositionally and geometrically to provide increased thermal impedance to the transfer of heat to the rotor bearings from a cutting element supported by the rotor of Group 4.

Groups 1-4 and 6-8 do not include the inventive concept of a rotor rotatable about a circularly cylindrical upper end portion of the stator to which the cutting element is concentrically matable for radial and axial support of the element, and an insert hold-down cap releasably engageable with an upper end of the rotor for clamping a cutting element mated with the rotor to the rotor for rotation of the rotor of Group 5.

Groups 1-5 and 7-8 do not include the inventive concept of the cutting element rotates in response to engagement of its cutting edge with a workpiece moving relative to the element in use of the element and the element becomes hot as a result of such engagement with a workpiece, and the cartridge includes an axial stator adapted to be fixedly secured to a tool body, the cartridge also including a rotor rotatable about the stator and which concentrically receives the annular cutting element and supports a bottom surface of the cutting element on a support platform of the rotor and the cartridge includes an axial stator adapted to be fixedly secured to a tool body of Group 6.

Groups 1-6 and 8 do not include the inventive concept of an exterior surface of the cartridge between the element cutting edge and the rotor exterior surface bottom edge comprising a right circular frustoconical surface having its major diameter at the cutting edge of Group 7.

---Please see continuation sheet---

INTERNATIONAL SEARCH REPORT

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--extra sheet 1 continued--

Groups 1-7 do not include the inventive concept of cooperatively configuring the cutting element and components of the cartridge which contact the cutting element to define heat energy flow paths in the element to the cartridge and in the cartridge components including paths which have low thermal conductance toward the bearings and paths which have high thermal conductance to other locations in the cartridge of Group 8.

None of these technical features are common to the other groups, nor do they correspond to a special technical feature in the other groups. Therefore, unity of invention is lacking.