



(43) International Publication Date  
13 December 2012 (13.12.2012)

- (51) International Patent Classification:  
*B23B 27/14* (2006.01) *B23B 51/00* (2006.01)  
*B23B 51/10* (2006.01)
- (21) International Application Number:  
PCT/EP2012/059979
- (22) International Filing Date:  
29 May 2012 (29.05.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
11169510.2 10 June 2011 (10.06.2011) EP
- (71) Applicant (for all designated States except US): **SECO TOOLS AB** [SE/SE]; S-737 82 Fagersta (SE).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): **JANSSON, Mikael** [SE/SE]; Midgårdsvägen 18, S-774 67 Avesta (SE).
- (74) Agent: **HAMMARSJÖ, Joakim**; Sandvik Intellectual Property AB, S-811 81 Sandviken (SE).

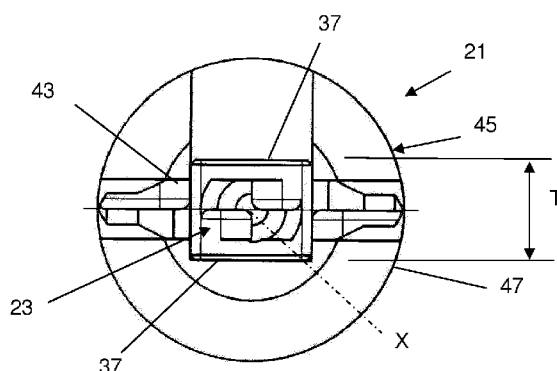
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: CUTTING INSERT HAVING A PLURALITY OF CUTTING ELEMENTS THEREON AND CUTTING TOOL THEREFOR



**FIG. 1B**

(57) Abstract: A cutting insert (23; 123; 223; 323; 423; 523; 623) includes at least one first insert supporting surface (25; 125; 225; 325; 425; 525; 625', 625'', 625''', 625'''), and a plurality of cutting elements (27; 127; 227; 327', 327'', 327''', 327'''; 427; 527; 627). Each cutting element includes at least one cutting edge (29), each cutting element projecting outwardly at its base (31) from the at least one first insert supporting surface (25; 125; 225; 325; 425; 525; 625', 625'', 625''', 625''') to a tip (35) of the cutting element remote from the at least one first insert supporting surface (25; 125; 225; 325; 425; 525; 625', 625'', 625''', 625'''). Each of the cutting elements (27; 227; 327'; 327''; 327'''; 327'''; 427) is substantially centered on a corresponding one of the plurality of first insert supporting surfaces (25; 225; 325; 425) in a thickness (T) direction of the cutting insert. There are four cutting elements (27; 127; 327', 327'', 327'''; 527), and each of the cutting elements (27; 327'; 327''; 327'''; 327''') is substantially centered on a corresponding one of the plurality of first insert supporting surfaces (25; 325).



## **CUTTING INSERT HAVING A PLURALITY OF CUTTING ELEMENTS THEREON AND CUTTING TOOL THEREFOR**

### **BACKGROUND AND SUMMARY**

[0001] The present invention relates generally to a cutting insert and a cutting tool and, more particularly, to such cutting inserts having a plurality of cutting elements thereon and cutting tools using such inserts.

[0002] It is desirable to provide cutting tools for metal chip removal with one or more replaceable cutting inserts having one or more cutting edges thereon that can be mounted to a toolholder and indexed to active positions and, after, becoming worn or damaged, can be moved to inactive positions so that other, unworn and undamaged cutting edges can be indexed to the active positions. Indexable cutting inserts are well known in machining operations such as rotating tool applications such as milling, drilling, and boring, and in turning applications. DE1271503 discloses a rotating tool with an insert that is indexable to two positions but, because of its configuration, cannot be adapted for indexing to additional positions, and can only be securely mounted in those two positions. However, in some applications, such as where it is desired to drill a relatively small diameter hole, conventional indexable inserts mounted on toolholders are not practical. It is desirable to provide cutting inserts and rotating cutting tools that facilitate provision of indexable cutting inserts in wide variety of applications. US5004379 discloses a cutting insert for a turning tool, the insert having three or more cutting edges, however, accurate positioning of the insert relative to a toolholder is complex.

[0003] According to an aspect of the present invention, a cutting insert includes at least one first insert supporting surface and a plurality of cutting elements. Each cutting element includes at least one cutting edge, each cutting element projecting outwardly at a base of the cutting element from the at least one first insert supporting surface to a tip of the cutting element remote from the at least one first insert supporting surface. There are four cutting elements and each of the cutting elements is substantially centered on a corresponding one of the plurality of first insert supporting surfaces.

[0004] According to another aspect of the present invention, a cutting tool comprises a toolholder having at least one insert-receiving recess and at least one cutting insert as described above mounted in the at least one insert-receiving recess.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The features and advantages of the present invention are well understood by reading the following detailed description in conjunction with the drawings in which like numerals indicate similar elements and in which:

[0006] FIGS. 1A and 1B are side and bottom views of a cutting tool according to an aspect of the present invention;

[0007] FIGS. 2A and 2B are perspective views of a cutting insert according to an aspect of the present invention;

[0008] FIG. 3 is a schematic side view of a cutting insert according to another aspect of the present invention;

[0009] FIG. 3 is a schematic side view of a cutting insert according to another aspect of the present invention;

[0010] FIG. 4 is a schematic side view of a cutting insert according to another aspect of the present invention;

[0011] FIG. 5 is a schematic side view of a cutting insert according to another aspect of the present invention;

[0012] FIG. 6 is a schematic side view of a cutting insert according to another aspect of the present invention;

[0013] FIG. 7 is a schematic side view of a cutting insert according to another aspect of the present invention; and

[0014] FIG. 8 is a schematic side view of a cutting insert according to another aspect of the present invention.

#### DETAILED DESCRIPTION

[0015] A cutting tool 21 according to an aspect of the present invention is shown in FIGS. 1A and 1B and includes a cutting insert 23 according to a further aspect of the present invention.

The cutting insert 23, an embodiment of which is shown in FIGS. 2A and 2B, comprises at least

one first insert supporting surface 25 (four shown in the embodiment of FIGS. 2A-2B) and a plurality of cutting elements 27. An insert supporting surface is defined as a surface that is designed to support the insert against an abutment surface, usually on a toolholder and it may be continuous, e.g. by being planar or being smoothly curved. An insert supporting surface is distinguished from an ordinary surface particularly in that the shape of the surface will ordinarily correspond with the shape of an abutment surface, and in that a location of the insert supporting surface relative to the cutting edge(s) of the insert is important to ensure proper positioning of the cutting edge when the insert supporting surface supports the insert by abutting against an abutment surface.

[0016] Each cutting element 27 comprises at least one cutting edge 29. Each cutting element 27 projects outwardly at its base 31 from the at least one first insert supporting surface 25 to a tip 35 of the cutting element remote from the at least one first insert supporting surface.

[0017] In a variety of embodiments such as are shown in FIGS. 2A-2B, 3, 4, 5, 6, and 8 the cutting insert 23, 123, 223, 323, 423, and 623 comprises a plurality of first insert supporting surfaces 25, 125, 225, 325, and 425 respectively. The embodiments of FIGS. 2A-2B, 3, 5, and 8 show cutting inserts 23, 123, 323, and 623 with four first insert supporting surfaces 25, 125, 325, and 625' (and 625'', 625''', 625'''); FIG. 4 shows a cutting insert 223 with three insert supporting surfaces 225; and FIG. 6 shows a cutting insert 423 with two (elliptical) first insert supporting surfaces. FIG. 7 shows an embodiment of a cutting insert 523 with a single first insert supporting surface 525 and a plurality of cutting elements 527 arranged around an indexing axis A of the cutting insert.

[0018] In each embodiment of the cutting insert 23, 123, 223, 323, 423, 523, and 623, the plurality of first insert supporting surfaces 25, 125, 225, 325, 425, 525, and 625', 625'', 625''', 625'''' and the plurality of cutting elements 27, 127, 227, 327' (and 327'', 327''', and 327'''), 427, 527, and 627 on the inserts can be arranged around an indexing axis A of the cutting insert, although it is not necessary that the first insert supporting surfaces or the cutting elements be arranged around an indexing axis. Each of the cutting elements 27, 227, 327', 327'', 327''', 327'''' and 427 is substantially centered on a corresponding one of the plurality of first insert supporting surfaces 25, 225, 325 and 425 in the thickness T direction of the cutting insert. Stated another way, each of the cutting elements 27, 227, 327', 327'', 327''', 327'''' and 427 may be disposed substantially in about a center of a corresponding one of the plurality of first insert supporting

surfaces 25, 225, 325 and 425 in a thickness T direction. The thickness T is defined as the distance between the second insert supporting surfaces 37.

Each of the cutting elements 27, 227, 327', 327'', 327''', 327'''' and 427 may be spaced from the at least two second insert supporting surfaces 37. Each of the cutting inserts 23, 123, 223, 323, 423, and 523 show each of the one or more first insert supporting surfaces arranged equidistantly from the indexing axis A of the cutting insert, however, as seen in the embodiment of FIG. 8, it will be appreciated that a cutting insert 623 might have one or more of a plurality of first insert supporting surfaces 625', 625'', 625''', and 625'''' arranged at different distances from an indexing axis A.

[0019] All of the cutting inserts 23, 123, 223, 423, 523, and 623 shown in FIGS. 2A-2B, 3, 4, 6, 7, and 8 have cutting elements 27, 127, 227, 427, 527, and 627 that are identical. If desired, however, a cutting insert 323 as shown in FIG. 5 can have one or more cutting elements 327', 327'', 327''', and 327'''' that differ from other ones of the plurality of cutting elements.

[0020] In the cutting inserts 23, 123, 223, 323, and 423 shown in FIGS. 2A-2B and 4-6, each of the cutting elements 27, 127, 227, 327' (and 327'', 327''', and 327'''), and 427, is shown disposed substantially in a center of a corresponding one of a plurality of first insert supporting surfaces 25, 125, 225, 325, 425. However, as seen in, for example, FIGS. 3 and 8, one or more of the cutting elements 627 can be disposed remote from a center of a first insert supporting surface 625'' and 625'''.

[0021] As seen with reference to the insert 23 shown in FIGS. 2A and 2B, the insert can include one or more (two shown) second insert supporting surfaces 37 extending transverse to an indexing axis A of the cutting insert. The second insert supporting surfaces 37 are illustrated as extending perpendicularly to the indexing axis A, and as being flat, however, it is not necessary that they extend perpendicularly to the indexing axis or that they be flat.

[0023] The insert 23 further comprises a through hole 39 extending between the at least two second insert supporting surfaces 37. As seen in FIG. 1A, the through hole 39 can be used to receive a mounting screw 41 for mounting the insert 23 relative to a recess 43 in a toolholder 45 of the cutting tool 21.

[0024] In the insert 23 shown in FIGS. 2A-B, each of the cutting elements 27 is substantially surrounded by a corresponding one of the plurality of first insert supporting surfaces 25.

However, it will be appreciated that the first insert supporting surface need not completely surround a particular cutting element. Moreover, a cutting element 127 might extend over a plurality of first insert supporting surfaces 125 as shown in FIG. 3.

[0025] The cutting tool 21 shown in FIGS. 1A and 1B comprises a toolholder 45 having at least one insert-receiving recess 43 and at least one cutting insert 23 mounted in the at least one insert-receiving recess. If desired, the cutting tool might have a plurality of recesses and a plurality of inserts mounted in the recesses. If the cutting tool comprises a plurality of recesses, not all of the cutting inserts provided in the recesses need to be the same type of insert.

[0026] The cutting tool 21 shown in FIGS. 1A and 1B is a stationary tool and, more particularly, a drilling tool with cutting elements 27 in the form of counterbore elements, such as dowel hole drill tips. It will be appreciated, however, that a cutting tool according to an aspect of the present invention might be a rotating tool such as a milling tool or another type of tool, such as a turning tool. In the cutting tool 21 shown in FIGS. 1A and 1B, the at least one cutting insert 23 is mounted in the at least one insert-receiving recess 43 so that at least one cutting element 27 is in an active position and a central axis X of the at least one active cutting element is substantially coaxial with an axis of rotation X' of the cutting tool. Other ones of the cutting element 27 are in inactive positions. The inactive cutting elements 27 can be disposed inside of an outer peripheral surface 47 of the toolholder 37 which can facilitate avoiding damage to the inactive cutting elements.

[0027] The cutting insert 23 shown in FIGS. 2A and 2B includes cutting edges 29 proximate the tips 35 of the cutting elements 27 and extending down to the base 31 of the element at the first insert supporting surface 25. The cutting elements 27 of the cutting insert 23 further comprise one or more flutes 49 extending from the tip 35 to the base 31 of the cutting elements. Other embodiments of the cutting insert might include a cutting edge only at a top or a side of the cutting element, and might include a chip breaker (not shown) to facilitate breakage and/or removal of chips.

[0028] The cutting insert 23 can be made of any suitable material, such as a sintered cemented tungsten carbide material.

[0029] In the present application, the use of terms such as “including” is open-ended and is intended to have the same meaning as terms such as “comprising” and not preclude the presence of other structure, material, or acts. Similarly, though the use of terms such as “can” or “may” is

intended to be open-ended and to reflect that structure, material, or acts are not necessary, the failure to use such terms is not intended to reflect that structure, material, or acts are essential. To the extent that structure, material, or acts are presently considered to be essential, they are identified as such.

[0030] While this invention has been illustrated and described in accordance with a preferred embodiment, it is recognized that variations and changes may be made therein without departing from the invention as set forth in the claims.

[0031] The disclosures in EP Patent Application No. 11169510.2, from which this application claims priority, are incorporated herein by reference.

## WHAT IS CLAIMED IS:

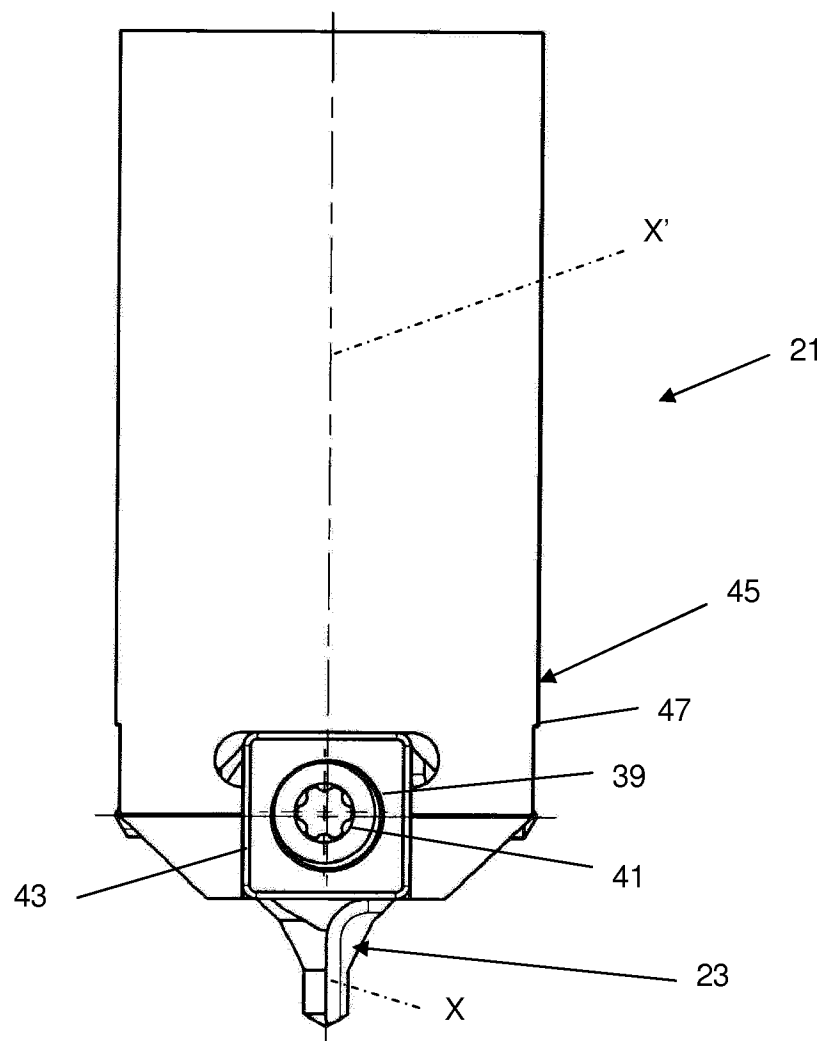
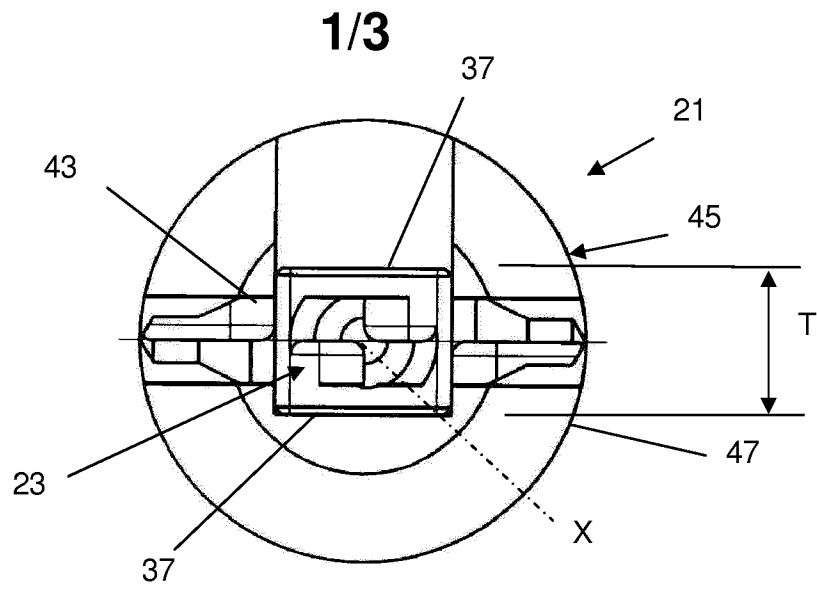
1. A cutting insert (23; 123; 323; 523) for a cutting tool, the insert comprising:
  - at least one first insert supporting surface (25; 125; 325; 525); and
  - a plurality of cutting elements (27; 127; 327', 327'', 327''', 327''''; 527), each cutting element comprising at least one cutting edge (29), each cutting element projecting outwardly at a base (31) of the cutting element from the at least one first insert supporting surface (25; 125; 325; 525) to a tip (35) of the cutting element remote from the at least one first insert supporting surface (25; 125; 325; 525) each of the cutting elements (27; 327'; 327''; 327'''; 327''') is substantially centered on a corresponding one of the plurality of first insert supporting surfaces (25; 325) in a thickness (T) direction of the cutting insert,
 

**characterized in that** there are four cutting elements (27; 127; 327', 327'', 327''', 327''''; 527), and each of the cutting elements (27; 327'; 327''; 327'''; 327''') is substantially centered on a corresponding one of the plurality of first insert supporting surfaces (25; 325).
2. The cutting insert (23; 123; 323) as set forth in claim 1, characterized in that the cutting insert comprises a plurality of first insert supporting surfaces (25; 125; 325).
3. The cutting insert (23; 123; 323) as set forth in claim 2, characterized in that the plurality of first insert supporting surfaces are arranged around an indexing axis (A) of the cutting insert.
4. The cutting insert (23; 123; 323; 523) as set forth in any of claims 1-3, characterized in that each of the plurality of first insert supporting surfaces (25; 125; 325; 525) is arranged equidistantly from an indexing axis (A) of the cutting insert.
5. The cutting insert (23; 123; 323; 523) as set forth in any of claims 1-4, characterized in that the plurality of cutting elements (27; 127; 327', 327'', 327''', 327''''; 527) are arranged around an indexing axis (A) of the cutting insert.
6. The cutting insert (23; 123; 323; 523) as set forth in any of claims 1-5, characterized in that each of the plurality of cutting elements (27; 127; 327', 327'', 327''', 327''''; 527) is arranged equidistantly from an indexing axis (A) of the cutting insert.

7. The cutting insert (23; 123; 323; 523) as set forth in any of claims 1-6, characterized in that at least two second insert supporting surfaces (37) extend transverse to an indexing axis (A) of the cutting insert.
8. The cutting insert (23; 123; 323; 523) as set forth in claim 6, characterized in that a through hole (39) extends between the at least two second insert supporting surfaces (37).
9. The cutting insert (23; 123; 523) as set forth in any of claims 1-7, characterized in that each of the cutting elements (27; 127; 527) is identical.
10. The cutting insert (23; 323) as set forth in any of claims 1-8, characterized in that each of the cutting elements (27; 327', 327'', 327''', 327''') is spaced from the at least two second insert supporting surfaces (37).
11. The cutting insert (23; 123; 323; 523) as set forth in any of claims 1-9, characterized in that each of the cutting elements (27; 327', 327'', 327''', 327'''; 527) is substantially surrounded by a corresponding one of the plurality of first insert supporting surfaces (25; 325; 525).
12. The cutting insert as set forth in any of claims 1-11, characterized in that the cutting element of the cutting insert comprises one or more flutes (49) extending from the tip (35) to a base (31) of the cutting element.
13. The cutting insert as set forth in any of claims 1-12, characterized in that the cutting element (27; 127; 327', 327'', 327''', 327'''; 527) is a drill.
14. A cutting tool (21) characterized in that it comprises a toolholder (45) having at least one insert-receiving recess (43) and at least one cutting insert (23; 123; 323; 523) as set forth in any of claims 1-12 mounted in the at least one insert-receiving recess.

15. The cutting tool (21) as set forth in claim 14, characterized in that the at least one cutting insert (23; 123; 323; 523) is mounted in the at least one insert-receiving recess (43) so that at least one cutting element (27) is in an active position and a central axis (X) of the at least one active cutting element (27) is substantially coaxial with an axis of rotation (X') of the cutting tool (21).

16. The cutting tool (21) as set forth in any of claims 14-15, characterized in that the at least one cutting insert (23; 123; 323; 523) is mounted in the at least one insert-receiving recess (43) so that at least one cutting element (27) is in an active position and at least one cutting element (27) is in an inactive position, and the at least one inactive cutting element is disposed inside of an outer peripheral surface (47) of the toolholder (45).



2/3

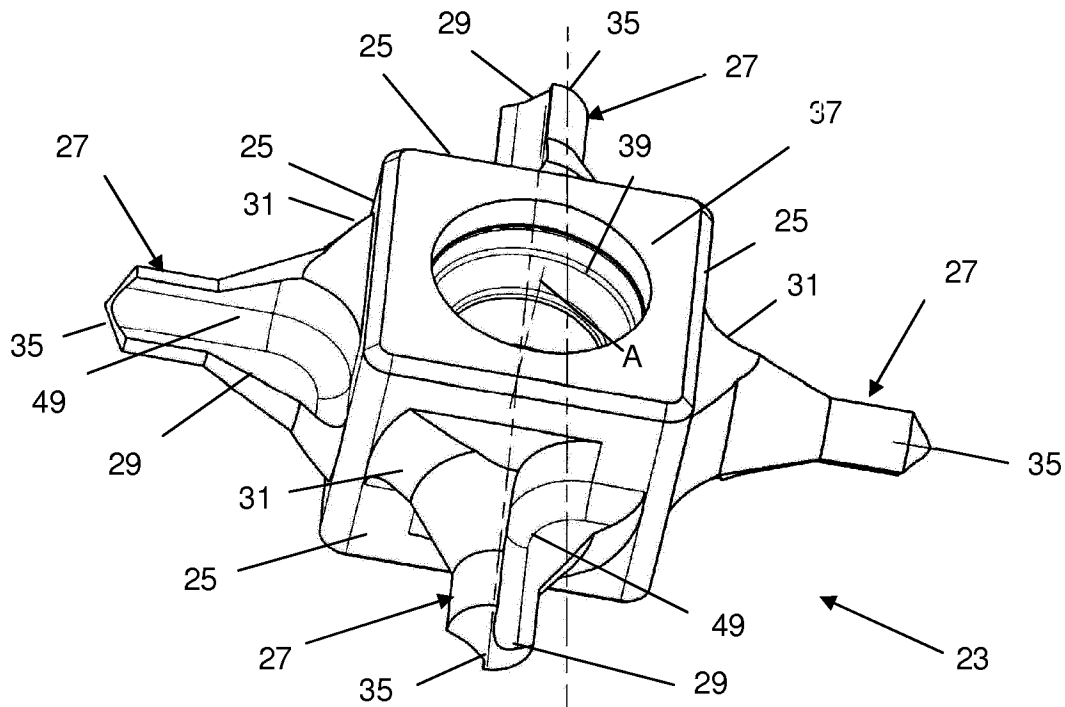


FIG. 2A

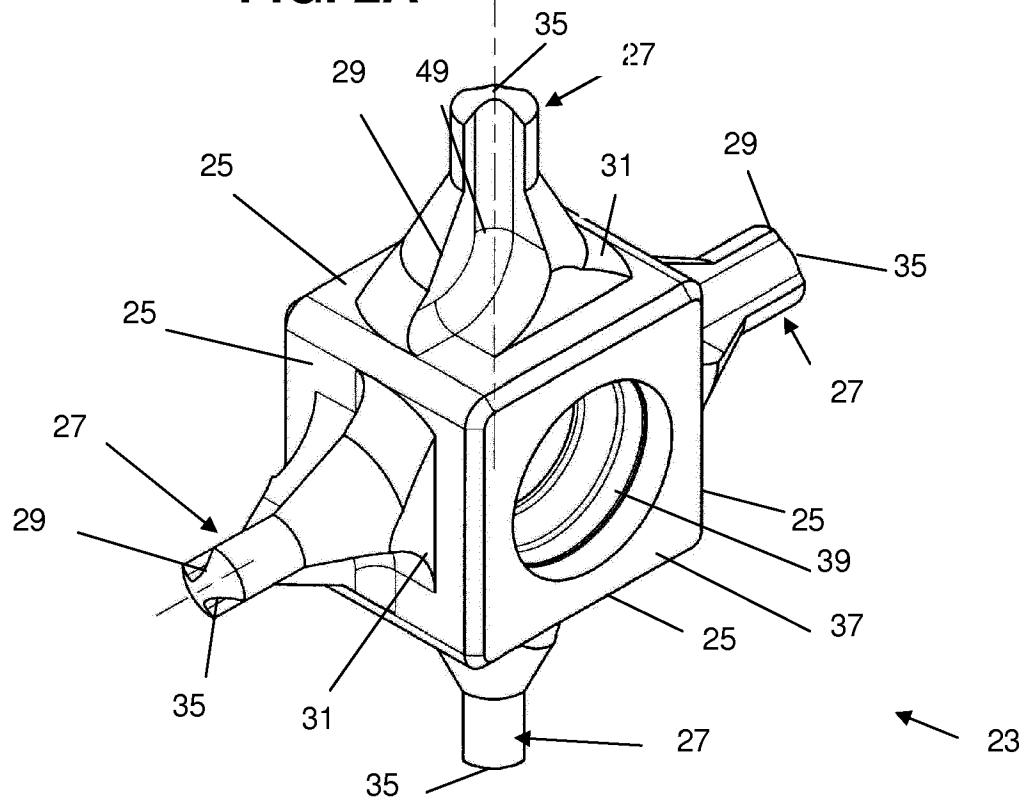


FIG. 2B

3/3

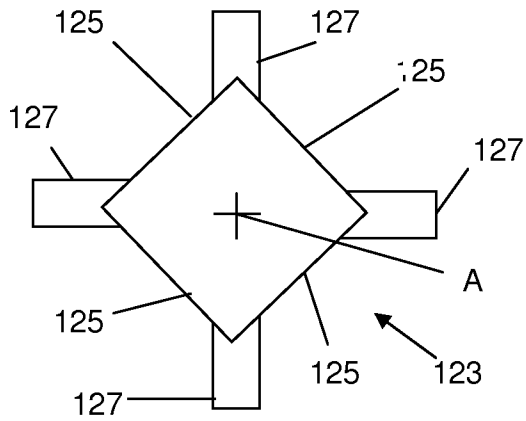


FIG. 3

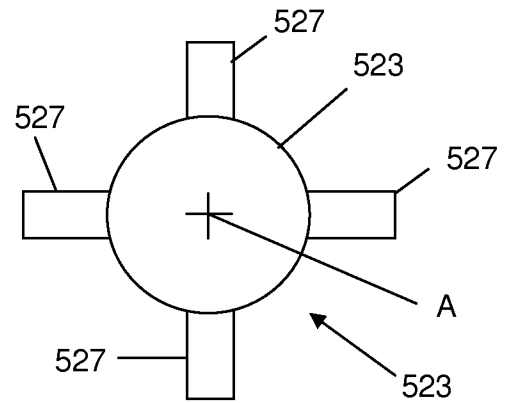


FIG. 7

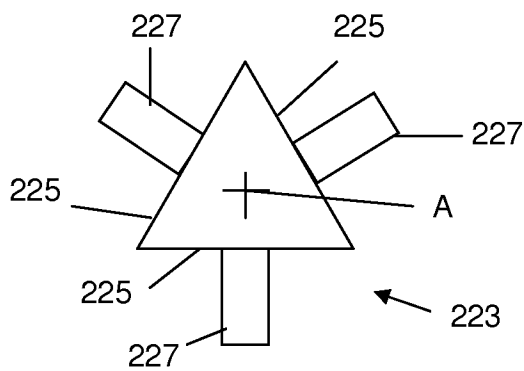


FIG. 4

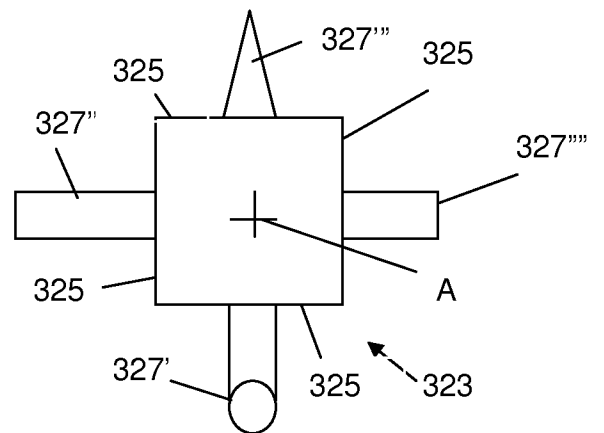


FIG. 5

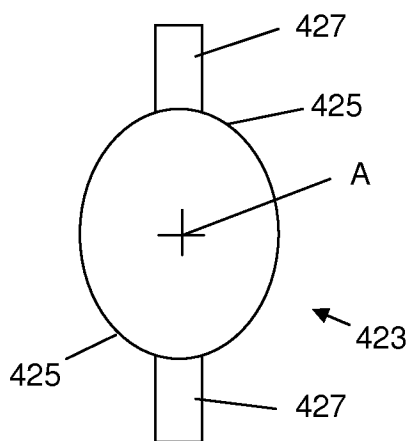


FIG. 6

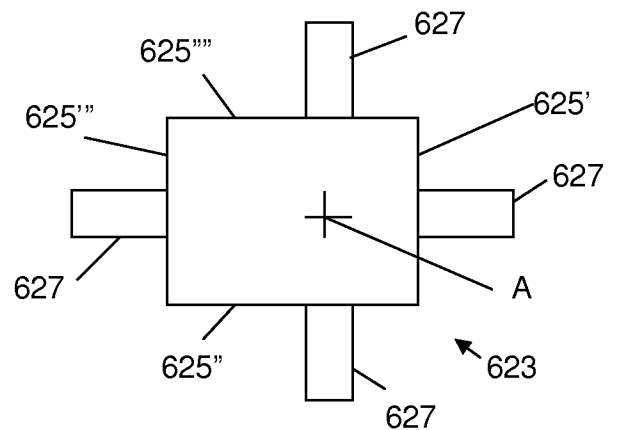


FIG. 8

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2012/059979

## A. CLASSIFICATION OF SUBJECT MATTER

INV. B23B27/14 B23B51/10 B23B51/00  
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)  
B23B B23C

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)

EPO-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. |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | US 5 004 379 A (LITTLE ROGER W [US])<br>2 April 1991 (1991-04-02)<br>cited in the application<br>column 2, line 54 - line 66<br>column 3, line 45 - line 47<br>column 4, line 15 - line 28; figures<br>----- | 1-16                  |
| A         | DE 100 42 779 A1 (SANDVIK AB [SE])<br>14 March 2002 (2002-03-14)<br>paragraph [0019]<br>paragraph [0042]; figures 6,7<br>-----                                                                               | 1-16                  |
| A         | US 2004/253063 A1 (MURRELL ROGER A [US])<br>16 December 2004 (2004-12-16)<br>paragraph [0018]<br>paragraph [0022]<br>paragraph [0025]; figures 6,7<br>-----<br>-/-                                           | 1-16                  |



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

23 July 2012

Date of mailing of the international search report

30/07/2012

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040,  
Fax: (+31-70) 340-3016

Authorized officer

Barrow, Jeffrey

## INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2012/059979

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                                     |                       |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Category*                                            | Citation of document, with indication, where appropriate, of the relevant passages                                                  | Relevant to claim No. |
| A                                                    | DE 12 71 503 B (ROBERT BREUNING)<br>27 June 1968 (1968-06-27)<br>column 2, line 14 - line 19; claims 1,2;<br>figures<br>-----       | 1                     |
| A                                                    | JP 1 092006 A (FUJI VALVE)<br>11 April 1989 (1989-04-11)<br>abstract; figures<br>-----                                              | 1                     |
| A                                                    | GB 625 229 A (FRY S LONDON LTD; ERNEST<br>LEONARD SIMMONS) 23 June 1949 (1949-06-23)<br>page 2, line 44 - line 71; figures<br>----- | 1                     |

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/059979

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date                                        |
|-------------------------------------------|---------------------|----------------------------|------------------------------------------------------------|
| US 5004379                                | A                   | 02-04-1991                 | NONE                                                       |
| DE 10042779                               | A1                  | 14-03-2002                 | NONE                                                       |
| US 2004253063                             | A1                  | 16-12-2004                 | US 2004253063 A1 16-12-2004<br>WO 2004105988 A2 09-12-2004 |
| DE 1271503                                | B                   | 27-06-1968                 | NONE                                                       |
| JP 1092006                                | A                   | 11-04-1989                 | JP 1092006 A 11-04-1989<br>JP 2626693 B2 02-07-1997        |
| GB 625229                                 | A                   | 23-06-1949                 | NONE                                                       |