

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization

International Bureau



(10) International Publication Number

WO 2014/155375 A1

(43) International Publication Date
2 October 2014 (02.10.2014)

WIPO | PCT

(51) International Patent Classification:
B23B 27/16 (2006.01) B23C 5/20 (2006.01)

(21) International Application Number:
PCT/IL2014/050236

(22) International Filing Date:
9 March 2014 (09.03.2014)

(25) Filing Language:
English

(26) Publication Language:
English

(30) Priority Data:
13/850,961 26 March 2013 (26.03.2013) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

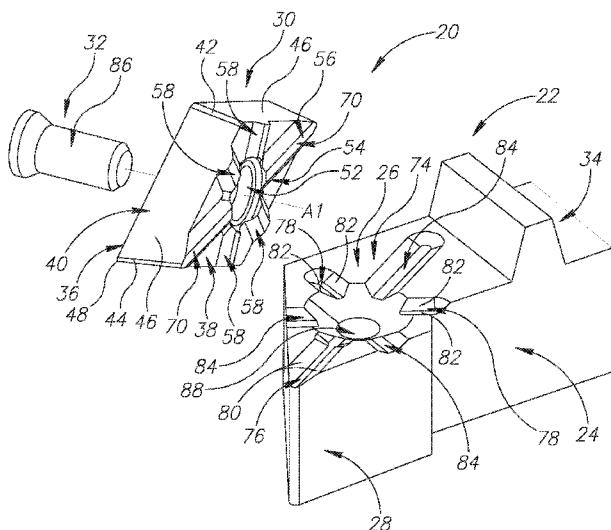
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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, KM, ML, MR, NE, SN, TD, TG).

Published:

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

(54) Title: RHOMBUS-SHAPED INDEXABLE CUTTING INSERT AND CUTTING TOOL



RHOMBUS-SHAPED INDEXABLE CUTTING INSERT AND CUTTING TOOL

FIELD OF THE INVENTION

The present invention relates to a cutting tool and a cutting insert for use in metal cutting processes in general, and for turning operations in particular.

5 BACKGROUND OF THE INVENTION

Within the field of cutting tools used in turning operations, there are many examples of cutting inserts being removably secured in an insert receiving pocket of a tool holder. In some instances, these cutting tools are configured such that the co-operating surfaces of the cutting insert and the insert receiving pocket are formed with protrusions and recesses. In other 10 instances, these cutting tools are configured such that the co-operating surfaces of the cutting insert and the insert receiving pocket are formed with male and female type mating elements.

US 7,201,545 discloses a cutting tool having a holder, a shim and an indexable cutting insert. The shim, having a substantially rhomboidal shape with substantially parallel upper and lower sides, is mounted in a pocket of the holder. The cutting insert, having a substantially 15 rhomboidal shape, in analogy with the shim, is mounted against the shim, whereby three out of six protrusions on a lower side of the cutting insert are in 'active' abutment with two support surfaces on the upper side of the shim, whilst two recesses on the upper side of the shim provide clearance for the other three 'passive' protrusions. Indexing the cutting insert by 180° results in the three 'active' protrusions becoming 'passive' and vice versa.

US 7,387,474 discloses a cutting tool having a holder with an insert seat, and an indexable cutting insert, with a rhombic basic shape, mounted therein. The insert seat includes two male type engagement portions in the form of elongated ridges oriented at 90° to each other, and forming a T-shaped configuration. A bottom side of the cutting insert includes two sets of female type engagement portions, each set having two elongated grooves oriented at 90° to each 25 other. In each index position of the cutting insert, one set is actively engaged with the two elongated ridges and the other set is inactive.

It is an object of the present invention to provide an improved cutting tool.

It is also an object of the present invention to evenly distribute the clamping force between the cutting insert and the insert holder, and to achieve stable three-point clamping.

It is a further object of the present invention to provide an engagement configuration between the cutting insert and the insert holder which provides good resistance to lateral cutting force components at the insert's operative nose cutting edge

5 It is a further object of the present invention to provide a tool holder that can be efficiently manufactured.

SUMMARY OF THE INVENTION

10 In accordance with the present invention, there is provided a generally rhombus-shaped indexable cutting insert comprising:

opposing upper and lower surfaces and a peripheral side surface extending therebetween, the peripheral side surface having alternating obtuse and acute corner surfaces separated by four relief surfaces;

15 a central axis passing through the upper and lower surfaces, about which central axis the cutting insert is indexable;

a minor vertical plane containing the central axis and intersecting the two obtuse corner surfaces; and

20 a nose cutting edge formed at the intersection of at least one of the upper and lower surfaces with each of the two acute corner surfaces,

at least one of the upper and lower surfaces comprising:

an engagement surface comprising a single primary engagement element and four secondary engagement elements,

25 the primary engagement element having an elongated pair of primary engagement flank surfaces and a primary engagement plane, the primary engagement element exhibiting mirror symmetry about the primary engagement plane,

each secondary engagement element including a secondary engagement portion, the secondary engagement portion having an elongated pair of secondary engagement flank surfaces and a secondary engagement plane, the secondary engagement portion exhibiting mirror symmetry about the secondary engagement plane,

wherein the primary engagement plane contains the central axis and intersects each nose cutting edge, and

wherein each secondary engagement plane does not contain the central axis and forms an acute engagement angle with the primary engagement plane.

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Also in accordance with the present invention, there is provided a cutting tool comprising:

a tool holder having a main body with an insert receiving pocket formed in a front end thereof, and a cutting insert of the sort described above removably secured in the insert receiving pocket by means of a clamping member.

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Further in accordance with the present invention, there is provided a generally rhombus-shaped indexable cutting insert comprising:

opposing upper and lower surfaces and a peripheral side surface extending therebetween, the peripheral side surface having alternating obtuse and acute corner surfaces separated by four relief surfaces;

a central axis passing through the upper and lower surfaces, about which central axis the cutting insert is indexable;

a minor vertical plane containing the central axis and intersecting the two obtuse corner surfaces; and

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a nose cutting edge formed at the intersection of at least one of the upper and lower surfaces with each of the two acute corner surfaces,

at least one of the upper and lower surfaces comprising:

an engagement surface comprising a single primary engagement element and four secondary engagement elements,

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the primary engagement element extending along a primary engagement plane which contains the central axis and intersects each nose cutting edge, the primary engagement element exhibiting mirror symmetry about the primary engagement plane, and the four secondary engagement elements constituting two pairs of parallel, offset secondary engagement elements, each pair having one member on either side of the primary engagement plane.

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BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding, the invention will now be described, by way of example only, with reference to the accompanying drawings in which chain-dash lines represent cut-off boundaries for partial views of a member and in which:

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Fig. 1 is a perspective view of a cutting tool in accordance with some embodiments of the present invention;

Fig. 2 is a side view of the cutting tool shown in Fig. 1;

Fig. 3 is an exploded perspective view of the cutting tool shown in Fig. 1;

10 **Fig. 4** is a bottom view of a 'single-sided' cutting insert in accordance with some embodiments of the present invention;

Fig. 5 is an imaginary four-sided polygon associated with the cutting insert shown in Fig. 4; and

15 **Fig. 6** is a bottom view of a 'double-sided' cutting insert in accordance with some embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a cutting tool **20** comprising a tool holder **22** having a main body **24** with an insert receiving pocket **26** formed in a front end **28** thereof, and a 20 generally rhombus-shaped indexable cutting insert **30**, **30'** removably secured in the insert receiving pocket **26** by means of a clamping member **32**.

In some embodiments of the present invention, as shown in Figs. 1 to 3, the cutting tool **20** may be in the form of a turning tool, having a holder shank **34** extending away from the front end **28** of the main body **24**.

25 Also, in some embodiments of the present invention, the tool holder **22** may be manufactured from machined steel, and the cutting insert **30**, **30'** may preferably be manufactured by form pressing and sintering a cemented carbide, such as tungsten carbide, and may be coated or uncoated.

According to the present invention, as shown in Figs. 1, 4 and 6, the generally rhombus-shaped cutting insert **30**, **30'** has opposing upper and lower surfaces **36**, **38** and a peripheral side

surface **40** extending therebetween, the peripheral side surface **40** having alternating obtuse and acute corner surfaces **42, 44** separated by four relief surfaces **46**.

In some embodiments of the present invention, the four relief surfaces **46** may be planar.

Also according to the present invention, a nose cutting edge **48** is formed at the intersection 5 of at least one of the upper and lower surfaces **36, 38** with each of the two acute corner surfaces **44**.

In some embodiments of the present invention, as shown in Figs. 1, 2 and 6, a rake surface **50** may be formed on at least one of the upper and lower surfaces **36, 38** adjacent each nose cutting edge **48**.

According to the present invention, as shown in Figs. 3, 4 and 6, a central axis **A1** passes 10 through the upper and lower surfaces **36, 38**, about which central axis **A1** the cutting insert **30, 30'** is indexable.

In some embodiments of the present invention, as shown in Figs. 4 and 6, a clamping bore 52 may extend co-axially with the central axis **A1** and open out to at least one of the upper and lower surfaces **36, 38**.

15 Also, in some embodiments of the present invention, the cutting insert **30, 30'** may exhibit two-fold rotational symmetry about the central axis **A1**.

According to the present invention, as shown in Figs. 3, 4 and 6, at least one of the upper and lower surfaces **36, 38** comprises an engagement surface **54** having five engagement ridges and/or grooves **56, 58**, the five engagement ridges and/or grooves **56, 58** comprising a single 20 primary engagement element **56** and four secondary engagement elements **58**.

In some embodiments of the present invention, the engagement surface **54** may have exactly five engagement ridges and/or grooves **56, 58**.

Also, in some embodiments of the present invention, when the cutting insert **30, 30'** is viewed axially along the central axis **A1**, as shown in Figs. 4 and 6, the four secondary engagement 25 elements **58** may be entirely located inside an imaginary circle **S** circumscribing the two obtuse corner surfaces **42**, and the primary engagement element **56** may intersect the imaginary circle **S**.

Further, in some embodiments of the present invention, only the lower surface **38** may 30 comprise an engagement surface **54**, and nose cutting edges **48** may only be formed at the intersection of the upper surface **36** with the two acute corner surfaces **44**. For these 'single-sided' embodiments of the cutting insert **30**, as shown in Fig. 4, the primary engagement element **56** of the lower surface **38** may intersect the two acute corner surfaces **44**.

Also, for these 'single-sided' embodiments of the cutting insert **30**, each of the four secondary engagement elements **58** of the lower surface **38** may intersect the peripheral side surface **40**.

Further, for these 'single-sided' embodiments of the cutting insert **30**, the cutting insert **30** 5 may be described as 'positive', having four relief surfaces **46** inclined inwardly in a direction away from the upper surface **36**.

Alternatively, in some embodiments of the present invention, as shown in Fig. 6, the cutting insert **30'** may be 'double-sided', with nose cutting edges **48** being formed at the intersection of both the upper and lower surfaces **36**, **38** with the two acute corner surfaces **44**, and 10 both the upper and lower surfaces **36**, **38** comprising an engagement surface **54**.

It should be appreciated that the 'double-sided' cutting insert **30'**, having a total of four nose cutting edges **48**, provides greater economic efficiency.

Further, for these 'double-sided' embodiments of the cutting insert **30'**, the cutting insert **30'** may be described as 'negative' or 'neutral', having four relief surfaces **46** parallel to the insert axis 15 **A1**.

According to the present invention, as shown in Figs. 4 and 6, the primary engagement element **56** has an elongated pair of primary engagement flank surfaces **60** and a vertically extending primary engagement plane **P1**. The primary engagement element **56** exhibits mirror symmetry about the primary engagement plane **P1**.

20 In some embodiments of the present invention, the cutting insert **30**, **30'** may exhibit mirror symmetry about the primary engagement plane **P1**.

Also, in some embodiments of the present invention, the two surface components of the pair of primary engagement flank surfaces **60** may be separated by the primary engagement plane **P1**.

25 Further, in some embodiments of the present invention, the primary engagement element **56** may be V-shaped when viewed in a cross-section perpendicular to the primary engagement plane **P1**.

Yet further, in some embodiments of the present invention, the two surface components of the pair of primary engagement flank surfaces **60** may extend parallel to each other.

30 It should be appreciated that use of the term "V-shaped" throughout the description and claims, is not restricted to a pair of flank surfaces forming a 'V' shape and intersecting at a vertex

point (when viewed in cross-section), but also accounts for an additional surface spacing apart the pair of flank surfaces.

In some embodiments of the present invention, the primary engagement element **56** may include a primary intermediate surface **62** spacing apart the pair of primary engagement flank surfaces **60**.

According to the present invention, as shown in Figs. 4 and 6, the primary engagement plane **P1** contains the central axis **A1** and intersects each nose cutting edge **48**.

In some embodiments of the present invention, the primary engagement plane **P1** may bisect each nose cutting edge **48**, and each nose cutting edge **48** may exhibit mirror symmetry about the primary engagement plane **P1**.

According to the present invention, as shown in Figs. 4 and 6, each secondary engagement element **58** includes a secondary engagement portion **64**, where the secondary engagement portion **64** has an elongated pair of secondary engagement flank surfaces **66** and a vertically extending secondary engagement plane **P2**. The secondary engagement portion **64** exhibits mirror symmetry about the secondary engagement plane **P2**.

In some embodiments of the present invention, the two surface components of each pair of secondary engagement flank surfaces **66** may be separated by their respective secondary engagement plane **P2**.

Also, in some embodiments of the present invention, each secondary engagement element **58** may be V-shaped when viewed in a cross-section perpendicular to its respective secondary engagement plane **P2**.

Further, in some embodiments of the present invention, the two surface components of each pair of secondary engagement flank surfaces **66** may extend parallel to each other.

Yet further, in some embodiments of the present invention, each secondary engagement portion **64** may include a secondary intermediate surface **68** spacing apart its respective pair of secondary engagement flank surfaces **66**.

In some embodiments of the present invention, the four secondary engagement portions **64** may be identical to each other.

Also, in some embodiments of the present invention, each secondary engagement plane **P2** may be non-coplanar with the other three secondary engagement planes **P2**. However, pairs of secondary engagement portions **64** intersecting opposite relief surfaces **46** may be parallel to one

another. This results in the four secondary engagement elements **58** constituting two pairs of parallel, offset secondary engagement elements **58**, each pair having one member on either side of the primary engagement plane **P1**.

Further, in some embodiments of the present invention, as shown in Figs. 4 and 6, each secondary engagement element **58** may be entirely located on one side of the primary engagement plane **P1**. For these embodiments of the present invention, two secondary engagement planes **P2** of two secondary engagement elements **58** located on the same side of the primary engagement plane **P1** may intersect at an intersection point **I** located on the opposite side of the primary engagement plane **P1**.

According to the present invention, a minor vertical plane **P3** contains the central axis **A1** and intersects the two obtuse corner surfaces **42**.

In some embodiments of the present invention, the minor vertical plane **P3** may bisect each obtuse corner surface **42**, and each obtuse corner surface **42** may exhibit mirror symmetry about the minor vertical plane **P3**.

Also, in some embodiments of the present invention, the cutting insert **30**, **30'** may exhibit mirror symmetry about the minor vertical plane **P3**.

Further, in some embodiments of the present invention, as shown in Figs. 4 and 6, each secondary engagement element **58** may be entirely located on one side of the minor vertical plane **P3**.

Yet further, in some embodiments of the present invention, as shown in Figs. 4 and 6, the primary engagement element **56** may comprise two spaced apart primary engagement portions **70**, and the two primary engagement portions **70** may be entirely located on opposite sides of the minor vertical plane **P3**. For these embodiments of the present invention, the two primary engagement portions **70** may be separated by the clamping bore **52**.

According to the present invention, as shown in Figs. 4 and 6, each secondary engagement plane **P2** does not contain the central axis **A1** and forms an acute engagement angle **α** with the primary engagement plane **P1**.

In some embodiments of the present invention, the four engagement angles **α** associated with the four secondary engagement planes **P2** may have the same value.

Also, in some embodiments of the present invention, as shown in Figs. 4 and 6, each secondary engagement plane **P2** may intersect with exactly two other secondary engagement planes **P2** to form total of four intersection points **I** when viewed axially along the central axis **A1**.

For embodiments of the present invention having four intersection points **I**, the four 5 intersection points **I** may form four imaginary corners **C_A**, **C_O** of an imaginary four-sided polygon **R**, as shown in Fig. 5.

For these 'imaginary four-sided polygon' embodiments of the present invention, the primary engagement plane **P1** may contain two imaginary corners **C_O** of the imaginary four-sided polygon **R**.

10 Also, for these 'imaginary four-sided polygon' embodiments of the present invention, the central axis **A1** may be located at the center of the imaginary four-sided polygon **R**.

Further, for these 'imaginary four-sided polygon' embodiments of the present invention, the imaginary four-sided polygon **R** may be rhombus-shaped, having two diagonally opposed acute imaginary corners **C_A** and two diagonally opposed obtuse imaginary corners **C_O**.

15 For these 'imaginary rhombus-shaped polygon' embodiments of the present invention, as shown in Fig. 5, at each obtuse imaginary corner **C_O** two imaginary sides **72** of the imaginary four-sided polygon **R** may intersect to form an obtuse polygon angle **β**, and the primary engagement plane **P1** may contain the two obtuse imaginary corners **C_O**.

The obtuse polygon angle **β** has a preferable range of 105°-135°.

20 According to the present invention, as shown in Fig. 3, the insert receiving pocket **26** comprises a support surface **74** having three support ridges and/or grooves **76**, **78**, the three support ridges and/or grooves **76**, **78** comprising a single primary support element **76** and two secondary support elements **78**.

25 Also, according to the present invention, either the upper or lower surface **36**, **38** of the cutting insert **30**, **30'** is clamped against the support surface **74** of the insert receiving pocket **26** solely by:

the primary engagement element **56** making contact with the primary support element **76**; and

30 two of the four secondary engagement elements **58** making contact with the two secondary support elements **78**.

In some embodiments of the present invention, as shown in Fig. 2, except for the contact between the engagement elements **56**, **58** and the support elements **76**, **78**, a gap **G** is formed between the operative upper or lower surface **36**, **38** and the support surface **74**.

5 In some embodiments of the present invention, the primary engagement element **56** may make contact with the primary support element **76** at least outside the imaginary circle **S** of the cutting insert **30**, **30'**.

10 Also, in some embodiments of the present invention, where the primary engagement element **56** comprises two spaced apart primary engagement portions **70** located on opposite sides of the minor vertical plane **P3**, only the primary engagement portion **70** on the same side of the minor vertical plane **P3** as the operative nose cutting edge **48** may make contact with the primary support element **76**.

15 Further, in some embodiments of the present invention, the two operative secondary engagement elements **58**, making contact with the two secondary support elements **78**, may be entirely located on one side of the minor vertical plane **P3**, and the operative nose cutting edge **48** may be located on the other side of the minor vertical plane **P3**.

It should be appreciated that locating the two operative secondary engagement elements **58** on the opposite side of the minor vertical plane **P3** from the operative primary engagement portion **70** evenly distributes the clamping force, applied by the clamping member **32**, between these three components, and achieves stable three-point clamping.

20 Even distribution of the clamping force is also successfully achieved for embodiments of the present invention where the two operative secondary engagement elements **58** are located inside the the imaginary circle **S** and the operative primary engagement portion **70** makes contact with the primary support element **76** outside the imaginary circle **S**.

25 In some embodiments of the present invention, as shown in Fig. 2, the operative nose cutting edge **48** may be subject to a main cutting force **F** directed generally parallel to the central axis **A1**, when the cutting tool **20** is used to cut a workpiece.

30 Also, in some embodiments of the present invention, the pair of primary engagement flank surfaces **60** of the primary engagement element **56** may make contact with a corresponding pair of primary support flank surfaces **80** on the primary support element **76**, and each pair of secondary engagement flank surfaces **66** of the two operative secondary engagement elements **58**, making

contact with the two secondary support elements **78**, may make contact with a corresponding pair of secondary support flank surfaces **82** on one of the two secondary support elements **78**.

It should be appreciated that by configuring the four secondary engagement elements **58** such that each secondary engagement plane **P2** does not contain the central axis **A1**, but forms an acute engagement angle α with the primary engagement plane **P1**, the corresponding secondary support elements **78** advantageously provide good resistance to lateral cutting force components at the operative nose cutting edge **48** directed away from the central axis **A1**.

In some embodiments of the present invention, the primary and secondary engagement elements **56**, **58** may be in the form of ridges, and the primary and secondary support elements **76**, **78** may be in the form of grooves.

For embodiments of the present invention having the engagement surface **54** configured with primary and secondary engagement ridges **56**, **58** and the support surface **74** configured with primary and secondary support grooves **76**, **78**, the support surface **74** also includes support recesses **84** to accommodate the non-operative engagement ridges **56**, **58** and portions thereof, such that the non-operative engagement ridges **56**, **58** and portions thereof make no contact with the support surface **74**.

It should be appreciated that the support surface **74** being configured with primary and secondary support grooves **76**, **78** and support recesses **84**, enables the insert receiving pocket **26** to be manufactured with greater efficiency.

In some embodiments of the present invention, the clamping bore **52** may open out to both the upper and lower surfaces **36**, **38**, and the clamping member **32** may be in the form of a clamping screw **86** located in the clamping bore **52** and threadingly engaged in a threaded bore **88** in the support surface **74**.

Also, in some embodiments of the present invention, the peripheral side surface **40** may not make contact with the insert receiving pocket **26**.

CLAIMS

What is claimed is:

1. A generally rhombus-shaped indexable cutting insert (30, 30') comprising:
 - opposing upper and lower surfaces (36, 38) and a peripheral side surface (40) extending therebetween, the peripheral side surface (40) having alternating obtuse and acute corner surfaces (42, 44) separated by four relief surfaces (46);
 - a central axis (A1) passing through the upper and lower surfaces (36, 38), about which central axis (A1) the cutting insert (30, 30') is indexable;
 - a minor vertical plane (P3) containing the central axis (A1) and intersecting the two obtuse corner surfaces (42); and
 - a nose cutting edge (48) formed at the intersection of at least one of the upper and lower surfaces (36, 38) with each of the two acute corner surfaces (44),
 - at least one of the upper and lower surfaces (36, 38) comprising:
 - an engagement surface (54) comprising a single primary engagement element (56) and four secondary engagement elements (58),
 - the primary engagement element (56) having an elongated pair of primary engagement flank surfaces (60) and a primary engagement plane (P1), the primary engagement element (56) exhibiting mirror symmetry about the primary engagement plane (P1),
 - each secondary engagement element (58) including a secondary engagement portion (64), the secondary engagement portion (64) having an elongated pair of secondary engagement flank surfaces (66) and a secondary engagement plane (P2), the secondary engagement portion (64) exhibiting mirror symmetry about the secondary engagement plane (P2),
 - wherein the primary engagement plane (P1) contains the central axis (A1) and intersects each nose cutting edge (48), and
 - wherein each secondary engagement plane (P2) does not contain the central axis (A1) and forms an acute engagement angle (α) with the primary engagement plane (P1).

2. The cutting insert (30, 30') according to claim 1, wherein when viewed axially along the central axis (A1):

the four secondary engagement elements (58) are entirely located inside an imaginary circle (S) circumscribing the two obtuse corner surfaces (42), and

the primary engagement element (56) intersects the imaginary circle (S).

3. The cutting insert (30, 30') according to claim 1 or 2, wherein each secondary engagement plane (P2) is non-coplanar with the other three secondary engagement planes (P2).

4. The cutting insert (30, 30') according to any one of the preceding claims, wherein the engagement surface (54) has exactly five engagement ridges and/or grooves, each primary and secondary engagement element (56, 58) being a ridge or a groove.

5. The cutting insert (30, 30') according to any one of the preceding claims, wherein the four secondary engagement portions (64) are identical to each other.

6. The cutting insert (30, 30') according to any one of the preceding claims, wherein the four engagement angles (α) associated with the four secondary engagement planes (P2) have the same value.

7. The cutting insert (30, 30') according to any one of the preceding claims, wherein the primary engagement plane (P1) bisects each nose cutting edge (48), and wherein

each nose cutting edge (48) exhibits mirror symmetry about the primary engagement plane (P1).

8. The cutting insert (30, 30') according to any one of the preceding claims, wherein the cutting insert (30, 30') exhibits mirror symmetry about the primary engagement plane (P1).

9. The cutting insert (30, 30') according to any one of the preceding claims, wherein the cutting insert (30, 30') exhibits two-fold rotational symmetry about the central axis (A1).

10. The cutting insert (30, 30') according to any one of the preceding claims, wherein a rake surface (50) is formed on at least one of the upper and lower surfaces (36, 38) adjacent each nose cutting edge (48).

11. The cutting insert (30, 30') according to any one of the preceding claims, wherein the primary engagement element (56) is V-shaped when viewed in a cross-section perpendicular to the primary engagement plane (P1) and each secondary engagement element (58) is V-shaped when viewed in a cross-section perpendicular to its respective secondary engagement plane (P2).

12. The cutting insert (30, 30') according to any one of the preceding claims, wherein the primary engagement element (56) includes a primary intermediate surface (62) spacing apart the pair of primary engagement flank surfaces (60), and

wherein each secondary engagement portion (64) includes a secondary intermediate surface (68) spacing apart its respective pair of secondary engagement flank surfaces (66).

13. The cutting insert (30, 30') according to any one of the preceding claims, wherein the two surface components of the pair of primary engagement flank surfaces (60) extend parallel to each other, and

wherein the two surface components of each pair of secondary engagement flank surfaces (66) extend parallel to each other.

14. The cutting insert (30, 30') according to any one of the preceding claims, wherein the two surface components of the pair of primary engagement flank surfaces (60) are separated by the primary engagement plane (P1), and

wherein the two surface components of each pair of secondary engagement flank surfaces (66) are separated by their respective secondary engagement plane (P2).

15. The cutting insert (30, 30') according to any one of the preceding claims, wherein each secondary engagement element (58) is entirely located on one side of the minor vertical plane (P3).

16. The cutting insert (30, 30') according to any one of the preceding claims, wherein the primary engagement element (56) comprises two spaced apart primary engagement portions (70), and

wherein the two primary engagement portions (70) are entirely located on opposite sides of the minor vertical plane (P3).

17. The cutting insert (30, 30') according to any one of the preceding claims, wherein each secondary engagement element (58) is entirely located on one side of the primary engagement plane (P1).

18. The cutting insert (30, 30') according to claim 17, wherein two secondary engagement planes (P2) of two secondary engagement elements (58) located on the same side of the primary engagement plane (P1) intersect at an intersection point (I) located on the opposite side of the primary engagement plane (P1).

19. The cutting insert (30, 30') according to any one of the preceding claims, wherein each secondary engagement plane (P2) intersects with exactly two other secondary engagement planes (P2) to form total of four intersection points (I) when viewed axially along the central axis (A1).

20. The cutting insert (30, 30') according to claim 19, wherein the four intersection points (I) form four imaginary corners (C_A, C_O) of an imaginary four-sided polygon (R).

21. The cutting insert (30, 30') according to claim 20, wherein the primary engagement plane (P1) contains two imaginary corners (C_O) of the imaginary four-sided polygon (R).

22. The cutting insert (30, 30') according to claim 20 or 21, wherein the imaginary four-sided polygon (R) is rhombus-shaped, having two diagonally opposed acute imaginary corners (C_A) and two diagonally opposed obtuse imaginary corners (C_O).

23. The cutting insert (30, 30') according to claim 22, wherein at each obtuse imaginary corner (C_O), two imaginary sides (72) of the imaginary four-sided polygon (R) intersect to form an obtuse polygon angle (β), and

wherein the primary engagement plane (P1) contains the two obtuse imaginary corners (C_O).

24. The cutting insert (30) according to any one of the preceding claims, wherein only the lower surface (38) comprises an engagement surface (54) and nose cutting edges (48) are only formed at the intersection of the upper surface (36) with the two acute corner surfaces (44), and

wherein the primary engagement element (56) of the lower surface (38) intersects the two acute corner surfaces (44).

25. The cutting insert (30) according to any one of the preceding claims, wherein each of the four secondary engagement elements (58) of the lower surface (38) intersects the peripheral side surface (40).

26. The cutting insert (30') according to any one of claims 1 to 23, wherein nose cutting edges (48) are formed at the intersection of both the upper and lower surfaces (36, 38) with the two acute corner surfaces (44), and

wherein both the upper and lower surfaces (36, 38) comprise an engagement surface (54).

27. A cutting tool (20) comprising:

a tool holder (22) having a main body (24) with an insert receiving pocket (26) formed in a front end (28) thereof, and a cutting insert (30, 30') in accordance with any one of the preceding claims removably secured in the insert receiving pocket (26) by means of a clamping member (32), the cutting insert (30, 30') having an operative nose cutting edge (48).

28. The cutting tool (20) according to claim 27, wherein:
the insert receiving pocket (26) comprises:

a support surface (74) comprising a single primary support element (76) and two secondary support elements (78),

wherein the cutting insert (30, 30') is clamped against the support surface (74) of the insert receiving pocket (26) solely by:

the primary engagement element (56) making contact with the primary support element (76), and

two of the four secondary engagement elements (58) are operative, making contact with the two secondary support elements (78).

29. The cutting tool (20) according to claim 28, wherein:

the primary and secondary engagement elements (56, 58) are ridges, and
wherein the primary and secondary support elements (76, 78) are grooves.

30. The cutting tool (20) according to claim 28 or 29, wherein the pair of primary engagement flank surfaces (60) of the primary engagement element (56) makes contact with a corresponding pair of primary support flank surfaces (80) on the primary support element (76), and

wherein each pair of secondary engagement flank surfaces (66) of the two operative secondary engagement elements (58) makes contact with a corresponding pair of secondary support flank surfaces (82) on one of the two secondary support elements (78).

31. The cutting tool (20) according to any one of claims 28 to 30, wherein the two operative secondary engagement elements (58) are entirely located on one side of the minor vertical plane (P3) and the operative nose cutting edge (48) is located on the other side of the minor vertical plane (P3).

32. The cutting tool (20) according to any one of claims 28 to 31, wherein the primary engagement element (56) comprises two spaced apart primary engagement portions (70), the two primary engagement portions (70) entirely located on opposite sides of the minor vertical plane (P3), and

wherein only the primary engagement portion (70) on the same side of the minor vertical plane (P3) as the operative nose cutting edge (48) makes contact with the primary support element (76).

33. The cutting tool (20) according to any one of claims 28 to 32, wherein the four secondary engagement elements (58) are entirely located inside an imaginary circle (S) circumscribing the two obtuse corner surfaces (42), and

wherein the primary engagement element (56) makes contact with the primary support element (76) at least outside the imaginary circle (S).

34. A generally rhombus-shaped indexable cutting insert (30, 30') comprising:

opposing upper and lower surfaces (36, 38) and a peripheral side surface (40) extending therebetween, the peripheral side surface (40) having alternating obtuse and acute corner surfaces (42, 44) separated by four relief surfaces (46);

a central axis (A1) passing through the upper and lower surfaces (36, 38), about which central axis (A1) the cutting insert (30, 30') is indexable;

a minor vertical plane (P3) containing the central axis (A1) and intersecting the two obtuse corner surfaces (42); and

a nose cutting edge (48) formed at the intersection of at least one of the upper and lower surfaces (36, 38) with each of the two acute corner surfaces (44),

at least one of the upper and lower surfaces (36, 38) comprising:

an engagement surface (54) comprising a single primary engagement element (56) and four secondary engagement elements (58),

the primary engagement element (56) extending along a primary engagement plane (P1) which contains the central axis (A1) and intersects each nose cutting edge (48), the primary engagement element (56) exhibiting mirror symmetry about the primary engagement plane (P1), and

the four secondary engagement elements (58) constituting two pairs of parallel, offset secondary engagement elements (58), each pair having one member on either side of the primary engagement plane (P1).

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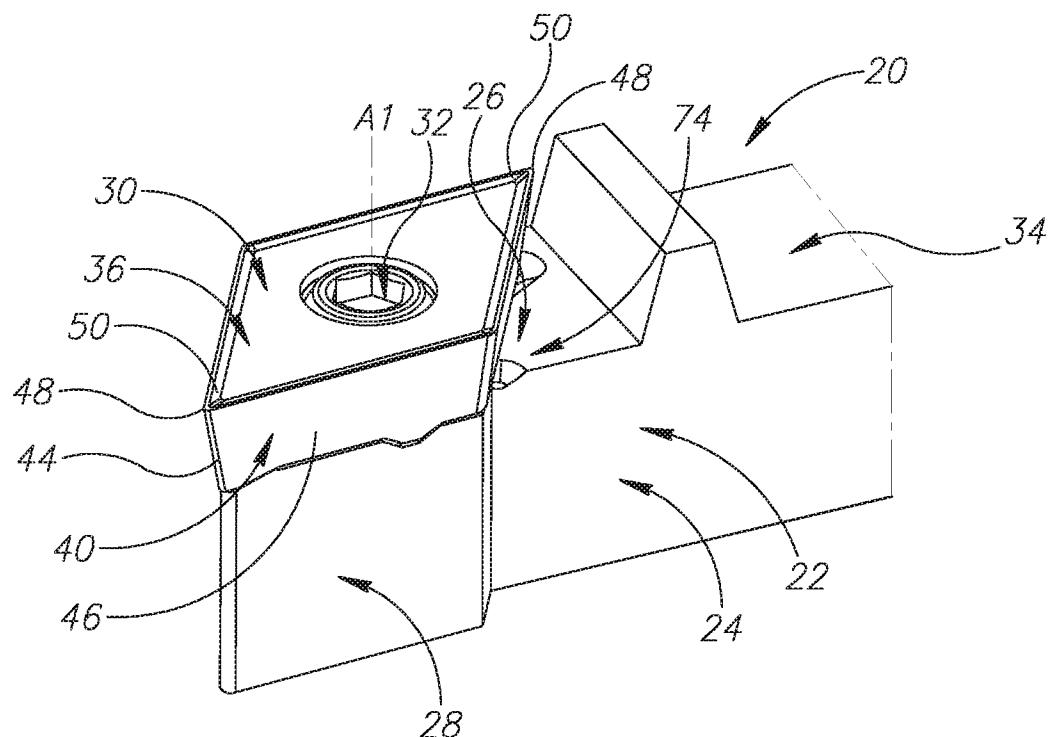


FIG.1

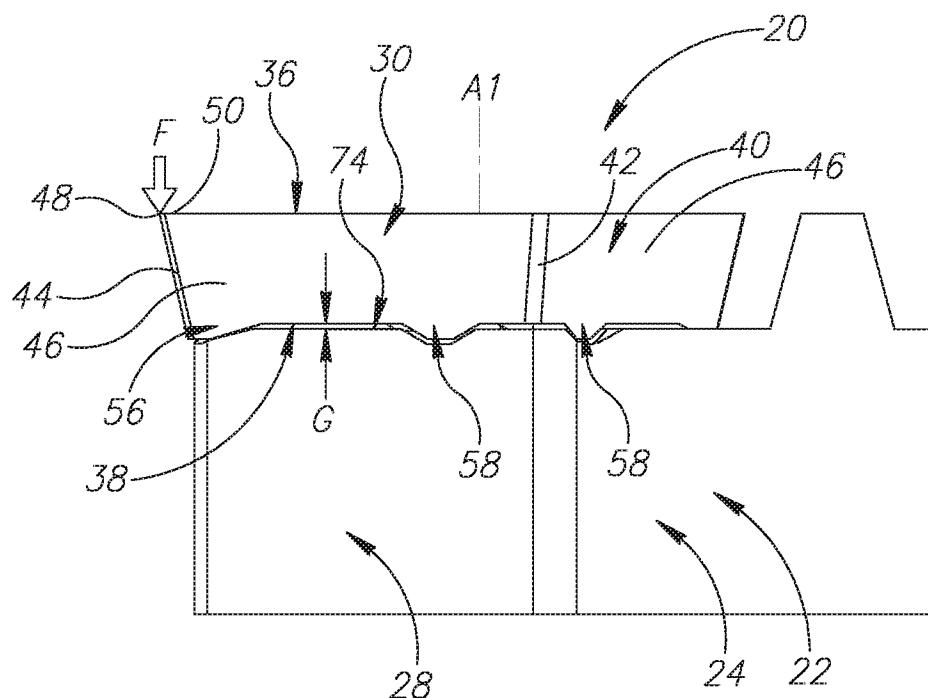


FIG.2

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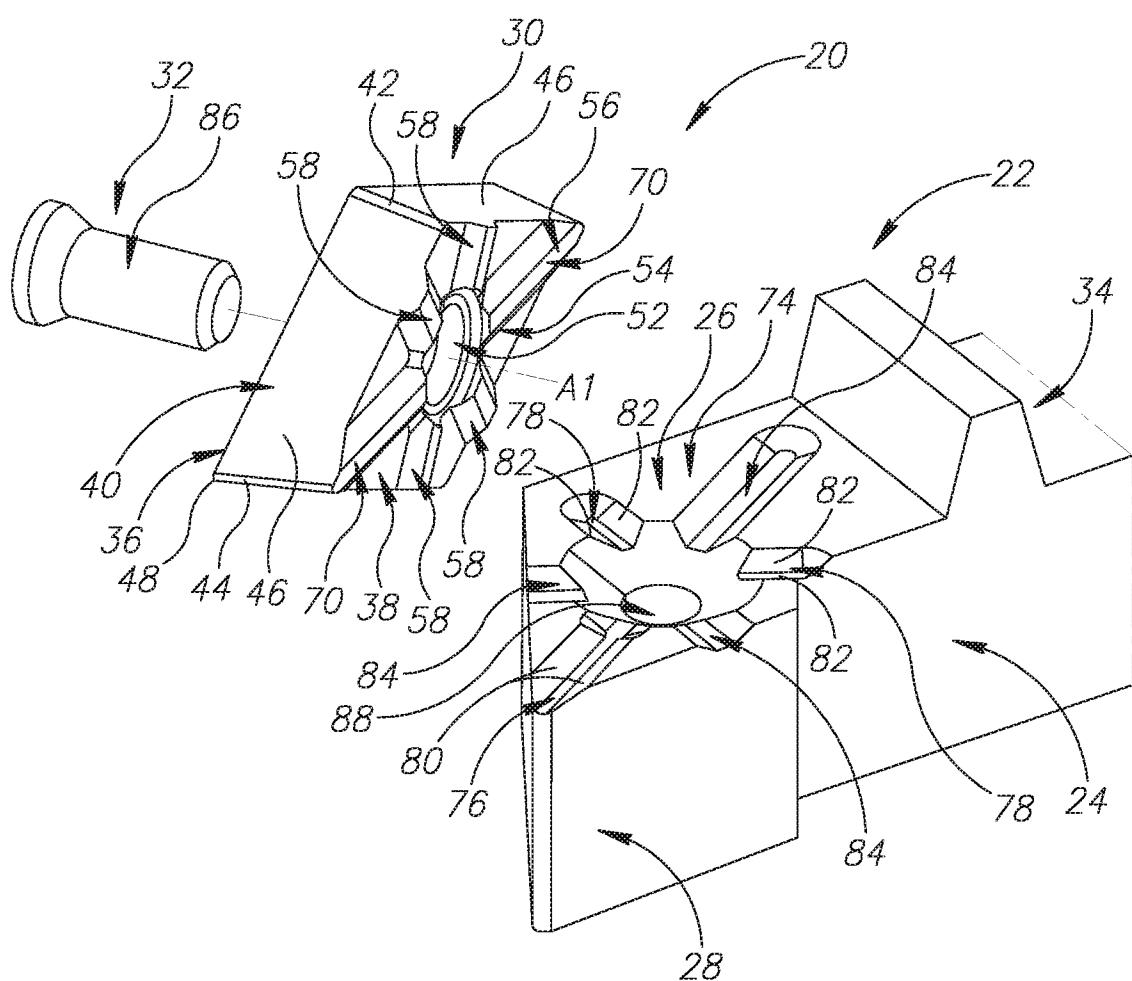


FIG.3

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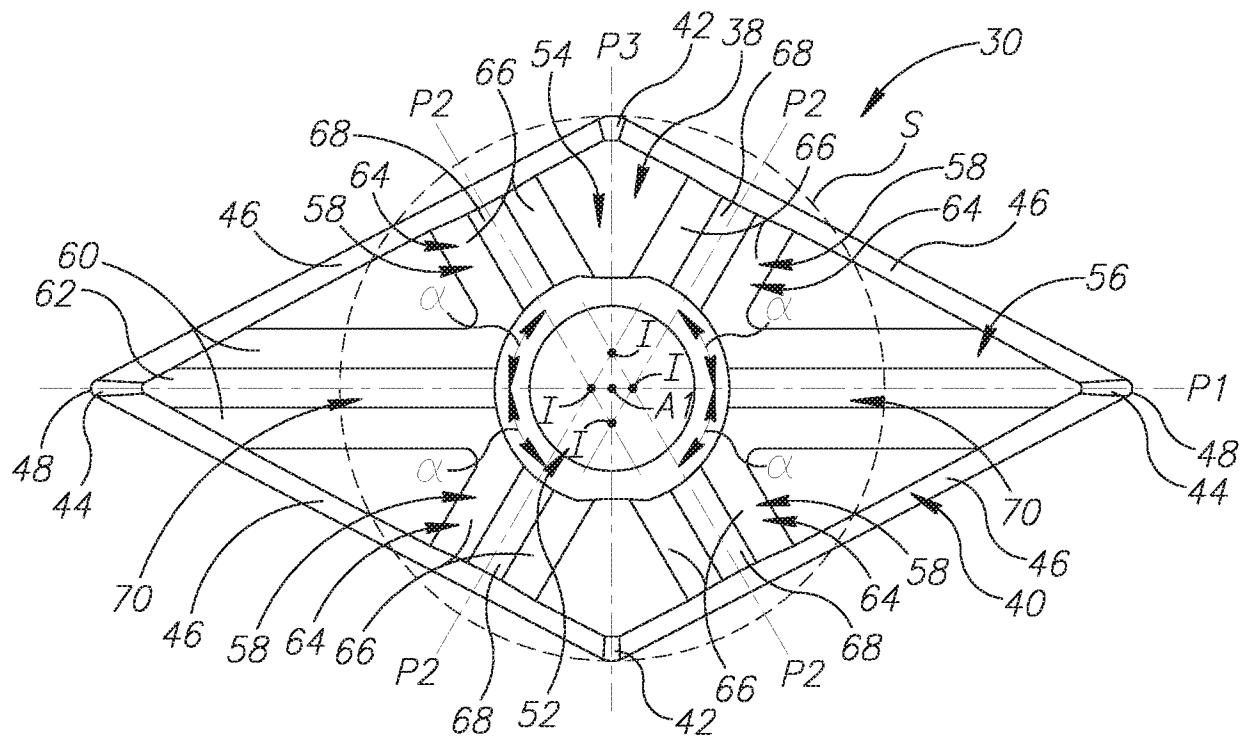


FIG. 4

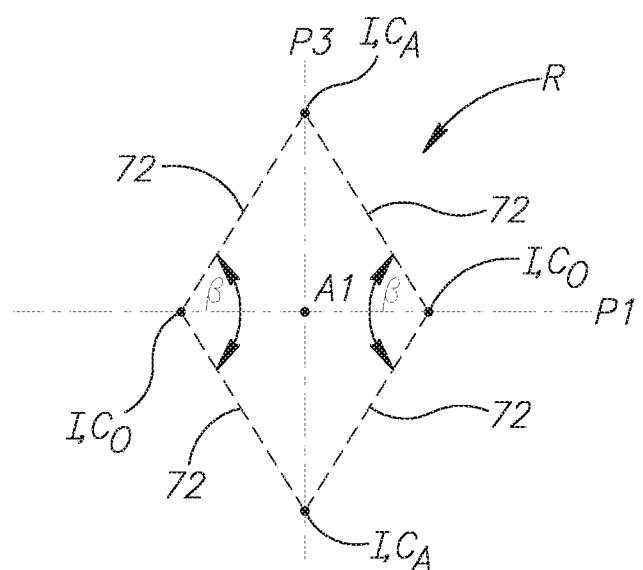


FIG.5

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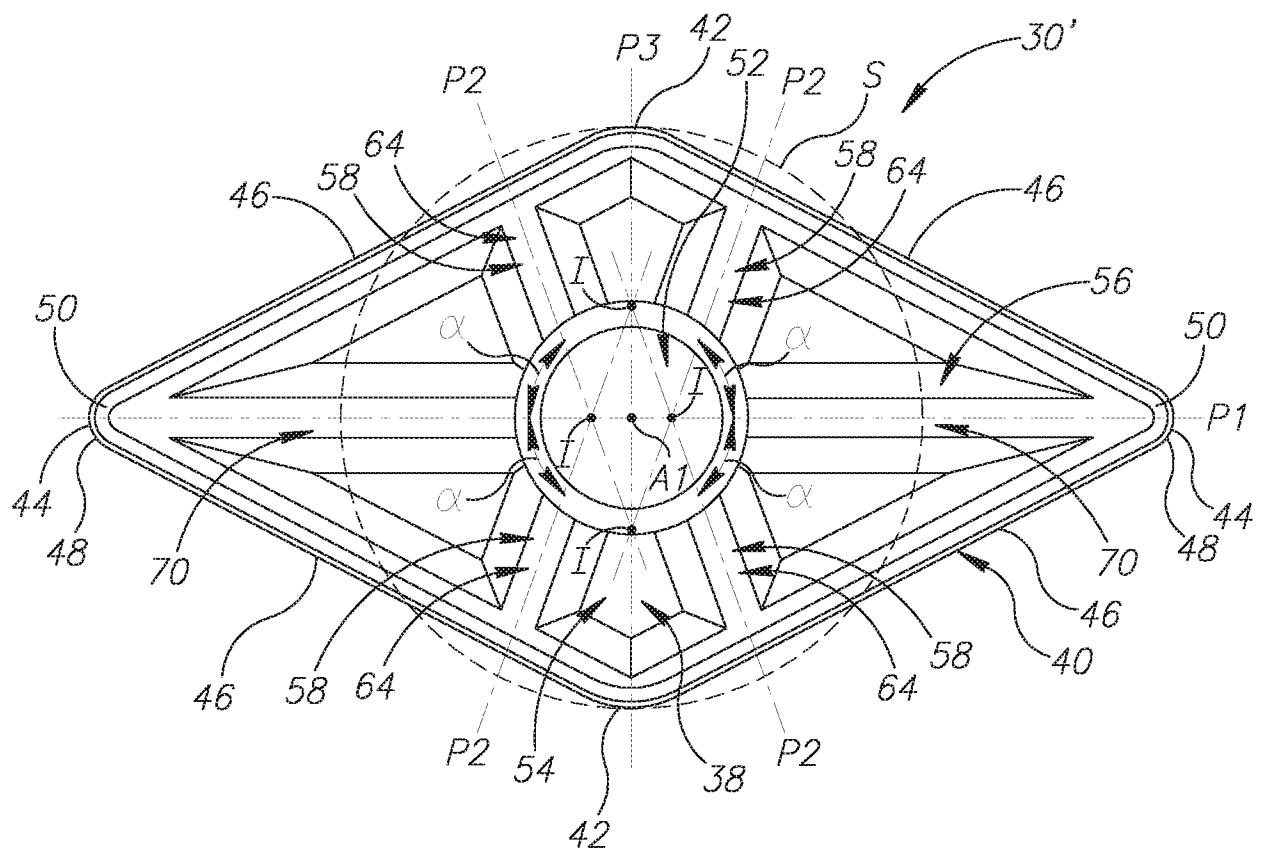


FIG.6

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2014/050236

A. CLASSIFICATION OF SUBJECT MATTER
INV. B23B27/16 B23C5/20
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.
X	JP 2007 075932 A (TUNGALOY CORP) 29 March 2007 (2007-03-29) abstract figures 1-6 -----	1-34
A	JP 2008 260090 A (TUNGALOY CORP) 30 October 2008 (2008-10-30) abstract figures 1-5 -----	1,34
A	US 7 387 474 B2 (EDLER DANIEL [SE] ET AL) 17 June 2008 (2008-06-17) cited in the application the whole document -----	1-34



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 June 2014	04/07/2014
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 Mioc, Marius

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IL2014/050236

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
JP 2007075932	A 29-03-2007	JP 2007075932	4797526 B2 A	19-10-2011 29-03-2007
JP 2008260090	A 30-10-2008	JP 2008260090	5141081 B2 A	13-02-2013 30-10-2008
US 7387474	B2 17-06-2008	CN EP JP JP KR SE US	1833801 A 1702703 A1 4933119 B2 2006255883 A 20060100292 A 0500623 A 2006216121 A1	20-09-2006 20-09-2006 16-05-2012 28-09-2006 20-09-2006 17-09-2006 28-09-2006