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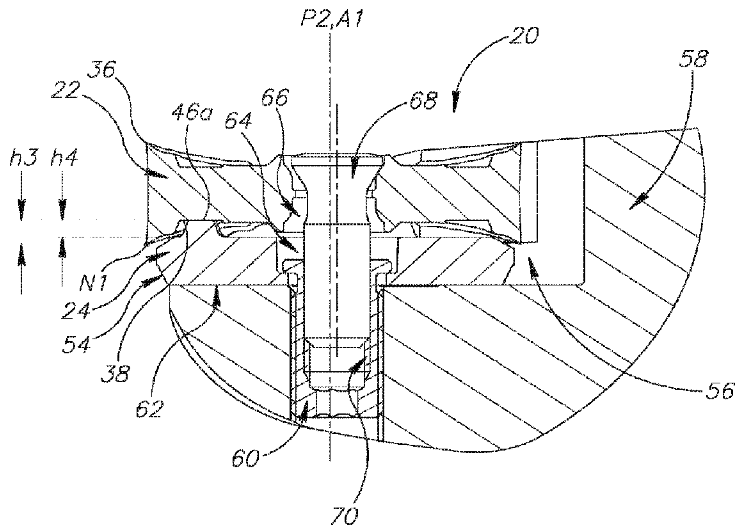
(54) Title: ASSEMBLY COMPRISING RHOMBUS-SHAPED INSERT AND SUPPORT SEAT AND RHOMBUS-SHAPED REVERSIBLE CUTTING INSERT



(57) Abrégé/Abstract:
An assembly (20) of a generally rhombus-shaped reversible (i.e. double-sided) cutting insert (22) and a support seat (24). Each end surface (26) of the cutting insert (22) has a corner abutment surface (38) adjacent each nose cutting edge (36), at least one inner abutment surface (40a, 40b) on one side of a lateral plane (P2), and at least one inner abutment surface (40a, 40b) on the opposite side of the lateral plane (P2), and each corner abutment surface (38) is located closer to a median plane (M) than its adjacent nose cutting edge (36). In each index position of the cutting insert (22) on the support seat (24), only one corner abutment surface (38) is in operative contact with one (44a) of a plurality of protruding supporting members (44a, 44b, 44c) of the support seat (24), and only the at least one inner abutment surface (40a, 40b) located on the opposite side of the lateral plane (P) from the operative corner abutment surface (38) is in contact with the at least one remaining supporting member (44b, 44c).

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(54) **Title**: ASSEMBLY COMPRISING RHOMBUS-SHAPED INSERT AND SUPPORT SEAT AND RHOMBUS-SHAPED REVERSIBLE CUTTING INSERT

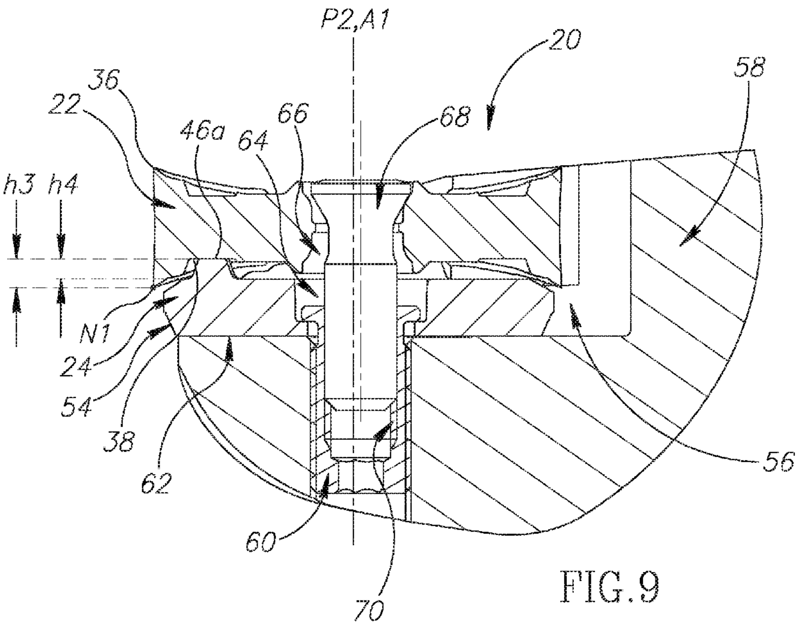

FIG.9

(57) Abstract: An assembly (20) of a generally rhombus-shaped reversible (i.e. double-sided) cutting insert (22) and a support seat (24). Each end surface (26) of the cutting insert (22) has a corner abutment surface (38) adjacent each nose cutting edge (36), at least one inner abutment surface (40a, 40b) on one side of a lateral plane (P2), and at least one inner abutment surface (40a, 40b) on the opposite side of the lateral plane (P2), and each corner abutment surface (38) is located closer to a median plane (M) than its adjacent nose cutting edge (36). In each index position of the cutting insert (22) on the support seat (24), only one corner abutment surface (38) is in operative contact with one (44a) of a plurality of protruding supporting members (44a, 44b, 44c) of the support seat (24), and only the at least one inner abutment surface (40a, 40b) located on the opposite side of the lateral plane (P) from the operative corner abutment surface (38) is in contact with the at least one remaining supporting member (44b, 44c).

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ASSEMBLY COMPRISING RHOMBUS-SHAPED INSERT AND SUPPORT SEAT AND RHOMBUS-SHAPED REVERSIBLE CUTTING INSERT

FIELD OF THE INVENTION

The present invention relates to an assembly of a generally rhombus-shaped reversible cutting insert and a support seat for use in metal cutting processes in general, and for turning operations in particular.

BACKGROUND OF THE INVENTION

Within the field of cutting tools used in turning operations, there are many examples of reversible cutting inserts removably retained in an insert receiving pocket of a tool holder, either directly or by employing a shim. In some instances, these reversible cutting inserts are configured such the abutment surfaces associated with the opposing end surfaces are lower than the corner cutting edges.

US 8,568,064 discloses a trigonal-shaped double-sided indexable cutting insert and a correspondingly shaped support plate. In one embodiment, the support plate has an upper surface with three separate flat contact surfaces defining an upper central plateau, with the upper central plateau being located above its adjoining transitional faces and upper edges. The upper and lower surfaces of the cutting insert each have three flat contact faces associated with its corner regions, which are recessed with respect to its corner cutting edges, and which are configured to engage the upper central plateau of the support plate in each index position.

US 2012/0114435 discloses a rectangular-shaped double-sided indexable cutting insert and a correspondingly shaped reinforcing part. The reinforcing part has four flat portions formed between the outside of a ring shaped elevated portion and each corner of the rectangle. The upper and lower surfaces of the cutting insert each have four dome-shaped convex portions associated with its corner regions, which are recessed with respect to its corner cutting edges, and at least three of which engage the four flat portions in each index position.

It is an object of the present invention to provide an improved assembly of a reversible cutting insert and a support seat.

It is also an object of the present invention to provide an improved assembly in which the cutting insert is retained on the support seat with a high level of stability and without being over-constrained.

It is a further object of the present invention to provide an improved assembly in which cutting forces are effectively transmitted through the cutting insert and into the support seat.

It is yet a further object of the present invention to provide an improved assembly in which the cutting insert is positioned on the support seat with a high level of accuracy and repeatability.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided an assembly of a generally rhombus-shaped reversible cutting insert and a support seat, wherein:

the cutting insert comprises two opposing end surfaces interconnected by a continuous peripheral surface, the peripheral side surface having alternating obtuse and acute corner surfaces separated by four side surfaces;

a median plane located between the two opposing end surfaces and intersecting the peripheral surface, an insert axis perpendicular to the median plane and about which the cutting insert is indexable, a nose cutting edge formed at the intersection of each acute corner surface and each end surface, a longitudinal plane containing the insert axis and bisecting the four nose cutting edges, a nose point located at the intersection of each nose cutting edge and the longitudinal plane, and a lateral plane containing the insert axis and bisecting the two obtuse corner surfaces,

each end surface having a corner abutment surface adjacent each nose cutting edge and a rake surface located therebetween, at least one inner abutment surface entirely located on one side of the lateral plane, and at least one inner abutment surface entirely located on the opposite side of the lateral plane, and

each corner abutment surface located closer to the median plane than its adjacent nose point,

the support seat comprises a seat surface with a plurality of supporting members protruding therefrom, each supporting member having a supporting surface in contact with the end surface facing the support seat, and wherein in each index position of the cutting insert:

only one of the two corner abutment surfaces of the end surface facing the support seat is in operative contact with the support seat, at a first supporting surface, and

only the at least one inner abutment surface of the end surface facing the support seat located on the opposite side of the lateral plane from the operative corner abutment surface is in contact with the support seat at the at least one remaining supporting surface.

Also in accordance with the present invention, there is provided generally rhombus-shaped reversible cutting insert comprising

two opposing end surfaces interconnected by a continuous peripheral surface, the peripheral side surface having alternating obtuse and acute corner surfaces separated by four side surfaces;

a median plane located between the two opposing end surfaces and intersecting the peripheral surface,

an insert axis perpendicular to the median plane and about which the cutting insert is indexable,

a nose cutting edge formed at the intersection of each acute corner surface and each end surface,

a longitudinal plane containing the insert axis and bisecting the four nose cutting edges,

each end surface having a corner abutment surface adjacent each nose cutting edge and a rake surface located therebetween,

a nose point located at the intersection of each nose cutting edge and the longitudinal plane, and

each corner abutment surface located closer to the median plane than its adjacent nose point,

wherein:

no point on each end surface is located further from the median plane than the two nose points associated therewith, the median plane intersects each side surface to form a side boundary line, two side boundary lines converge towards the same acute corner surface to form an acute nose corner angle which is less than 60°, and

in a cross-sectional view of the cutting insert taken along the longitudinal plane, a first imaginary straight line containing any one of the nose points and a radially outermost point of the adjacent corner abutment surface forms an acute first angle greater than 25° with the median plane.

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:

Fig. 1 is a perspective view of an assembly of a cutting insert and a support seat in accordance with some embodiments of the present invention;

Fig. 2 is an exploded perspective view of the assembly shown in Fig. 1;

Fig. 3 is a side view of the cutting insert in accordance with some embodiments of the present invention;

Fig. 4 is an end view of the cutting insert shown in Fig. 3;

Fig. 5 is a cross-sectional view of the cutting insert shown in Fig. 4, taken along the line V-V;

Fig. 6 is a cross-sectional view of the cutting insert shown in Fig. 3, taken along the line VI-VI;

Fig. 7 is a top view of the support seat in accordance with some embodiments of the present invention;

Fig. 8 is a cross-sectional view of the support seat shown in Fig. 7, taken along the line VIII-VIII; and

Fig. 9 is a cross-sectional view of the assembly taken along a longitudinal plane.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to an assembly **20** of a generally rhombus-shaped reversible cutting insert **22** and a support seat **24**, as shown in Figs. 1 and 2.

According to the present invention, the cutting insert **22** has two opposing rhombus-shaped end surfaces **26** interconnected by a continuous peripheral surface **28**, with the peripheral side surface **28** having alternating obtuse and acute corner surfaces **30**, **32** separated by four side surfaces **34**.

Also according to the present invention, a nose cutting edge **36** is formed at the intersection of each acute corner surface **32** and each end surface **26**, and each end surface **26** has a corner abutment surface **38** adjacent each nose cutting edge **36** and a rake surface **48** located therebetween.

In some embodiments of the present invention, the cutting insert **22** may preferably be manufactured by form pressing and sintering a cemented carbide, such as tungsten carbide, and may be coated or uncoated.

As shown in Fig. 3, a median plane **M** located between the two opposing end surfaces 26 intersects the peripheral surface **28**, and the cutting insert **22** is indexable about an insert axis **A1** perpendicular to the median plane **M**. Thus, in addition to being reversible (or “double-sided”) in the sense that cutting edges and seating surfaces are provided on both end surfaces **26**, each end surface **26** has two cutting sections that are 180° rotationally apart about the insert axis **A1**.

Also as shown in Fig. 4, a longitudinal plane **P1** containing the insert axis **A1** bisects the two acute corner surfaces **32** and the four nose cutting edges **36**.

In some embodiments of the present invention, the cutting insert **22** may exhibit mirror symmetry about the median plane **M**.

According to the present invention, as shown in Fig. 5, each corner abutment surface **38** is located closer to the median plane **M** than a nose point **N1** located at the intersection of its adjacent nose cutting edge **36** and the longitudinal plane **P1**.

In some embodiments of the present invention, no point on each end surface **26** may be located further from the median plane **M** than the two nose points **N1** associated therewith.

Also in some embodiments of the present invention, each corner abutment surface **38** may be entirely located closer to the median plane **M** than any point along its adjacent nose cutting edge **36**.

Further in some embodiments of the present invention, the two corner abutment surfaces **38** associated with each end surface **26** may be coplanar and parallel to the median plane **M**.

Yet further in some embodiments of the present invention, a closest point on each end surface **26** from the median plane **M** may be contained in one of the two corner abutment surfaces **38** associated therewith.

As shown in Fig. 4, the longitudinal plane **P1** may bisect the two corner abutment surfaces **38** associated with each end surface **26**.

In some embodiments of the present invention, each end surface **26** may have exactly two corner abutment surfaces **38**.

Also in some embodiments of the present invention, the cutting insert **22** may exhibit mirror symmetry about the longitudinal plane **P1**.

As shown in Figs. 3 and 6, the median plane **M** intersects each side surface **34** to form a side boundary line **Ls**, and two side boundary lines **Ls** converge towards the same acute corner surface **32** to form an acute nose corner angle **α1**.

In some embodiments of the present invention, the nose corner angle **α1** may be less than 60°, and suitable for profiling turning operations.

As shown in Fig. 4, a lateral plane **P2** containing the insert axis **A1** bisects the two obtuse corner surfaces **30**.

In some embodiments of the present invention, the cutting insert **22** may exhibit mirror symmetry about the lateral plane **P2**.

Also in some embodiments of the present invention, the longitudinal plane **P1** may be perpendicular to the lateral plane **P2**.

And in some embodiments of the present invention, the median plane **M**, the longitudinal plane **P1** and the lateral plane **P2** may be mutually perpendicular to one another, with the insert axis **A1** being located at the intersection of the longitudinal plane **P1** and the lateral plane **P2**, a longitudinal axis **A2** being located at the intersection of the median plane **M** and the longitudinal plane **P1**, and a lateral axis **A3** being located at the intersection of the median plane **M** and the lateral plane **P2**. In some embodiments, the insert may be mirror symmetric about all three planes **M**, **P1** and **P2**. In some embodiments, the insert may have 180° rotational symmetry about all three axes **A1**, **A2** and **A3**. In some embodiments, the insert may be mirror symmetric about all three planes **M**, **P1** and **P2** and also 180° rotationally symmetric about all three axes **A1**, **A2** and **A3**.

According to the present invention, as shown in Fig. 4, at least one inner abutment surface **40a**, **40b** is entirely located on one side of the lateral plane **P2**, and at least one inner abutment surface **40a**, **40b** is entirely located on the opposite side of the lateral plane **P2**.

In some embodiments of the present invention, as shown in Fig. 3, the at least two inner abutment surfaces **40a**, **40b** associated with each end surface **26** may be coplanar and parallel to the median plane **M**.

Also in some embodiments of the present invention, as shown in Figs. 3 and 5, the at least two inner abutment surfaces **40a**, **40b** associated with each end surface **26** may be entirely located closer to the median plane **M** than the two nose points **N1** associated with the same end surface **26**.

Further in some embodiments of the present invention, the two corner abutment surfaces **38** and the at least two inner abutment surfaces **40a**, **40b** associated with each end surface **26** may be coplanar.

Yet further in some embodiments of the present invention, as shown in Fig. 4, each inner abutment surface **40a**, **40b** may intersect at least one of the four side surfaces **34**.

Still further in some embodiments of the present invention, as shown in Fig. 4, each end surface **26** may have exactly two spaced apart inner abutment surfaces **40a**, **40b** located on each side of the lateral plane **P2**.

According to the present invention, as shown in Figs. 2, 7 and 8, the support seat **24** comprises a seat surface **42** with a plurality of supporting members **44a**, **44b**, **44c** protruding therefrom, each supporting member **44a**, **44b**, **44c** having a supporting surface **46a**, **46b**, **46c** in contact with the end surface **26** facing the support seat **24**.

It should be appreciated that regions of contact between the cutting insert **22** and the support seat **24** are represented by cross-hatching in in Fig. 2.

In some embodiments of the present invention, as shown in Fig. 8, the plurality of supporting surfaces **46a**, **46b**, **46c** may be coplanar.

It should be appreciated that for embodiments of the present invention having coplanar supporting surfaces **46a**, **46b**, **46c**, the support seat **24** can be manufactured with increased efficiency.

According to the present invention, in each index position of the cutting insert **22**; only one of the two corner abutment surfaces **38** of the end surface **26** facing the support seat **24** is in operative contact with the support seat **24**, at a first supporting surface **46a**, and only the at least one inner abutment surface **40a**, **40b** of the end surface **26** facing the support seat **24** located on the opposite side of the lateral plane **P2** from the operative corner abutment surface **38** is in contact with the support seat **24** at the at least one remaining supporting surface **46b**, **46c**.

In some embodiments of the present invention, as shown in Fig. 2, apart from the operative corner abutment surface **38**, no other portion of the end surface **26** facing the support seat **24** and located on the same side of the lateral plane **P2** may be in contact with the support seat **24**.

It should be appreciated that for embodiments of the present invention having exactly two spaced apart inner abutment surfaces **40a**, **40b** located on each side of the lateral plane **P2**, the assembly **20** is configured with exactly three spaced apart contact zones between the end surface **26** facing the support seat **24** and the support seat **24**, thus enabling the cutting insert **22** to be retained on the support seat **24** without being over-constrained.

This configuration can be achieved when the two spaced apart inner abutment surfaces **40a**, **40b** located on the opposite side of the lateral plane **P2** from the operative corner abutment surface **38** are in contact with two corresponding supporting surfaces **46b**, **46c**, as shown in Figs. 2, 4 and 7, or alternatively, when the two spaced apart inner abutment surfaces **40a**, **40b** located on the opposite side of the lateral plane **P2** from the operative corner abutment surface **38** are in contact with a single supporting surface (not shown in the figures).

In some embodiments of the present invention, a clamping force between the cutting insert **22** and the support seat **24** may be applied at a central region of an imaginary triangle delimited by the three spaced apart contact zones, thus enabling the cutting insert **22** to be retained on the support seat **24** with a high level of stability.

It should also be appreciated that for embodiments of the present invention having a single inner abutment surface (not shown in the figures) located on each side of the lateral plane **P2**, the assembly **20** may still be configured with exactly three spaced apart contact zones, by virtue of the single inner abutment surface located on the opposite side of the lateral plane **P2** from the operative corner abutment surface **38** being in contact with two spaced apart supporting surfaces **46b**, **46c**.

Also in some embodiments of the present invention, as shown in Fig. 9, the operative nose cutting edge **36** may be located on the opposite end surface **26** from the operative corner abutment surface **38** and on the same side of the lateral plane **P2** as the operative corner abutment surface **38**.

As shown in Fig. 5, in a cross-sectional view of the cutting insert **22** taken along the longitudinal plane **P1**, a first imaginary straight line **L1** containing one of the nose points **N1** and a radially outermost point **No** of the adjacent corner abutment surface **38** forms an acute first angle **β1** with the median plane **M**.

In some embodiments of the present invention, the first angle **β1** may be greater than 25°.

It should be appreciated that for embodiments of the present invention having a first angle **β1** greater than 25°, the operative corner abutment surface **38** is advantageously located 'under' the operative nose cutting edge **36**, thus enabling the effective transmission of cutting forces through the cutting insert **22** and into the support seat **24**.

Effective transmission of cutting forces through the cutting insert **22** and into the support seat **24** is particularly preferable for embodiments of the present invention where the cutting insert **22** has slender nose cutting corners and the nose corner angle **α1** is less than 60°.

As shown in Fig. 5, in a cross-sectional view of the cutting insert **22** taken along the longitudinal plane **P1**, the radially outermost point **No** of each corner abutment surface **38** is located a first height **h1** above the median plane **M**, and each nose point **N1** is located a second height **h2** above the median plane **M**.

In some embodiments of the present invention, the first height **h1** may be less than three quarters of the second height **h2**, i.e. **h1** < **h2** *3/4.

It should be appreciated that for embodiments of the present invention having the first height **h1** less than three quarters of the second height **h2**, the cutting insert **22** is advantageously compact in a direction transverse to the median plane **M**, resulting in reduced material costs and greater suitability for internal turning operations.

In some embodiments of the present invention, as shown in Figs. 4 and 5, a ramp surface **50** may be located between each rake surface **48** and its associated corner abutment surface **38**.

As shown in Fig. 5, in a cross-sectional view of the cutting insert **22** taken along the longitudinal plane **P1**, a second imaginary straight line **L2** tangential to a ramp point **NR** on each ramp surface **50** forms an acute second angle **β2** with the median plane **M**.

In some embodiments of the present invention, the second angle **β2** may be greater than the first angle **β1**.

Also, as shown in Fig. 5, each second imaginary straight line **L2** intersects the median plane **M** at an inner axial point **N2**.

In some embodiments of the present invention, each inner axial point **N2** may be located closer to the insert axis **A1** than its associated ramp point **NR**.

Also in some embodiments of the present invention, each ramp surface **50** may extend from its associated rake surface **48** to its associated corner abutment surface **38**, and as shown in Fig. 5, in a cross-sectional view of the cutting insert **22** taken along the longitudinal plane **P1**, the radially outermost point **NO** of each corner abutment surface **38** may be coincident with the ramp point **NR** of its associated ramp surface **50**.

It should be appreciated that for embodiments of the present invention having the second angle **β2** greater than the first angle **β1**, cutting chips flowing across the operative rake surface **48** are advantageously deflected away from the adjacently located non-operative corner abutment surface **38**, thus reducing the risk of abrasions and damage which may otherwise negatively affect the positional accuracy and repeatability of the cutting insert **22** when the end surface **26** facing the support seat **24** is reversed and the said non-operative corner abutment surface **38** becomes operative.

In some embodiments of the present invention, each rake surface **48** may extend from its associated nose cutting edge **36** to its associated ramp surface **50**, and in a cross-sectional view of the cutting insert **22** taken along the longitudinal plane **P1**, as shown in Fig. 5, each rake surface **48** may extend continuously towards the median plane **M** from its associated nose cutting edge **36** to its associated ramp surface **50**.

It should be appreciated that for embodiments of the present invention in which the rake surface **48** extends from its associated nose cutting edge **36** to its associated ramp surface **50** and continuously towards the median plane **M**, the cutting insert **22** can perform turning operations with a positive rake angle and a sharp cutting edge, thus reducing cutting forces and promoting improved chip flow, particularly suitable for machining aluminum. In such configurations, each nose cutting edge **36** is typically honed, having no negative land surface associated therewith.

As shown in Figs. 3 and 5, the median plane **M** intersects each acute corner surface **32** to form a nose boundary line **LN**, and the longitudinal plane **P1** intersects each nose boundary line **LN** at an outer axial point **N3**.

In some embodiments of the present invention, as shown in Fig. 5, each outer axial point **N3** may be located closer to the insert axis **A1** than the two nose points **N1** associated with the same acute corner surface **32**.

Also in some embodiments of the present invention, each end surface **26** may intersect the peripheral side surface **28** to form a peripheral edge **52**, and in a cross-sectional view of the cutting insert **22** taken along the median plane **M**, as shown in Fig. 6, each nose boundary line $\mathbf{L_N}$ may be entirely located inside the visible peripheral edge **52**.

It should be appreciated that for embodiments of the present invention having each nose boundary line $\mathbf{L_N}$ located inside the peripheral edge **52**, the cutting insert **22** takes the form of a double-positive type cutting insert, thus enabling turning operations to be performed with an increased positive rake angle, whilst maintaining sufficient clearance between the acute corner surface **32** and a workpiece (not shown).

As shown in Figs. 2, 7, 8 and 9, the support seat **24** may be in the form of a shim **54** removably retained in an insert receiving pocket **56** of a tool holder **58** by means of a threaded bushing **60**.

In some embodiments of the present invention, the shim **54** may preferably be manufactured from cemented carbide or another material which is harder than the material of the insert receiving pocket **56**.

As shown in Figs. 8 and 9, the shim **54** may have a flat base surface **62** opposing the seat surface **42**, and a shim bore **64** may intersect both the base surface **62** and the seat surface **42**.

Also as shown in Fig. 9, the threaded bushing **60** may be located in the shim bore **64** and threadingly engage the receiving pocket **56**.

In some embodiments of the present invention, as shown in Figs. 4 and 5, an insert bore **66** may extend coaxially with the insert axis **A1** and intersect the two end surfaces **26** of the cutting insert **22**.

Also in some embodiments of the present invention, as shown in Fig. 9, a clamping screw **68** may be located in the insert bore **66** and threadingly engage a threaded bore **70** in the threaded bushing **60** to apply the clamping force.

As shown in Figs. 5, 8 and 9, each nose point **N1** is located a third height **h3** above its associated corner abutment surface **38**, and the first supporting surface **46a** is located a fourth height **h4** above the seat surface **42**.

In some embodiments of the present invention, the third height **h3** may be greater than the fourth height **h4**.

As shown in Fig. 2, the insert receiving pocket **56** may include two pocket walls **72a**, **72b** transverse to the seat surface **42** of the shim **54**.

In some embodiments of the present invention, the two side surfaces **34** of the cutting insert **22** located on the opposite side of the lateral plane **P2** from the operative corner abutment surface **38** may be in contact with the two pocket walls **72a**, **72b**.

Contact between the cutting insert **22** and the two pocket walls **72a**, **72b** may be generated by the insert bore **66** and the threaded bore **70** being eccentric to each other, and a component of the clamping force from the clamping screw **68** being directed transverse to the insert axis **A1**.

In some embodiments of the present invention, the shim **54** may be non-indexable.

As shown in Figs. 1 to 5, each end surface **26** of the cutting insert **22** may have a male-type lateral member **74** extending between and intersecting the two obtuse corner surfaces **30**, and each lateral member **74** may have a raised lateral surface **76** having a fifth height **h5** above the median plane **M**.

It should be appreciated that for embodiments of the present invention having the male-type lateral member **74** extending between and intersecting the two obtuse corner surfaces **30**, rigidity of the cutting insert **22** is improved, such that deformations and inaccuracies resulting from the sintering process of the cutting insert **22** are reduced to a minimum.

In some embodiments of the present invention, as shown in Figs. 3 and 5, each raised lateral surface **76** may be located closer to the median plane **M** than the two nose points **N1** associated with the same end surface **26** (i.e., **h2** > **h5**), and each raised lateral surface **76** may be located further from the median plane **M** than the at least two inner abutment surfaces **40a**, **40b** of the same end surface **26**.

Also in some embodiments of the present invention, the raised lateral surface **76** may be parallel to the median plane **M**.

Further in some embodiments of the present invention, as shown in Fig. 5, the insert bore **66** may intersect the raised lateral surface **76** of each lateral member **74**.

Configuring the insert bore **66** to intersect the raised lateral surface **76** of each lateral member **74** enables the inclusion of a countersink in the insert bore **66** to receive the head of the clamping screw **68**, as shown in Fig. 9, which thus protects the clamping screw **68** from abrasions and damage from cutting chips flowing across the end surface **26** of the cutting insert **22** associated with the operative nose cutting edge **36**.

Although the present invention has been described to a certain degree of particularity, it should be understood that various alterations and modifications could be made without departing from the spirit or scope of the invention as hereinafter claimed.

CLAIMS

What is claimed is:

1. An assembly of a generally rhombus-shaped reversible cutting insert and a support seat, wherein:

the cutting insert comprises two opposing end surfaces interconnected by a continuous peripheral surface, the peripheral surface having alternating obtuse and acute corner surfaces separated by four side surfaces;

a median plane (M) located between the two opposing end surfaces and intersecting the peripheral surface, an insert axis (A1) perpendicular to the median plane (M) and about which the cutting insert is indexable, a nose cutting edge formed at the intersection of each acute corner surface and each end surface, a longitudinal plane (P1) containing the insert axis (A1) and bisecting the four nose cutting edges, a nose point (N1) located at the intersection of each nose cutting edge and the longitudinal plane (P1) and a lateral plane (P2) containing the insert axis (A1) and bisecting the two obtuse corner surfaces,

each end surface having a corner abutment surface adjacent each nose cutting edge and a rake surface located therebetween, at least one inner abutment surface entirely located on one side of the lateral plane (P2), and at least one inner abutment surface entirely located on the opposite side of the lateral plane (P2), and

each corner abutment surface located closer to the median plane (M) than its adjacent nose point (N1),

the support seat comprises a seat surface with a plurality of supporting members protruding therefrom, each supporting member having a supporting surface in contact with the end surface facing the support seat, and

wherein in each index position of the cutting insert:

only one of the two corner abutment surfaces of the end surface facing the support seat is in operative contact with the support seat, at a first supporting surface, and

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only the at least one inner abutment surface of the end surface facing the support seat located on the opposite side of the lateral plane (P2) from the operative corner abutment surface is in contact with the support seat at the at least one remaining supporting surface.

2. The assembly according to claim 1, wherein each corner abutment surface is entirely located closer to the median plane (M) than any point along its adjacent nose cutting edge.

3. The assembly according to either claim 1 or 2, wherein the two corner abutment surfaces associated with each end surface are coplanar and parallel to the median plane (M).

4. The assembly according to any one of claims 1 to 3, wherein the at least two inner abutment surfaces associated with each end surface are entirely located closer to the median plane (M) than the two nose points (N1) associated with the same end surface.

5. The assembly according to any one of claims 1 to 4, wherein each end surface has exactly two spaced apart inner abutment surfaces located on each side of the lateral plane (P2).

6. The assembly according to any one of claims 1 to 5, wherein apart from the operative corner abutment surface, no other portion of the end surface facing the support seat and located on the same side of the lateral plane (P2) is in contact with the support seat.

7. The assembly according to any one of claims 1 to 6, wherein the operative nose cutting edge is located on the opposite end surface from the operative corner abutment surface and on the same side of the lateral plane (P2) as the operative corner abutment surface.

8. The assembly according to any one of claims 1 to 7, wherein the median plane (M) intersects each side surface to form a side boundary line (Ls),

wherein two side boundary lines (Ls) converge towards the same acute corner surface to form an acute nose corner angle ($\alpha1$) less than 60°.

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9. The assembly according to any one of claims 1 to 8, wherein each end surface has a male-type lateral member extending between and intersecting the two obtuse corner surfaces, and

wherein each lateral member has a raised lateral surface.

10. The assembly according to any one of claims 1 to 9, wherein only the at least one inner abutment surface of the end surface facing the support seat located on the opposite side of the lateral plane (P2) from the operative corner abutment surface is in contact with the support seat at two spaced apart supporting surfaces.

11. The assembly according to any one of claims 1 to 10, wherein in a cross-sectional view of the cutting insert taken along the longitudinal plane (P1), a first imaginary straight line (L1) containing any one of the nose points (N1) and a radially outermost point (NO) of the adjacent corner abutment surface forms an acute first angle (β1) greater than 25° with the median plane (M).

12. The assembly according to claim 11, wherein a ramp surface is located between each rake surface and its associated corner abutment surface,

wherein in a cross-sectional view of the cutting insert taken along the longitudinal plane (P1), a second imaginary straight line (L2) tangential to a ramp point (NR) on the ramp surface forms an acute second angle (β2) with the median plane (M), and

wherein the second angle (β2) is greater than the first angle (β1).

13. The assembly according to claim 12, wherein each rake surface extends from its associated nose cutting edge to its associated ramp surface, and

wherein in a cross-sectional view of the cutting insert taken along the longitudinal plane (P1), each rake surface extends continuously towards the median plane (M) from its associated nose cutting edge to its associated ramp surface.

14. A generally rhombus-shaped reversible cutting insert comprising:

two opposing end surfaces interconnected by a continuous peripheral surface, the peripheral surface having alternating obtuse and acute corner surfaces separated by four side surfaces;

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a median plane (M) located between the two opposing end surfaces and intersecting the peripheral surface,

an insert axis (A1) perpendicular to the median plane (M) and about which the cutting insert is indexable,

a nose cutting edge formed at the intersection of each acute corner surface and each end surface,

a longitudinal plane (P1) containing the insert axis (A1) and bisecting the four nose cutting edges,

each end surface having a corner abutment surface adjacent each nose cutting edge and a rake surface located therebetween,

a nose point (N1) located at an intersection of each nose cutting edge and the longitudinal plane (P1), and

each corner abutment surface located closer to the median plane (M) than its adjacent nose point (N1),

wherein:

no point on each end surface is located further from the median plane (M) than the two nose points (N1) associated therewith,

the median plane (M) intersects each side surface to form a side boundary line (L_S), two side boundary lines (L_S) converge towards the same acute corner surface to form an acute nose corner angle ($\alpha 1$) which is less than 60°, and

in a cross-sectional view of the cutting insert taken along the longitudinal plane (P1), a first imaginary straight line (L1) containing any one of the nose points (N1) and a radially outermost point (N_O) of the adjacent corner abutment surface forms an acute first angle ($\beta 1$) greater than 25° with the median plane (M),

and wherein:

a ramp surface is located between each rake surface and its associated corner abutment surface,

in the cross-sectional view of the cutting insert taken along the longitudinal plane (P1), a second imaginary straight line (L2) tangential to a ramp point (N_R) on the ramp surface forms an acute second angle ($\beta 2$) with the median plane (M), and

the second angle ($\beta 2$) is greater than the first angle ($\beta 1$).

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15. The cutting insert according to claim 14, wherein no point on each end surface is located further from the median plane (M) than the two nose points (N1) associated therewith.

16. The cutting insert according to either claim 14 or 15, wherein each corner abutment surface is entirely located closer to the median plane (M) than any point along its adjacent nose cutting edge.

17. The cutting insert according to any one of claims 14 to 16, wherein:

each end surface has a male-type lateral member extending between and intersecting the two obtuse corner surfaces.

18. The cutting insert according to claim 17, wherein:

each lateral member has a raised lateral surface located closer to the median plane (M) than the two nose points (N1) associated with the same end surface.

19. The cutting insert according to claim 18, wherein:

an insert bore extends coaxially with the insert axis (A1) and intersects the raised lateral surface of each lateral member.

20. The cutting insert according to either claim 18 or 19, wherein in the cross-sectional view of the cutting insert taken along the longitudinal plane (P1):

the radially outermost point (No) of each corner abutment surface is located a first height (h1) above the median plane (M),

each raised lateral surface is located a fifth height (h5) above the median plane (M), and

the fifth height (h5) is greater than the first height (h1).

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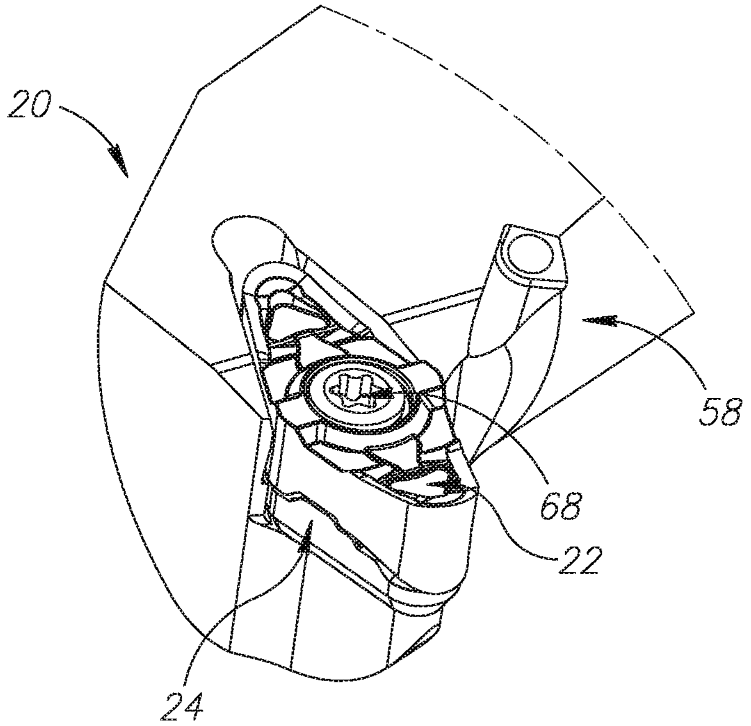


FIG.1

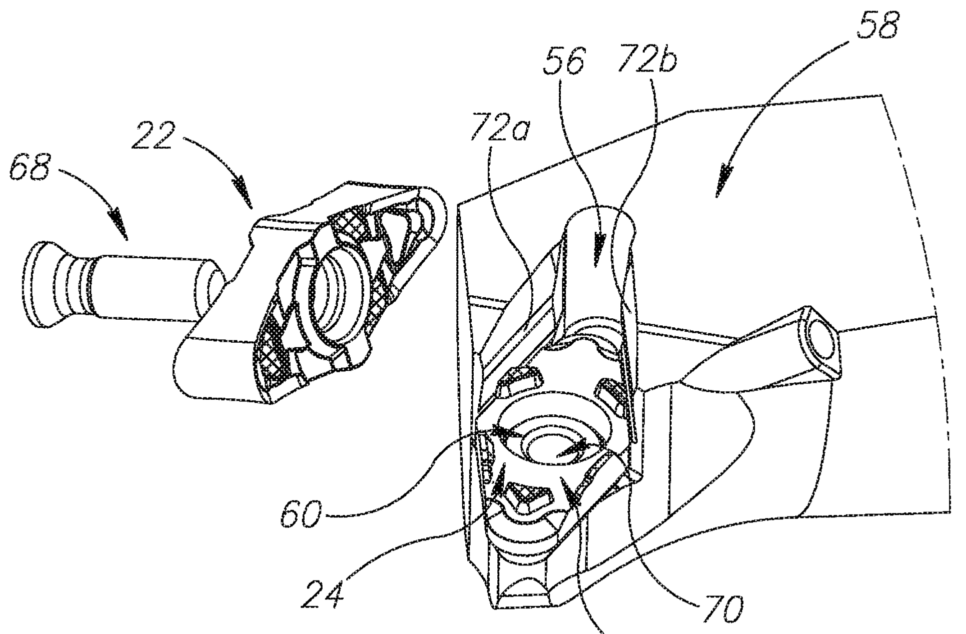
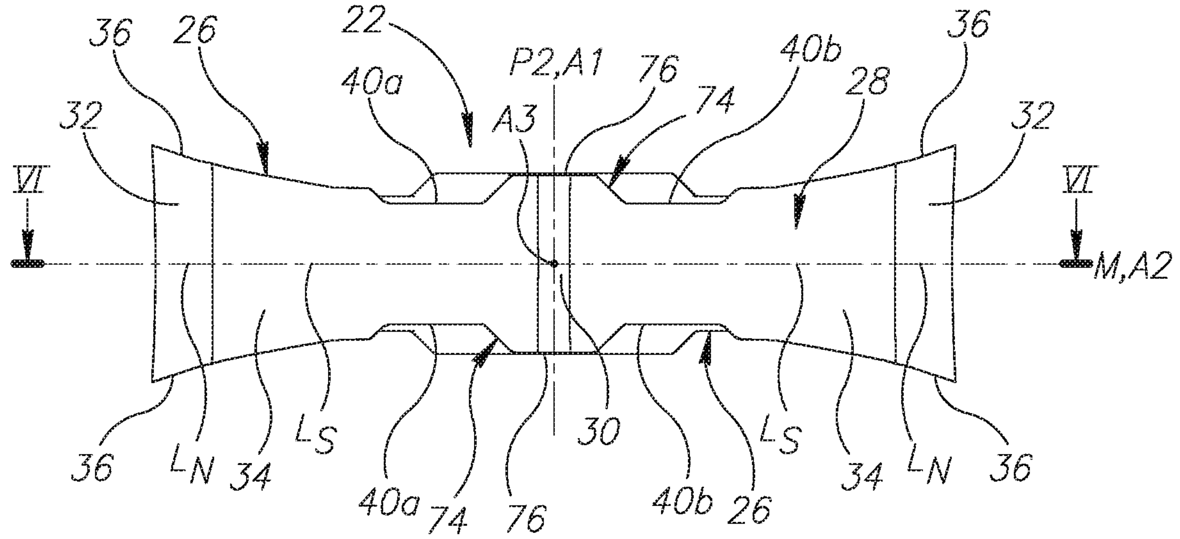


FIG.2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26
22
P2,A1
76
40b
28
36
32
40a
A3
74
32
VI
VI
M,A2
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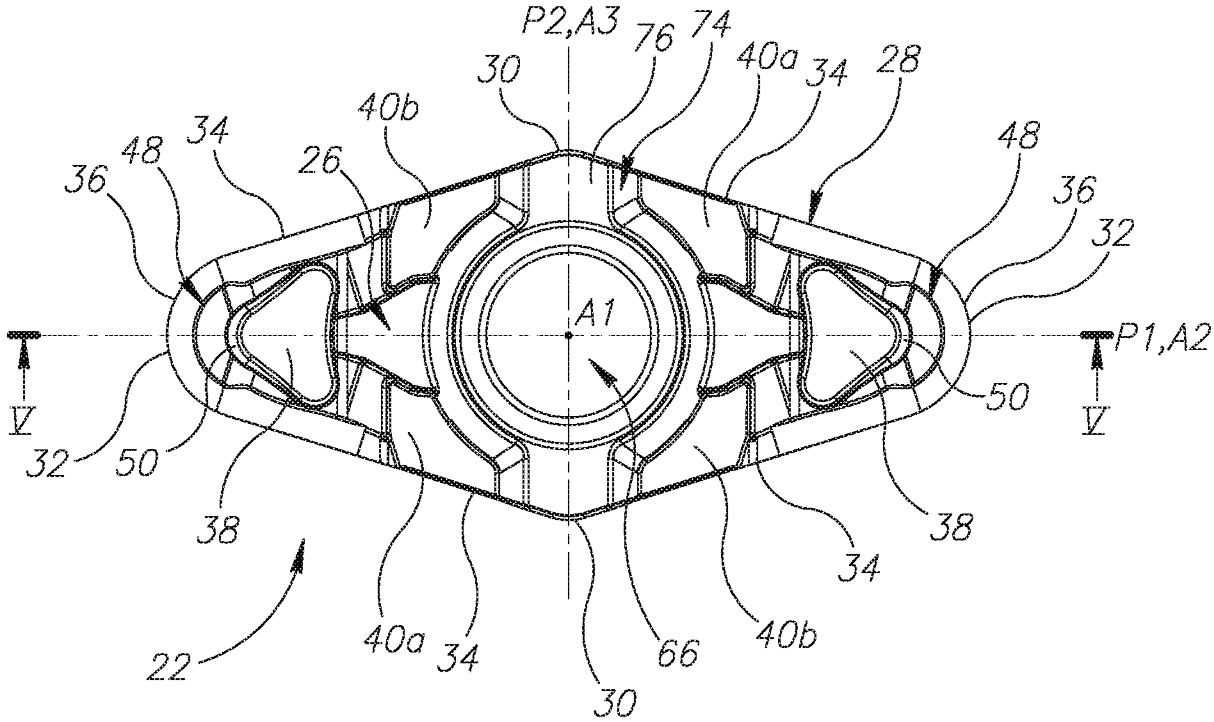
LN
34
LS
40a
74
76
30
40b
26
LS
34
LN
36

FIG.3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40b
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26
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48
36
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V
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38
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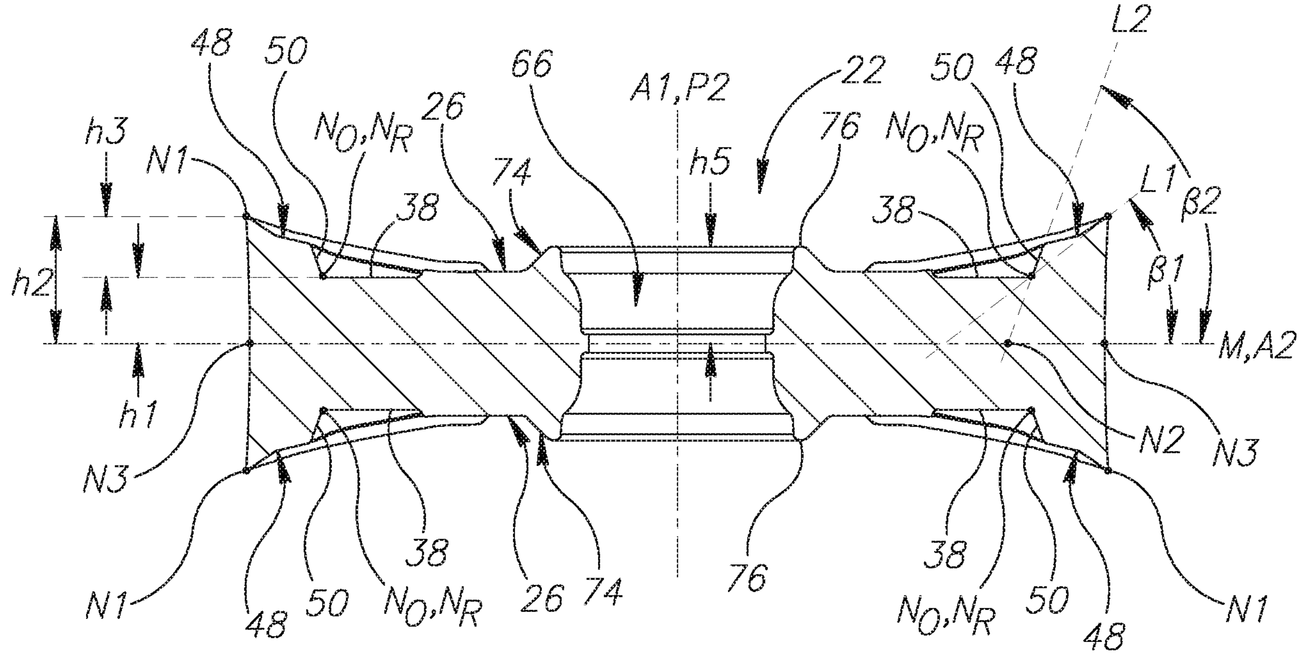
38
34
22
40a
34
30
66
40b

FIG.4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h3
N1
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26
66
A1,P2
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76
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L1
β2
β1
74
h5
38
38
h2
M,A2
h1
N3
N2
N3
N1
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N_O,N_R
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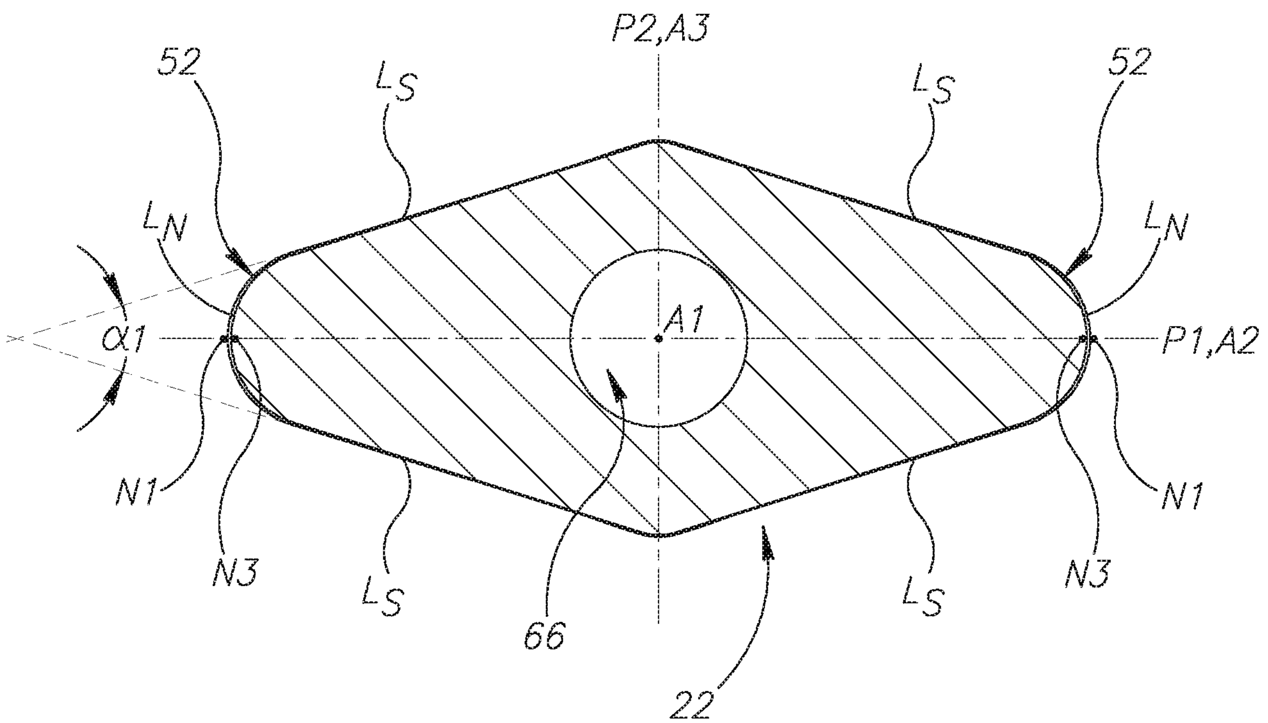
48
N1

FIG.5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L_S
L_S
52
L_N
L_N
α1
A1
P1,A2
N1
N3
L_S
66
L_S
N3
N1
22

FIG.6

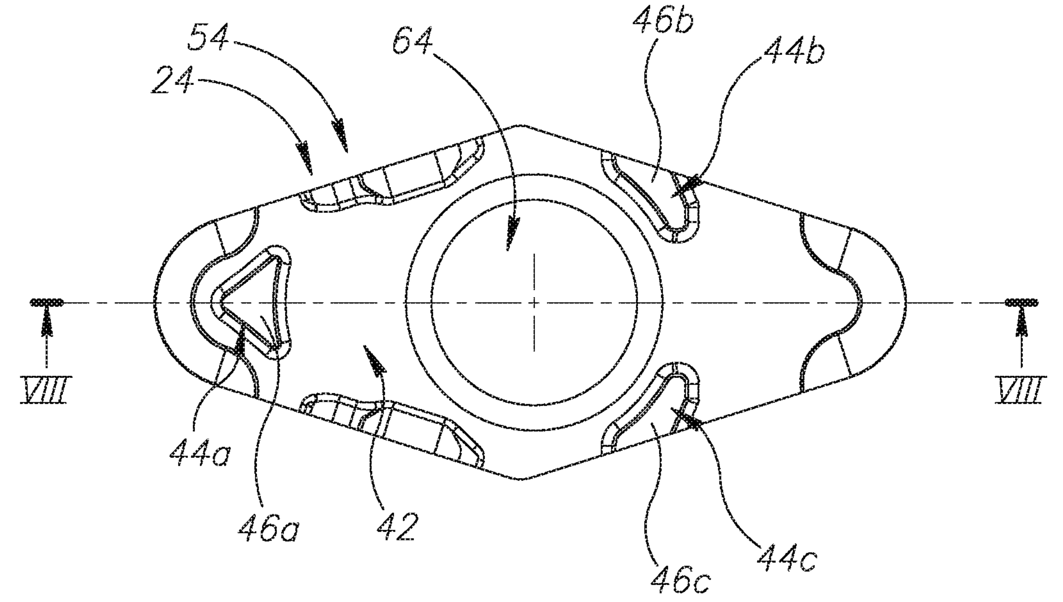

54
24
64
46b
44b
VIII
VIII
44a
46a
42
46c
44c

FIG.7

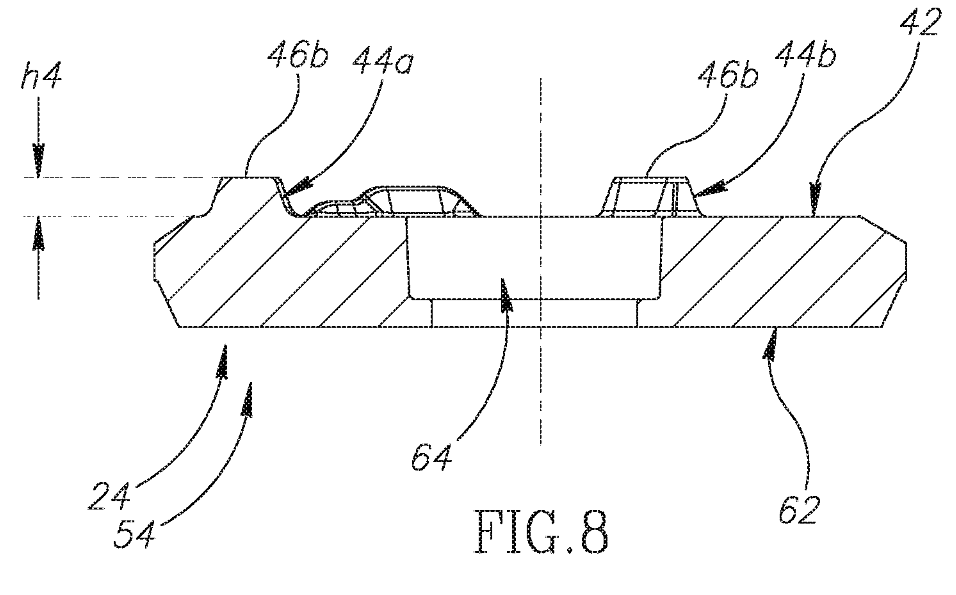

h4
46b
44a
46b
44b
42
24
54
64
62

FIG.8

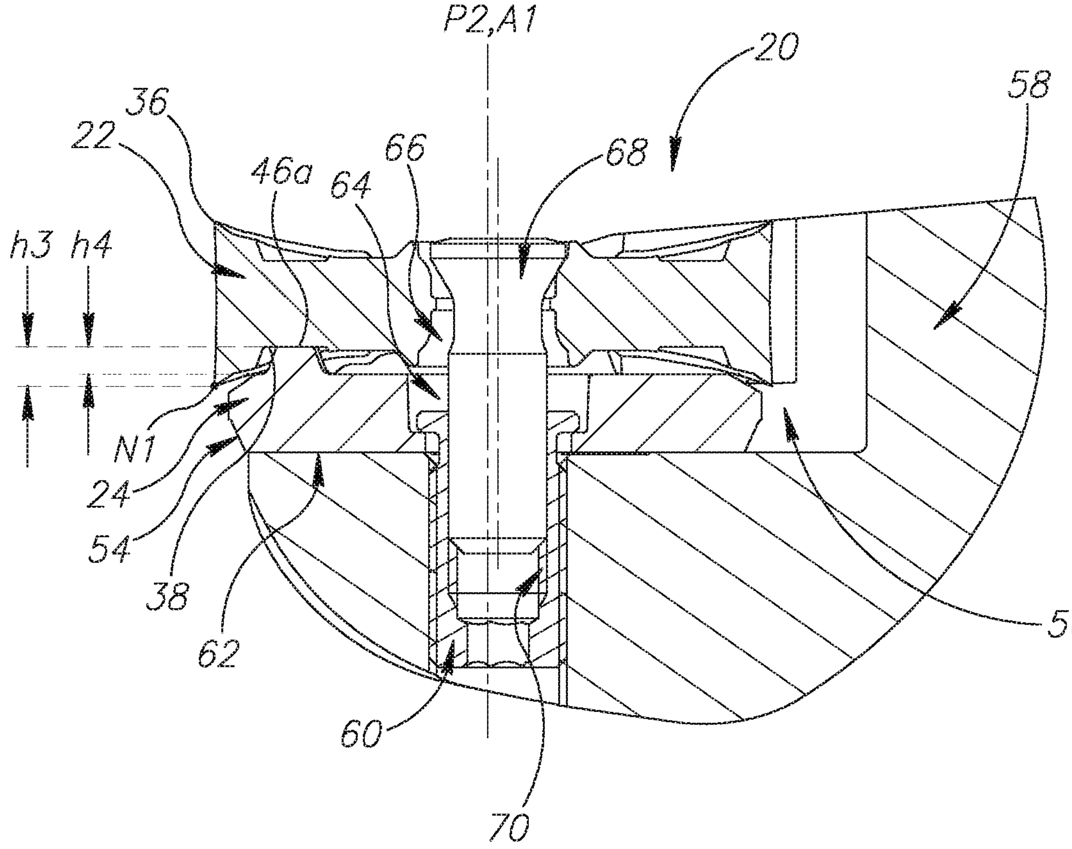
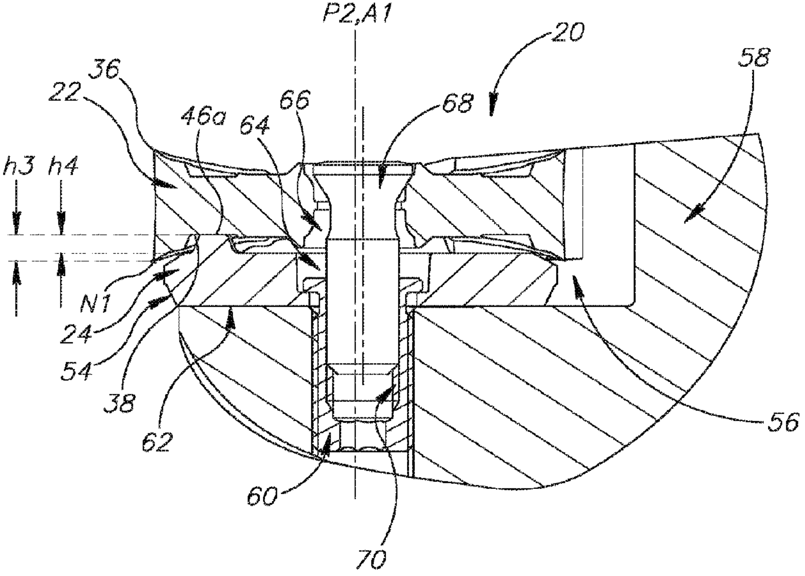


FIG.9



P2,A1
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36
22
46a
64
66
68
h3
h4
N1
24
54
38
62
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56