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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 November 2009 (26.11.2009)

PCT

(10) International Publication Number
WO 2009/141815 A1

(51) International Patent Classification:
B23B 29/04 (2006.01) *B23B 27/04* (2006.01)

(21) International Application Number:
PCT/IL2009/000393

(22) International Filing Date:
7 April 2009 (07.04.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
191520 18 May 2008 (18.05.2008) IL

(71) Applicant *(for all designated States except US)*: **ISCAR LTD.** [IL/IL]; P.O. Box 11, 24959 Tefen (IL).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **HECHT, Gil** [IL/IL]; 30/18 Ahad Ha'am Street, 22443 Nahariya (IL).

(74) Agent: **ISCAR LTD., PATENT DEPARTMENT**; P.O. Box 11, 24959 Tefen (IL).

(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, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, 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, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (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, SE, SI, SK, 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))*

WO 2009/141815 A1

(54) **Title**: CUTTING TOOL AND CUTTING INSERT THEREFOR

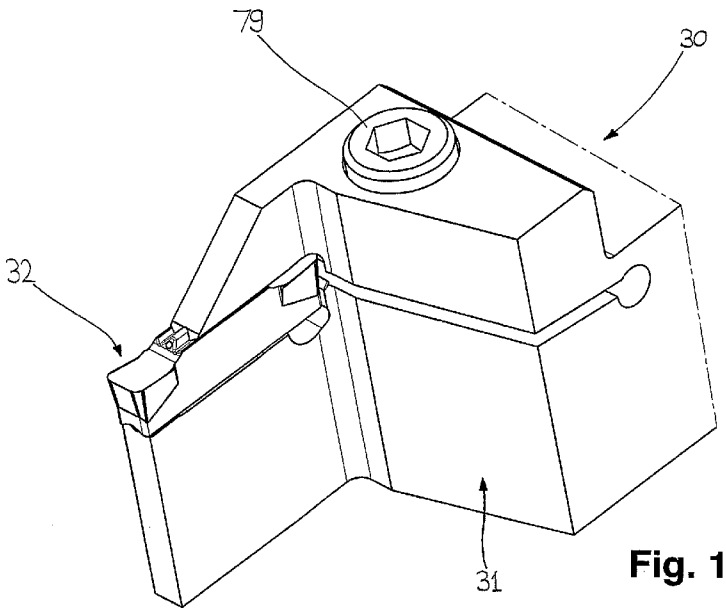

Fig. 1

(57) **Abstract**: A cutting tool for grooving and turning operations has a removably securable cutting insert. The cutting insert is clamped in an insert holder with a longitudinally extending insert receiving slot lower surface. The insert receiving slot lower surface has two separate contact sections, including a first contact section at a rear end having a V-shaped clamping surface with a wedge angle α1 in clamping contact with a first V-shaped clamping surface of the cutting insert lower surface also with a wedge angle α1, and a second contact section at a front end having a V-shaped clamping surface with a wedge angle α2 making clamping contact with a second V-shaped clamping surface of the cutting insert lower surface also with a wedge angle α2, where α1 and α2 are different.

CUTTING TOOL AND CUTTING INSERT THEREFOR

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 grooving and turning operations in particular.

BACKGROUND OF THE INVENTION

Cutting tools, cutting inserts, and insert holders in which they are retained for parting and grooving operations as disclosed in US 4,801,224, are typically small in width and subjected to single direction cutting forces. These cutting forces, produced as a result of axial direction machine feed, are transmitted through the insert tip and the forward section of the insert holder lower surface.

Support of the insert is provided by a lower V-shaped insert holder male surface (when viewed in cross-section) extending parallel to the axial machine feed direction with an obtuse internal angle between the two surface components, corresponding with an equivalent V-shaped surface on the insert with an obtuse external angle between the two surface components, where large forces can be absorbed whilst minimizing the risk of fracturing the insert. The upper surfaces of both the insert and insert holder also share these same features.

US 6,086,291 discloses a cutting tool for parting, grooving, and turning operations where each clamping surface includes a second V-shaped feature. A ridge style feature of narrower wedge angle is introduced along the length of the male V-shaped surface of the insert holder, and a flute style feature of narrower wedge angle is introduced along the length of the female V-shaped surface of the insert.

The insert and insert holder are manufactured such that when assembled, a small gap exists between the ridge and flute side surfaces. Thus, during operation, the wider obtuse angled V-shaped surfaces generally support the central main forces, and the narrower angled ridge and flute V-shaped surfaces generally support the transverse forces. The presence of a small gap between the ridge and flute side surfaces may give rise to an initial transverse movement of the insert of magnitude equal to the gap size at commencement of a turning operation.

US 6,244,790 discloses a cutting tool for parting, grooving, and turning operations, introducing lower support surfaces with a series of intermeshing ridges and grooves of V-shaped profile, each with a common narrow wedge angle. This solution is aimed at providing increased stability of the insert within the insert holder against twisting, whilst, in theory, also reducing the risk of the insert lower surface splitting by providing a larger surface area for the clamping force to be distributed.

Distribution of the clamping force over a large surface area requires successful mating of, and simultaneous contact between, the several ridge surfaces extending the entire longitudinal direction of the cutting insert, and the equal number of grooves extending along the entire longitudinal direction of the cutting insert pocket.

It is an object of the present invention to provide a cutting tool with a high level of stability and resistance to transverse forces typically associated with turning operations.

It is an object of the present invention to provide a cutting tool with a low risk of cutting insert fracture when subjected to high forces associated with axial direction machine feed grooving operations.

It is a further object of the present invention to provide a cutting tool, with reliable clamping contact between the cutting insert and insert holder clamping portions throughout a range of grooving and turning operations.

It is a further object of the present invention to provide a cutting tool for grooving and turning operations, which accounts for the manufacturing accuracies associated with cemented carbide cutting inserts.

SUMMARY OF THE INVENTION

In accordance with preferred embodiments of the present invention, there is provided a grooving and turning cutting tool comprising an insert holder with a holder head formed of a first material, and a cutting insert manufactured of a second harder material wherein the cutting insert is removably securable in the insert holder;

the cutting insert comprising:

upper and lower surfaces;

a peripheral side surface extending between the upper and lower surfaces, the peripheral side surface comprising front and rear end surfaces with a longitudinal axis passing therebetween;

peripheral edges formed at the intersection of the upper and lower surfaces with the peripheral side surface, wherein at least one portion of at least one of the peripheral edges comprises a cutting edge,

the holder head comprising:

an insert receiving slot opening out to a forward end of the insert holder, wherein the insert receiving slot includes upper and lower receiving slot surfaces sharing a common longitudinal direction, wherein the lower receiving slot surface comprises a first contact section adjacent a rear end thereof and a second contact section adjacent a front end thereof,

wherein:

clamping contact between a first of two generally V-shaped clamping surfaces of the cutting insert lower surface and the lower receiving slot surface occurs only at the first contact section, and clamping contact between a second of the two generally V-shaped clamping surfaces of the cutting insert lower surface and the lower receiving slot surface occurs only at the second contact section,

and wherein surface components of the second generally V-shaped clamping surfaces form an obtuse wedge angle $\alpha 2$, and surface components of the first generally V-shaped clamping surfaces form a wedge angle $\alpha 1$, which is smaller than wedge angle $\alpha 2$.

In accordance with some embodiments of the present invention, there is provided an insert holder comprising:

a holder head with an insert receiving slot opening out to a forward end of the insert holder, wherein the insert receiving slot includes upper and lower receiving slot surfaces sharing a common longitudinal direction; and

upper and lower clamping portions formed on the upper and lower receiving slot surfaces respectively, wherein the lower clamping portion has two generally V-shaped clamping surfaces located at separate contact sections along the lower receiving slot surface;

wherein:

a first contact section is located adjacent a rear end of the lower receiving slot surface and a second contact section is located adjacent a front end of the lower receiving slot surface, wherein surface components of the generally V-shaped clamping surface at the second contact section form an obtuse wedge angle $\alpha 2$ and surface components of the generally V-shaped clamping surface at the first contact section form a wedge angle $\alpha 1$, which is smaller than wedge angle $\alpha 2$.

In accordance with the first embodiment of the present invention, there is provided a cutting insert comprising:

upper and lower surfaces;

a peripheral side surface extending between the upper and lower surfaces, the peripheral side surface comprising front and rear end surfaces with a longitudinal axis passing therebetween;

peripheral edges formed at the intersection of the upper and lower surfaces with the peripheral side surface, wherein at least one portion of at least one of the peripheral edges comprises a cutting edge; and

upper and lower clamping portions formed on the upper and lower surfaces respectively;

wherein:

at least one of the upper and lower clamping portions has more than one generally V-shaped clamping surface when viewed in cross-section;

the surface components of the more than one generally V-shaped clamping surface form different wedge angles $\alpha 1$ and $\alpha 2$; and

the more than one generally V-shaped clamping surface have different longitudinal lengths.

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 of a perspective view of a cutting tool in accordance with a first embodiment of the present invention;

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

Fig. 3 is a top view of the cutting insert shown in Fig 1;

Fig. 4 is a perspective top view of the cutting insert shown in Fig. 1;

Fig. 5 is a perspective bottom view of the cutting insert shown in Fig. 1;

Fig. 6 is a perspective top view of the insert holder shown in Fig. 1;

Fig. 7 is a perspective bottom view of the insert holder shown in Fig. 1;

Fig. 8 is a cross-sectional view of the cutting tool shown in Fig. 2 taken along the line VIII-VIII;

Fig. 9 is a cross-sectional view of the cutting tool shown in Fig. 2 taken along the line IX-IX;

Fig. 10 is a cross-sectional view of the cutting tool shown in Fig. 2 taken along the line X-X;

Fig. 11 is of a perspective view of a cutting tool in accordance with a second embodiment of the present invention;

Fig. 12 is a side view of the cutting tool shown in Fig 11;

Fig. 13 is a bottom view of the cutting insert shown in Fig. 11;

Fig. 14 is a perspective bottom view of the cutting insert shown in Fig. 11;

Fig. 15 is a perspective top view of the insert holder shown in Fig. 11;

Fig. 16 is a cross-sectional view of the cutting tool shown in Fig. 12 taken along the line XVI-XVI;

Fig. 17 is a cross-sectional view of the cutting tool shown in Fig. 12 taken along the line XVII-XVII;

Fig. 18 is a cross-sectional view of the cutting tool shown in Fig. 12 taken along the line XVIII-XVIII;

Fig. 19 is of a perspective view of a cutting tool in accordance with a third embodiment of the present invention;

Fig. 20 is side view of the cutting tool shown in Fig 19;

Fig. 21 is a top view of the cutting insert shown in Fig. 19;

Fig. 22 is a perspective bottom view of the cutting insert shown in Fig. 19;

Fig. 23 is a perspective top view of the insert holder shown in Fig. 19;

Fig. 24 is a cross-sectional view of the cutting tool shown in Fig. 20 taken along the line XXIV-XXIV;

Fig. 25 is a cross-sectional view of the cutting tool shown in Fig. 20 taken along the line XXV-XXV;

Fig. 26 is a cross-sectional view of the cutting tool shown in Fig. 20 taken along the line XXVI-XXVI.

DETAILED DESCRIPTION OF THE INVENTION

Attention is first drawn to Figs. 1 and 2, showing a cutting tool **30** comprised of an insert holder **31** and a cutting insert **32**. The insert holder **31** is generally manufactured from steel, and the cutting insert **32** is generally manufactured by form pressing and sintering a cemented carbide, such as tungsten carbide, and can be coated or uncoated.

The cutting insert **32**, as shown in Figs. 3 to 5, comprises upper and lower surfaces **33**, **34** and a peripheral side surface **35** extending between the upper and lower surfaces **33**, **34**. The peripheral side surface **35** comprises front and rear end surfaces **36**, **37** with a longitudinal axis **A1** passing therebetween. Upper and lower clamping portions **38**, **39** are formed on the upper and lower surfaces **33**, **34** respectively.

According to a first embodiment of the present invention, the lower clamping portion **39** is comprised of two V-shaped clamping surfaces **40**, **41**. The first is a ridge type V-shaped clamping surface **40**, as shown in Fig. 10, with two surface components **42**, **43** forming an internal wedge angle **α1**, and the second is a groove type V-shaped clamping surface **41**, as shown in Fig. 8, with two surface components **44**, **45** forming an obtuse external wedge angle **α2**, where **α1** is less than **α2**. The groove type V-shaped clamping surface **41** fully extends from the front end surface **36** to the rear end surface **37**, whereas the ridge type V-shaped clamping surface **40** may extend longitudinally from a point rearward of the front end surface **36** to a point forward of the rear end surface **37**. That is, the groove type V-shaped clamping surface **41** and the ridge type V-shaped clamping surface **40** may have different longitudinal lengths (i.e., lengths taken along the longitudinal

axis **A1**), with the latter being shorter than the former. On the other hand, the groove type V-shaped clamping surface **41** and the ridge type V-shaped clamping surface **40** may have the same longitudinal lengths. The upper clamping portion **38** is comprised of a single ridge type V-shaped clamping surface **46**, as shown in Fig. 9, with two surface components **47**, **48** forming an internal wedge angle **α3**, where **α3** is less than **α2**.

Upper and lower peripheral edges **49**, **50** are formed at the intersection of the upper and lower surfaces **33**, **34** with the peripheral side surface **35**, where two cutting edges **51** are formed on the upper peripheral edge **49**.

Also according to the first embodiment, the cutting insert **32** may have mirror symmetry about a major plane **P1**, passing through the upper and lower surfaces **33**, **34** and the longitudinal axis **A1**, and in addition mirror symmetry about a minor plane **P2**, which is perpendicular to **P1**.

It should be appreciated that throughout the detailed description and claims, the surface components of the V-shaped clamping surfaces are substantially planar, and use of the term; V-shaped clamping surface, is not restricted to a clamping surface with two surface planar components forming a 'V' shape and intersecting at a vertex point (when viewed in cross-section), but also accounts for a clamping surface with a curve or radius joining the two planar surface components, or a clamping surface with a secondary groove or ridge feature between the two planar surface components.

It should also be appreciated that throughout the detailed description and claims, an "internal angle" refers to an angle between two surface components of a member surface as measured internal to the member, whereas an "external angle" refers to an angle between two surface components of a member surface as measured external to the member.

As shown in Figs. 6 and 7, the insert holder **31** comprises a holder head **52** having an insert receiving slot **53** opening out to a forward end **54** of the insert holder **31**, with upper and lower receiving slot surfaces **55**, **56** sharing a common

longitudinal direction from a front end **57** to a rear end **58** of the lower receiving slot surface **56**. Extending rearwards from the insert receiving slot **53** is a narrow spring slot **59** which divides the holder head **52** into an upper clamping jaw **60** and a lower base jaw **61**.

According to the first embodiment of the present invention, a lower clamping portion **62** formed on the lower receiving slot surface **56** is comprised of two V-shaped clamping surfaces **63**, **64**, the first a groove type V-shaped clamping surface **63** and the second a ridge type V-shaped clamping surface **64**. The two V-shaped clamping surfaces **63**, **64** are located at separate contact sections **65**, **66** along the longitudinal direction of the lower receiving slot surface **56**. A first contact section **65** is located adjacent the rear end **58**, where two surface components **67**, **68** of the groove type V-shaped clamping surface **63**, as shown in Fig. 10, form an external wedge angle **α1**, and a second contact section **66** is located adjacent the front end **57**, where two surface components **69**, **70** of the ridge type V-shaped clamping surface **64**, as shown in Fig. 8, form an obtuse internal wedge angle **α2**, where **α1** is less than **α2**.

As shown in Fig. 6, a rear step **71** transverse to the longitudinal direction of the lower receiving slot surface **56** defines the physical boundary of the first contact section **65**, and a front step **72** transverse to the longitudinal direction of the lower receiving slot surface **56** defines the physical boundary of the second contact section **66**.

A groove type guiding surface **73** forward of the rear step **71** and a ridge type guiding surface **74** rearward of the front step **72** on the lower receiving slot surface **56**, are not features of the lower clamping portion **62** of the insert holder **31**, and do not provide a means of clamping contact with the lower clamping portion **39** of the cutting insert **32**.

An upper clamping portion **75** formed on the upper receiving slot surface **55** is comprised of a single groove type V-shaped clamping surface **76**, with two

surface components **77**, **78**, as shown in Fig. 9, forming an external wedge angle **α3**, where **α3** is less than **α2**.

Also according to the first embodiment, a fastening screw **79** positioned within the through bore **80** of the upper clamping jaw **60** and rotatable in a threaded bore **81** of the lower base jaw **61**, maybe used to control the distance between the upper and lower receiving slot surfaces **55**, **56**, in order to clamp or release the cutting insert **32**.

Assembly of the cutting insert **32** within the insert holder **31** of the first embodiment can be described in the following four stages:-

The first stage requires confirmation that the distance between the upper and lower receiving slot surfaces **55**, **56** is sufficient to accept the cutting insert **32**. This may require an operator to rotate the fastening screw **79** in an anti-clockwise direction to allow the spring effect of the spring slot **59** to release the upper clamping jaw **60**.

The second stage of assembly requires the operator to interface the groove type V-shaped clamping surface **41** of the cutting insert **32** lower surface **34** with the ridge type V-shaped clamping surface **64** of the insert holder **31** lower receiving slot surface **56**.

The third assembly stage requires the operator to slide the cutting insert **32** along the longitudinal direction of the lower receiving slot surface **56**, until an end abutment surface **82** of the cutting insert **32**, generally parallel to minor plane **P2**, abuts against a vertical abutment wall **83** of the insert holder **31**.

The fourth assembly stage requires the operator to rotate the fastening screw **79** in a clockwise direction to overcome the spring effect of the spring slot **59**, and close the distance between the upper and lower receiving slot surfaces **55**, **56** until the cutting insert **32** is firmly secured in the insert holder **31**.

With the cutting insert **32** firmly secured in the insert holder **31**, clamping contact occurs between the cutting insert **32** and insert holder **31** as described below.

The groove type V-shaped clamping surface **41** of the cutting insert **32** lower surface **34** is in clamping contact with the ridge type V-shaped clamping surface **64** at the second contact section **66** of the insert holder **31** lower receiving slot surface **56**, where as shown in Fig. 8, the surface components **44**, **45** of the groove type V-shaped clamping surface **41** of the cutting insert **32** lower surface **34** are in respective abutment with the surface components **69**, **70** of the ridge type V-shaped clamping surface **64** of the insert holder **31** lower receiving slot surface **56,** and the surface components **44**, **45** and **69**, **70** share a common obtuse wedge angle **α2**. Wedge angle **α2** has a typical range of 120°-150°.

The ridge type V-shaped clamping surface **40** of the cutting insert **32** lower surface **34** is in clamping contact with the groove type V-shaped clamping surface **63** at the first contact section **65** of the insert holder **31** lower receiving slot surface **56**, where as shown in Fig. 10, the surface components **42**, **43** of the ridge type V-shaped clamping surface **40** of the cutting insert **32** lower surface **34** are in respective abutment with the surface components **67**, **68** of the groove type V-shaped clamping surface **63** of the insert holder **31** lower receiving slot surface **56**, and the surface components **42**, **43** and **67**, **68** share a common wedge angle **α1**, where **α1** is less than **α2**. Wedge angle **α1** has a typical range of 60°-120°.

Clamping contact between the V-shaped clamping surface components **44**, **45** and **69**, **70** at the second contact section **66** of the insert holder **31** lower receiving slot surface **56** occurs at a greater distance from major plane **P1** of the cutting insert **32** than clamping contact between the V-shaped clamping surface components **42**, **43** and **67**, **68** at the first contact section **65** of the insert holder **31** lower receiving slot surface **56**.

No clamping contact is made between the cutting insert **32** and insert holder **31**, as shown in Fig. 9, along the longitudinal direction of the insert holder **31** lower receiving slot surface **56**, between the rear step **71** of the first contact section **65** and the front step **72** of the second contact section **66**.

The ridge type V-shaped clamping surface **46** of the cutting insert **32** upper surface **33** is in clamping contact with the groove type V-shaped clamping surface **76** of the insert holder **31** upper receiving slot surface **55**, where as shown in Fig. 9, the surface components **47**, **48** of the ridge type V-shaped clamping surface **46** of the cutting insert **32** upper surface **33** are in respective abutment with the surface components **77**, **78** of the groove type V-shaped clamping surface **76** of the insert holder **31** upper receiving slot surface **55**, and the surface components **47**, **48** and **77**, **78** share a common wedge angle **α3**, where **α3** is less than **α2**. Wedge angle **α3** has a typical range of 60°-120°.

The second embodiment of the cutting tool **130**, as shown in Figs. 11 and 12, comprises a cutting insert **132** and insert holder **131**.

The cutting insert **132**, as shown in Figs. 13 and 14, comprises upper and lower surfaces **133**, **134**, and a peripheral side surface **135** extending between the upper and lower surfaces **133**, **134**. The peripheral side surface **135** comprises front and rear end surfaces **136**, **137** with a longitudinal axis **A1'** passing therebetween. Upper and lower clamping portions **138**, **139** are formed on the upper and lower surfaces **133**, **134** respectively.

The lower clamping portion **139** is comprised of two groove type V-shaped clamping surfaces **140**, **141**. The first groove type V-shaped clamping surface **140**, as shown in Fig. 18, has two surface components **142**, **143** forming an external wedge angle **α1**, and the second groove type V-shaped clamping surface **141**, as shown in Fig. 16, has two surface components **144**, **145** forming an obtuse external wedge angle **α2**, where **α1** is less than **α2**. A groove type guiding surface **184** adjacent the front end surface **136**, is not a feature of the lower clamping portion **139** of the cutting insert **132**, and does not provide a means of clamping contact with a lower clamping portion **162** of the insert holder **131**.

The upper clamping portion **138** is comprised of a single groove type V-shaped clamping surface **146**, as shown in Fig. 17, with two surface components **147**, **148** forming an external wedge angle **α3**, where **α3** is less than **α2**.

Also according to the second embodiment, the cutting insert **132** may have mirror symmetry about a major plane **P1'**, passing through the upper and lower surfaces **133**, **134** and the longitudinal axis **A1'**, and in addition rotational symmetry about a minor axis **A2'**, which is perpendicular to the longitudinal axis **A1'** and passes through the peripheral side surface **135**. Upper and lower peripheral edges **149**, **150** are formed at the intersection of the upper and lower surfaces **133**, **134** with the peripheral side surface **135**, where a cutting edge **151** is formed on a portion of each of the upper and lower peripheral edges **149**, **150**.

As shown in Fig. 15, the insert holder **131** of the second embodiment, comprises a holder head **152** having an insert receiving slot **153** opening out to a forward end **154** of the insert holder **131**, with upper and lower receiving slot surfaces **155**, **156** sharing a common longitudinal direction from a front end **157** to a rear end **158** of the lower receiving slot surface **156**.

A lower clamping portion **162** is formed at a first and second contact section **165**, **166** adjacent the rear and front ends **158**, **157** of the lower receiving slot surface **156**, respectively. Each of the first and second contact sections **165**, **166** is comprised of two ridge type V-shaped clamping surfaces **163**, **164**. The first V-shaped clamping surface **163**, as shown in Fig. 18, has two surface components **167**, **168** forming an internal wedge angle **α1**, and the second V-shaped clamping surface **164**, as shown in Fig. 16, has two surface components **169**, **170** forming an obtuse internal wedge angle **α2**, where **α1** is less than **α2**.

An upper clamping portion **175** formed on the upper receiving slot surface **155** is comprised of a single ridge type V-shaped clamping surface **176**, as shown in Fig. 17, with two surface components **177**, **178** forming an internal wedge angle **α3**, where **α3** is equal to **α1**.

With the cutting insert **132** firmly secured in the insert holder **131**, clamping contact occurs between the cutting insert **132** and insert holder **131** as described below.

The second groove type V-shaped clamping surface **141** of the cutting insert **132** lower surface **134**, is in clamping contact with the second ridge type V-shaped clamping surface **164** at the second contact section **166** of the insert holder **131** lower receiving slot surface **156**, where as shown in Fig. 16, the surface components **144**, **145** of the second groove type V-shaped clamping surface **141** of the cutting insert **132** lower surface **134** are in respective abutment with the surface components **169**, **170** of the second ridge type V-shaped clamping surface **164** of the insert holder **131** lower receiving slot surface **156**, and the surface components **144**, **145** and **169**, **170** share a common obtuse wedge angle **α2**.

The first groove type V-shaped clamping surface **140** of the cutting insert **132** lower surface **134**, is in clamping contact with the first ridge type V-shaped clamping surface **163** at the first contact section **165** of the insert holder **131** lower receiving slot surface **156**, where as shown in Fig. 18, the surface components **142**, **143** of the first groove type V-shaped clamping surface **140** of the cutting insert **132** lower surface **134** are in respective abutment with the surface components **167**, **168** of the first ridge type V-shaped clamping surface **163** of the insert holder **131** lower receiving slot surface **156**, and the surface components **142**, **143** and **167**, **168** share a common wedge angle **α1**, where **α1** is less than **α2**.

Clamping contact between the V-shaped clamping surface components **144**, **145** and **169**, **170** at the second contact section **166** of the insert holder **131** lower receiving slot surface **156** occurs at a greater distance from major plane **P1'** of the cutting insert **132** than clamping contact between the V-shaped clamping surface components **142**, **143** and **167**, **168** at the first contact section **165** of the insert holder **131** lower receiving slot surface **156**.

No clamping contact is made between the cutting insert **132** and insert holder **131**, as shown in Fig. 17, along the longitudinal direction of the insert holder **131** lower receiving slot surface **156** between the first and second contact section **165**, **166**.

The groove type V-shaped clamping surface **146** of the cutting insert **132** upper surface **133** is in clamping contact with the ridge type V-shaped clamping surface **176** of the insert holder **131** upper receiving slot surface **155**, where as shown in Fig. 17, the surface components **147**, **148** of the groove type V-shaped clamping surface **146** of the cutting insert **132** upper surface **133** are in respective abutment with the surface components **177**, **178** of the ridge type V-shaped clamping surface **176** of the insert holder **131** upper receiving slot surface **155**, and the surface components **147**, **148** and **177**, **178** share a common wedge angle **α3**, where **α3** is less than **α2**.

The third embodiment of the cutting tool **230**, as shown in Figs. 19 and 20, comprises a cutting insert **232** and insert holder **231**.

The cutting insert **232**, as shown in Fig. 21 and 22, comprises upper and lower surfaces **233**, **234**, and a peripheral side surface **235** extending between the upper and lower surfaces **233**, **234**. The peripheral side surface **235** comprises front and rear end surfaces **236**, **237** with a longitudinal axis **A1"** passing therebetween. Upper and lower clamping portions **238**, **239** are formed on the upper and lower surfaces **233**, **234**, respectively.

The lower clamping portion **239** is comprised of two groove type V-shaped clamping surfaces **240**, **241**. The first groove type V-shaped clamping surface **240**, as shown in Fig. 26, has two surface components **242**, **243** forming an external wedge angle **α1**, and the second groove type V-shaped clamping surface **241**, as shown in Fig. 24, has two surface components **244**, **245** forming an external wedge angle **α2**, where **α1** is less than **α2**.

An upper clamping portion **238** formed on the upper surface **233**, is comprised of a single groove type V-shaped clamping surface **246**, as shown in Fig. 25, with two surface components **247**, **248** forming an external wedge angle **α3**, where **α3** is less than **α2**.

Also according to the third embodiment, the cutting insert **232** may have mirror symmetry about a major plane **P1"**, passing through the upper and lower

surfaces **233**, **234** and the longitudinal axis **A1"**. Upper and lower peripheral edges **249**, **250** are formed at the intersection of the upper and lower surfaces **233**, **234**, respectively, with the peripheral side surface **235**, and a cutting edge **251** is formed along a portion of the upper peripheral edge **249**.

As shown in Fig. 23, the insert holder **231** of the third embodiment comprises a holder head **252** having an insert receiving slot **253** opening out to a forward end **254** of the insert holder **231**, with upper and lower receiving slot surfaces **255**, **256** sharing a common longitudinal direction from a front end **257** to a rear end **258** of the lower receiving slot surface **256**.

A lower clamping portion **262** formed on the lower receiving slot surface **256**, is comprised of two ridge type V-shaped clamping surfaces **263**, **264** located at separate contact sections **265**, **266** along the longitudinal direction of the lower receiving slot surface **256**. A first contact section **265** is located adjacent the rear end **258**, where two surface components **267**, **268** of the first ridge type V-shaped clamping surface **263**, as shown in Fig. 26, form an internal wedge angle **α1**, and a second contact section **266** is located adjacent the front end **257**, where two surface components **269**, **270** of the second ridge type V-shaped clamping surface **264**, as shown in Fig. 24, form an obtuse internal wedge angle **α2**, where **α1** is less than **α2**.

An upper clamping portion **275** formed on the upper receiving slot surface **255** is comprised of a single ridge type V-shaped clamping surface **276**, with two surface components **277**, **278**, as shown in Fig. 25, forming an internal wedge angle **α3**, where **α3** is less than **α2**.

With the cutting insert **232** firmly secured in the insert holder **231**, clamping contact occurs between the cutting insert **232** and insert holder **231** as described below.

The second groove type V-shaped clamping surface **241** of the cutting insert **232** lower surface **234** is in clamping contact with the second ridge type V-shaped clamping surface **264** at the second contact section **266** of the insert holder **231** lower receiving slot surface **256**, where as shown in Fig. 24, the surface

components **244**, **245** of the second groove type V-shaped clamping surface **241** of the cutting insert **232** lower surface **234** are in respective abutment with the surface components **269**, **270** of the second ridge type V-shaped clamping surface **264** of the insert holder **231** lower receiving slot surface **256**, and the surface components **244**, **245** and **269**, **270** share a common obtuse wedge angle **α2**.

The first groove type V-shaped clamping surface **240** of the cutting insert **232** lower surface **234** is in clamping contact with the first ridge type V-shaped clamping surface **263** at the first contact section **265** of the insert holder **231** lower receiving slot surface **256**, where as shown in Fig. 26, the surface components **242**, **243** of the first groove type V-shaped clamping surface **240** of the cutting insert **232** lower surface **234** are in respective abutment with the surface components **267**, **268** of the first ridge type V-shaped clamping surface **263** of the insert holder **231** lower receiving slot surface **256**, and the surface components **242**, **243** and **267**, **268** share a common wedge angle **α1**, where **α1** is less than **α2**.

The groove type V-shaped clamping surface **246** of the cutting insert **232** upper surface **233** is in clamping contact with the ridge type V-shaped clamping surface **276** of the insert holder **231** upper receiving slot surface **255**, where as shown in Fig. 25, the surface components **247**, **248** of the groove type V-shaped clamping surface **246** of the cutting insert **232** upper surface **233** are in respective abutment with the surface components **277**, **278** of the ridge type V-shaped clamping surface **276** of the insert holder **231** upper receiving slot surface **255**, and the surface components **247**, **248** and **277**, **278** share a common wedge angle **α3**, where **α3** is less than **α2**.

In accordance with some embodiments, the three wedge angles **α1**, **α2**, and **α3** formed between the surface components **42**, **43**, **142**, **143**, **242**, **243**; **44**, **45**, **144**, **145**, **244**, **245**; **47**, **48**, **147**, **148**, **247**, **248** of the V-shaped clamping surfaces **40**, **140**, **240**; **41**, **141**, **241**; **46**, **146**, **246** of the cutting inserts **32**, **132**, **232** have values higher or lower than the matching wedge angle on the insert holder **31**, **131**, **231** by approximately 1°, in order to control the location of resultant clamping contact

regions between the cutting insert **32**, **132**, **232** and the insert holder **31**, **131**, **231** following assembly, and therefore reduce the risk of excessive stress concentrations during operation, and use of the expression "common wedge angle" means wedge angles common to within the approximate 1°.

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:

1. A cutting tool (30, 130, 230) comprising an insert holder (31, 131, 231) with a holder head (52, 152, 252) formed of a first material, and a cutting insert (32, 132, 232) manufactured of a second harder material, wherein the cutting insert (32, 132, 232) is removably securable in the insert holder (31, 131, 231);

the cutting insert (32, 132, 232) comprising:

upper and lower surfaces (33, 133, 233; 34, 134, 234);

a peripheral side surface (35, 135, 235) extending between the upper and lower surfaces (33, 133, 233; 34, 134, 234), the peripheral side surface (35, 135, 235) comprising front and rear end surfaces (36, 136, 236; 37, 137, 237) with a longitudinal axis A1, A1', A1" passing therebetween;

peripheral edges (49, 149, 249; 50, 150, 250) formed at the intersection of the upper and lower surfaces (33, 133, 233; 34, 134, 234) with the peripheral side surface (35, 135, 235), wherein at least one portion of at least one of the peripheral edges (49, 149, 249) comprises a cutting edge (51, 151, 251),

the holder head (52, 152, 252) comprising:

an insert receiving slot (53, 153, 253) opening out to a forward end (54, 154, 254) of the insert holder (31, 131, 231), wherein the insert receiving slot (53, 153, 253) includes upper and lower receiving slot surfaces (55, 155, 255; 56, 156, 256) sharing a common longitudinal direction, wherein the lower receiving slot surface (56, 156, 256) comprises a first contact section (65, 165, 265) adjacent a rear end (58, 158, 258) thereof and a second contact section (66, 166, 266) adjacent a front end (57, 157, 257) thereof,

wherein:

clamping contact between a first of two generally V-shaped clamping surfaces (40, 140, 240; 63, 163, 263) of the cutting insert (32, 132, 232) lower surface (34, 134, 234) and the lower receiving slot surface (56, 156, 256) occurs only at the first contact section (65, 165, 265), and clamping contact between a second of the two generally V-

shaped clamping surfaces (41, 141, 241; 64, 164, 264) of the cutting insert (32, 132, 232) lower surface (34, 134, 234) and the lower receiving slot surface (56, 156, 256) occurs only at the second contact section (66, 166, 266),

and wherein surface components (44, 45, 144, 145, 244, 245; 69, 70, 169, 170, 269, 270) of the second generally V-shaped clamping surfaces (41, 141, 241; 64, 164, 264) form an obtuse wedge angle $\alpha 2$, and surface components (42, 43, 142, 143, 242, 243; 67, 68, 167, 168, 267, 268) of the first generally V-shaped clamping surfaces (40, 140, 240; 63, 163, 263) form a wedge angle $\alpha 1$, which is smaller than wedge angle $\alpha 2$.

2. The cutting tool (30, 130, 230) according to claim 1, wherein a single generally V-shaped clamping surface (46, 146, 246) of the cutting insert (32, 132, 232) upper surface (33, 133, 233), with surface components (47, 48, 147, 148, 247, 248) forming a wedge angle $\alpha 3$, is in clamping contact with a single generally V-shaped clamping surface (76, 176, 276) on the upper receiving slot surface (55, 155, 255), with surface components (77, 78, 177, 178, 277, 278) also forming a wedge angle $\alpha 3$.

3. The cutting tool (30, 130, 230) according to claim 2, wherein the wedge angle $\alpha 3$ formed by the surface components (47, 48, 147, 148, 247, 248; 77, 78, 177, 178, 277, 278) of the generally V-shaped clamping surfaces (46, 146, 246; 76, 176, 276) of the cutting insert (32, 132, 232) upper surface (33 133, 233) and upper receiving slot surface (55, 155, 255), is less than the wedge angle $\alpha 2$ formed by the surface components (44, 45, 144, 145, 244, 245; 69, 70, 169, 170, 269, 270) of the second generally V-shaped clamping surfaces (41, 141, 241; 64, 164, 264).

4. The cutting tool (30, 130, 230) according to claim 2, wherein the wedge angle $\alpha 3$ formed by the surface components (47, 48, 147, 148, 247, 248; 77, 78, 177, 178, 277, 278) of the generally V-shaped clamping surfaces (46, 146, 246; 76, 176, 276) of the cutting insert (32, 132, 232) upper surface (33 133, 233) and upper receiving slot surface (55, 155, 255), is equal to the wedge angle $\alpha 1$ formed by the surface components (42, 43, 142, 143, 242, 243; 67, 68, 167, 168, 267, 268) of the first generally V-shaped clamping surfaces (40, 140, 240; 63, 163, 263).

5. The cutting tool (30, 130, 230) according to claim 1, wherein the cutting insert (32, 132, 232) has mirror symmetry about a major plane P1, P1', P1" passing through the upper and lower surfaces (33 133, 233; 34, 134, 234) and the longitudinal axis A1, A1', A1".

6. The cutting tool (30, 130) according to claim 5, wherein clamping contact between the surface components (44, 45, 144, 145; 69, 70, 169, 170) of the second generally V-shaped clamping surfaces (41, 141; 64, 164) occurs at a greater distance from the major plane P1, P1' of the cutting insert (32, 132) than clamping contact between the surface components (42, 43, 142, 143; 67, 68, 167, 168) of the first generally V-shaped clamping surfaces (40, 140; 63, 163).

7. The cutting tool (30) according to claim 1, wherein the two generally V-shaped clamping surfaces (40, 41) of the cutting insert (32) lower surface (34) have different longitudinal lengths.

8. An insert holder (31, 231) comprising:

a holder head (52, 252) with an insert receiving slot (53, 253) opening out to a forward end (54, 254) of the insert holder (31, 231), wherein the insert receiving slot (53, 253) includes upper and lower receiving slot surfaces (55, 255; 56, 256) sharing a common longitudinal direction; and

upper and lower clamping portions (75, 275; 62, 262) formed on the upper and lower receiving slot surfaces (55, 255; 56, 256) respectively, wherein the lower clamping portion (62, 262) has two generally V-shaped clamping surfaces (63, 263; 64, 264) located at separate contact sections (65, 265; 66, 266) along the lower receiving slot surface (56 256);

wherein:

a first contact section (65, 265) is located adjacent a rear end (58, 258) of the lower receiving slot surface (56, 256) and a second contact section (66, 266) is located adjacent a front end (57, 257) of the lower receiving slot surface (56, 256), wherein

surface components (69, 70, 269, 270) of the generally V-shaped clamping surface (64, 264) at the second contact section (66, 266) form an obtuse wedge angle α2 and surface components (67, 68, 267, 268) of the generally V-shaped clamping surface (63, 263) at the first contact section (65, 265) form a wedge angle α1, which is smaller than wedge angle α2.

9. The insert holder (31, 231) according to claim 8, wherein the wedge angle α1 formed by the surface components (67, 68, 267, 268) of the generally V-shaped clamping surface (63, 263) at the first contact section (65, 265) is acute.

10. The insert holder (31, 231) according to claim 8, wherein the upper clamping portion (75, 275) has a single generally V-shaped clamping surface (76, 276), with surface components (77, 78, 277, 278) forming a wedge angle α3.

11. The insert holder (31, 231) according to claim 10, wherein the wedge angle α3 formed by the surface components (77, 78, 277, 278) of the generally V-shaped clamping surface (76, 276) on the upper clamping portion (75, 275), is less than the wedge angle α2 formed by the surface components (69, 70, 269, 270) of the generally V-shaped clamping surface (64, 264) at the second contact section (66, 266) of the lower receiving slot surface (56, 256).

12. The insert holder (31, 231) according to claim 10, wherein the wedge angle α3 formed by the surface components (77, 78, 277, 278) of the generally V-shaped clamping surface (76, 276) on the upper clamping portion (75, 275), is equal to the wedge angle α1 formed by the surface components (67, 68, 267, 268) of the generally V-shaped clamping surface (63, 263) at the first contact section (65, 265) of the lower receiving slot surface (56, 256).

13. A cutting insert (32) comprising:

upper and lower surfaces (33; 34);

a peripheral side surface (35) extending between the upper and lower surfaces (33; 34), the peripheral side surface (35) comprising front and rear end surfaces (36; 37) with a longitudinal axis A1 passing therebetween;

peripheral edges (49; 50) formed at the intersection of the upper and lower surfaces (33; 34) with the peripheral side surface (35), wherein at least one portion of at least one of the peripheral edges (49) comprises a cutting edge (51); and

upper and lower clamping portions (38; 39) formed on the upper and lower surfaces (33; 34) respectively;

wherein:

at least one of the upper and lower clamping portions (39) has more than one generally V-shaped clamping surface (40; 41) when viewed in cross-section;

the surface components (42, 43; 44, 45) of the more than one generally V-shaped clamping surface (40; 41) form different wedge angles $\alpha 1$ and $\alpha 2$; and

the more than one generally V-shaped clamping surface (40; 41) have different longitudinal lengths.

14. The cutting insert (32) according to claim 13, wherein one of the more than one generally V-shaped clamping surface (41) fully extends from the front end surface (36) to the rear end surface (37).

15. The cutting insert (32) according to claim 14, wherein the generally V-shaped clamping surface (41) fully extending from the front end surface (36) to the rear end surface (37) is a groove type V-shaped clamping surface.

16. The cutting insert (32) according to claim 14, wherein the generally V-shaped clamping surface (41) fully extending from the front end surface (36) to the rear end surface (37) has surface components (44, 45) forming an obtuse wedge angle $\alpha 2$.

17. The cutting insert (32) according to claim 13, wherein at least one of the more than one generally V-shaped clamping surface (40) has surface components (42, 43) forming an acute wedge angle $\alpha 1$.

18. The cutting insert (32) according to claim 13, having mirror symmetry about a major plane P1 passing through the upper and lower surfaces (33; 34) and the longitudinal axis A1.

19. The cutting insert (32) according to claim 13, having mirror symmetry about a minor plane P2 perpendicular to the longitudinal axis A1.

20. The cutting insert (32) according to claim 13, wherein two portions of at least one of the peripheral edges (49) comprise a cutting edge (51).

21. The cutting insert (32) according to claim 13, wherein one of the upper and lower clamping portions (38) has a single generally V-shaped clamping surface (46) when viewed in cross-section with surface components (47, 48) forming a wedge angle $\alpha 3$, which is smaller than wedge angle $\alpha 2$.

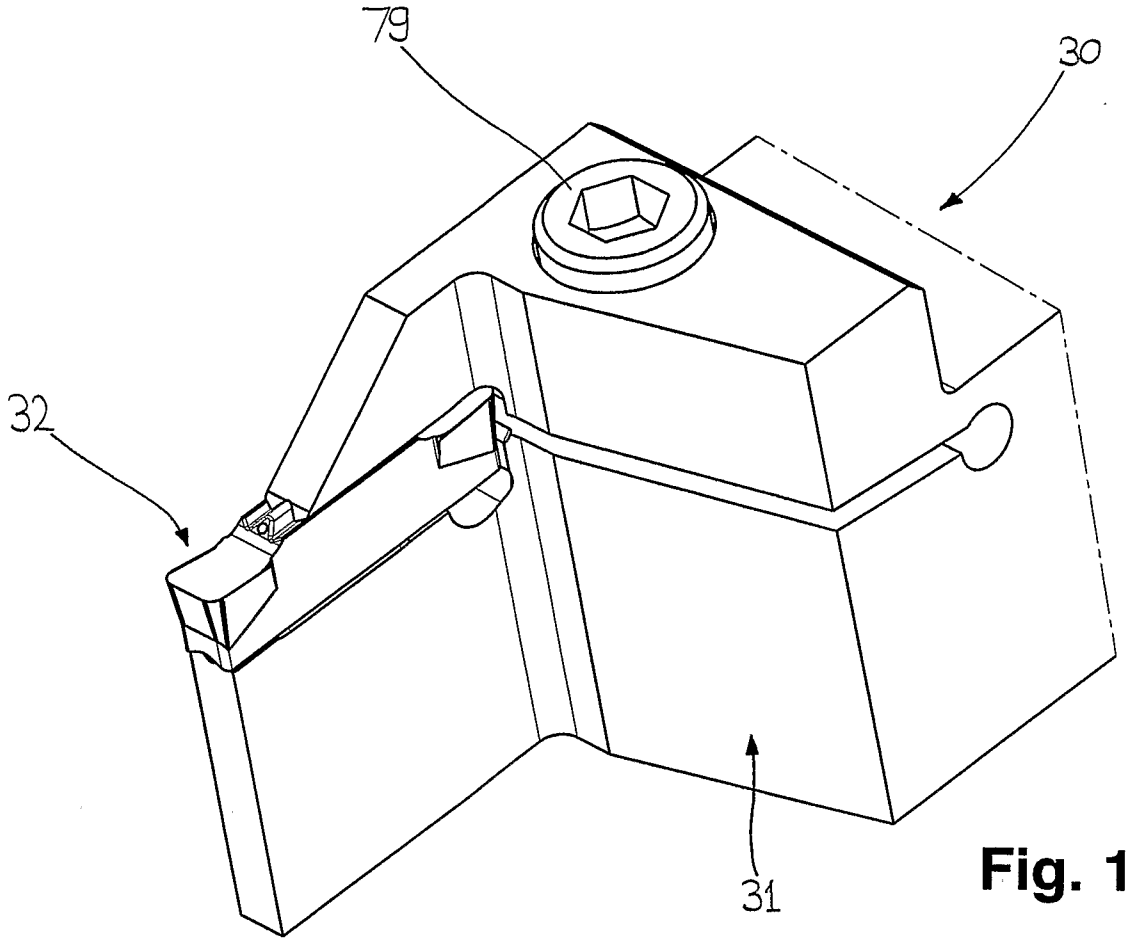

Fig. 1

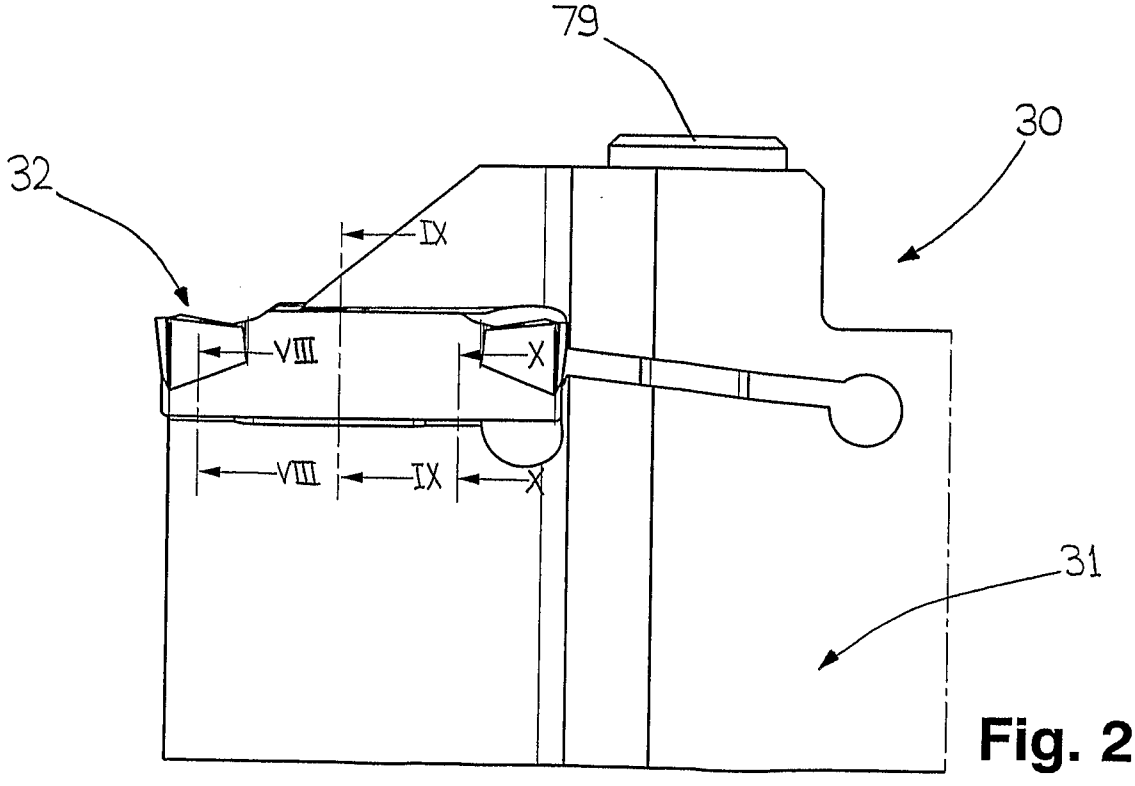

Fig. 2

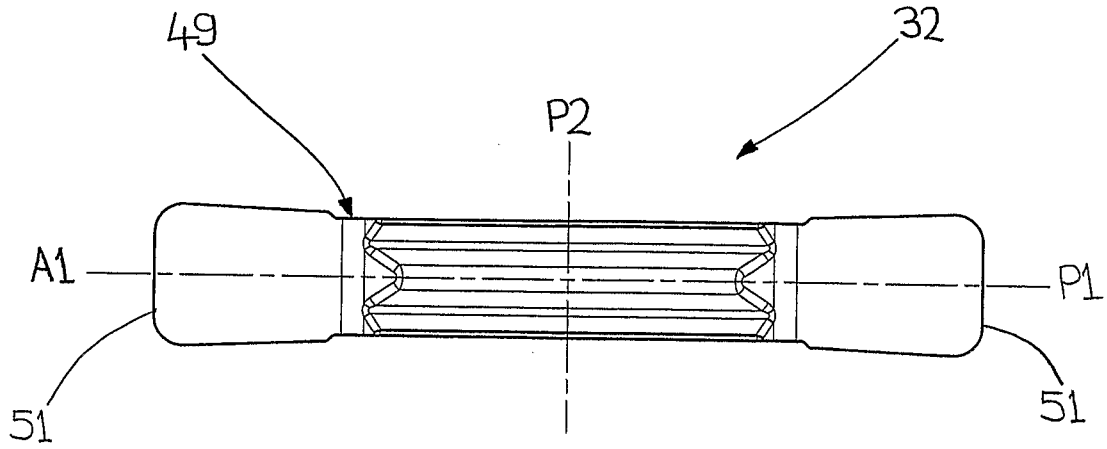

Fig. 3

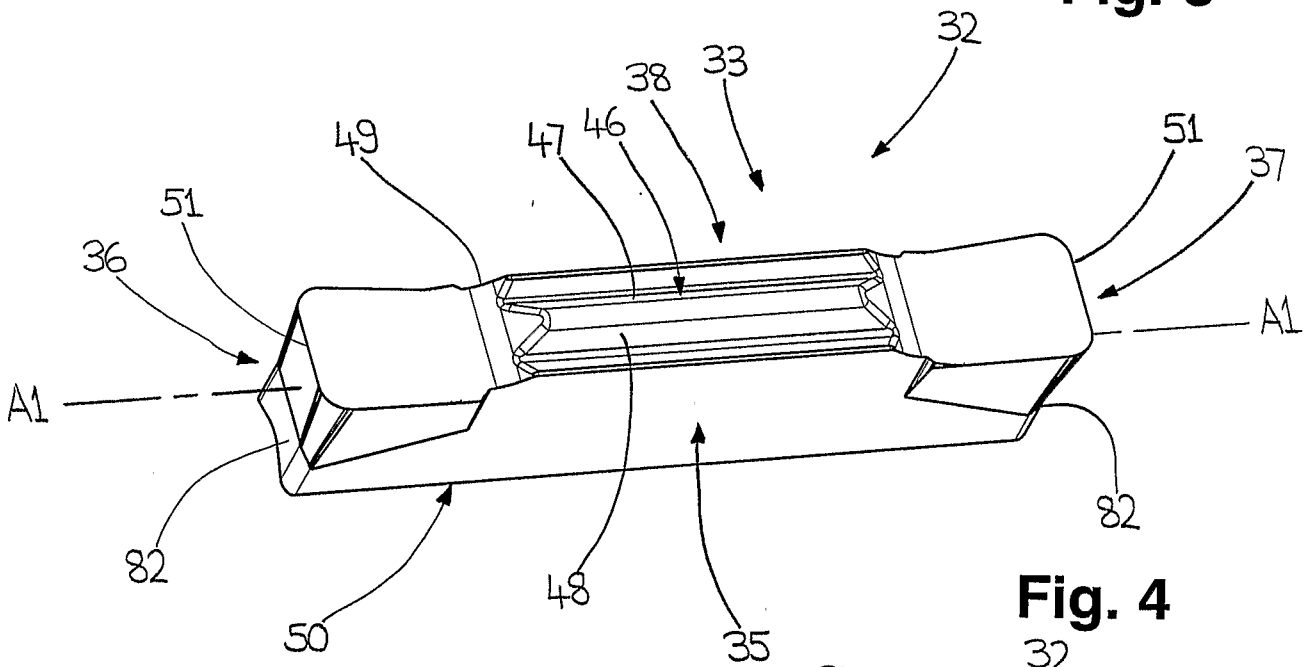

Fig. 4

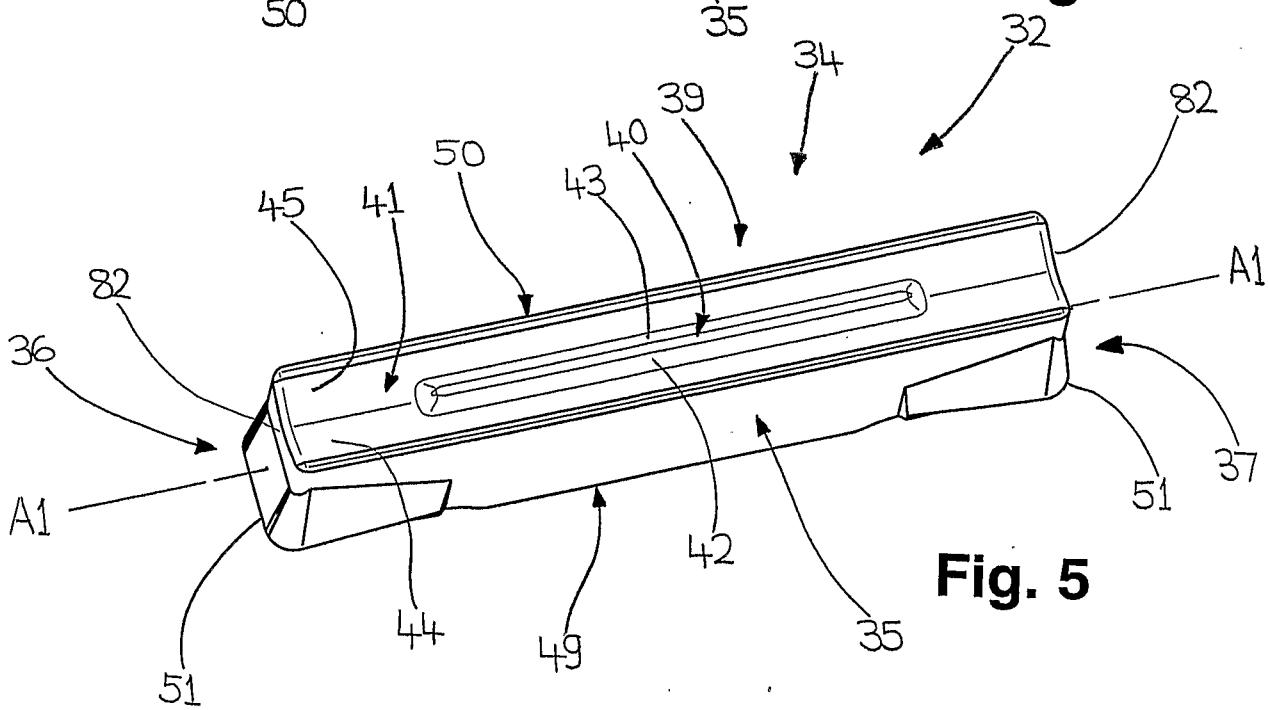

Fig. 5

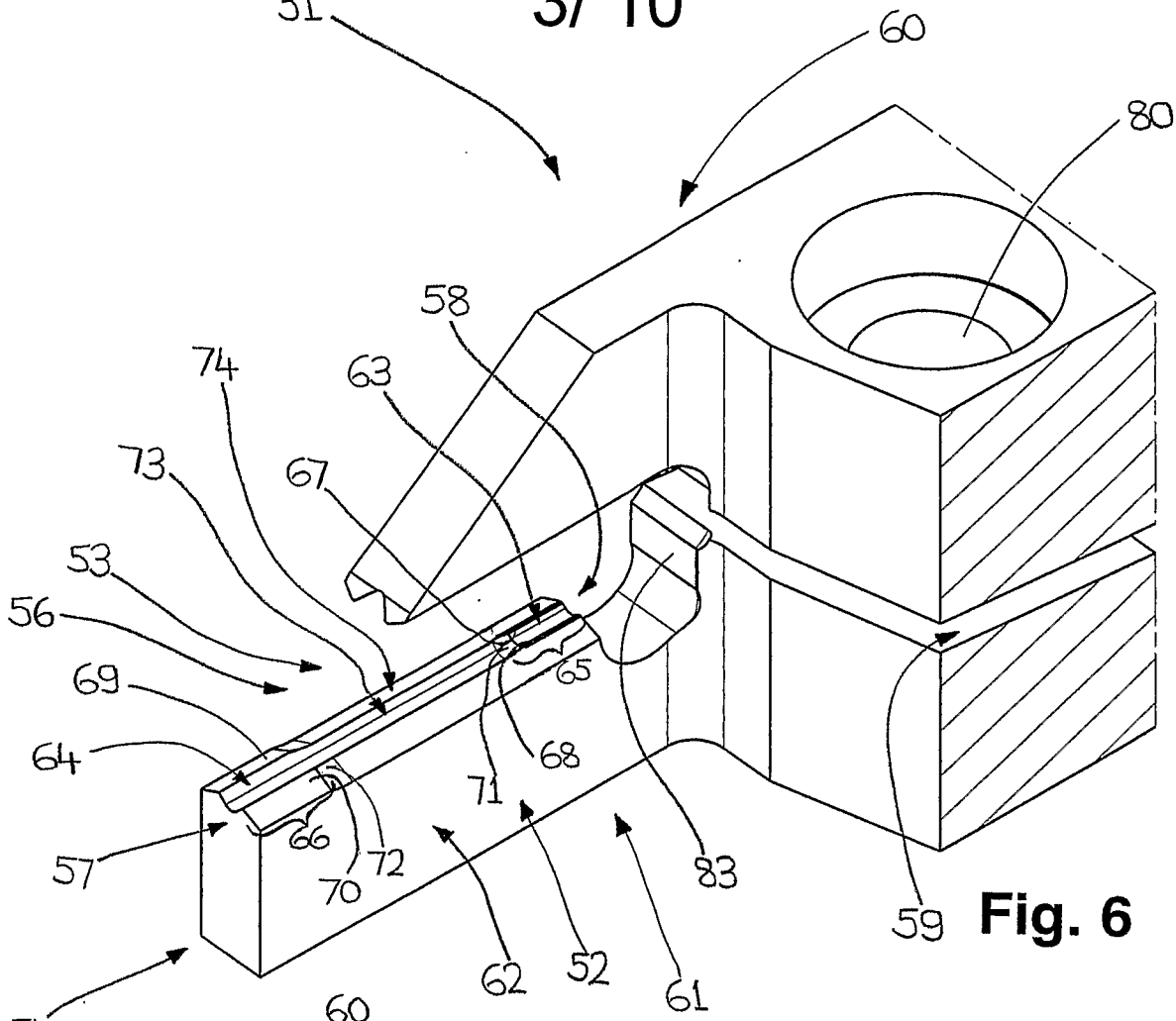
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Fig. 6

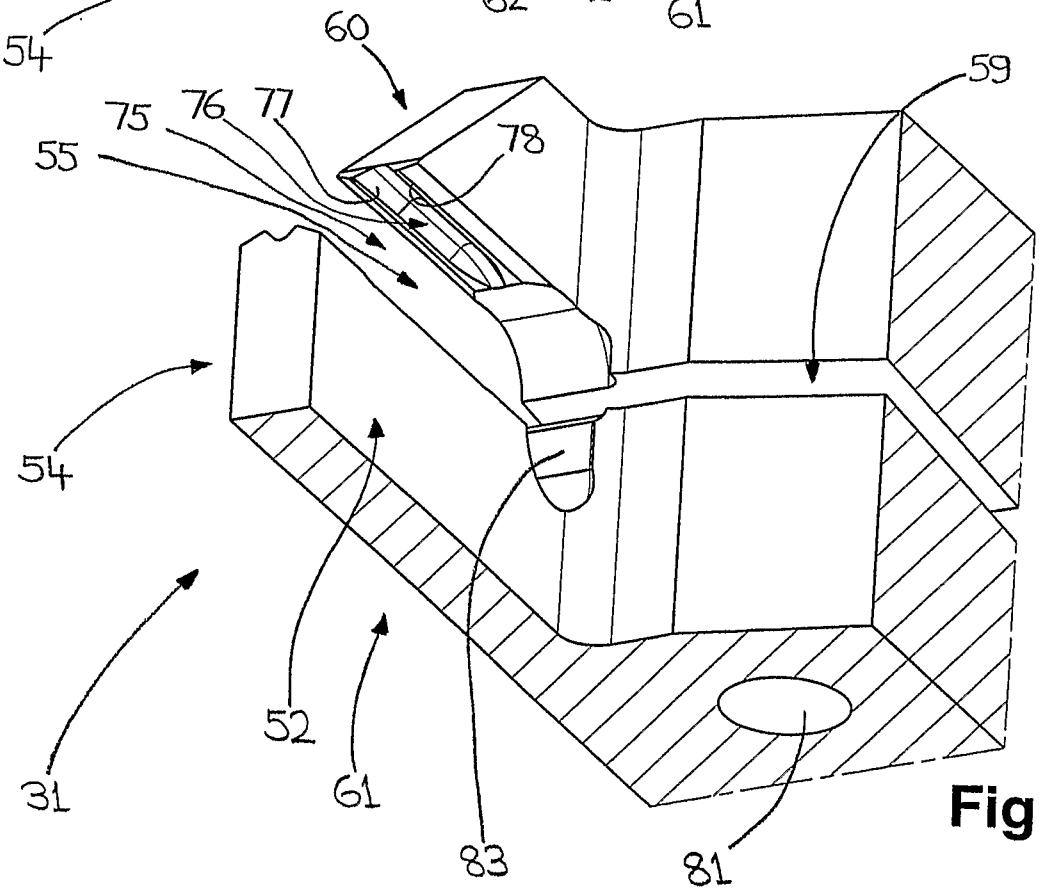
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Fig. 7

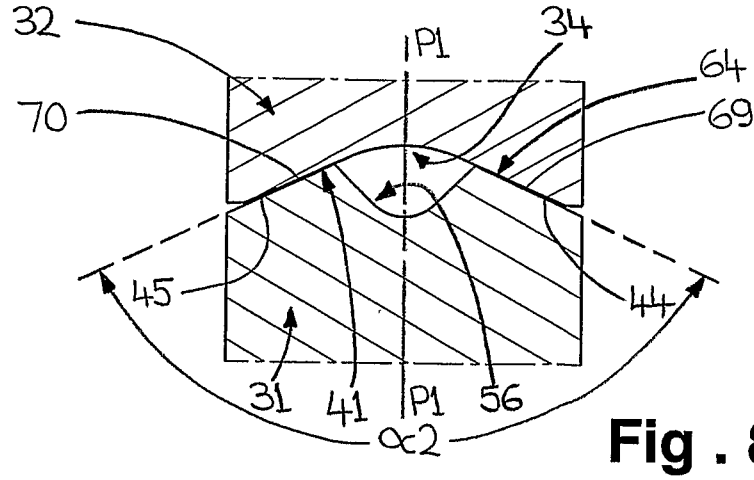

Fig . 8

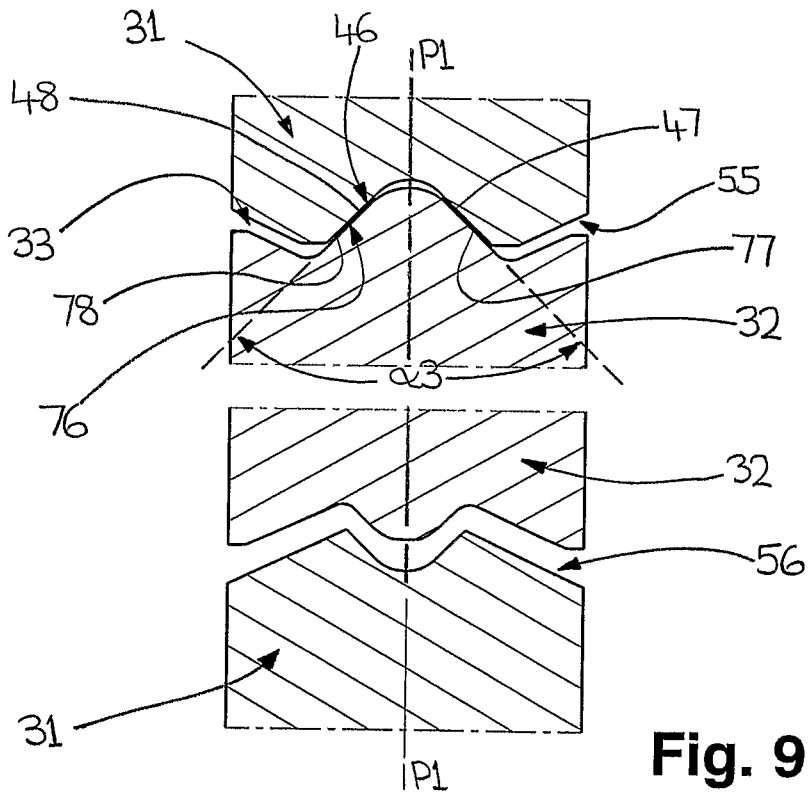

Fig. 9

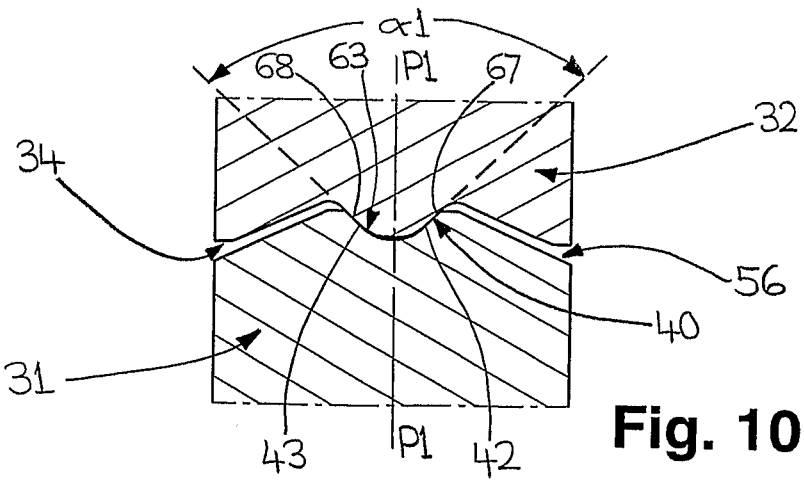

Fig. 10

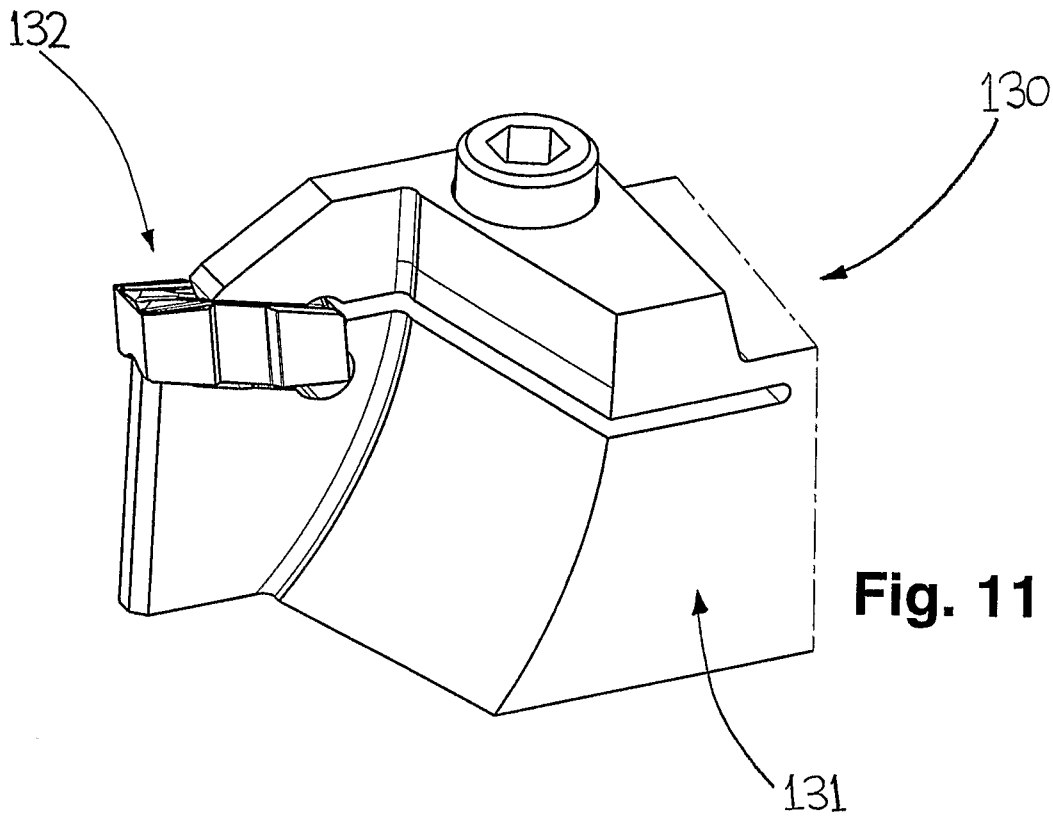

Fig. 11

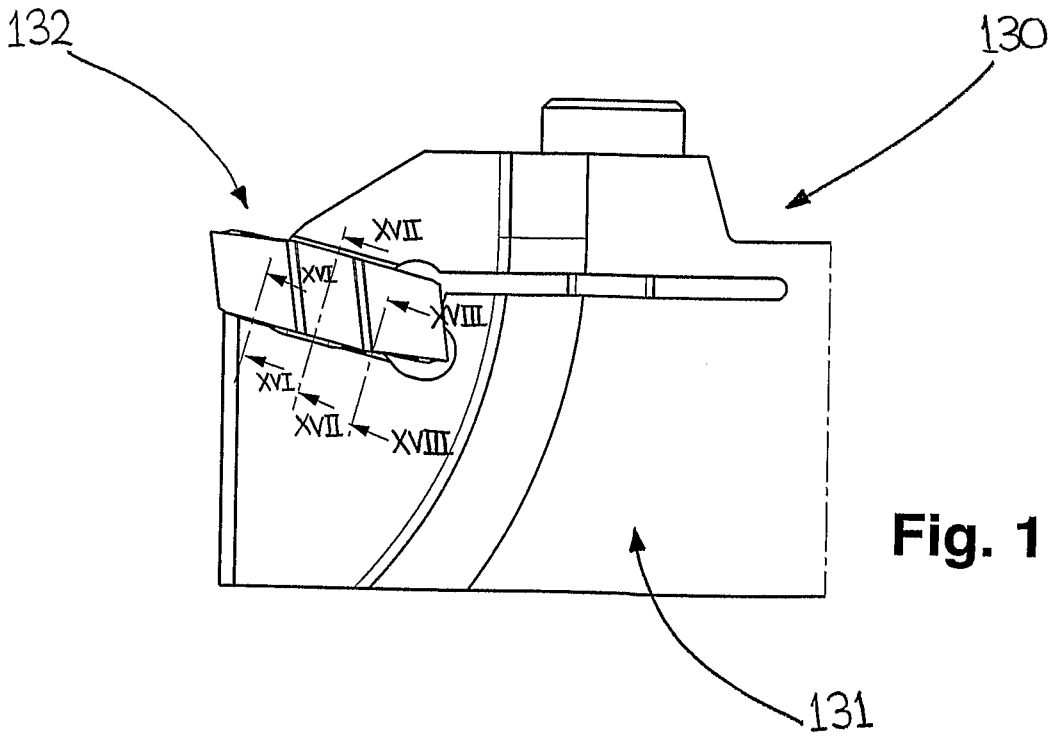

Fig. 12

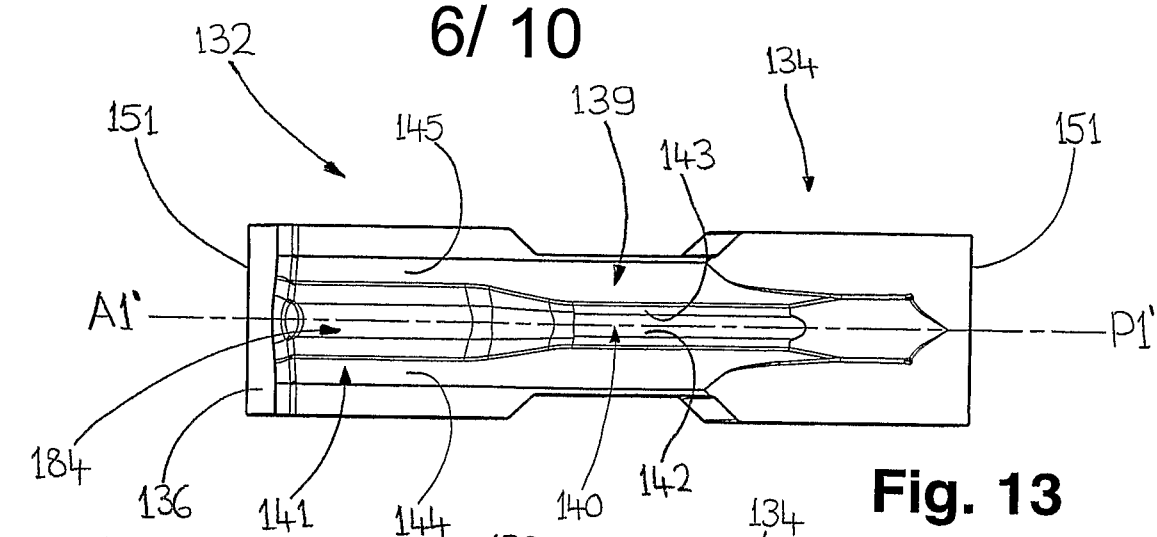

Fig. 13

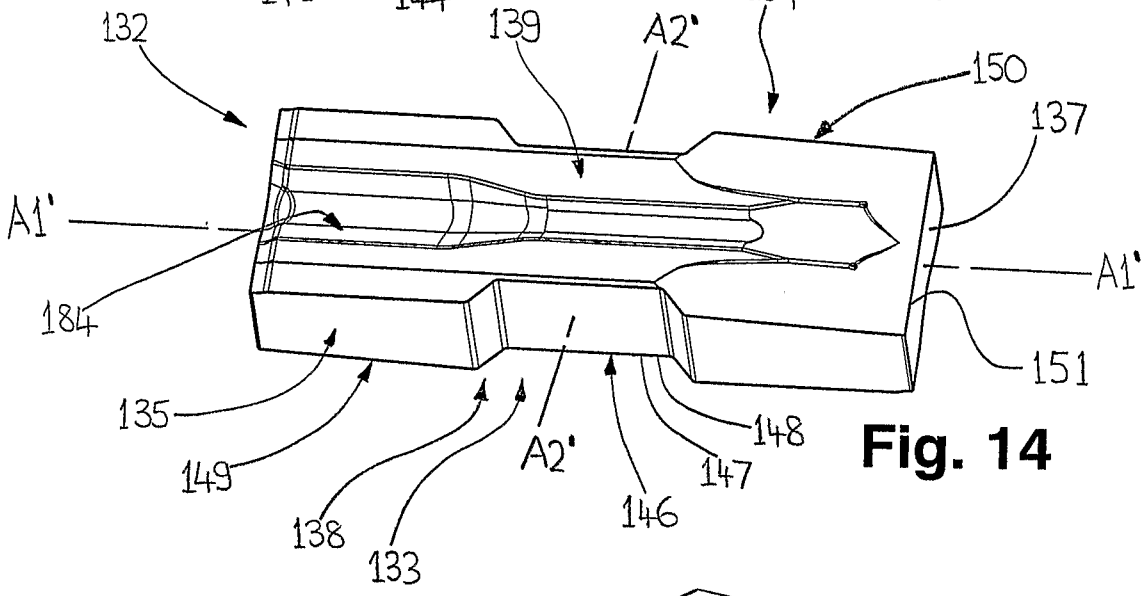

Fig. 14

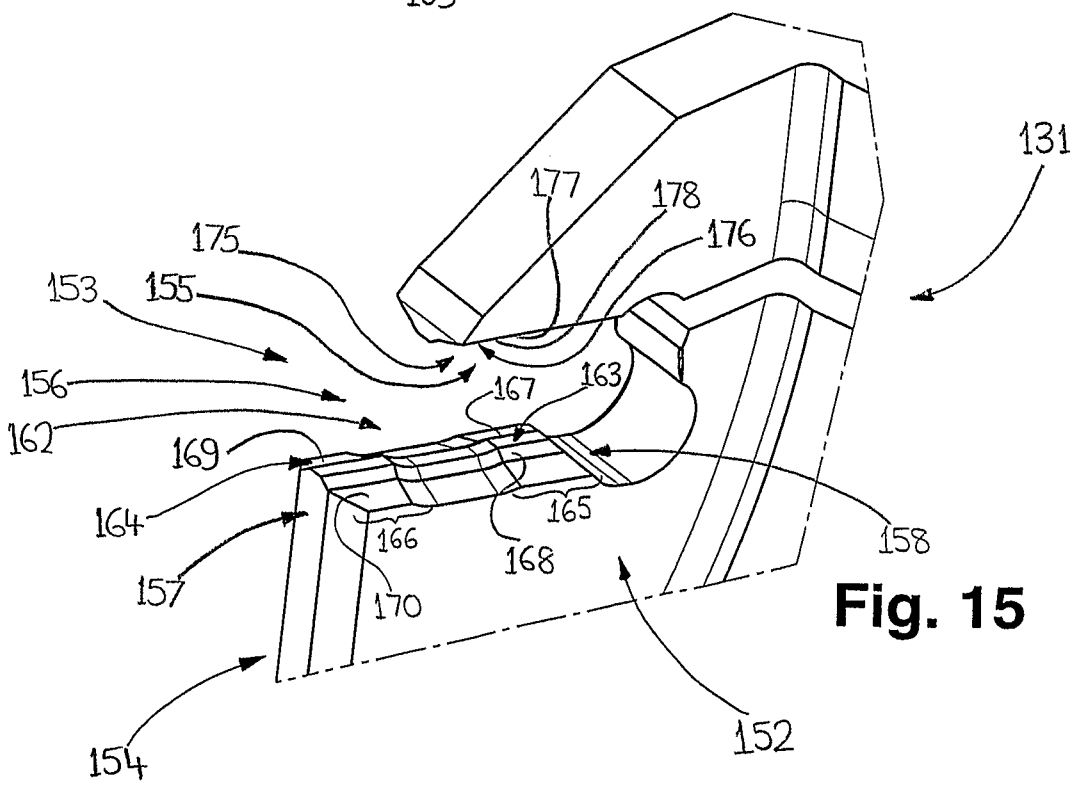

Fig. 15

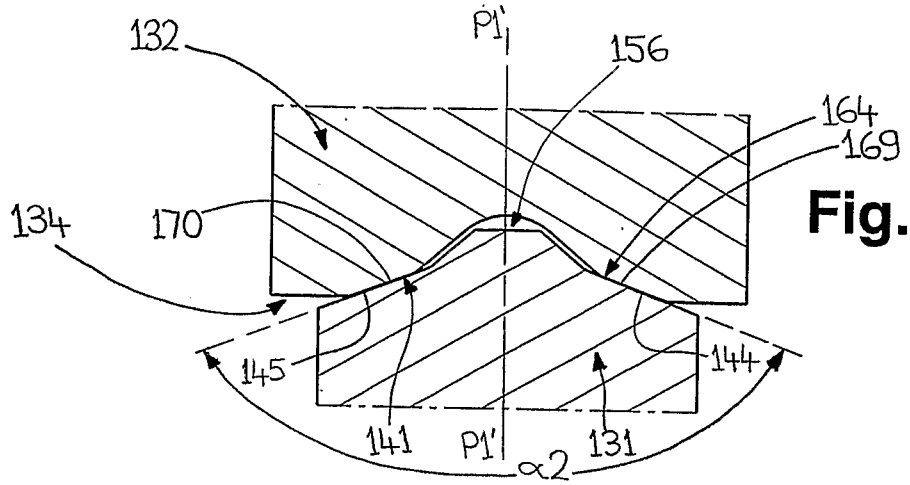

Fig. 16

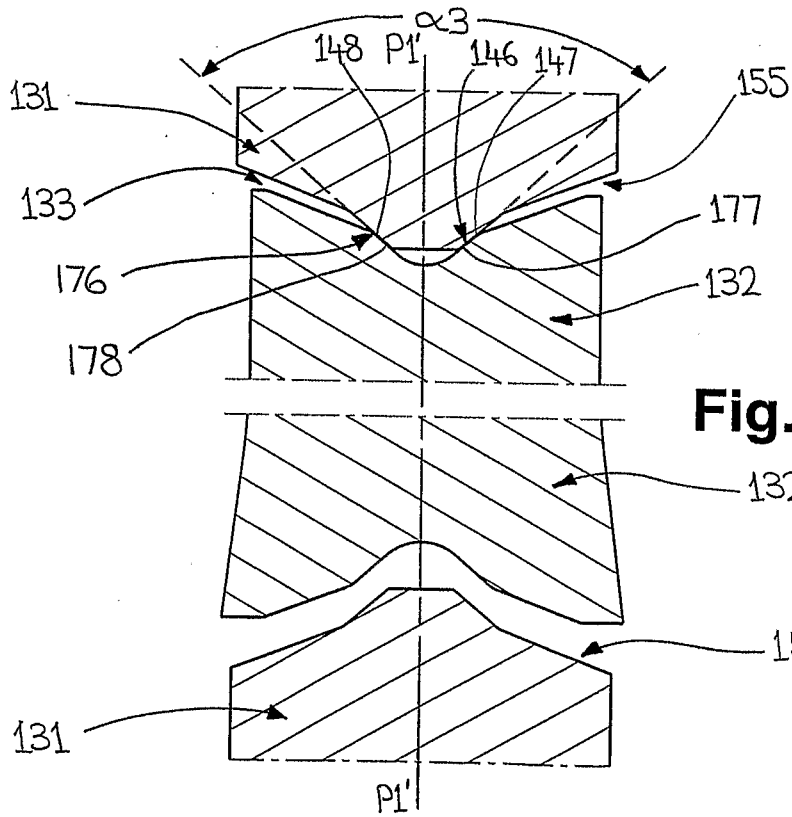

Fig. 17

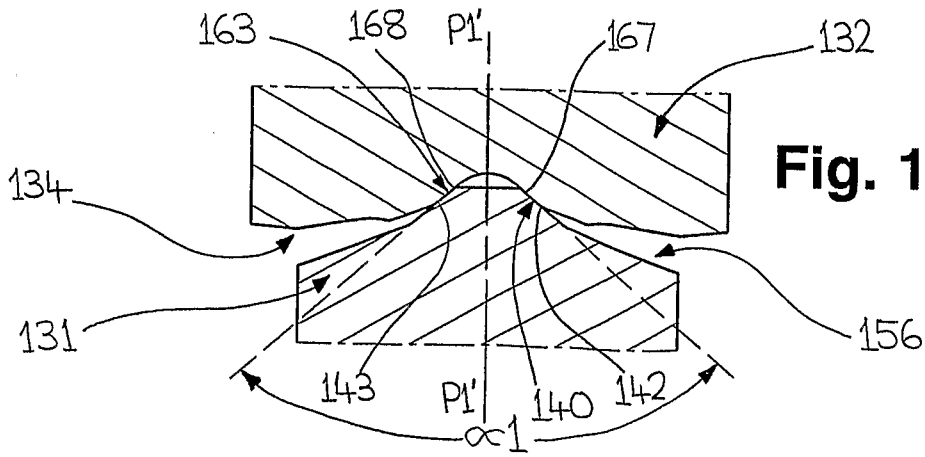

Fig. 18

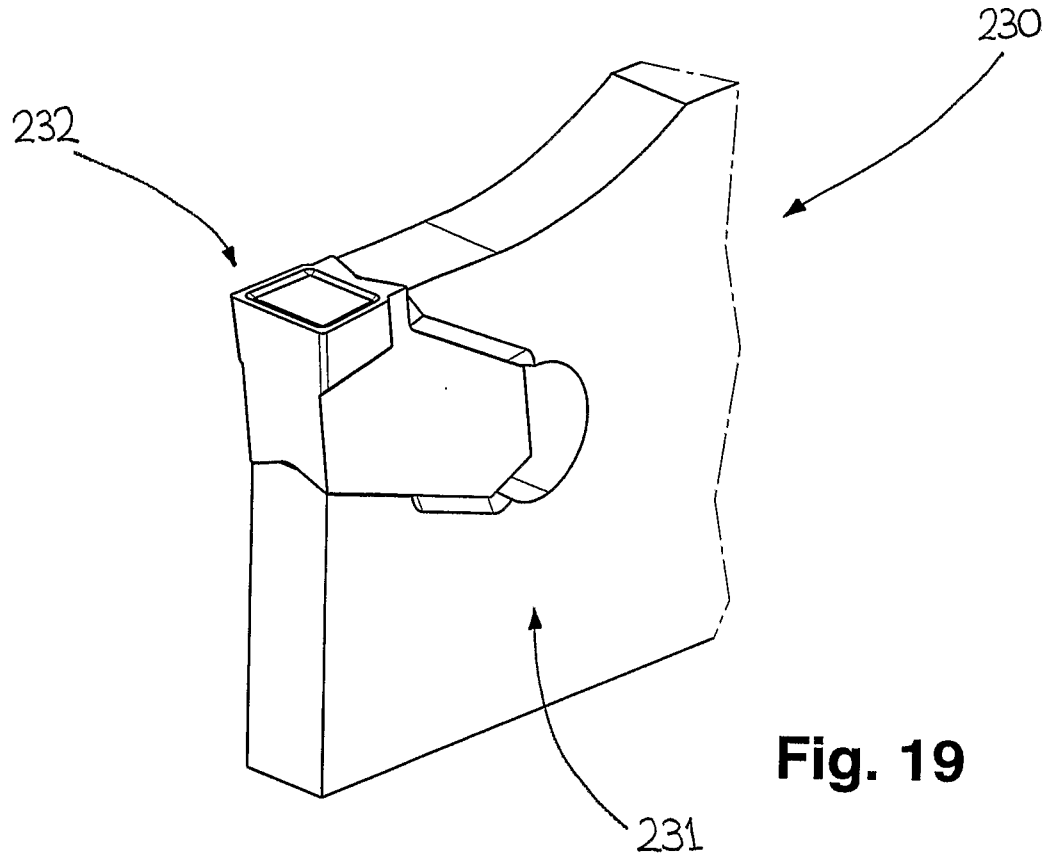

Fig. 19

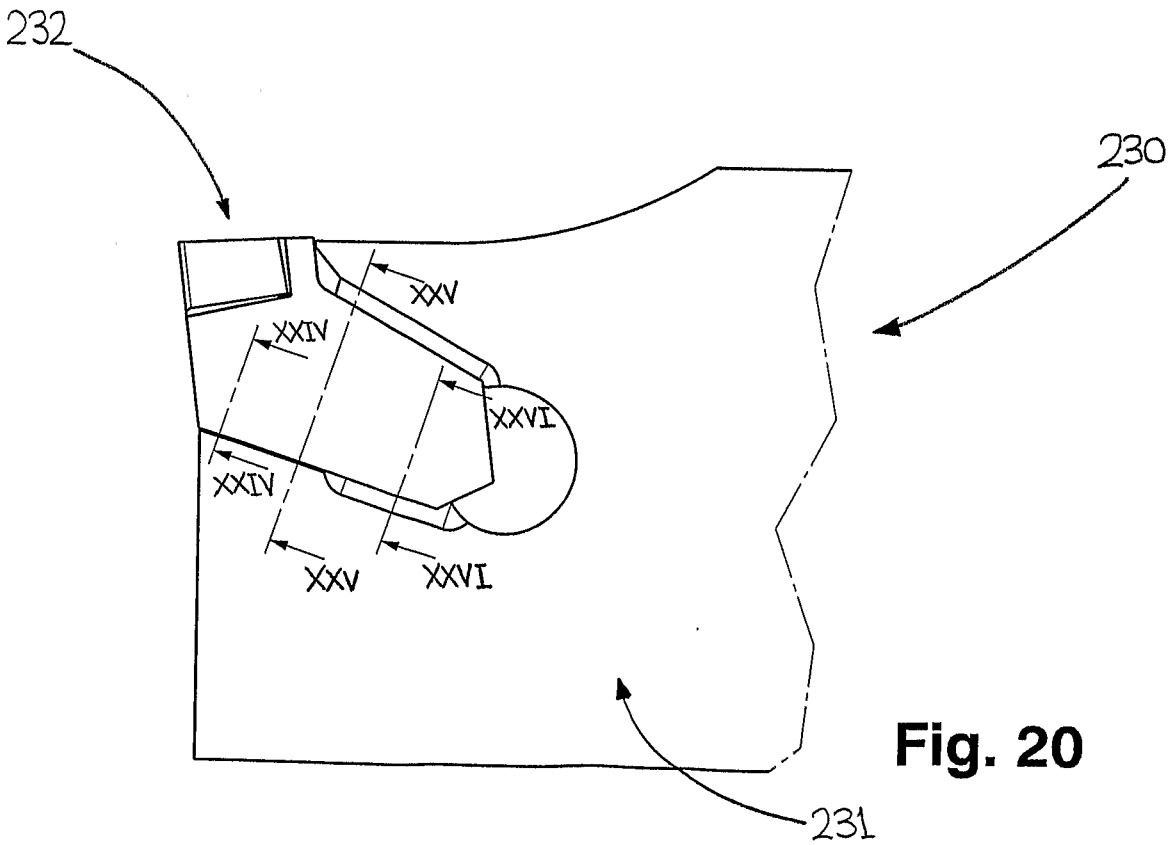

Fig. 20

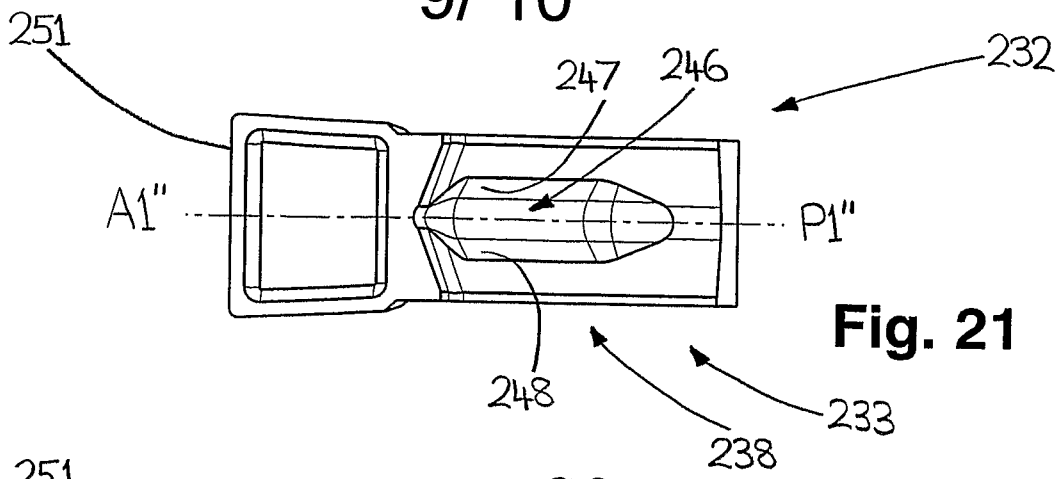

Fig. 21

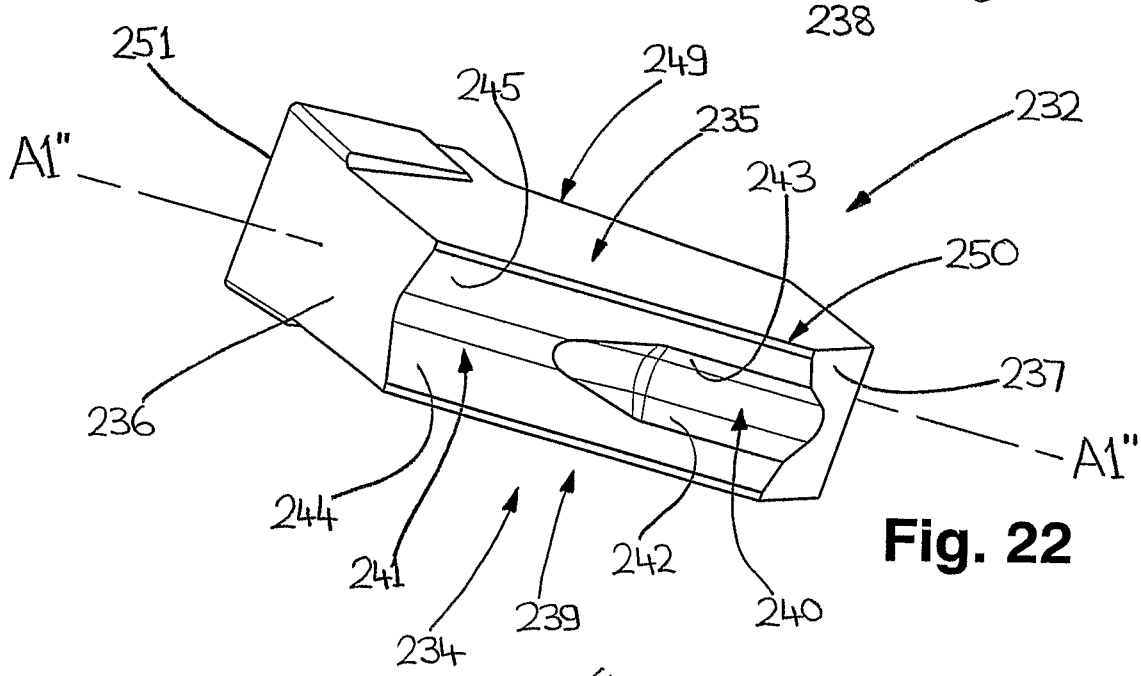

Fig. 22

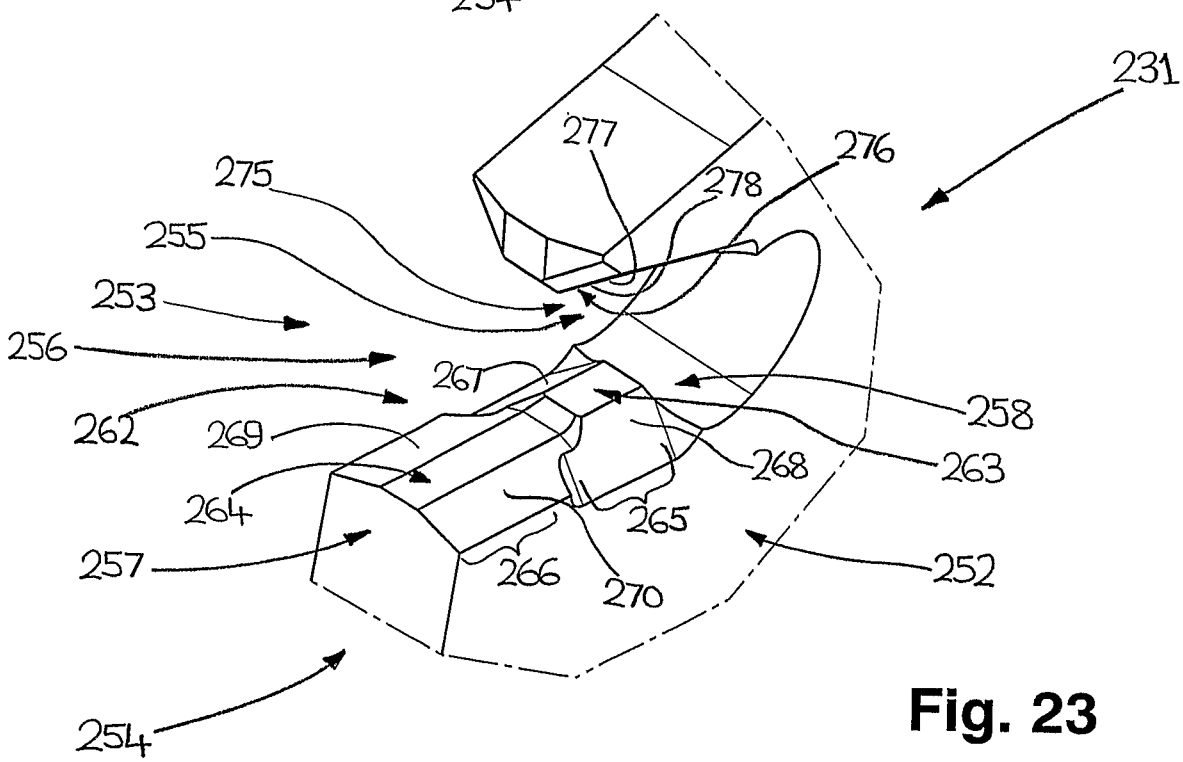

Fig. 23

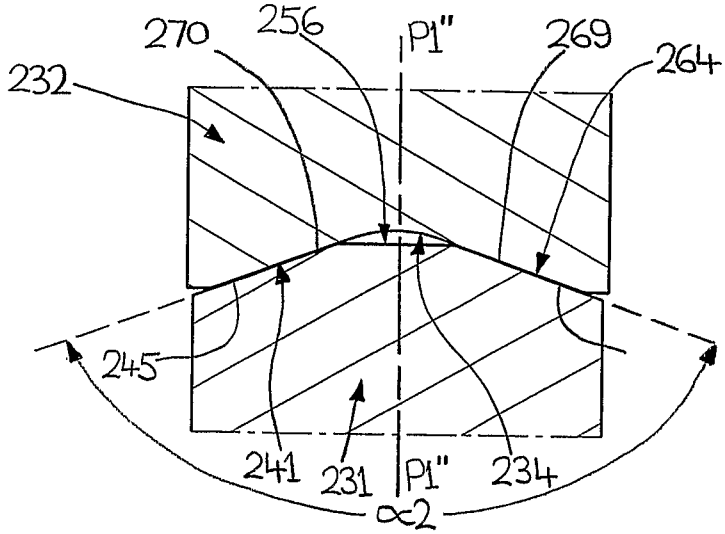

Fig. 24

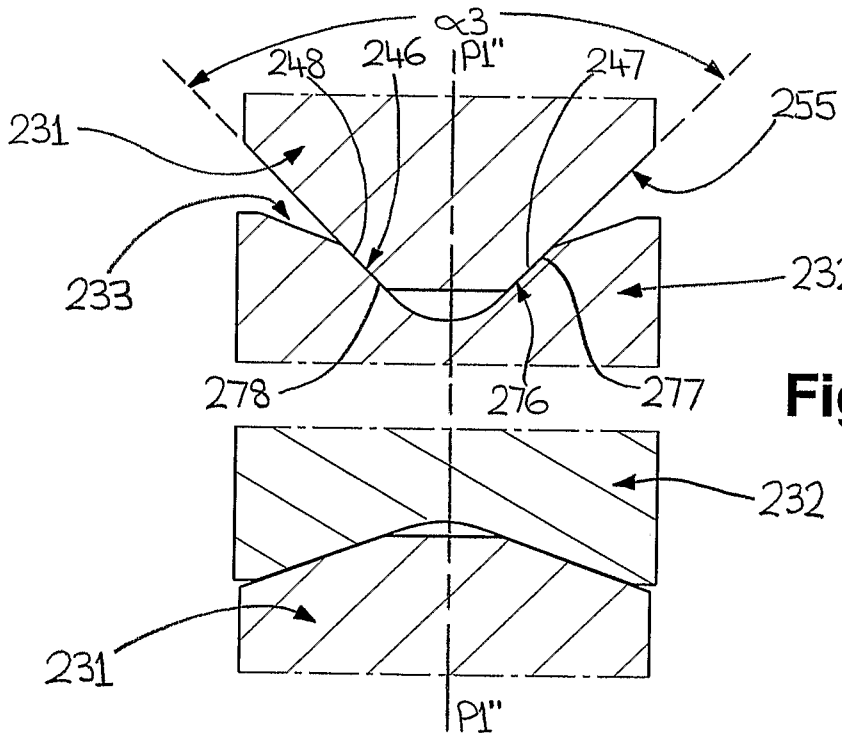

Fig. 25

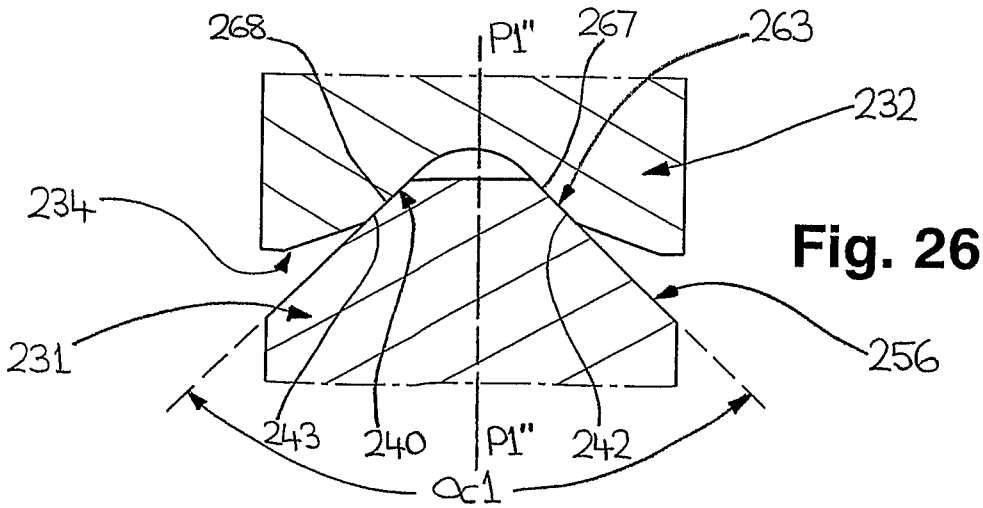

Fig. 26

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2009/000393

A. CLASSIFICATION OF SUBJECT MATTER
INV. B23B29/04 B23B27/04

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

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2005 019945 A1 (KEMMER HARTMETALLWERKZEUGE GMB [DE]) 2 November 2006 (2006-11-02) figure 5	13-21
A		1,8
A	EP 1 671 725 A (MITSUBISHI MATERIALS CORP [JP]) 21 June 2006 (2006-06-21) figures 9,11	1,8

☐ 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 document 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

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Date of the actual completion of the international search	Date of mailing of the international search report
23 July 2009	14/08/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Kornmeier, Martin

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IL2009/000393

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