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CA 2474611 C 2007/11/13

(11)(21) 2 474 611

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2003/01/22
(87) Date publication PCT/PCT Publication Date: 2003/08/28
(45) Date de délivrance/Issue Date: 2007/11/13
(85) Entrée phase nationale/National Entry: 2004/07/26
(86) N° demande PCT/PCT Application No.: IL 2003/000051
(87) N° publication PCT/PCT Publication No.: 2003/070403
(30) Priorités/Priorities: 2002/02/19 (IL148228);
2002/10/07 (IL152161)

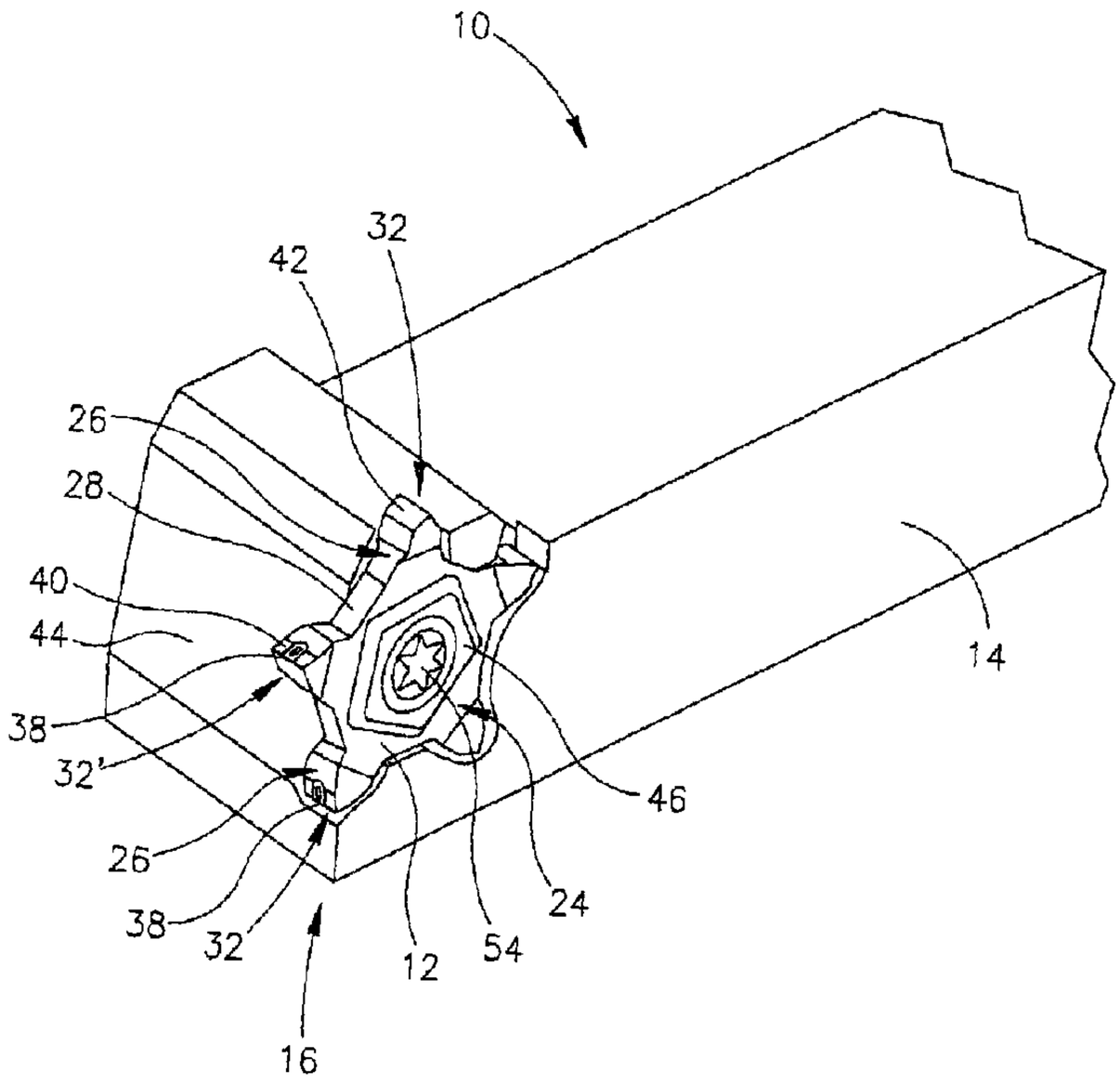
(51) Cl.Int./Int.Cl. *B23B 27/08* (2006.01)

(72) Inventeurs/Inventors:
FRIEDMAN, JACOB, IL;
BOOKS, BARUCH, IL

(73) Propriétaire/Owner:
ISCAR LTD., IL

(74) Agent: DIMOCK STRATTON LLP

(54) Titre : OUTIL DE COUPE DE METAUX
(54) Title: METAL CUTTING TOOL



(57) Abrégé/Abstract:
A metal cutting tool (10) having an indexable cutting insert (12) retained in an insert pocket (16) of an insert holder (14). The cutting insert has two opposing side surfaces (24) with a peripheral edge surface (26) extending therebetween and a plurality of cutting portions (32). The peripheral edge surface (26) has a plurality of abutment sections (28), each abutment section (28) lying on a portion of a sidewall of an imaginary regular polygon. A plurality of cutting portions (32) extend outwardly from the imaginary polygon and are equal in number to the number of side walls thereof. Each abutment section (28) is located between two cutting portions (32). The insert holder (14) has an insert pocket (16) in which the cutting insert (12) is retained with the peripheral edge surface (26) being abutted at two abutment sections (28) by two support walls (20) of the insert pocket (16), the support walls (20) being fixed and integral parts of the insert holder(14).

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 August 2003 (28.08.2003)

PCT

(10) International Publication Number
WO 03/070403 A1

(51) International Patent Classification[7]: B23B 27/08

(21) International Application Number: PCT/IL03/00051

(22) International Filing Date: 22 January 2003 (22.01.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

148228	19 February 2002 (19.02.2002)	IL
152161	7 October 2002 (07.10.2002)	IL

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

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **FRIEDMAN, Jacob** [IL/IL]; Erez Street 5, 25147 Kfar Vradim (IL). **BOOKS, Baruch** [IL/IL]; Dolev Street 24, 25147 Kfar Vradim (IL).

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

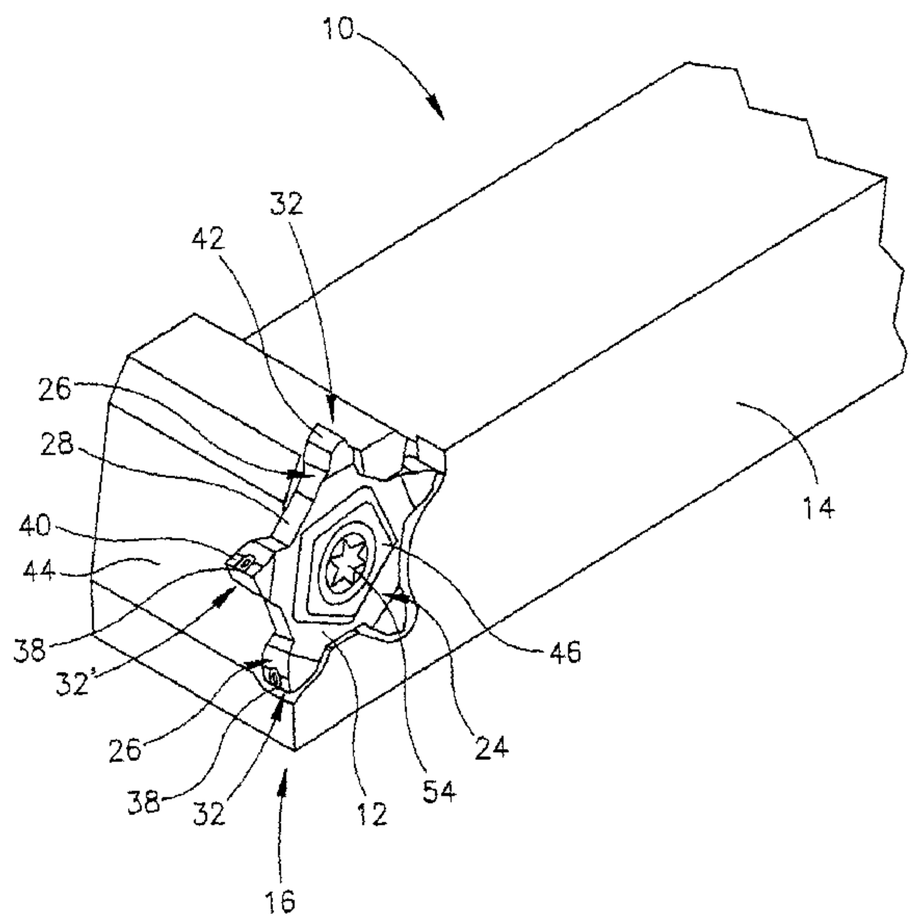
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METAL CUTTING TOOL



(57) Abstract: A metal cutting tool (10) having an indexable cutting insert (12) retained in an insert pocket (16) of an insert holder (14). The cutting insert has two opposing side surfaces (24) with a peripheral edge surface (26) extending therebetween and a plurality of cutting portions (32). The peripheral edge surface (26) has a plurality of abutment sections (28), each abutment section (28) lying on a portion of a sidewall of an imaginary regular polygon. A plurality of cutting portions (32) extend outwardly from the imaginary polygon and are equal in number to the number of side walls thereof. Each abutment section (28) is located between two cutting portions (32). The insert holder (14) has an insert pocket (16) in which the cutting insert (12) is retained with the peripheral edge surface (26) being abutted at two abutment sections (28) by two support walls (20) of the insert pocket (16), the support walls (20) being fixed and integral parts of the insert holder(14).

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METAL CUTTING TOOL

FIELD OF THE INVENTION

The present invention relates to metal cutting tools for use in turning, grooving, parting, and threading operations having an indexable insert with a plurality of cutting edges.

BACKGROUND OF THE INVENTION

Metal cutting tools of this type are well known in the art. US Patent No. 4,320,996 discloses a cutoff tool that enables narrow grooves to be produced. The tool consists of a holder having a recess in one side face in which a cutting insert is located and clamped by means of a center screw threadably engageable with the holder. The insert is triangular and is provided with a protruding triangular central portion, which is received in the recess, whereas the remainder of the insert extends laterally from the holder for cutoff purposes. Since the insert has a protruding central portion, it is one-handed, that is, if the insert has been designed for a right-handed tool, as shown in US 4,320,996, then it can only be used with a right-handed tool.

US Patent No. 4,169,690 discloses an indexable insert for heavy-duty capabilities. The cutting insert has a plurality of cutting edge portions

extending outwardly from a central body portion. The insert is held in a pocket of a holder by a clamp arm either from the side or from the top. The existence of the clamp arm somewhat complicates the structure of the holder.

US Patent No. 5,308,197 discloses a machining apparatus, comprising a holder bar with a pocket member that mounts on the bar that holds an insert. The insert has a mount portion and a plurality of arms. The mount portion locating sides bear against a pair of positioning sides of the pocket member. The pocket member complicates the production and use of the apparatus. Other disadvantages include a clamping system limiting the depth of cut.

US Patent No. 3,613,197 discloses an indexable and reversible, threading or grooving insert. It includes an insert support that engages the insert at the lower cutting edge. The insert support screws to the tool body and engages the cutting arm in use, limiting depth of cut.

US Patent Application Publication No. 2001/0022123 A1, describes in one embodiment (see Fig. 2) a holding element in which a cutting bit with four cutting edges sits on the holding element at three spaced apart locations 10′, 10″, and 10‴. It is pointed out that the cutting bit can, in principle, also touch the holding element at a fourth location 10⁗ and that during use for the intended purpose a force is exerted on the cutting bit so that the bit would possibly no longer rest on the holding element at the location 10⁗. This means that in principle the cutting bit is not stably seated. The cutting bit would be in one position with 4 points of contact before use and then would move to another position with three points of contact during use. This is clearly disadvantageous because it means that the location of the cutting edge changes and is therefore not well defined.

It is an object of the present invention to provide a new metal cutting tool, primarily for grooving, parting and turning operations, comprising an indexable cutting insert having a plurality of cutting edges, wherein the cutting

insert can be used for either right or left handed cutting operations and wherein the above-referred-to difficulties and disadvantages are significantly reduced.

It is another object of the present invention to provide the metal cutting tool, wherein the cutting insert is positively secured in a well-defined position without necessitating the use of an external clamp.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a metal cutting tool comprising:

an indexable cutting insert, comprising two opposing side surfaces, and a peripheral edge surface extending therebetween and having an insert axis of rotational symmetry passing through the side surfaces; the peripheral edge surface having a plurality of abutment sections, each abutment section lying on a portion of a side wall of an imaginary regular polygon having a plurality of side walls, a plurality of cutting portions extending outwardly from the imaginary polygon, the plurality of cutting portions being equal in number to the number of side walls of the imaginary polygon, each cutting portion having a cutting edge, each abutment section being located between two cutting portions; and

an insert holder comprising an insert pocket in which the cutting insert is retained with the peripheral edge surface being abutted at two abutment sections only, the insert pocket comprising a lower support wall abutting a first abutment section, and an upper support wall abutting a second abutment section; the lower support wall and the upper support wall each being fixed and integral parts of the insert holder.

In accordance with the present invention, the upper support wall and the lower support wall define an acute angle α between them.

In accordance with a specific application, the acute angle α is 36°.

In accordance with a preferred embodiment of the present invention, the cutting portions are generally triangular in a side view of the cutting insert.

In a preferred application of the present invention, the cutting tool is for grooving, parting and turning.

In accordance with a preferred embodiment of the present invention, the cutting insert has a varying width dimension, taken in a direction parallel to the insert axis.

Preferably, the cutting insert has three width dimensions, a first width dimension, D1, at the cutting portions, a second width dimension, D2, at a generally centrally located region of the cutting insert and a third width dimension D3, at all other regions of the cutting insert.

Further preferably, the second width dimension D2 is greater than the first width dimension D1, and the first width dimension D1 is greater than the third width dimension D3.

Still further preferably, the generally centrally located region of the cutting insert having the second width dimension is polygonal in form, from a side view of the cutting insert, thereby forming a protruding polygon from each side surface.

Typically, the imaginary polygon has a polygon axis that is coincident with the insert axis.

If desired the protruding polygon is angularly offset from the imaginary polygon with respect to the insert axis.

In accordance with a preferred embodiment present invention, the regular imaginary polygon is a regular imaginary pentagon; the cutting insert having five abutment sections, each abutment section lying on a portion of a side wall of the imaginary regular pentagon; five cutting portions spaced at regular intervals one from the other; and the protruding polygons are protruding pentagons, each protruding pentagon having an area smaller than a surface area

of the imaginary pentagon and each protruding pentagon is angularly offset with respect to the imaginary pentagon.

In accordance with the present invention, the insert pocket comprises a base surface from which the lower and upper support walls generally uprightly extend, the base surface being abutted by a given protruding polygon of the cutting insert.

In accordance with the present invention, the cutting tool further comprises a screw, for securing the insert in the insert pocket, the screw extending through an insert through bore and threadingly engaged with a threaded receiving bore in the base surface; the insert through bore extending between the two opposing side surfaces.

In accordance with the present invention, the insert through bore extends between the protruding polygons.

In accordance with the preferred embodiment present invention, the operative first and second abutment sections divide the cutting insert into two sections.

Further in accordance with the preferred embodiment present invention, a first section contains an operative cutting portion and two cutting portions on either side of the operative cutting portion and a second section contains two adjacent cutting portions.

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:

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

Fig. 2 is an perspective view of an insert holder in accordance with the present invention;

Fig. 3 is a side view of the metal cutting tool shown in Fig. 1; and

Fig. 4 is an edge-on view of the cutting insert shown in Fig 1.

DETAILED DESCRIPTION OF THE INVENTION

Attention is first drawn to Figs. 1-3, showing a metal cutting tool **10** in accordance with the present invention. The metal cutting tool **10** comprises a cutting insert **12**, having an insert axis **A**, and an insert holder **14** with the cutting insert **12** retained in an insert pocket **16** (**16'**, **16''**) of the insert holder **14**. The cutting insert **12** is produced by form pressing and sintering a hard metal body made from a carbide powder such as Tungsten Carbide. However, the cutting insert **12** can also be produced by injection molding. The insert holder **14** is formed of machined steel or other hard materials. The insert holder **14**, shown in Fig. 2, has two insert pockets **16**, one **16'** for right-handed cutting operations and the other **16''** for left-handed cutting operations. The cutting insert **12**, which will be described in detail below, can be used for both right-handed and left-handed cutting operations and as such can be retained in either of the insert pockets **16'**, **16''**. The insert axis **A** is an axis of rotational symmetry about which the cutting insert **12** has five-fold rotational symmetry.

The insert pocket **16** comprises a base surface **18**, a lower support wall **20** extending generally uprightly from the base surface **18**, and an upper support **22** wall also extending generally uprightly from the base surface **18**. The upper support wall **22** and lower support wall **20** form an acute angle **α** between them. In accordance with a specific application, the acute angle **α** is 36°, within manufacturing tolerances. The lower and upper support walls **20**, **22** are integrally formed with the base surface **18**.

Attention is now additionally drawn to Fig. 4. The cutting insert **12** comprises two identical opposing side surfaces **24** and a peripheral edge surface **26** extending therebetween. Since the side surfaces **24** are identical, only one will be described, it being understood that the other side surface has identical structure. The peripheral edge surface **26** has five abutment sections **28** and five

equally spaced apart cutting portions **32**. Each of the five abutment sections **28** lies on a portion of a side wall **34** of an imaginary regular pentagon **36** (shown by a dashed line in Fig. 3) and are separated from one another by a given cutting portion **32**.

Each cutting portion **32** of the cutting insert **12** is triangular shaped and extends outwardly from the imaginary regular pentagon **36** of the cutting insert **12**. At a radially outermost portion of each cutting portion **32** a cutting edge **38** is formed at the intersection of a rake surface **40**, on a leading side **41** of the cutting portion **32**, and a relief surface **42**, a trailing side **43** of the cutting portion **32**. The leading and trailing sides **41**, **43** of the cutting portion **32** are not radially directed. As can be seen, the cutting edges **38** are radially more distant from the insert axis **A** than the abutment sections **28**. The rake and relief surfaces **40** and **42** being located on the peripheral edge surface **26**. An operative cutting portion **32'** projects from an end surface **44** (in Fig. 3 shown by a line of short dashes) of the insert holder **14** to cut a workpiece (not shown). An operative first abutment section **28'** abuts the lower support wall **20**, and an operative second abutment section **28"** abuts the upper support wall **22**. Clearly, the operative first and second abutment sections **28'**, **28"** form an angle between them substantially equal to the angle **α**. Apart from the operative first and second abutment sections **28'**, **28"** no other portion of the peripheral edge surface **26** comes into contact with the insert holder **14**. The operative first and second abutment sections **28'**, **28"** divide the cutting insert **12** into two sections. A first section contains the operative cutting portion **32'** and two cutting portions **32** on either side of the operative cutting portion **32'**. The second section contains two adjacent cutting portions **32**.

As can be seen, each side surface **24** has a centrally located outwardly protruding portion in the form of a protruding pentagon **46** having a flat surface **50**. The flat surfaces **50** of each protruding pentagon **46** are parallel to each other. The flat surface **50** of the protruding pentagon **46** is smaller in

surface area than the imaginary pentagon **36**. The surface **50** of the protruding pentagon **46** abuts the base surface **18** of the insert pocket **16**. The protruding pentagon **46** is also angularly offset with respect to the imaginary pentagon about the insert axis **A**, such that a given side wall **52** of the protruding pentagon **46** is coplanar with the end surface **44** of the insert holder **14**. This offset maximizes the contact area between the insert **12** and the insert holder **14** without reducing the depth of cut.

The cutting insert **12** has three width dimensions. A first width dimension **D1**, being the width of the cutting portion **32**. A generally centrally located region of the cutting insert **12** has a second width dimension **D2** between the flat surfaces **50** of the two protruding pentagons **46**. A third width dimension **D3**, is defined by all other regions of the cutting insert **12** not included in the first and second width dimensions **D1**, **D2**. The second width dimension **D2** is greater than the first width dimension **D1**, which ensures the cutting edge **38** does not abut the base surface **18** of the insert pocket **16**. It will be appreciated that the cutting portion **32** slightly tapers inwardly from the cutting edge **38**. That is, the first width dimension **D1** is slightly variable, having a maximum value at the cutting edge **38** and decreasing in magnitude inwardly towards the insert axis **A**. This arrangement assures that the sides **24** of the cutting portions **32** are relieved from a workpiece during cutting operations.

An insert through bore **56** extends between the flat surface **50** of the protruding pentagon **46** and has a bore axis that is coincident with the insert axis **A**. The insert through bore **56** is countersunk on both sides. A screw **54** extends through the insert through bore **56** and threadingly engages a threaded receiving bore **57** in the base surface **18** of the insert pocket **16**.

The lower support wall **20**, the upper support wall **22**, and the base surface **18** of the insert holder **14** and the screw **54** positively lock the cutting insert **12** in the insert pocket **16**. The relative positioning of the lower support wall **20** and the upper support wall **22** are such that cutting forces exerted on the

operative cutting portion **32'** during cutting operations are exerted primarily on the lower support wall **20** and on the upper support wall **22** and only minimally on the screw **54**. This removes the need for additional structure, such as a clamp, to positively lock the cutting insert **12** and limits the possibility of failure by the screw **54**.

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. For example, a cutting insert could have four or six or more cutting portions instead of five. The width dimensions **D1**, **D2**, and **D3** can be changed to suit various applications. Furthermore, it will be appreciated that the present invention can also be applied to threading operations. The angle **α** may be modified to suit other geometrical configurations. A lever or pin mechanism could be used in place of the screw.

What is claimed is:

1. A metal cutting tool comprising:

an indexable cutting insert, comprising two opposing side surfaces, and a peripheral edge surface extending therebetween and having an insert axis of rotational symmetry passing through the side surfaces; the peripheral edge surface having a plurality of abutment sections, each abutment section lying on a portion of a side wall of an imaginary regular polygon having a plurality of side walls, a plurality of cutting portions extending outwardly from the imaginary polygon, the plurality of cutting portions being equal in number to the number of side walls of the imaginary polygon, each cutting portion having a cutting edge, each abutment section being located between two cutting portions; and

an insert holder comprising an insert pocket in which the cutting insert is retained with the peripheral edge surface being abutted at two abutment sections only, the insert pocket comprising a lower support wall abutting a first abutment section, and an upper support wall abutting a second abutment section; the lower support wall and the upper support wall having a unitary, one-piece construction,

wherein each cutting edge is located at an intersection of a relief surface and a rake surface,

wherein the rake surface is located on the peripheral edge surface; and

wherein the upper support wall and the lower support wall define an acute angle (α) between them.

2. The metal cutting tool according to claim 1, wherein the acute angle (α) is 36°.

3. The metal cutting tool according to claim 1, wherein the cutting portions are generally triangular in a side view of the cutting insert.

4. The metal cutting tool according to claim 1, wherein the cutting insert has a varying width dimension, taken in a direction parallel to the insert axis.

5. The metal cutting tool according to claim 4, wherein the cutting insert has three width dimensions, a first width dimension, D1, at the cutting portions, a second width dimension,

D2, at a generally centrally located region of the cutting insert and a third width dimension D3, at all other regions of the cutting insert.

6. The metal cutting tool according to claim 5, wherein the second width dimension D2 is greater than the first width dimension D1, and the first width dimension D1 is greater than the third width dimension D3.

7. The metal cutting tool according to claim 6, wherein the generally centrally located region of the cutting insert having the second width dimension is polygonal in form from a side view of the cutting insert, thereby forming a protruding polygon from each side surface.

8. The metal cutting tool according to claim 7, wherein the imaginary polygon has a polygon axis coincident with the insert axis.

9. The metal cutting tool according to claim 8, wherein the protruding polygon is angularly offset from the imaginary polygon with respect to the insert axis.

10. The metal cutting tool according to claim 9, wherein the regular imaginary polygon is a regular imaginary pentagon;

the cutting insert has five abutment sections, each abutment section lying on a portion of a side wall of the imaginary regular pentagon; five cutting portions spaced at regular intervals one from the other; and the protruding polygons are protruding pentagons, each protruding pentagon having an area smaller than a surface area of the imaginary pentagon and each protruding pentagon is angularly offset with respect to the imaginary pentagon.

11. The metal cutting tool according to claim 7, wherein the insert pocket comprises a base surface from which the lower and upper support walls generally uprightly extend, the base surface being abutted by a given protruding polygon of the cutting insert.

12. The metal cutting tool according to claim 11, wherein the cutting tool further comprises a screw, for securing the cutting insert in the insert pocket, the screw extending trough an insert trough bore and threadingly engaging a threaded receiving bore in the base

surface; the insert trough bore extending between the two opposing side surfaces.

13. The metal cutting tool according to claim 12, wherein the insert through bore extends between the protruding polygons.

14. A metal cutting tool comprising:

an indexable cutting insert, comprising two opposing side surfaces, and a peripheral edge surface extending therebetween and having an insert axis of rotational symmetry passing trough the side surfaces; the peripheral edge surface having a plurality of abutment sections, each abutment section lying on a portion of a side wall of an imaginary regular polygon having a plurality of side walls, a plurality of cutting portions extending outwardly from the imaginary polygon, the plurality of cutting portions being equal in number to the number of side walls of the imaginary polygon, each cutting portion having a cutting edge, each abutment section being located between two cutting portions; and

an insert holder comprising an insert pocket in which the cutting insert is retained with the peripheral edge surface being abutted at two abutment sections only, the insert pocket comprising a lower support wall abutting a first abutment section, and an upper support wall abutting a second abutment section; the lower support wall and the upper support wall having a unitary, one-piece construction, wherein:

the regular imaginary polygon is a regular imaginary pentagon;

the cutting insert has five abutment sections, each abutment section lying on a portion of a side wall of the imaginary regular pentagon; and five cutting portions spaced at regular intervals one from the other; and

the upper support wall and the lower support wall define an acute angle (α) of 36° between them.

15. A metal cutting tool comprising:

an insert holder formed from a single continuous piece of material that includes an insert pocket having a lower support wall and an upper support wall, the lower and upper support walls defining an acute angle (α) therebetween; and

an indexable cutting insert, comprising two opposing side surfaces, and a peripheral edge surface extending therebetween and having an insert axis of rotational symmetry

passing through the side surfaces; the peripheral edge surface having a plurality of abutment sections, each abutment section lying on a portion of a side wall of an imaginary regular polygon having a plurality of side walls, a plurality of cutting portions extending outwardly from the imaginary polygon, the plurality of cutting portions being equal in number to the number of side walls of the imaginary polygon, each cutting portion having a cutting edge, each abutment section being located between two cutting portions;

wherein:

the cutting insert is retained in the insert pocket with the peripheral edge surface being abutted at only two of said abutment sections with a first of said abutment sections being abutted by the lower support wall and a second of said abutment sections being abutted by the upper support wall;

the first and second of said abutment sections belong to non-adjacent legs of the imaginary regular polygon;

each cutting edge is located at an intersection of a relief surface and a rake surface; and

the rake surface is located on the peripheral edge surface.

16. The metal cutting tool according to claim 15, wherein:

the regular imaginary polygon is a regular imaginary pentagon;

the cutting insert has five abutment sections, each abutment section lying on a portion of a side wall of the imaginary regular pentagon; and five cutting portions spaced at regular intervals one from the other; and

said acute angle (α) is 36°.

17. A metal cutting tool comprising:

an indexable cutting insert, comprising two opposing side surfaces, and a peripheral edge surface extending therebetween and having an insert axis of rotational symmetry passing through the side surfaces; the peripheral edge surface having a plurality of abutment sections, each abutment section lying on a portion of a side wall of an imaginary regular polygon having a plurality of side walls, a plurality of cutting portions extending outwardly from the imaginary polygon, the plurality of cutting portions being equal in number to the number of side walls of the imaginary polygon, each cutting portion having a cutting edge,

each abutment section being located between two cutting portions; and

an insert holder comprising an insert pocket in which the cutting insert is retained with the peripheral edge surface being abutted at two abutment sections only, the insert pocket comprising a lower support wall abutting a first abutment section, and an upper support wall abutting a second abutment section; the lower support wall and the upper support wall having a unitary, one-piece construction,

wherein the entire cutting edge of each cutting portion is radially outward of the imaginary regular polygon; and

wherein the upper support wall and the lower support wall define an acute angle (α) between them.

18. A metal cutting tool comprising:

an indexable cutting insert, comprising two opposing side surfaces, and a peripheral edge surface extending therebetween and having an insert axis of rotational symmetry passing through the side surfaces; the peripheral edge surface having a plurality of abutment sections, each abutment section lying on a portion of a side wall of an imaginary regular polygon having a plurality of side walls, a plurality of cutting portions extending outwardly from the imaginary polygon, the plurality of cutting portions being equal in number to the number of side walls of the imaginary polygon, each cutting portion having a cutting edge, each abutment section being located between two cutting portions; and

an insert holder comprising an insert pocket in which the cutting insert is retained with the peripheral edge surface being abutted at two abutment sections only, the insert pocket comprising a lower support wall abutting a first abutment section, and an upper support wall abutting a second abutment section; the lower support wall and the upper support wall having a unitary, one-piece construction,

wherein the cutting edge of each cutting portion has an associated rake surface that is located on the peripheral edge surface; and

wherein the upper support wall and the lower support wall define an acute angle (α) between them.

19. A metal cutting tool comprising:

an indexable cutting insert, comprising two opposing side surfaces, and a peripheral

edge surface extending therebetween and having an insert axis of rotational symmetry passing through the side surfaces; the peripheral edge surface having a plurality of abutment sections, each abutment section lying on a portion of a side wall of an imaginary regular polygon having a plurality of side walls, a plurality of cutting portions extending outwardly from the imaginary polygon, the plurality of cutting portions being equal in number to the number of side walls of the imaginary polygon, each cutting portion having a cutting edge, each abutment section being located between two cutting portions; and

an insert holder comprising an insert pocket in which the cutting insert is retained with the peripheral edge surface being abutted at two abutment sections only, the insert pocket comprising a lower support wall abutting a first abutment section, and an upper support wall abutting a second abutment section; the lower support wall and the upper support wall having a unitary, one-piece construction,

wherein the first and second abutment sections belong to non-adjacent legs of the imaginary regular polygon.

20. A metal cutting tool comprising:

an indexable cutting insert, comprising two opposing side surfaces, and a peripheral edge surface extending therebetween and having an insert axis of rotational symmetry passing through the side surfaces; the peripheral edge surface having a plurality of abutment sections, each abutment section lying on a portion of a side wall of an imaginary regular polygon having a plurality of side walls, a plurality of cutting portions extending outwardly from the imaginary polygon, the plurality of cutting portions being equal in number to the number of side walls of the imaginary polygon, each cutting portion having a cutting edge, each abutment section being located between two cutting portions; and

an insert holder comprising an insert pocket in which the cutting insert is retained with the peripheral edge surface being abutted at two abutment sections only, the insert pocket comprising a lower support wall abutting a first abutment section, and an upper support wall abutting a second abutment section; the lower support wall and the upper support wall having a unitary, one-piece construction,

wherein each cutting edge extends between the two opposing side surfaces and along a thickness of the peripheral edge surface; and

wherein the upper support wall and the lower support wall define an acute angle (α) between them.

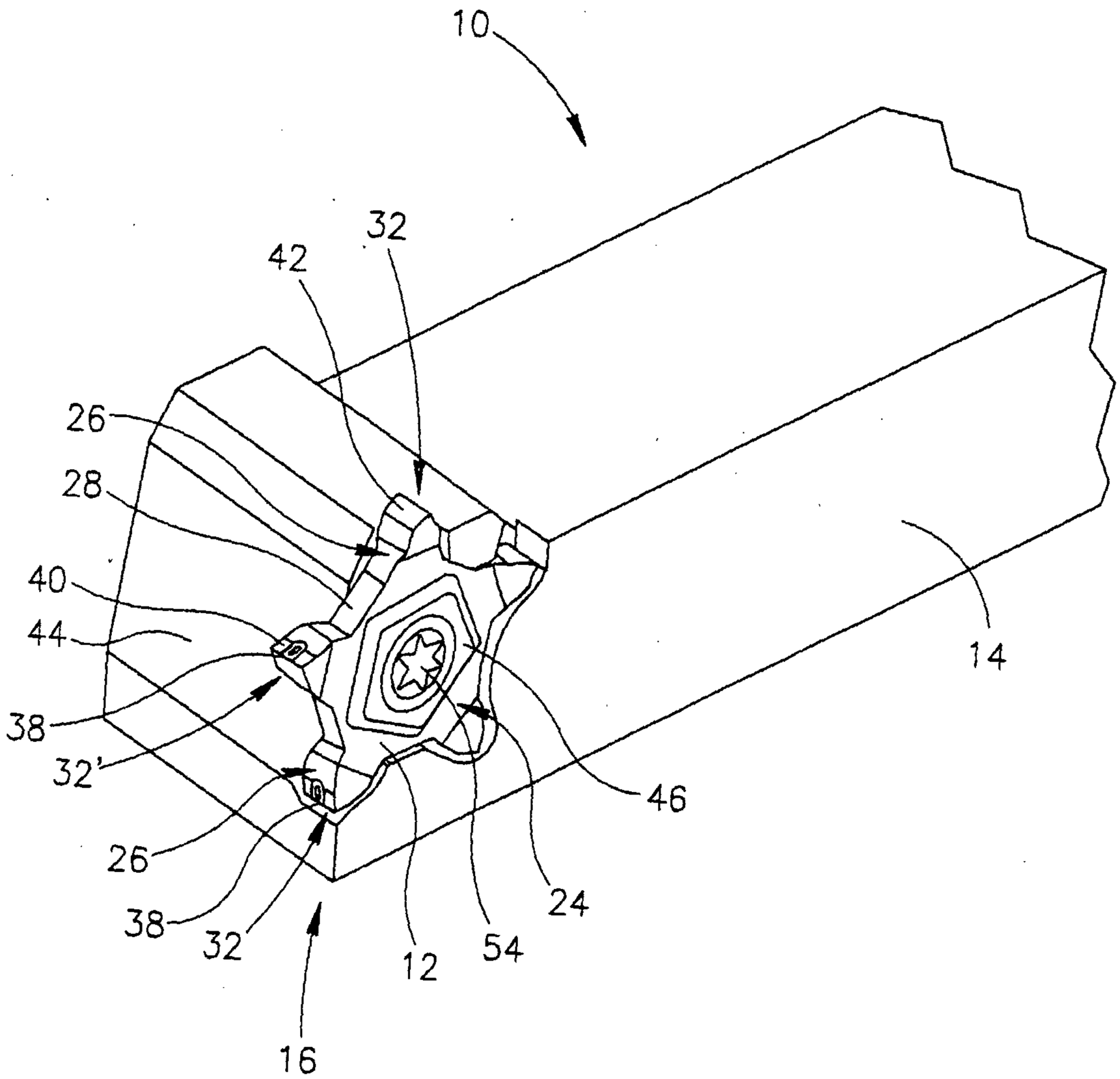


FIG.1

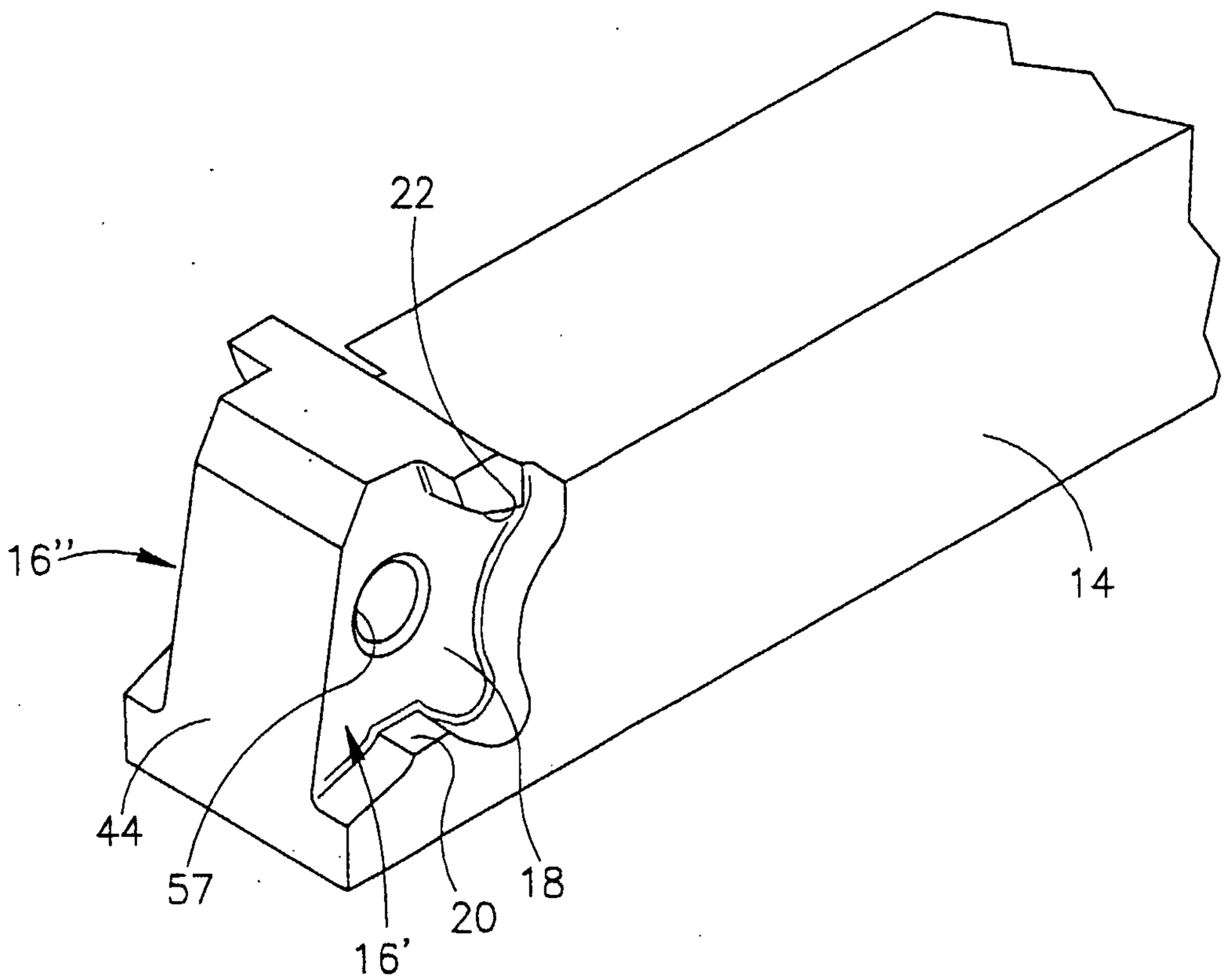


FIG.2

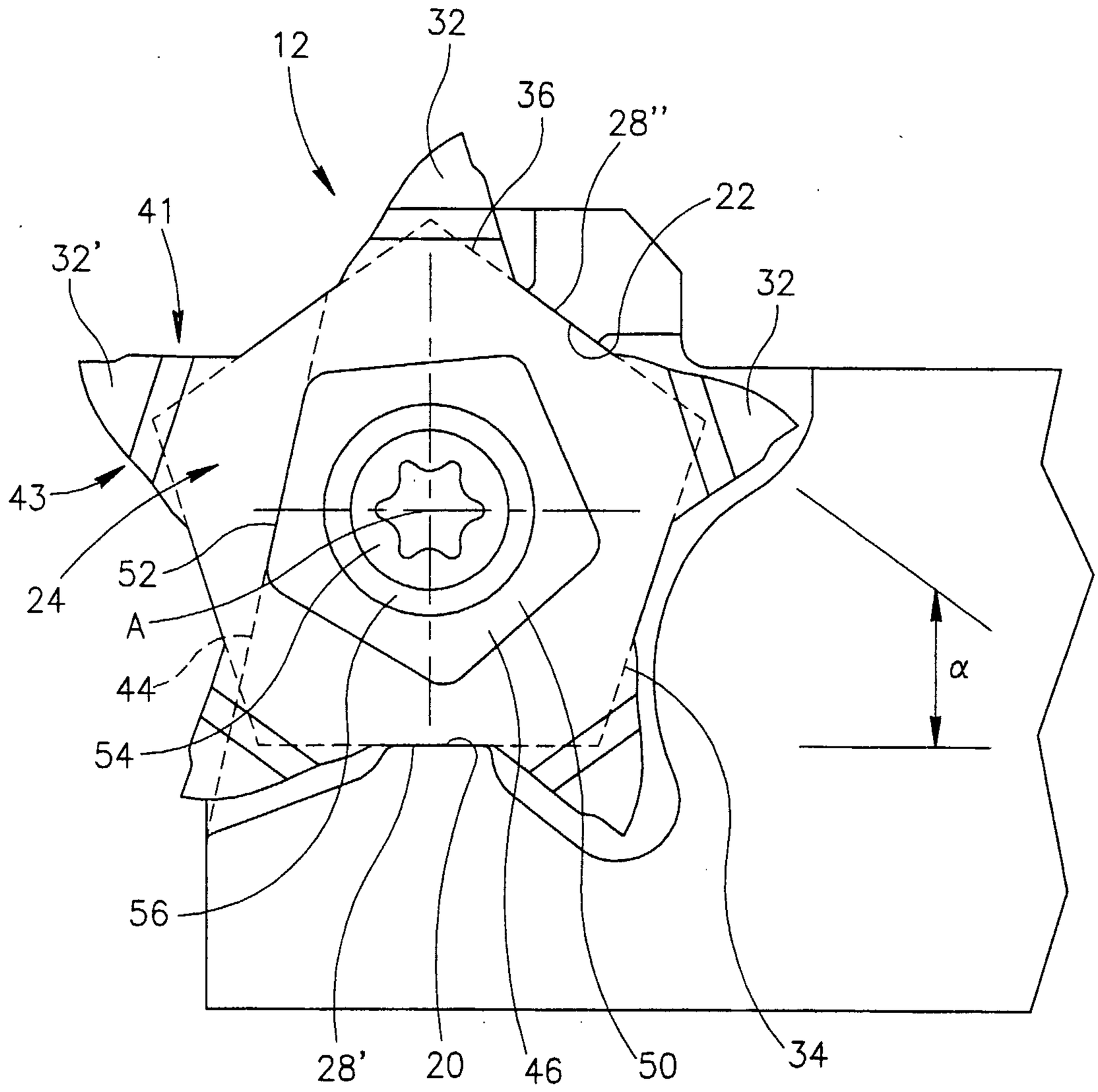


FIG.3

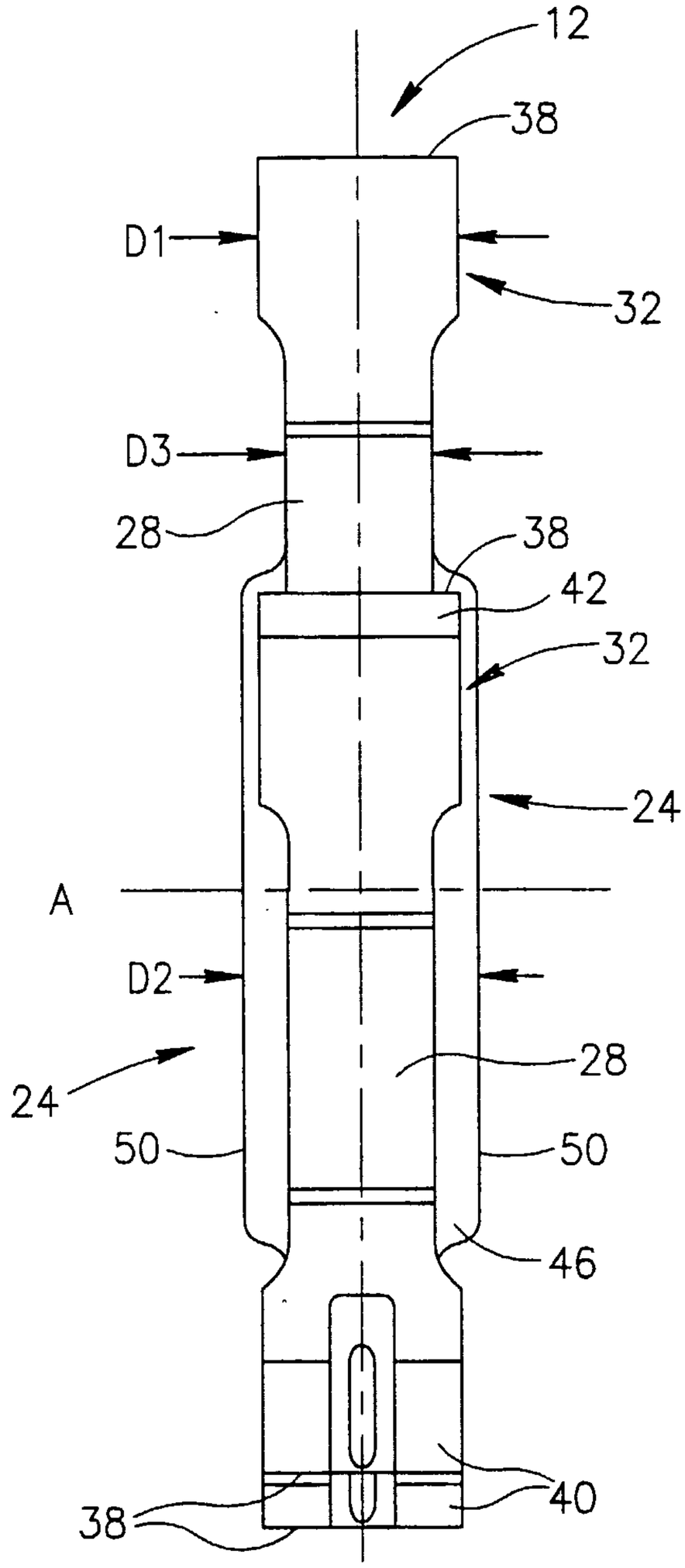
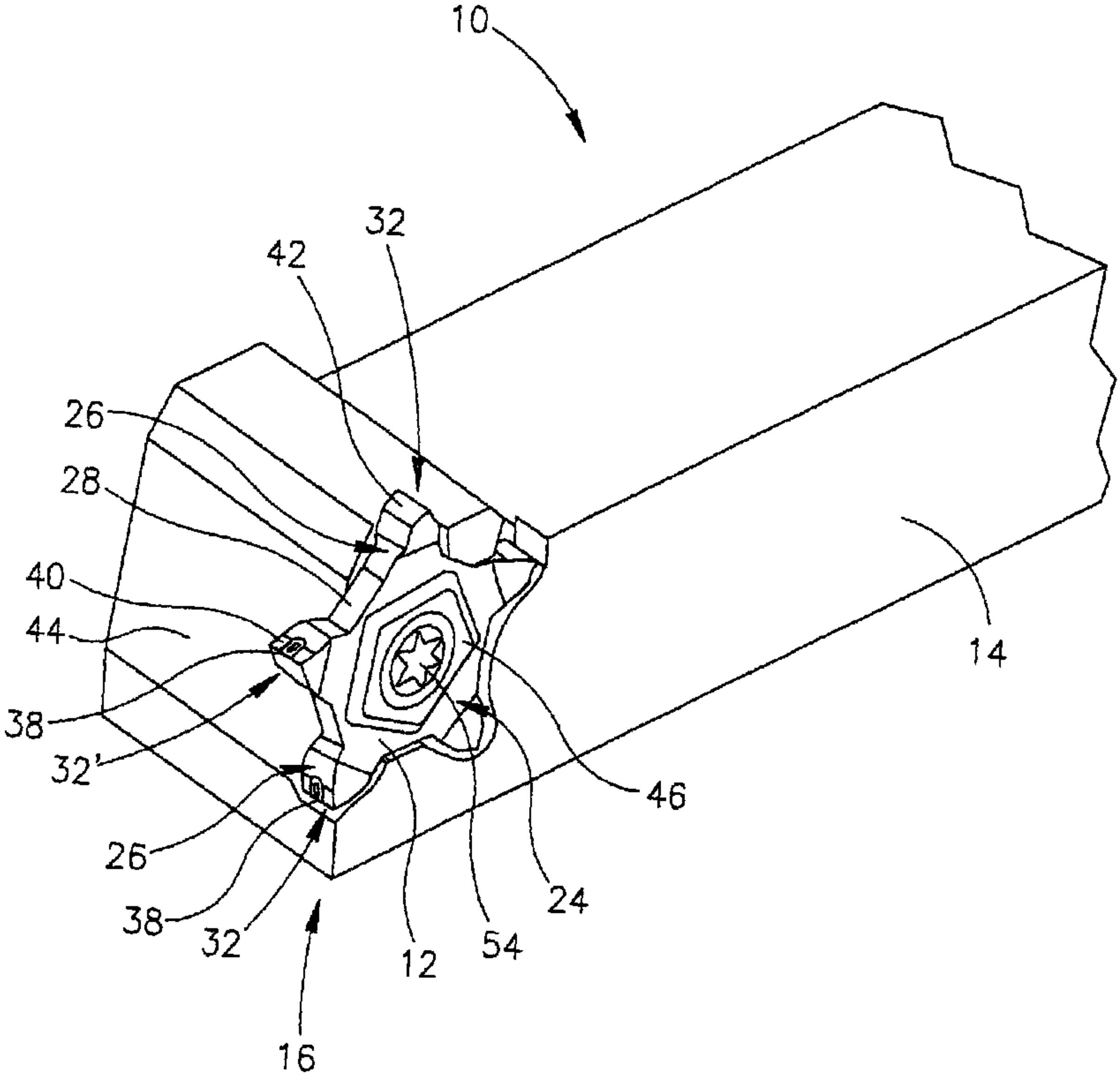


FIG.4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