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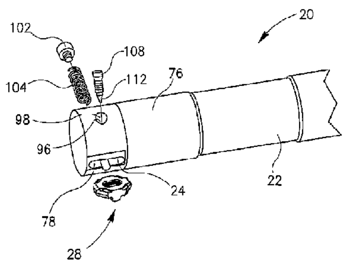
(54) **Title:** DEBURRING TOOL AND CUTTING INSERT THEREFOR



(57) **Abstract:** A deburring tool having an indexable cutting insert having four cutting edges. The cutting insert has a main body portion and a protruding guide member (54). The cutting insert is slidably retained in an insert pocket with the main body portion of the insert located in a generally rectangular slot portion of the insert pocket and with the guide member located and engaging a guide groove portion (74) of the insert pocket. The cutting insert is moveable between a retracted position and an extended position by means of a spring which biases the cutting insert towards the extended position. The sliding movement of the cutting insert is performed by the sliding of the guide member within the guide groove.

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DEBURRING TOOL AND CUTTING INSERT THEREFOR

FIELD OF THE INVENTION

The present invention relates to a tool comprising a spring-loaded cutting insert for the deburring of bores.

BACKGROUND OF THE INVENTION

An example of such a deburring tool is disclosed in US 5,755,538 in accordance with which a cutting insert with a cutting portion, loaded by a spring engaged in a rear groove of the insert, is held in a radially, outwardly sealed window in a tool holder. In the first embodiment, the insert is guided slidable in the tool holder and can, accordingly, be moved in or out by a radial sliding or swinging out of the window of the tool holder. The insert is designed with a lateral groove which is located perpendicular to its longitudinal axis. In the area of this groove, a tension pin is engaged perpendicular to the cutting portion-longitudinal axis and flush in the tool holder and is fixed by the size of the groove in the insert-sliding direction of the insert-sliding path in the window-sliding direction. The insert has only one cutting portion comprising two cutting edges. One cutting edge being operative in the forward direction and the other in the reverse direction.

SUMMARY OF THE INVENTION

In accordance with the invention there is provided a deburring tool comprising:

at one least cutting insert and a tool body;

the cutting insert comprising:

a top surface, a bottom surface and a peripheral surface therebetween; and

two identical opposing cutting portions, each cutting portion comprising two identical cutting edges, each cutting edge being located between a rake surface and a relief surface, the two cutting portions being reflection symmetric with respect to a major median plane of the cutting insert, the two identical cutting edges of each cutting portion being reflection symmetric with respect to a minor median plane of the cutting insert;

the bottom surface comprising two bottom surface sections and a single guide member therebetween, the guide member comprising at least one ridge protruding beyond the bottom surface sections in a direction away from the top surface, the guide member having a longitudinal axis directed perpendicular to the major median plane;

the tool body having at least one insert pocket in which the at least one cutting insert is slidably retained, the at least one insert pocket opening out to a peripheral surface of the tool body via an aperture, the at least one insert pocket comprising a slot and a guide groove with the guide member engaging the guide groove and the cutting insert located at least partially in the slot.

the cutting insert being slidable between a retracted position and an extended position by means of a spring which biases the cutting insert towards the extended position, wherein in the extended position a given cutting portion protrudes from the aperture beyond the peripheral surface of the tool body.

The spring may be a compression spring. Preferably, the cutting insert is held in the extended position by a holding member.

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:

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Fig. 1 is a side view of a deburring tool in accordance with the present invention;

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

Fig. 3 is top perspective view of one embodiment of a cutting insert in accordance with the present invention;

Fig. 4 is bottom perspective view of the cutting insert shown in Fig. 3;

Fig. 5 is top view of the cutting insert shown in Fig. 3;

Fig. 6 is bottom view of the cutting insert shown in Fig. 3;

Fig. 7 is top perspective view of an alternative embodiment of a cutting insert in accordance with the present invention;

Fig. 8 is bottom perspective view of the cutting insert shown in Fig. 7;

Fig. 9 is a partial side view of the deburring tool shown in Fig. 1 rotated through 90° with the cutting insert removed;

Fig. 10 is a cross-sectional view of the deburring tool shown in Fig. 9 taken along the line X-X;

Fig. 11 is the view of the deburring tool shown in Fig. 9 with the cutting insert retained in the insert pocket;

Fig. 12 is a cross-sectional view of the deburring tool shown in Fig. 11 taken along the line XII-XII; and

Fig. 13 is a drill combined with a deburring tool in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Attention is first drawn to Figs. 1 and 2, showing a deburring tool **20** in accordance with the present invention. The deburring tool **20** has a longitudinal axis of rotation **A**, defining a forward to rear direction, and comprises a generally cylindrical tool body **22** having an insert pocket **24** at the forward end **26** of the tool body **22** in which an indexable cutting insert **28** is slidably retained. The cutting insert **28** is shown in greater detail in Figs. 3 to 6 and comprises a top surface **30**, a bottom surface **32** and peripheral surface **34** extending between the top and bottom surfaces **30**, **32**. It should be noted that directional terms appearing throughout the specification and claims, e.g. "top", "bottom", "upper", "lower", etc., are used as terms of convenience to distinguish various surfaces relative to each other. Although these terms may be meaningful with reference to particular component orientations, they are used for illustrative purposes only, and are not intended to limit the scope of the appended claims. The cutting insert **28** is octagonally shaped in top and bottom views and has two identical opposing cutting portions **36**, each cutting portion **36** comprising two identical cutting edges **38**, each cutting edge **38** being located between a rake surface **40** and a relief surface **42**. Therefore, the cutting insert **28** has a total of four cutting edges **38**, all associated with the top surface **30** of the cutting insert **28**. Each relief surface **42** is located in the peripheral surface **34** and each rake surface **40** is located in the top surface **30** and forms part of a chip groove **44** in the top surface **30**. Each chip groove **44** merges with a major top surface section **46** of the top surface **30**. The major top surface section **46** is typically flat. The two cutting portions **36** are reflection symmetric with respect to a major median plane **P1** of the cutting insert **28**, and the two identical cutting edges **38** of each cutting portion **36** are reflection symmetric about a minor median plane **P2** of the cutting insert **28**.

The peripheral surface **34** comprises two opposing end surfaces **48** that are reflection symmetric about the major median plane **P1**, each end surface **48** belonging to a given cutting portion **36**, and two opposing side surfaces **50** that are reflection symmetric about the minor median plane **P2**, the side surfaces **50** being located between the cutting portions **36**.

The bottom surface **32** of the cutting insert **28** comprises two bottom surface sections **52** and a centrally located guide member **54** therebetween. The two bottom surface sections **52** are typically flat and coplanar and parallel to the major top surface section **46** and are located on either side of the minor median plane **P2**. The guide member **54** protrudes outwardly forming a ridge, protruding beyond the bottom surface sections **52** in a direction away from the major top surface section **46** and runs parallel to the minor median plane **P2** and has a longitudinal axis **B** lying in the minor median plane **P2**. As seen in Fig. 6, the longitudinal axis **B** intersects the opposing end surfaces **48**.

The minor median plane **P2** constitutes a longitudinal median plane of the guide member **54**, dividing it longitudinally. Therefore, the cutting insert **28** comprises a main body portion **56** having a protruding guide member **54**. The guide member **54** comprises opposing flat abutment surfaces **58** located on either side of the minor median plane **P2**, extending outwardly away from the bottom surface sections **52** and merging with a longitudinally extending convex surface **60** that bridges between the abutment surfaces **58**. For later discussion, it is noted that (see Fig. 6) each side surface **50** has a first length, **L1**, and the guide member **54** has a second length, L2; each length being measured in the direction of the longitudinal axis **B** of the guide member **54**, the first length, **L1**, being smaller than the second length, **L2**.

An insert through hole **62**, passing between the top and bottom surfaces **30**, **32** divides the guide member **54** into two guide member portions **54'**, that is, divides the ridge into two ridges, located on either side of the major median plane **P1**. The insert through hole **62** has a hole-surface **64** forming a holding surface **65** of the cutting insert **28**. In an alternative embodiment, shown in Figs. 7 and 8, instead of a through hole **62**, the cutting insert **28** is provided with a recess **66** in the top surface **30**. The recess **66** comprises a recess side surface **68** extending inwardly from the top surface **30** of the cutting insert **28** to a bottom surface **70** of the recess **66**. In this embodiment, the recess side surface **68** forms the holding surface **65**. As can be seen in Fig. 8, in this embodiment, the guide member **54** comprises a single uninterrupted ridge.

Attention is now turned to Figs. 9 and 10. The insert pocket **24** has the general form of a T-shaped slot comprising a generally rectangular slot **72** (the "arms" of the "T") and a guide groove **74** (the "foot" of the "T"). The generally rectangular slot **72** has a first width, **W1**, and the guide groove **74** has a second width, **W2**, the two widths being measured in the direction of the longitudinal axis of rotation **A** of the deburring tool **20**; where the first width, **W1**, is greater than the second width, **W2**. The insert pocket **24** opens out to a peripheral surface **76** of the tool body **22** via a first aperture **78**. The insert pocket **24** extends from the peripheral surface **76** of the tool body **22** inwardly in a generally radial direction relative to the axis of rotation **A** of the deburring tool **20**. In the cross section shown in Fig. 10, the peripheral surface **76** of the tool body **22** is generally circular, having a given radius, **R**, with the axis of rotation **A** being located at the origin, **O**, of the circle. The generally rectangular slot **72** comprises opposing upper and lower walls **80, 82** joined by sidewalls **84**. The lower wall **82** comprises two lower wall sections **86** that are parallel to the upper wall **80**. The guide groove **74** is located between the two lower wall sections **86** and comprises opposing flat groove support surfaces **88** extending from respective lower wall sections **86** in a direction away from the upper wall **80** and merging with a longitudinally extending concave surface **90** that defines a longitudinal axis **C** of the guide groove **74** and that bridges between the two groove support surfaces **88**. With reference to Fig. 9, the generally rectangular slot **72** has a first width, **W1**, and the guide groove **74** has a second width, **W2**; each width being measured in the direction of the rotational axis **A** of the deburring tool **20**, the first width, **W1**, being greater than the second width, **W2**.

Two bores communicate with the insert pocket **24**. A major bore **92** extends from a second aperture **94** in the peripheral surface **76** of the tool body **22** to the insert pocket **24**. The second aperture **94** of the major bore **92** is substantially diametrically opposite the first aperture **78** of the insert pocket **24**. The major bore **92** has a longitudinal axis **D** that is perpendicular to the axis of rotation **A** of the deburring tool **20**. The axis of rotation **A** of the deburring tool **20** passes through the major bore **92** which communicates with the insert pocket **24**. A threaded minor bore **96** extends from a third aperture **98** in the peripheral surface **76** of the tool body **22** to the insert pocket **24**. The minor bore **96** has a longitudinal axis **E** that makes an acute angle with the longitudinal axis **D** of the major bore **92**.

Attention is now turned to Figs. 11 and 12. The cutting insert **28** is slidably retained in the insert pocket **24** with the guide member **54** engaging the guide groove **74** and the main body portion **56** of the cutting insert **28** located in the generally rectangular slot **72**. At the rear end of the major bore **92**, in the vicinity of the second aperture **94**, the major bore **92** has a threaded portion **100** in which a first screw **102** is threaded. A spring **104**, such as a helical compression spring, is located in the major bore **92** between the first screw **102** and the cutting insert **28** for urging the cutting insert **28** radially outwardly through the first aperture **78** at a predetermined pressure. The spring **104** abuts the inner end surface **48'** of the cutting insert **28**. The inner end surface **48'** being the end surface **48** facing inwards into the insert pocket **24**, as opposed to the outer end surface **48''** that faces outwards in a direction away from the insert pocket **24**. The pressure applied by the spring **104** can be adjusted by adjusting the location of the first screw **102**, which also acts as a plug to prevent the spring **104** from exiting the major bore **92** through the second aperture **94**.

As can be seen in Fig. 10, the major bore **92** and the insert pocket **24** are not fully aligned so that the forward end of the major bore **92**, adjacent the insert pocket **24**, is partially closed forming a spring retaining surface **106**. Therefore, even when the cutting insert **28** is removed from the insert pocket **24**, the spring **104** is held in position between the spring retaining surface **106** and the first screw **102**. The cutting insert **28** is held in an extended position, as shown in Fig. 1, with one of the cutting portions **36** protruding from the first aperture **78**, by means of a holding member **108** which prevents the cutting insert **28** from being completely pushed out of the insert pocket **24** by the spring **104**. In the embodiment shown, the holding member **108** is a second screw threaded in the minor bore **96**.

To retain the cutting insert **28** in the extended position, the second screw **108** is set in a first position with its forward end protruding beyond the forward end **114** of the minor bore **96** and located partially within the insert through hole **62** (or within the recess **66**, for the cutting insert **28** shown in Figs. 7 and 8) so that it engages the holding surface **65** of the cutting insert **28**. The cutting insert **28** can be urged radially inwardly into the insert pocket **24** to a retracted position by applying a radially inwardly directed force to the outer end surface **48"** of the cutting insert **28**. To remove the cutting insert **28** from the insert pocket **24**, in order to index or replace it, the second screw **108** is set in a second position by unscrewing it until its forward end **112** is withdrawn from the insert through hole **62** (or the recess **66**), thereby enabling the cutting insert **28** to slide freely out of the insert pocket **24**. During deburring operations in which the cutting insert **28** slides between the retracted and extended positions, the second screw **108** is maintained in the first position.

In accordance with the present invention, the sliding movement of the cutting insert **28** between the retracted and extended positions is performed mainly by the sliding of the guide member **54** in the guide groove **74**. This arrangement has a number of advantages. It enables a compact cutting insert design without compromising free sliding movement of the cutting insert **28**. In other words the first length, **L1**, of the side surfaces **50** of the cutting insert **28** can be made relatively small in relation to the first width, **W1**, of the generally rectangular slot **72**.

If the cutting insert **28** were to comprise only the main body portion **56** without the protruding guide member **54**, then the sliding movement of the cutting insert **28** would take place through sliding abutment of the side surfaces **50** of the cutting insert **28** with the sidewalls **84** of the generally rectangular slot **72**. In accordance with the present invention, the first length, **L1**, of the side surfaces **50** of the cutting insert **28** is less than the first width, **W1**, of the generally rectangular slot **72**. In accordance with a non-binding example, the first width, **W1**, is five to six times greater than the first length, **L1**. This being the case, the cutting insert **28** can easily get wedged in the generally rectangular slot **72**. To avoid wedging, the first length, **L1**, would have to be larger than the first width, **W1**. Due to requirement of four cutting edges **38** and due to the constraint of reflection symmetry with respect to the major median plane **P1** of the cutting insert **28** (i.e., the cutting insert **28** is a "double ended" cutting insert with a cutting portion **36** at each end, each cutting portion **36** having two cutting edges **38**), the cutting insert **28** is constrained to have the octagonal form shown in Figs. 5 and 6, and any attempt to design the first length, **L1**, to be larger than the first width, **W1**, would create an impractically large cutting insert.

By transferring the sliding movement of the cutting insert **28** to the sliding of the guide member **54** within the guide groove **74**, the dimensions that determine the possibility of wedging are the second length, **L2**, of the guide member **54** and the second width, **W2**, of the guide groove **74**. In accordance with a non-binding example, the second length, **L2**, is about three times greater than the second width, **W2**. Choosing the second length, **L2**, to be greater than the second width, **W2**, prevents wedging of the guide member **54** in the guide groove **74** and therefore prevents wedging of the cutting insert **28** in the insert pocket **24**.

Clearly, by transferring the sliding movement of the cutting insert **28** from the sliding contact between the main body portion **56** of the cutting insert **28** and the generally rectangular slot **72** portion of the insert pocket **24** to the sliding contact of the guide member **54** within the guide groove **74**, the wedging constraint is decoupled from the geometry of the main body portion **56** of the cutting insert **28**, thus enabling the design of a compact "double-ended" cutting insert. Moreover, by transferring the sliding movement of the cutting insert **28** to the sliding of the guide member **54** within the guide groove **74**, neither the sidewalls **84** of the insert pocket **24** nor the side surfaces **50** of the cutting insert **28** have to be manufactured with high accuracy, since they do not play an essential role in the sliding movement of the cutting insert **28**.

Since sliding movement of the cutting insert **28** is carried out by the sliding of the guide member **54** within the guide groove **74**, there is a designed clearance between the insert pocket sidewalls **84** and the cutting insert side surfaces **50** ensuring that there will be no contact between these surfaces. Any contact between these surfaces could lead to wedging of the insert in the rectangular slot **72**. There is also a designed clearance between the lower wall sections **86** of the insert pocket **24** and the bottom surface sections **52** of the cutting insert **28** and between the upper wall **80** of the insert pocket **24** and the major top surface section **46** of the cutting insert **28**. There is also a designed clearance between the concave surface **90** of the guide groove **74** and the convex surface **60** of the guide member **54**. The only designed contact during sliding movement is between the groove support surfaces **88** of the guide groove **74** and the abutment surfaces **58** of the guide member **54**. However, due to cutting forces acting on the cutting edges **38** during the deburring of bores, or due to forces acting on the cutting insert **28** as the forward end **26** of the deburring tool **20** rotates and passes through a bore, there will be a certain amount of uncontrollable contact between the lower wall sections **86** of the insert pocket **24** and the bottom surface sections **52** of the cutting insert **28** and also between the upper wall **80** of the insert pocket **24** and the major top surface section **46** of the cutting insert **28**. However, these forms of uncontrollable contact cannot give rise to wedging of the cutting insert **28** due to the favorable relative dimensions of the members involved in the above-described uncontrollable contact.

It will be appreciated from Figs. 2, 11 and 12 that the "deburring mechanism", of the deburring tool **20** of the present invention, that is, the cutting insert **28**, spring **104** and first and second screws **102, 108** described hereinabove, is localized in a small region of the tool body **22**. It will be clear to the skilled person that it is a simple matter of design to locate the "deburring mechanism" in any required tool body by forming the insert pocket **24**, and minor and major bores **96, 92** in the tool body, in much the manner as in the deburring tool 20 described herein above. Fig. 13 shows a drill **116** in which the "deburring mechanism" of the present invention has been incorporated, showing the cutting insert **28** in the extended position.

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 scope of the invention as hereinafter claimed.

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or any other country.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A deburring tool comprising:

at one least cutting insert and a tool body;

the cutting insert comprising:

a top surface, a bottom surface and a peripheral surface therebetween; and

two identical opposing cutting portions, each cutting portion comprising two identical cutting edges, each cutting edge being located between a rake surface and a relief surface, the two cutting portions being reflection symmetric with respect to a major median plane of the cutting insert, the two identical cutting edges of each cutting portion being reflection symmetric with respect to a minor median plane of the cutting insert;

the bottom surface comprising two bottom surface sections and a single guide member therebetween, the guide member comprising at least one ridge protruding beyond the bottom surface sections in a direction away from the top surface, the guide member having a longitudinal axis directed perpendicular to the major median plane;

the tool body having at least one insert pocket in which the at least one cutting insert is slidably retained, the at least one insert pocket opening out to a peripheral surface of the tool body via an aperture, the at least one insert pocket comprising a slot and a guide groove with the guide member engaging the guide groove and the cutting insert located at least partially in the slot.

the cutting insert being slidable between a retracted position and an extended position by means of a spring which biases the cutting insert towards the extended position, wherein in the extended position a given cutting portion protrudes from the aperture beyond the peripheral surface of the tool body.

2. The deburring tool according to claim 1, wherein the spring is a compression spring.

3. The deburring tool according to claim 1, wherein the cutting insert is held in the extended position by a holding member.

4. The deburring tool according to claim 3, wherein in the extended

position the holding member abuts a holding surface of the cutting insert.

5. The deburring tool according to claim 4, wherein the cutting insert further comprises a through hole, passing between the top and bottom surfaces, the through hole dividing the guide member into two guide member portions, located on either side of the major median plane.

6. The deburring tool according to claim 5, wherein the insert through hole has a hole-surface forming the holding surface of the cutting insert.

7. The deburring tool according to claim 4, wherein the cutting insert further comprises a recess in the top surface.

8. The deburring tool according to claim 7, wherein the holding surface is a portion of the recess in the top surface.

9. The deburring tool according to claim 1, wherein the cutting insert is octagonally shaped in a top view of the cutting insert.

10. The deburring tool according to claim 1, wherein the tool body of the deburring tool comprises a shank portion of a drill.

11. The cutting insert according to claim 1, wherein the rake surface is located in the top surface and the relief surface is located in the peripheral surface of the cutting insert.

12. The cutting insert according to claim 1, wherein the two bottom surface sections are flat and coplanar.

13. A cutting insert substantially as herein described with reference to the accompanying drawings.

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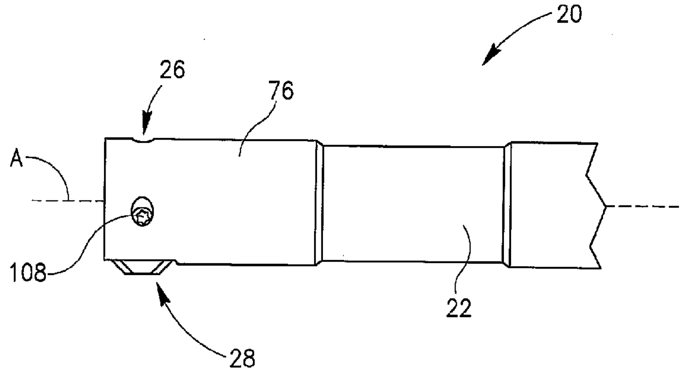

FIG.1

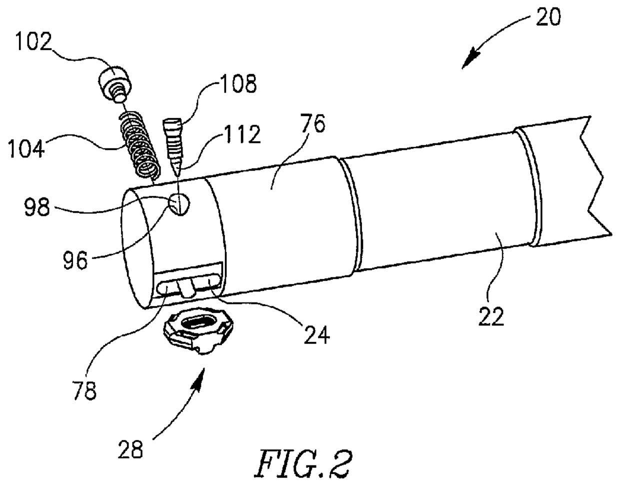

FIG.2

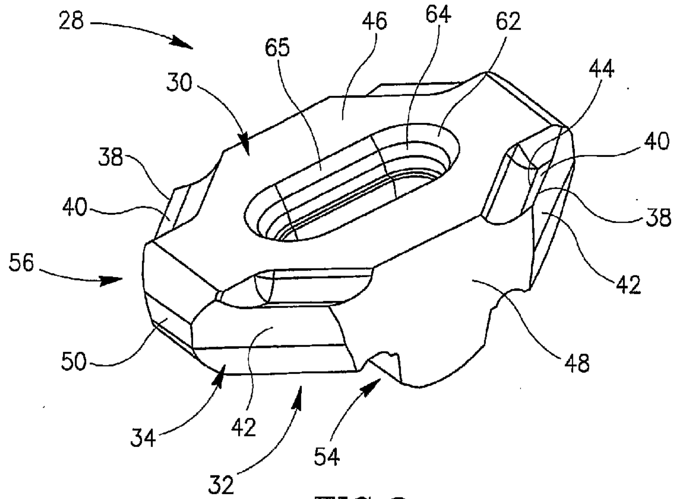
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FIG.3

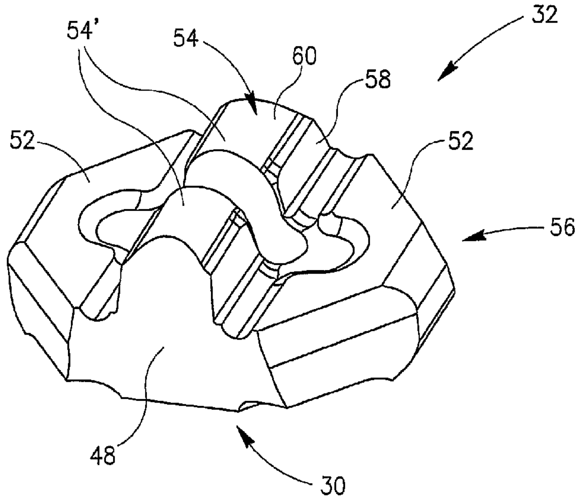
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FIG.4

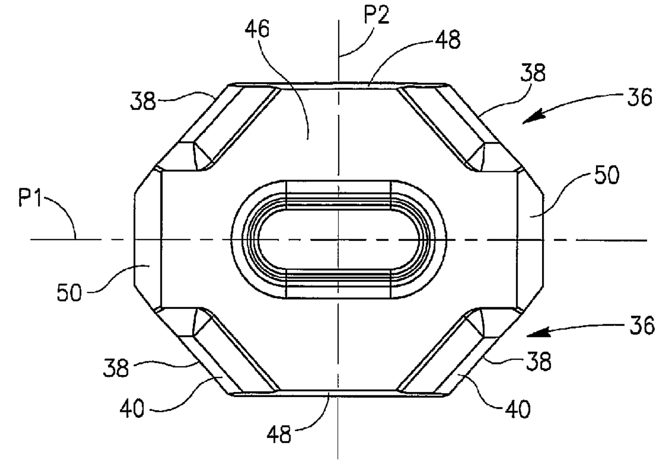
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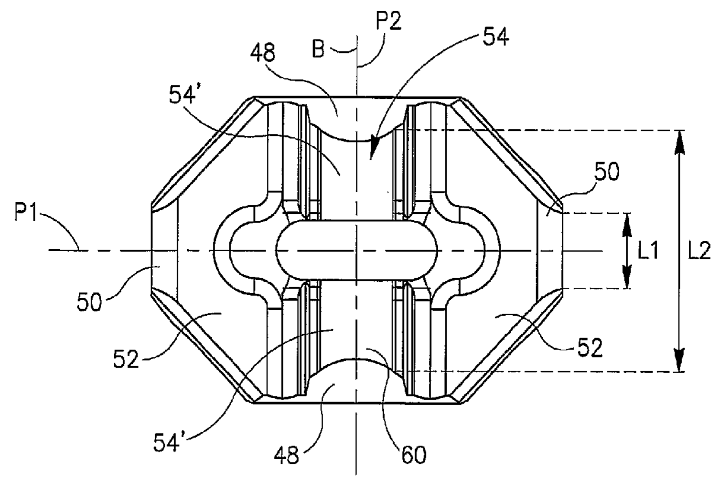
FIG.5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P1
L1
L2
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54'
48
60

FIG.6

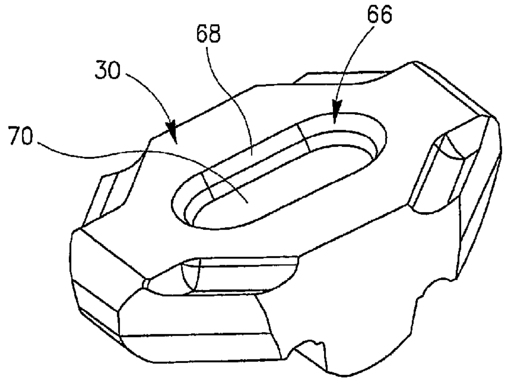

FIG. 7

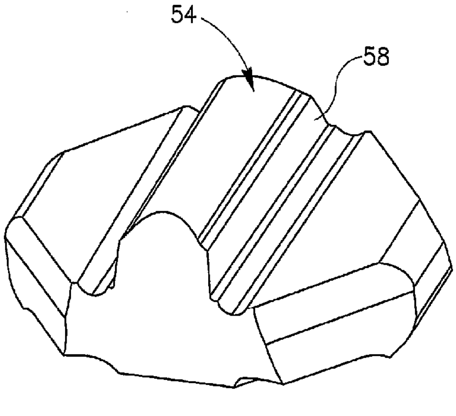

FIG. 8

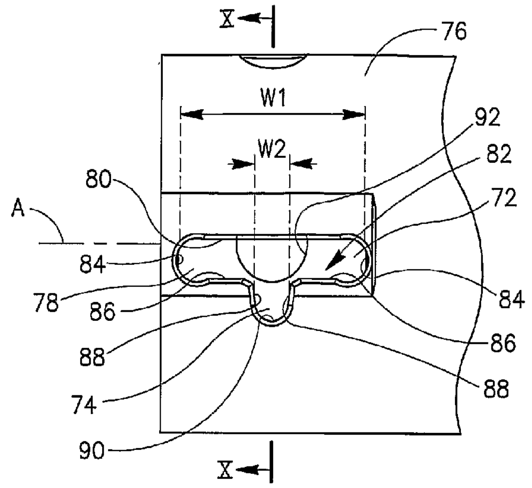
X
76
W1
92
W2
82
80
72
A
84
78
86
84
88
86
74
88
90
X

FIG.9

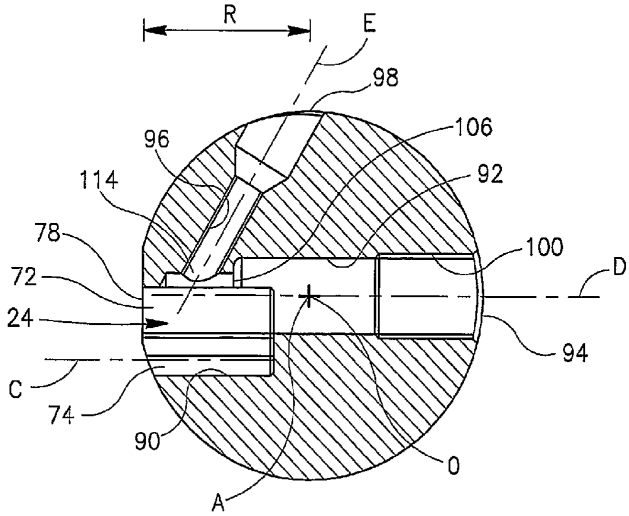
R
E
98
96
106
114
92
78
100
72
D
24
94
C
74
90
0
A

FIG.10

6/7

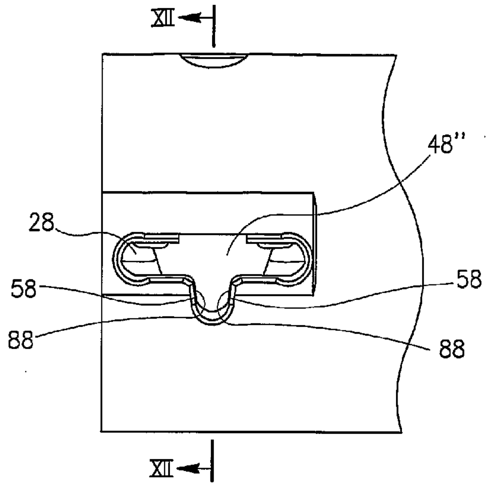

FIG.11

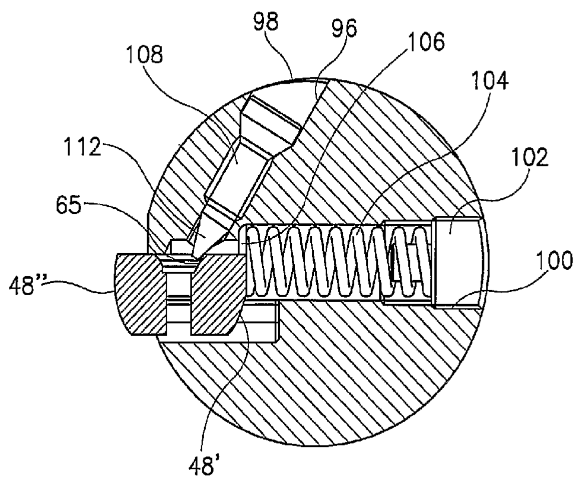

FIG.12

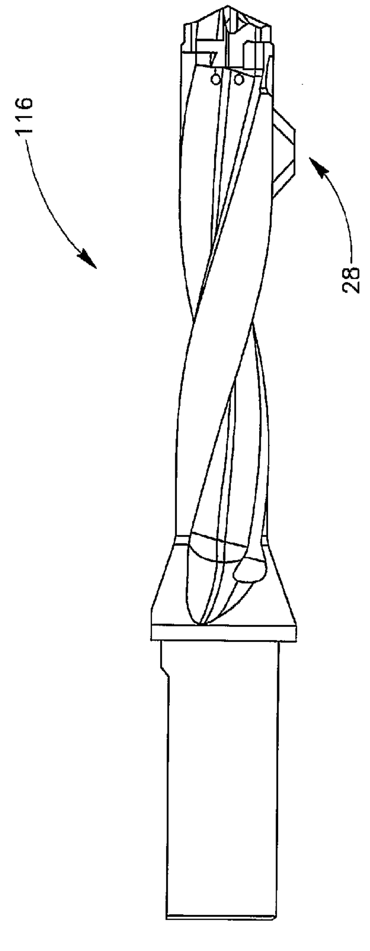

FIG.13