

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.

5 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
10 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
15 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.

20 SUMMARY OF THE INVENTION

It is an object of the present invention to provide an indexable cutting insert having four cutting edges for deburring operations.

It is a further object of the present invention to provide a deburring

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tool comprising the double-sided indexable cutting insert.

In accordance with the present invention there is provided an indexable cutting insert, comprising:

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

5 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
10 minor median plane P2 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
15 the major median plane.

If desired, the cutting insert is provided with 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

20 In accordance with the present invention, the rake surface is located in the top surface and the relief surface is located in the peripheral surface of the cutting insert.

Preferably, the two bottom surface sections are flat and coplanar.

Further if desired, the cutting insert is provided with a recess in the top
25 surface.

Preferably, the cutting insert is octagonally shaped in a top view of the cutting insert.

There is also provided in accordance with the present invention, a deburring tool comprising:

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at one least cutting insert in accordance with the present invention; and

a 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
5 comprising a slot and a guide groove with the guide member engaging the guide groove and a 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
10 protrudes from the aperture beyond the peripheral surface.

In accordance with the present invention, the spring is a compression spring.

Typically, the cutting insert is held in the extended position by a holding member.

15 Preferably, in the extended position the holding member abuts a holding surface of the cutting insert.

If desired, the holding surface is a portion of a hole-surface of an insert through hole formed in the cutting insert

Further if desired, the holding surface is a portion of a recess in the
20 top surface.

In accordance with one application of the present invention, the tool body of the deburring tool comprises a shank portion of a drill.

BRIEF DESCRIPTION OF THE DRAWINGS

25 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 a side view of a deburring tool in accordance with the present invention;

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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;

5 **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;

10 **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;

15 **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
20 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
25 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

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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**.

5 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
10 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
15 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
20 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
25 **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

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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

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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
5 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
10 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
15 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
20 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
25 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.

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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. 5 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 10 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.

15 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 20 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 25 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

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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.

- 5 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.

CLAIMS:

1. An indexable cutting insert (28), comprising:
a top surface (30), a bottom surface (32) and a peripheral surface (34) therebetween; and
5 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), the two cutting portions (36) being reflection symmetric with respect to a major median plane (P1) of the cutting insert (28), the two identical cutting edges (38) of each cutting portion
10 (36) being reflection symmetric with respect to a minor median plane (P2) of the cutting insert (28);
the bottom surface (32) comprising two bottom surface sections (52) and a single guide member (54) therebetween, the guide member (54) comprising at least one ridge protruding beyond the bottom surface sections (52) in a direction
15 away from the top surface (30), the guide member (54) having a longitudinal axis **B** directed perpendicular to the major median plane (P1).
2. The cutting insert (28) according to claim 1, further comprising a through hole (62), passing between the top and bottom surfaces (30, 32), the through hole (62) dividing the guide member (54) into two guide member
20 portions (54'), located on either side of the major median plane (P1).
3. The cutting insert (28) according to claim 1, further comprising a recess (66) in the top surface (30).
4. The cutting insert (28) according to claim 1, wherein the rake surface (40) is located in the top surface (30) and the relief surface (42) is located in the
25 peripheral surface (34) of the cutting insert (28).
5. The cutting insert (28) according to claim 1, wherein the two bottom surface sections (52) are flat and coplanar.
6. The cutting insert (28) according to claim 1, wherein the cutting insert (28) is octagonally shaped in a top view of the cutting insert (28).

7. A deburring tool (20) comprising:
at one least cutting insert (28) in accordance with claim 1; and
a tool body (22) having at least one insert pocket (24) in which the at least one cutting insert (28) is slidably retained, the at least one insert pocket (24) opening out to a peripheral surface (76) of the tool body (22) via an aperture, the at least one insert pocket (24) comprising a slot (72) and a guide groove (74) with the guide member (54) engaging the guide groove (74) and the cutting insert (28) located at least partially in the slot (72);
the cutting insert (28) being slidable between a retracted position and an extended position by means of a spring (104) which biases the cutting insert (28) towards the extended position, wherein in the extended position a given cutting portion (36) protrudes from the aperture beyond the peripheral surface (76) of the tool body (22).
8. The deburring tool (20) according to claim 7, wherein the spring (104) is a compression spring.
9. The deburring tool (20) according to claim 7, wherein the cutting insert (28) is held in the extended position by a holding member (108).
10. The deburring tool (20) according to claim 9, wherein in the extended position the holding member (108) abuts a holding surface (65) of the cutting insert (28).
11. The deburring tool (20) according to claim 10, wherein the cutting insert (28) further comprises a through hole (62), passing between the top and bottom surfaces (30, 32), the through hole (62) dividing the guide member (54) into two guide member portions (54'), located on either side of the major median plane (P1).
12. The deburring tool (20) according to claim 11, wherein the insert through hole (62) has a hole-surface (64) forming the holding surface (65) of the cutting insert (28).
13. The deburring tool (20) according to claim 10, wherein the cutting

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insert (28) further comprises a recess (66) in the top surface (30).

14. The deburring tool (20) according to claim 13, wherein the holding surface (65) is a portion of the recess (66) in the top surface (30).

15. The deburring tool (20) according to claim 7, wherein the cutting
5 insert (28) is octagonally shaped in a top view of the cutting insert (28).

16. The deburring tool (20) according to claim 7, wherein the tool body (22) of the deburring tool (20) comprises a shank portion of a drill (116).