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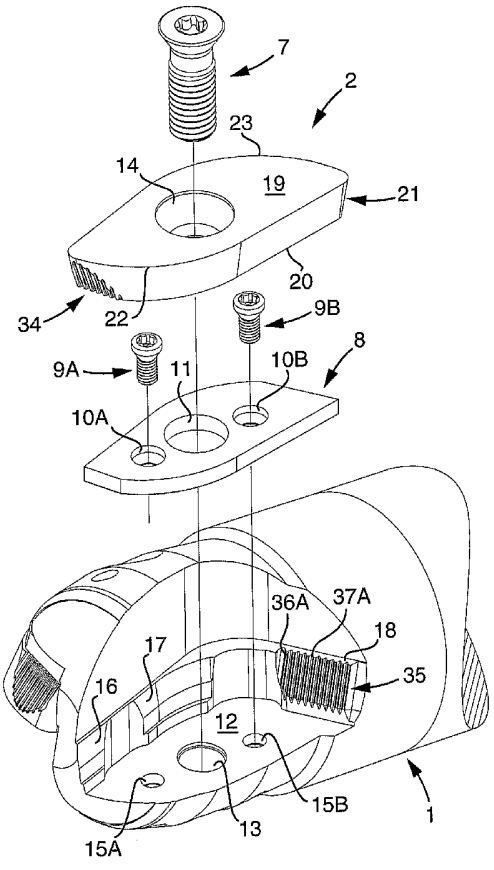
(54) Title: A MILLING INSERT AND A MILLING TOOL, AS WELL AS A SHIM PLATE FOR SUCH TOOLS



(57) Abstract: In one aspect, the invention relates to an indexable milling insert (2) of the type that comprises opposite top and bottom sides (19,20) between which a circumferential clearance surface (21) extends, and two opposite cutting edges (22,23) formed in the transition between the top side (19) and the clearance surface (21), each one of the cutting edges (22,23) including a substantially straight portion in connection with a straight section of the clearance surface (21) and a curved portion in connection with a convex arched section of the clearance surface (21), the milling insert (2) comprising a coupling means (34) having one or more male- and/or female-like engagement members. Characteristic of the invention is that the coupling means (34) is located along said clearance surface (21). In such a way, a milling insert (2) is provided that can be mounted in a stable and exact way, where the precision in respect of the position of the cutting edges (22,23) in relation to a basic body (1) is retained also during machining. Furthermore, the invention relates to a milling tool, as well as an attachment in the form of a shim plate, for such milling tools.

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A MILLING INSERT AND A MILLING TOOL, AS WELL AS A SHIM PLATE FOR SUCH TOOLS

Technical Field of the Invention

In a first aspect, this invention relates to an indexable milling insert of the type that comprises opposite top and bottom sides between which a clearance surface extends, and two opposite cutting edges formed in the transition between the top side and the clearance surface, each one of the cutting edges including a substantially straight portion in connection with a straight section of the clearance surface and a curved portion in connection with a convex arched section of the clearance surface, the milling insert comprising a coupling means having one or more male- and/or female-like engagement members.

In a second aspect, the invention also relates to a milling tool. This tool comprises a basic body having an insert seat and a milling insert, which is detachably mounted in the insert seat by means of a tightening element, the milling insert and the insert seat including co-operating coupling means, each one of which has male- and/or female-like engagement members having the purpose of securing the milling insert in a mounted state.

In a third aspect, the invention also relates to an attachment in the form of a shim plate intended for the tool.

Prior Art

Within the field of cutting machining, it has become more and more common to use, as interface between different components included in cutting tools, coupling means of the type that are formed with co-operating male- and female-like engagement members. Particularly frequently, such coupling means are found in the interface between the basic body of the tool and the replaceable milling insert(s).

The invention relates to a tool for contour milling of the type that is exemplified in US 6149355 A. This tool comprises a conventional, indexable milling insert for a contour or end mill. Such a conventional milling insert includes two cutting edges, each one of which comprises a curved portion and a substantially straight portion connecting with the same. The milling insert has in its entirety an oval shape as viewed in a planar view. The bottom and side-support surfaces of the milling insert are planar and the fixation of the milling insert is guaranteed principally by the tightening force from a tightening screw, as well as the co-operation between the clearance surfaces of the milling insert and the side-support surfaces of the insert seat. For this type of tools, especially in machining at small cutting depths, when only the curved portion of the cutting edge is in engagement with a workpiece, a great axial force component arises, which tends to press the milling insert out of the insert seat thereof, which results in the tightening screw being subjected to great forces and the fixation running a risk of becoming unstable. At great cutting depths, when also the straight portion is in engagement with the workpiece, this problem does not arise to the same extent, since there is a counteracting force from the part of the workpiece that is machined by the straight portion.

In US 5 951 213 A, a milling tool and a milling insert are disclosed, which intend to solve the problem with unstable fixation by arranging a recess on the bottom side of the milling insert, which recess is intended to co-operate with a projection in the bottom surface of the insert seat. In the mounted state, contact is established on one hand between the bottom side of the milling insert and the bottom surface of the insert seat, and on the other hand between parts of the clearance surface of the milling insert and a plurality of side-support surfaces of the insert seat, as well as between the recess of the milling insert and the projection of the insert seat. However, this solution suffers from the drawback that the abutment becomes overdetermined, i.e., precise positioning of the cutting edges in relation to the basic body is lost and the milling insert, in the worst case, wobbles in the insert seat.

In WO 2004/082877 A1, a milling tool and a milling insert are disclosed, which intend to solve the problems with unstable fixation and inexact positioning by arranging a plurality of recesses on the bottom side of the milling insert. These recesses are intended to co-operate with a plurality of projections in the bottom surface of the insert seat. Upon mounting, the milling insert is inserted into the insert seat in such a way that the plural recesses become aligned with the plural projections. In the correct position, a screw can be inserted through a hole and be tightened in a threaded hole, such that the bottom side of the milling insert is pressed against the bottom surface, while parts of a clearance surface come into abutment against side-support surfaces in the insert seat. The flanks of the projections come into abutment against the recesses only upon machining, if the milling insert moves somewhat. Although this solution does not suffer from the abutment becoming overdetermined, displacement of the milling insert must be allowed in the insert seat such that the precise positioning of the cutting edges in relation to the basic body is lost.

Objects and Features of the Invention

The present invention aims at obviating the above-mentioned drawbacks and at providing an improved milling tool.

Thus, in a first aspect, an object of the invention is to provide a milling insert for contour milling, which can be mounted in a stable and exact way, where the precision in respect of the position of the cutting edges in relation to the basic body is retained also during machining.

According to the invention, at least this object is attained by means of the features defined in the characterizing clause of claim 1. Preferred embodiments of the invention are further defined in the dependent claims.

In a second aspect, the invention also aims at providing a milling tool that is improved in respect of stable and exact fixation of one or more milling inserts. The features of this tool are seen in claim 12.

In a third aspect, the invention further aims at providing a shim plate intended for the milling tool, the features of which plate are seen in claim 13.

Brief Description of the Appended Drawings

In the drawings:

Fig. 1 is a perspective view showing a milling tool according to the present invention,

Fig. 2 is a perspective exploded view showing a milling tool according to Fig. 1, a milling insert being shown separated from an insert seat in the holder or basic body of the tool, as well as a shim plate between the basic body and the milling insert,

Fig. 3 is a perspective view obliquely from below of the milling insert according to Fig. 2,

Fig. 4 is an analogous perspective view showing the milling insert rotated 180°, in relation to the position according to Fig. 3,

Fig. 5 is a planar view from above of the same milling insert,

Fig. 6 is a planar view from below of the milling insert,

Fig. 7 is a side view of the milling insert,

Fig. 8 is an opposite side view of the milling insert,

Fig. 9 is a schematic and very enlarged section of the milling insert and the insert seat before the coupling means have been brought together, and

Fig. 10 is a perspective view of a shim plate according to the present invention.

Detailed Description of Preferred Embodiments of the Invention

In Figs. 1–8, a cutting tool is shown in the form of a contour mill for machining metal, which in a conventional way includes a basic body 1, as well as a number of milling inserts 2. The basic body comprises a shaft 3, which can be fixed in a tool holder and a front end 4. In the front end 4, two insert seats are formed, *viz.* an inner insert seat 5 and an outer insert seat 6, each of which individually carries a milling insert 2, preferably made from sintered cemented carbide. The "inner" and "outer" designation of the insert seats 5, 6 is related to the radial position of the respective insert seat. A clamping member in form of a screw 7 is shown holding the milling insert 2 in the insert seat 6. The insert seats 5, 6, and the respective milling inserts 2A, 2B, are placed in such a way that the inner

milling insert 2A in the inner insert seat 5 extends into and preferably past an imaginary axis C-C, around which the basic body 1 is rotatable and which is located in the centre of the basic body 2. Such placement means that the tool can drill into a workpiece. The outer milling insert 2B in the outer insert seat 6 is arranged somewhat beside the geometrical axis C-C. The active cutting edges of the milling inserts are arranged in such a way that upon rotation, a perfect semi-sphere may be formed. Preferably, the milling inserts 2A, 2B are identical. When the active edges of the milling inserts 2A, 2B become worn out or blunt, previously inactive edges are indexed up to an active position and, at the same time the milling inserts 2A, 2B are exchanged between the insert seat 5, 6.

Respective shim plates 8 are arranged between the respective milling insert 2A, 2B and insert seats 5, 6. A shim plate 8 is secured in a respective insert seat by two screws 9A, 9B, which co-operate with the holes 10A, 10B. The shim plate also comprises a centre hole 11.

Each insert seat 5, 6 comprises a bottom surface 12, in which a threaded hole 13 is formed in order to receive the screw 7 extending through a through hole 14 in the milling insert 2, and in which two smaller threaded holes 15A, 15B are formed in order to receive the screws 9A, 9B. Furthermore, each the insert seat has a front side-support surface 16, an intermediate side-support surface 17, and a rear side-support surface 18, where the positional designations are related to the axial direction of the tool.

The milling insert 2, which individually is shown in Figs. 3–8, fits, as mentioned above, in each of the insert seats 5, 6. The milling insert 2 has an eye-like or leaf-like basic shape, which is determined by generally planar opposite top and bottom sides 19, 20, which are mutually parallel. Between the top and bottom sides 19, 20, a circumferential peripheral surface extends, which forms a clearance surface, which in the figures has been given a general designation 21. The concept of clearance surface 21 should, in this connection, be interpreted in the widest sense thereof. Thus, the clearance surface 21 may be formed as a continuous surface extending between the top and bottom sides 19, 20 of the milling insert, alternatively as a number of partial surfaces that jointly form a

surface extending between the top and bottom sides 19, 20 of the milling insert. In the transition between the top side 19 and the clearance surface 21, two opposite cutting edges 22, 23 are formed. Each cutting edge 22, 23 includes a substantially straight edge portion 24, 25 in connection with a straight section 26, 27 of the clearance surface 21, and includes a curved edge portion 28, 29 in connection with a convex arched section 30, 31 of the clearance surface 21. The curved edge portions 28, 29 are of different length, which most clearly is seen in Figs. 5 and 6. The straight portions 24, 25 are not parallel but form an angle with each other, suitably between 4° and 20°, and preferably between 6° and 15°. At a first end, the straight edge portions 24, 25 connect with a corner 32, 33, and at a second end, with a curved edge portion 28, 29. The curved edge portions 28, 29 are both defined by a substantially identical radius of curvature. Each of the curved edge portions 28, 29 represents at least 40 % of the total length of the respective cutting edge 22, 23. It should also be mentioned that the clearance surface 21 of the milling insert is oriented at an acute angle, e.g., within the range of 80–85° (not indicated), to the top side 19.

As far as the shown tool has been generally described hitherto, the same is in all essentials previously known.

New and characteristic of the insert according to the invention is that the milling insert 2 comprises at least one first coupling means 34, which is situated on the clearance surface 21 of the milling insert 2. The coupling means 34 is intended to, in the mounted state of the milling insert, co-operate with a second coupling means 35, which is formed in the rear side-support surface 18 of an insert seat 5, 6. In order to guarantee that the coupling means 34, 35 are pressed together in connection with mounting of the milling insert 2, the threaded hole 13 in the insert seat 6 and the hole 14 in the milling insert 2 are adapted in such a way, that tightening of the screw 7 gives a certain prestress. In the shown preferred embodiment, each of the coupling means 34, 35 has engagement members in the form of ridges 36 and grooves 37. The cross-section shape of the ridges 36 is conventional and therefore not especially illustrated in a separate figure. Generally, it may however be said that an individual ridge is delimited by two opposite flank

surfaces or flanks, between which there is a crest, which forms the highest situated portion of a ridge. Preferably, a common angle between the flank surfaces is approximately 60°. However, other angles are also feasible. It is essential that the crests of the ridges in one of the coupling means do not bottom in the grooves in the other coupling means. It is also essential that the spacing between adjacent ridges is the same in both coupling means to ensure that the coupling means fit together.

In the choice of engagement members, ridges and grooves are preferable, because the forces to be carried principally act in a plane that is parallel to the bottom surface 12 of an insert seat. More precisely, it is preferable to prevent the milling insert from sliding along the bottom surface 12. The forces are carried by a number of ridges 36 via the force-transferring flanks thereof, the total surface of which becomes relatively great compared with other types of members that are not as long, for instance knob-shaped members, which are suitable for carrying forces in a plurality of directions. Grooves and ridges are particularly advantageous with small insert dimensions since other engagement members – for carrying the corresponding forces – have to be given a size which is too dominant and which thereby disadvantageously affects to a great extent the geometry and properties of the milling insert.

In Figs. 3 and 4, it is seen that the number of ridges 36 in the convex arched section situated in connection with the corner 32 amounts to seven, and that the number of ridges 36 in the convex arched section situated in connection with the corner 33 amounts to nine. Of course, the number of ridges may vary, but it is preferred that they amount to at least three ridges 36 and at most twelve ridges 36. It is also seen that each one of the grooves 37 along the entire length thereof opens out from the clearance surface 21, and that the longitudinal axes of the ridges 36 and of the grooves 37, respectively, extend at an angle to the bottom side 20 of the milling insert. This angle may vary, but is preferably approximately 90°. Of course the ridges 36A and the grooves 37A, respectively, in the insert seat are arranged correspondingly in relation to the bottom surface 12 of the insert seat, i.e., preferably they form an approximately right angle with the bottom surface

12. The number of ridges and grooves in one of the coupling means, e.g., the milling insert 2, does not necessarily need to correspond to the number of ridges and grooves in the other coupling means, e.g., insert seat.

As has been mentioned above, the coupling means 34 are situated along the convex arched sections 30, 31 of the clearance surface 21, but it is also feasible to arrange the same along the straight sections 26, 27. However, a position along the convex arched sections is preferable, since these sections that have a greater tendency to be pressed out or displaced along the rear side-support surface 18 in a direction along the bottom surface 12, especially all at small cutting depths, such as has been described above. It is further preferred that the coupling means occupies only a limited part, preferably at most 15 %, of the total peripheral length, (or expressed in another way, the total length extension) of the clearance surface 21, since the position of the milling insert 2 in the insert seat otherwise tends to become overdetermined, which may result in instability.

In Figs. 3 and 4, it is also seen that distal ends, i.e., with respect to the bottom side 20 of the milling insert, of the respective ridges 36 are spaced from the cutting edges 22, 23. In this way, an unbroken, continuous cutting edge 22, 23 is obtained, which in most cases is desirable. The length of the longest ridge 36 may of course vary, but should amount to at least 25% of the height of the milling insert 2, where the height is defined as the distance from the top side 19 to the bottom side 20. In roughing, it would also be feasible to use a milling insert 2 having a cutting edge 22, 23 that is uneven or toothed, which would be the result if one or more of the respective ridges 36 extend all the way up to and ends in the top side 19 of the milling insert 2.

In Fig. 9, a schematic section of a milling insert 2 and an insert seat 6 is shown before the coupling means have been brought together. Here, it is seen that the separation of the grooves 37 from the cutting edge 22, 23 has been accomplished by the fact that the respective groove 37 has a depth that successively decreases in the direction towards the top side 19 of the milling insert 2. Consequently, also the ridges 36 have a height that successively decreases in the direction towards the top side 19 of the milling insert 2. The greatest height,

i.e., with respect to the bottom side 20 of the milling insert 2, of the respective ridges 36 should amount to 0,1 mm and not be greater than 1 mm. The ridges 36 and the grooves 37, respectively, may be produced by means of a milling cutter adapted for the purpose.

Also the ridges 36A on the insert seat 6, more precisely in the rear side-support surface 18, may be produced by milling. However, in this case, the depth of the grooves 37A is constant. In this connection, it may also be observed that the crests of the ridges 36A of the insert seat 6 are parallel to the bottoms of the grooves 37A of the milling insert 2, as is seen from the two dash-dotted lines.

In Fig. 10, an embodiment is illustrated of a shim plate 8A according to the present invention. The shim plate 8A has a generally eye-like or leaf-like basic shape, which is determined by generally planar opposite top and bottom sides 38, 39, which are mutually parallel. Between the top and bottom sides 38, 39, a circumferential peripheral surface extends, which in the figures has been given a general designation 40. In the transition between the top side 38 and the peripheral surface 40, two opposite edges 41, 42 are formed. Each of the edges 41, 42 includes a substantially straight portion 43, in connection with a straight section 44 of the peripheral surface 40, and a curved portion 45, in connection with a convex arched section 46 of the peripheral surface 40. New and characteristic of the shim plate according to the invention is that the shim plate 8A comprises a coupling means 47, which is located along said peripheral surface 40. This coupling means 47 co-operates with the corresponding coupling means on a side-support surface of the insert seat 5, 6. In order to stably fix the milling insert, on the top side 38 thereof the shim plate 8A is provided with engagement members 48 (e.g., cylindrical recesses) intended to co-operate with engagement members on the bottom side of a milling insert (not shown). Thus, according to this embodiment, it is not necessary to have coupling means on the clearance surface of the milling insert. The coupling means 47 has engagement members in the form of ridges and grooves, but it should however be pointed out that also other types of engagement members are feasible. In other respects, it also applies for the shim plate 8A that the number of ridges may vary, but that it is preferred that they

amount to at least three and at most twelve, that the ridges and grooves, respectively, extend at a preferably right angle to the bottom side 39 of the shim plate, that the coupling means 47 may be situated on the convex arched section 46 of the peripheral surface 40, and that the coupling means 47 occupies only a limited part, preferably at most 15 %, of the total length of the peripheral surface 40. Furthermore, the depth of the grooves in the coupling means 47 is advantageously constant along the length of the grooves and the grooves extend between the top and bottom side 38, 39 of the shim plate 8A. Also the shim plate 8A may, as well as the milling insert 2, advantageously be indexable and thereby comprise coupling means on the part of the peripheral surface 40 not shown.

Feasible Modifications of the Invention

The invention is not only limited to the embodiments described above and illustrated in the drawings. On the contrary, a plurality of alternative embodiments are feasible within the scope of the subsequent claims. For example, the ridges and the grooves, respectively, of the milling insert may be produced by direct pressing. In this case, it is possible to form also the grooves and ridges, respectively, of the milling insert with constant depth, also in the case where the end of the grooves closest to the cutting edge is spaced from the cutting edge. In this case, the ridges and the grooves, respectively, in the end closest to the cutting edge may have an abrupt termination.

Instead of a plurality of elongate ridges (and intermediate grooves), it is also feasible to use only a single male-like projection in one of the surfaces for the connection with a female-like seat in the other surface, wherein the projection and the seat may have an arbitrary shape, e.g., round, oval, quadrangular, etc.

Claims

1. Indexable milling insert (2), comprising opposite top and bottom sides (19,20) between which a clearance surface (21) extends, and two opposite cutting edges (22,23) formed in the transition between the top side (19) and the clearance surface (21), each one of the cutting edges (22,23) including a substantially straight portion (24,25) in connection with a straight section (26,27) of the clearance surface (21), and a curved portion (28,29) in connection with a convex arched section (30,31) of the clearance surface, the milling insert (2) comprising a coupling means (34) having one or more male- and/or female-like engagement members, *characterized* in that the coupling means (34) is located along said clearance surface (21).

2. Milling insert according to claim 1, *characterized* in that the coupling means (34) occupies only a limited part of the peripheral length of the clearance surface (21).

3. Milling insert according to claim 2, *characterized* in that the coupling means (34) occupies at most 15 % of the peripheral length of the clearance surface (21).

4. Milling insert according to any one of the preceding claims, *characterized* in that the coupling means (34) is located along the convex arched section (30, 31) of the clearance surface (21).

5. Milling insert according to any one of the preceding claims, *characterized* in that a distal end of the coupling means (34) with respect to the bottom side of the milling insert is spaced from the cutting edge (22,23).

6. Milling insert according to any one of the preceding claims,

characterized in that said engagement members comprise a plurality of ridges (36), which are separated by grooves (37).

7. Milling insert according to claim 6, *characterized* in that the number of ridges (36) amounts to at least three and at most twelve.

8. Milling insert according to claim 6 or 7, *characterized* in that said ridges (36) and grooves (37), respectively, extend at an angle with respect to the bottom side (20) of the milling insert (2).

9. Milling insert according to any one of claims 6–8, *characterized* in that each individual groove (37) has a depth that successively decreases in a direction towards the top side (19) of the milling insert.

10. Milling insert according to any one of claims 6–9, *characterized* in that the ridges (36) have a greatest height of at least 0,1 mm.

11. Milling insert according to any one of claims 6–10, *characterized* in that the ridges (36) have a greatest height of at most 1 mm.

12. Milling tool comprising a basic body (1) including an insert seat (5,6) having a bottom surface (12) and at least one side-support surface (16,17,18), a milling insert (2) being detachably mounted in the insert seat (5,6) and comprising opposite top and bottom sides (19,20) between which a clearance surface (21) extends, the milling insert (2) comprising two opposite cutting edges (22,23) formed in the transition between the top side (19) and the clearance surface (21), and each one of the cutting edges (22,23) including a substantially straight portion (24,25) in connection with a straight section (26,27) of the clearance surface (21) and a curved portion (28,29) in connection with a convex arched section (30,31) of the clearance surface (21), the milling insert (2) and the insert seat (5,6) including co-operating coupling means (34,35), which individually has one or more male-

and/or female-like engagement members having the purpose of securing the milling insert in a mounted state, *characterized* in that the coupling means (34) of the milling insert (2) is located along said clearance surface (21), and that the coupling means (35) of the insert seat (5,6) is located along said side-support surface (16,17,18).

13. Shim plate (8A) for milling tools, comprising opposite top and bottom sides (38,39) between which a peripheral surface (40) extends, and two opposite edges (41,42) formed in the transition between the top side (38) and the peripheral surface (40), each one of the edges (41,42) including a substantially straight portion (43) in connection with a straight section (44) of the peripheral surface (40) and a curved portion (45) in connection with a convex arched section (46) of the peripheral surface (40), the shim plate (8) comprising a coupling means (47) having one or more male- and/or female-like engagement members, *characterized* in that the coupling means (47) is located along said peripheral surface (40).

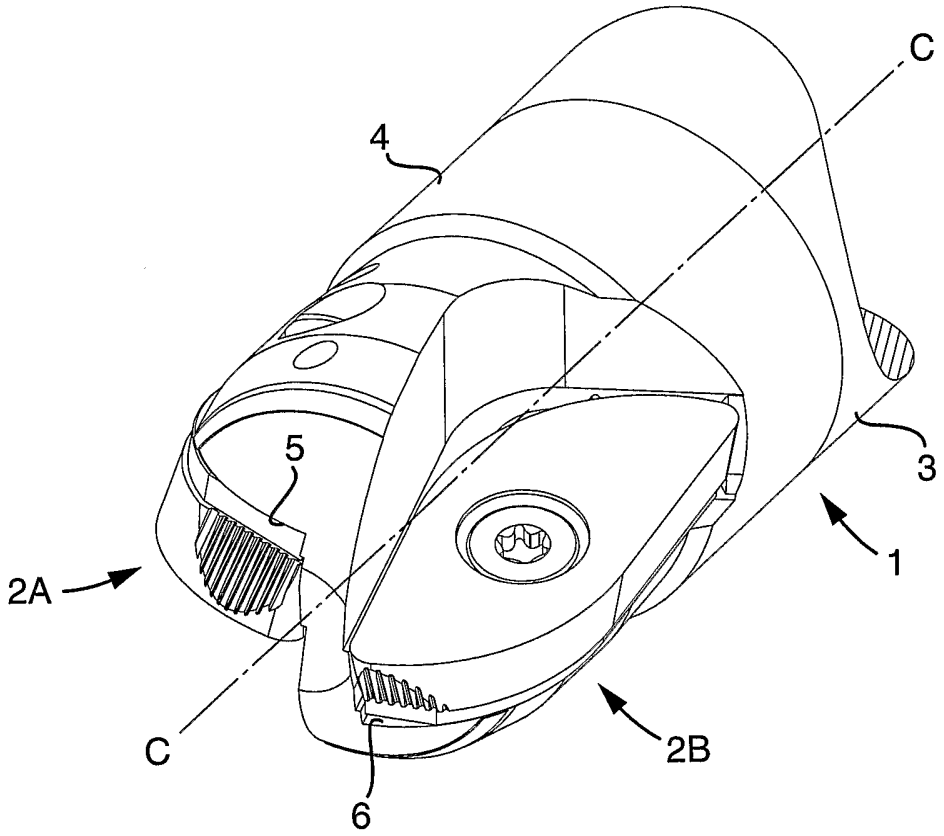

Fig 1

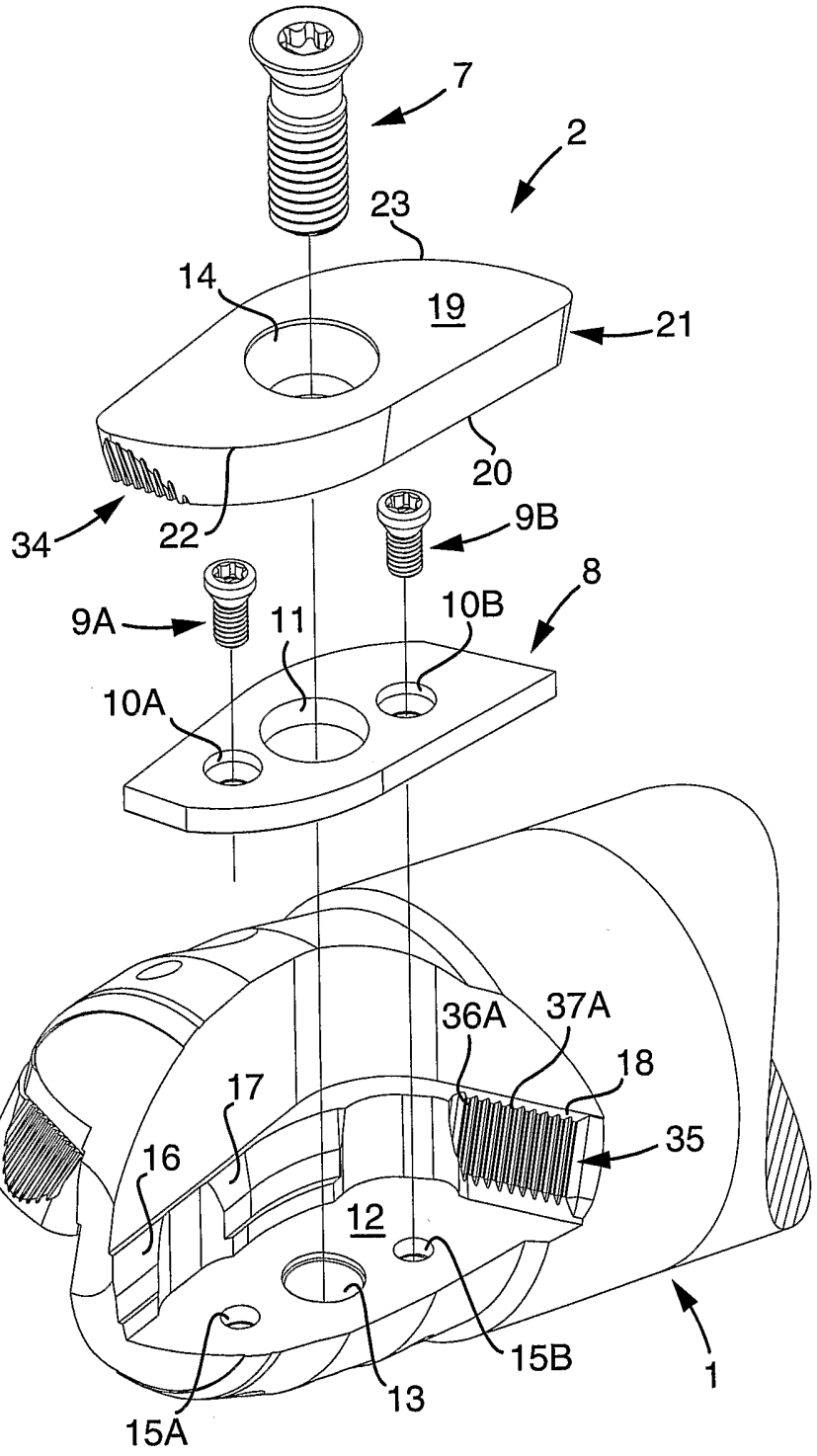
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Fig 2

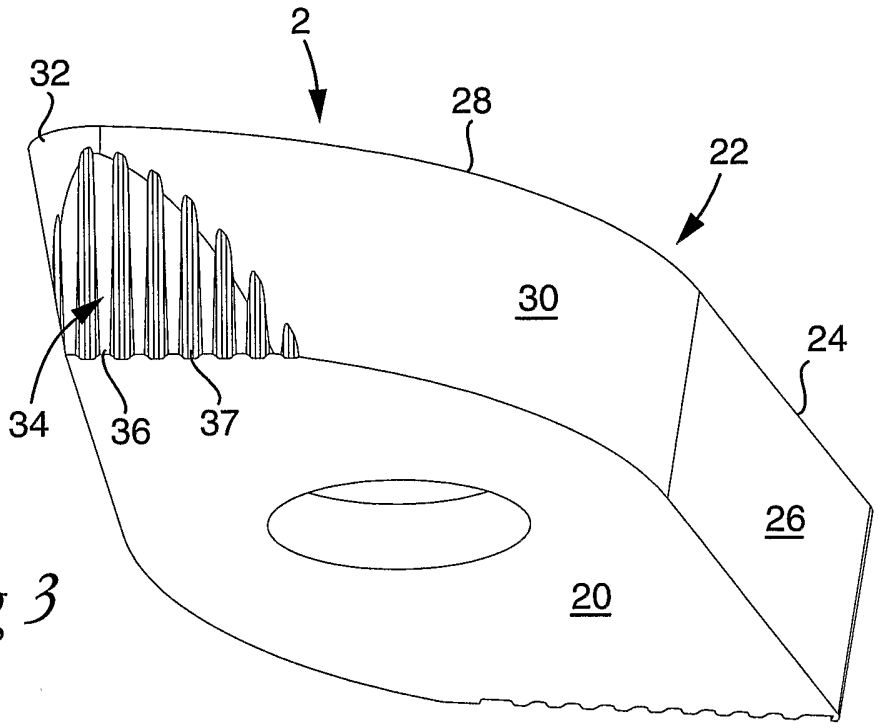

Fig 3

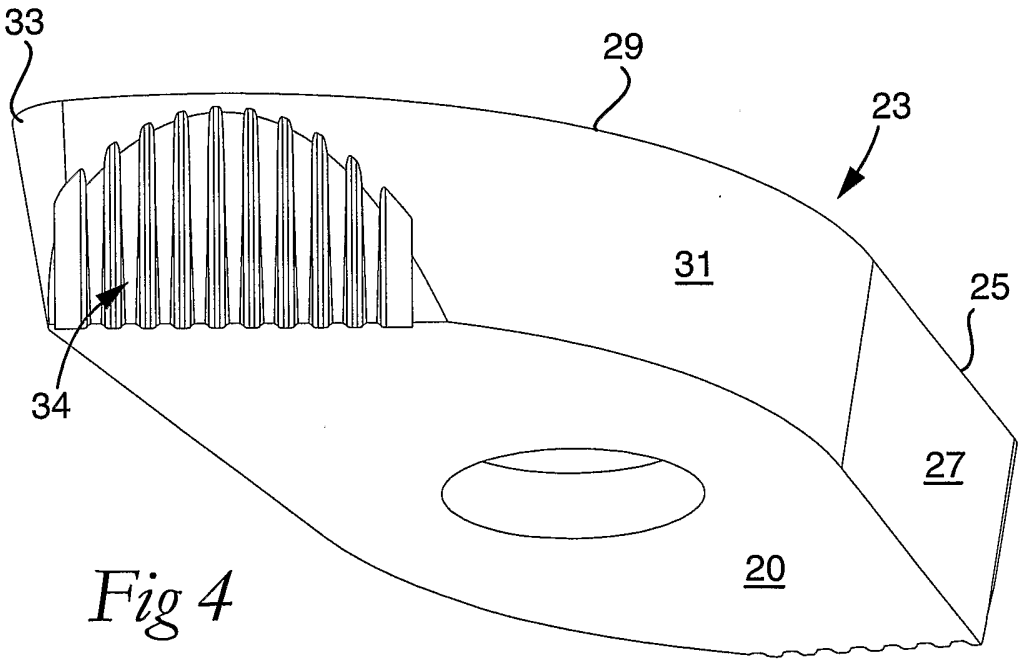

Fig 4

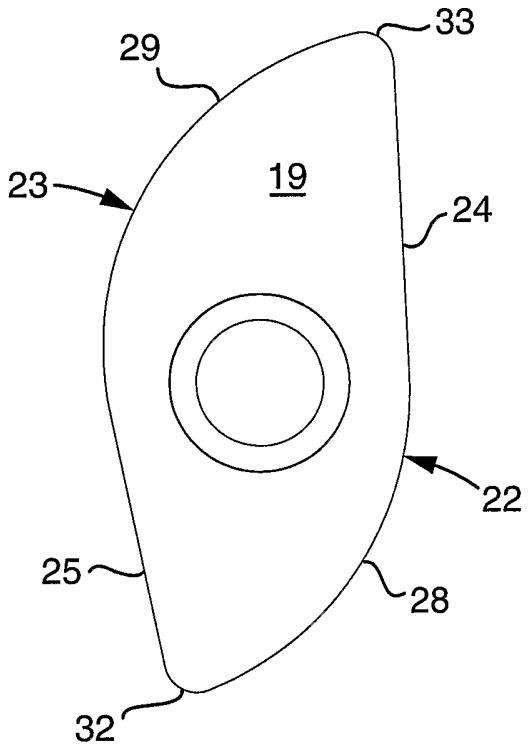

Fig 5

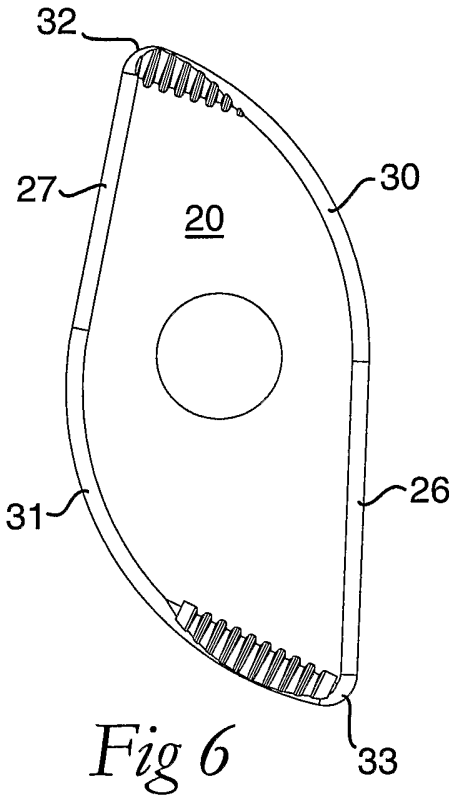

Fig 6

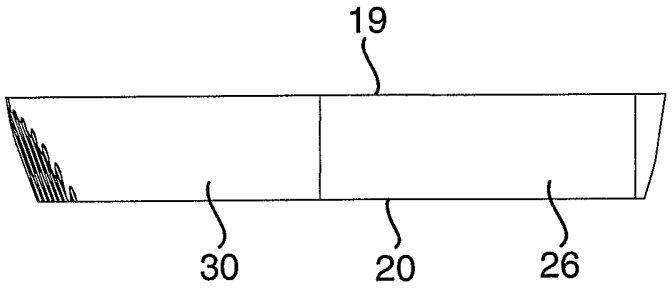

Fig 7

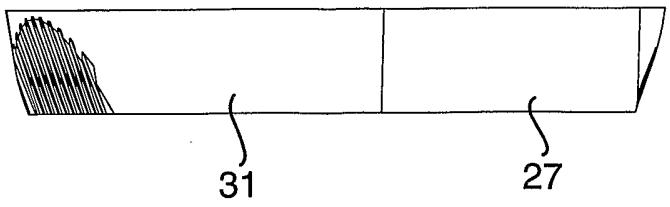

Fig 8

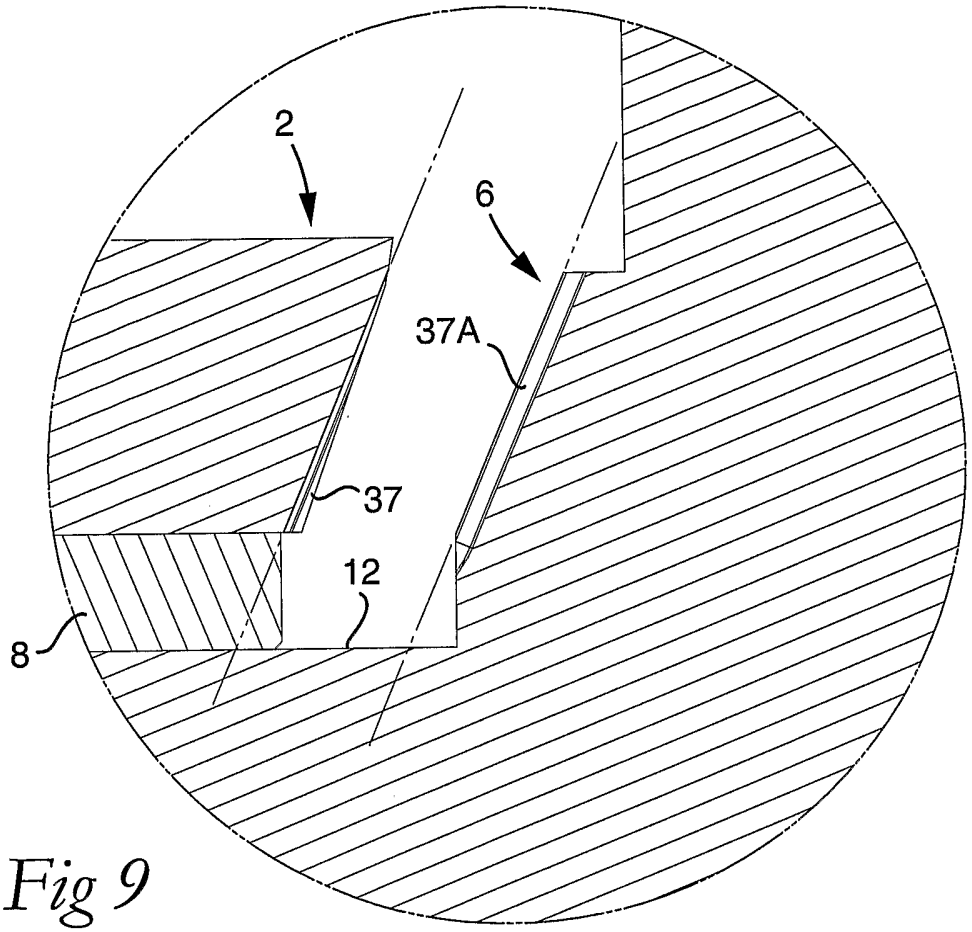

Fig 9

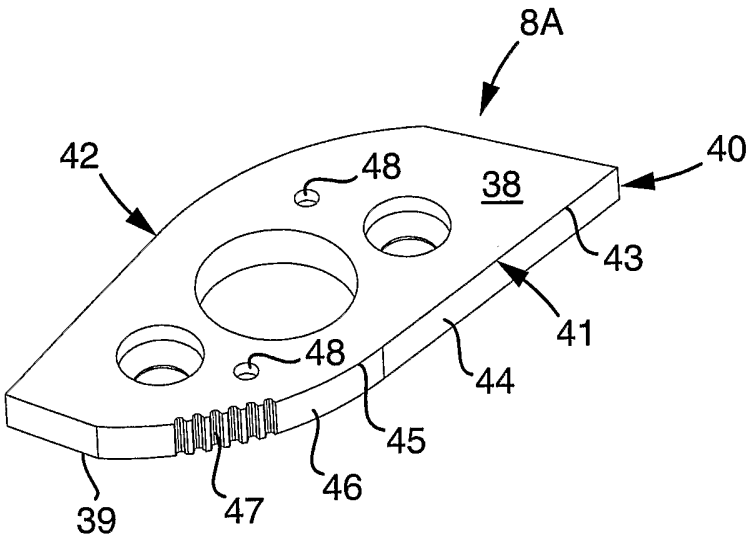

Fig 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2006/000619

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B23B, B23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6715968 B1 (P. TÄGSTRÖM ET AL), 6 April 2004 (06.04.2004), figures 4,5, abstract ---	1-13
A	US 5017055 A (O. TSUJIMURA ET AL), 21 May 1991 (21.05.1991), figures 1-11, abstract ---	1-13
A	WO 2004082877 A1 (SECO TOOLS AB), 30 Sept 2004 (30.09.2004), figures 1A-F, abstract ---	1-13
A	US 6149355 A (R. FOUQUER ET AL), 21 November 2000 (21.11.2000), figures 1,2, abstract ---	1-13

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
19 Sept 2006	20 -09- 2006
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Fredrik Strand / MRo Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2006/000619

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5951213 A (L. FAUSER ET AL), 14 Sept 1999 (14.09.1999), figures 2a-c, abstract -- --------	1-13

International patent classification (IPC)

B23C 5/22 (2006.01)
B23B 27/16 (2006.01)
B23B 51/00 (2006.01)

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Cited literature, if any, will be enclosed in paper form.

US	6715968	B1	06/04/2004	AT	260728	T	15/03/2004
				CN	1115219	B,C	23/07/2003
				CN	1315890	A,T	03/10/2001
				DE	69915315	D,T	22/07/2004
				EP	1112132	A,B	04/07/2001
				JP	2002524272	T	06/08/2002
				SE	514872	C	07/05/2001
				SE	9803083	A	10/03/2000
				WO	0013824	A	16/03/2000
				AT	280691	T	15/11/2004
				AU	4790000	A	17/11/2000
				DE	60015321	D,T	10/11/2005
				EP	1177116	A,B	06/02/2002
				ES	2232453	T	01/06/2005
				JP	2002542982	T	17/12/2002
				PT	1177116	T	31/03/2005
				SE	521728	C	02/12/2003
				SE	9901565	A	04/11/2000
				WO	0066400	A	09/11/2000
US	5017055	A	21/05/1991	DE	3807119	A	15/09/1988
				DE	3807165	A	15/09/1988
				DE	3807195	A,C	15/09/1988
				DE	3844785	C	12/03/1992
				DE	3844787	C	23/04/1992
				DE	3844788	C	12/03/1992
				JP	1963393	C	25/08/1995
				JP	6093528	B	16/11/1994
				JP	7015686	Y	12/04/1995
				JP	63140315	U	14/09/1988
				JP	63198391	A	17/08/1988
				US	4802181	A	31/01/1989
				US	4834591	A	30/05/1989
				US	4898499	A	06/02/1990
				AT	71732	T	15/02/1992
				DE	3867709	A	27/02/1992
				EP	0293779	A,B	07/12/1988
				JP	7027050	Y	21/06/1995
				JP	63305251	A	13/12/1988
				JP	64046115	U	22/03/1989
				KR	9501371	Y	03/03/1995
				US	4952520	A	28/08/1990
				JP	7030247	Y	12/07/1995
				JP	63312554	A	21/12/1988
				JP	64052612	U	31/03/1989
				JP	1064321	U	25/04/1989
				JP	7037774	Y	30/08/1995
				JP	64001774	A	06/01/1989
				JP	1024767	A	26/01/1989
				JP	1084916	U	06/06/1989
				JP	7044410	Y	11/10/1995

WO	2004082877	A1	30/09/2004	AU	2003224593	A	00/00/0000
				BR	0309959	A	22/02/2005
				CA	2481019	A	20/11/2003
				CN	1761546	A	19/04/2006
				CN	1761547	A	19/04/2006
				EP	1504507	A	09/02/2005
				EP	1635976	A	22/03/2006
				EP	1635977	A	22/03/2006
				MX	PA04011241	A	17/02/2005
				SE	526109	C	05/07/2005
				SE	0300739	A	18/09/2004
				US	20050168889	A	04/08/2005
				US	20060056926	A	16/03/2006
				US	20060056928	A	16/03/2006
				WO	2004082876	A	30/09/2004
US	6149355	A	21/11/2000	FR	2765507	A	08/01/1999
				WO	9902293	A	21/01/1999
US	5951213	A	14/09/1999	AT	234701	T	15/04/2003
				CN	1066991	B,C	13/06/2001
				CN	1171314	A	28/01/1998
				DE	19624342	C	11/12/1997
				DE	59709539	D	00/00/0000
				EP	0813926	A,B	29/12/1997
				SE	0813926	T3	
				ES	2193295	T	01/11/2003
				JP	3037635	B	24/04/2000
				JP	10071521	A	17/03/1998
				KR	258400	B	01/08/2000