

CUTTING TOOL AND CUTTING INSERT THEREFOR

5 FIELD OF THE INVENTION

The present invention relates to cutting tools of the type in which a cutting insert is resiliently clamped in a self-retaining manner in an insert pocket.

10 BACKGROUND OF THE INVENTION

Cutting tools employing a resilient clamping mechanism for clamping cutting inserts are generally of relatively narrow thickness, typically in the range of 0.5 mm to 12 mm and the cutting insert is retained in an insert pocket located between the clamping surfaces of upper and lower jaws of the cutting tool. In cutting operations such as grooving and parting off the cutting tool is in the form of a holder blade. The holder blade is, in turn, generally clamped in a blade-retaining block. The holder blade is generally provided with a suitably designed opening, in the vicinity of the insert pocket whereby a relatively narrow bridging portion is formed enabling a limited degree of resilient displacement of one of the holder blade's jaws relative to the other. Generally, the lower jaw is rigid and the upper jaw is resiliently displaceable. The opening can be of the form of an aperture, or a slot, or a slot terminating in an aperture. Examples of such cutting tools are disclosed in U.S. Patent No 3,785,021, U.S. Patent No

4,580,930 and U.S. Patent No 5,829,924. A rotary slot-cutting tool employing a resilient insert clamping mechanism is disclosed in U.S. Patent No 4,417,833. The cutter body is disc-shaped and of relatively narrow thickness, with cutting insert pockets located around its periphery. As with
5 the holder blade, an insert pocket of a rotary slot-cutting tool has two jaws between which an insert is clamped by means of the resilient force resulting from the displacement of the clamping jaw.

Whether the cutting tool is a holder blade or a rotary slot cutting tool, the displacement of the clamping jaw is obtained by manufacturing the
10 insert pocket so that the distance between the clamping surfaces of the jaws is smaller than the height of the portion of the insert located between the clamping surfaces. Consequently, when an insert is located in the insert pocket, the clamping jaw is held in a displaced position creating an elastic force by means of which the insert is clamped in position.

15 A well-known problem with cutting tools of the type described above is that the cutting insert is not positively secured in the insert pocket and therefore can become dislodged during cutting operations. For example, this can happen during grooving operations when attempting to withdraw the holder blade from a workpiece. In some cases the cutting
20 insert can be completely pulled out of the holder blade and become embedded in the workpiece. This problem can be especially troubling with rotary slot-cutting tools where the cutting insert can even fly out of the insert pocket under the influence of centrifugal forces, a situation that can be particularly dangerous when operating at high speeds.

25 It is an object of the present invention to provide a cutting tool with a resilient clamping mechanism in which the above referred to disadvantage is substantially reduced or overcome.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a cutting insert comprising

5 a cutting portion and a locating portion, the cutting portion comprising a cutting edge formed at the intersection of a rake surface and a relief surface;

an upper surface, a lower surface and a peripheral side surface therebetween, the peripheral side surface comprising

10 opposing forward and rear surfaces and opposing side surfaces extending between the forward and rear surfaces; the relief surface being located in the forward surface and the rake surface being located in the upper surface; the locating portion extends downwardly from the cutting portion away from the upper surface; the locating portion comprising opposing forward and rear locating surfaces, the rear locating surface being
15 located in the rear surface and the forward locating surface being located in the lower surface; and

a lower locating surface located in the lower surface and opposing the upper surface, and extending between the forward surface and the forward locating surface.

20 Preferably, in a side view of the cutting insert the cutting portion is wider than locating portion.

Further preferably, the forward and rear locating surfaces converge downwardly.

If desired, the rear surface is concave.

25 Further if desired, the rear surface is concavely V-shaped.

If desired, the lower locating surface is concave.

Further if desired, the lower locating surface is concavely V-shaped.

Typically, the rake surface is provided with a chip forming groove.

If desired, the cutting insert is provided with side cutting edges formed at the intersection of the side surfaces with the rake surface

5 There is also provided in accordance with the present invention a cutting tool comprising an insert holder in which a cutting insert in accordance with the present invention is resiliently retained in an insert pocket, the insert holder comprising a clamping portion, the clamping portion comprising a clamping jaw resiliently connected to a base jaw and
10 forming a single integral piece therewith,

 the base jaw has an abutment surface and the clamping jaw has a clamping surface facing opposite a lower portion of the abutment surface, the clamping jaw is further provided with an insert stop surface that is generally transverse to the clamping surface, and

15 the cutting insert is retained in the insert pocket with the abutment surface of the base jaw abutting the rear surface of the cutting insert, the clamping surface of the clamping jaw abutting the forward locating surface of the cutting insert and the insert stop surface of the clamping jaw abutting the lower locating surface of the cutting insert.

20 If desired, the abutment surface is convex.

 Further if desired, the abutment surface is convexly V-shaped.

 Generally, the abutment surface is divided by a base recess into an upper abutment surface and lower abutment surface.

 If desired, the insert stop surface is convex.

25 Further if desired, the insert stop surface is convexly V-shaped.

 Typically, the base jaw is connected to the clamping jaw via a recess, and a through hole is located rearwardly to the base jaw for receiving a key.

In accordance with one application of the present invention, the cutting tool is a rotary slot cutting tool.

In accordance with another application the cutting tool is a grooving, parting off or turning tool and the insert holder is a holder blade.

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BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention and to show how the same may be carried out in practice, reference will now be made to the accompanying drawings, in which:

10 **Fig. 1** is a perspective view of a first cutting tool in accordance with the present invention;

Fig. 2 is a perspective view of a second cutting tool in accordance with the present invention;

15 **Fig. 3** is a side view of a cutting section of the cutting tools in accordance with the present invention;

Fig. 4 is a side view of a cutting insert in accordance with the present invention;

Fig. 5 is a side view of the cutting section of Fig. 3 with the cutting insert removed;

20 **Fig. 6** is an exploded perspective view of the cutting section of Fig. 3; and

Figs. 7 is a partial cross sectional view taken along the line VII- VII in Figs. 3 passing through the clamping surface of the insert holder and forward locating surface of the cutting insert.

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DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Attention is first drawn to Figs. 1 and 2 showing two cutting tools in accordance with the present invention. Fig. 1 shows a first cutting tool **10** used for metal cutting operations such as grooving and parting off.

The first cutting tool 10 comprises an insert holder 12 in the form of a rectangular blade with a cutting insert 14 resiliently retained in an insert pocket 16. The cutting insert 14 is typically manufactured by form-pressing and sintering carbide powders. Fig. 2 shows a second cutting tool 20, used for rotary slot metal cutting operations. The second cutting tool 20 comprises an insert holder 22 in the form of a circular disc with cutting inserts 14 resiliently retained in identical insert pockets 16 arranged around the periphery of the disc. The cutting tools 10, 20 comprise a cutting section 18 which includes the cutting insert 14, the insert pocket 16 and the immediate vicinity of the insert pocket 16. The cutting section 18 is shown in Fig. 3. It should be noted that directional terms appearing throughout the specification and claims, e.g. "forward", "rear", "upper", "lower", etc., are used as terms of convenience to distinguish the location of various surfaces relative to each other. These terms are defined with reference to Figs. 3, 4 and 5; however, they are used for illustrative purposes only, and are not intended to limit the scope of the appended claims.

Attention is now drawn to Fig. 4. The cutting insert 14 comprises a cutting portion 24 and a locating portion 26. The cutting portion 24 comprises a cutting edge 28 formed at an intersection of a rake surface 30 and a relief surface 32. The cutting insert 14 further comprises an upper surface 34, a lower surface 36 and a peripheral side surface therebetween. The peripheral side surface comprises opposing forward and rear surfaces 38, 40 and opposing side surfaces 42 extending between the forward and rear surfaces 38, 40. The relief surface 32 is located in the forward surface 38 and the rake surface 30 is located in the upper surface 34. A first distance W1 is defined between the forward surface 38 and the rear surface 40. The locating portion 26 extends downwardly from the cutting portion 24 in a direction away from upper surface 34 and comprises opposing forward and rear locating surfaces 44, 46 that converge downwardly. A second distance

W2 is defined between the forward and the rear locating surfaces 44, 46. Although the first distance W1 is not necessarily constant for the whole of the cutting portion 24 and although the second distance W2 decreases downwardly along the length of the locating portion 26, the cutting portion 24 is wider than the locating portion 26 in a side view of the cutting insert 14, as can be seen in the figures, and especially in Figs. 3 and 4. In other words, the first distance W1 is greater than the second distance W2. The rear locating surface 46 is located in the rear surface 40 and the forward locating surface 44 is located in the lower surface 36. In addition, a lower locating surface 48 is located in the lower surface 36 opposing the upper surface 34 and extends between the forward surface 38 and the forward locating surface 44.

Referring to Fig. 5, a clamping portion 50 of the insert holder 12, 22 comprises a clamping jaw 52 resiliently connected via a recess 54 to a base jaw 56 forming a single integral piece therewith. The base jaw 56 has an abutment surface 58 adjacent the insert pocket 16. The abutment surface 58 is divided by a base recess 60 into an upper abutment surface 62 along an upper portion thereof and a lower abutment surface 64 along a lower portion thereof. The clamping jaw 52 has a clamping surface 66 adjacent the insert pocket 16 and generally facing opposite the lower abutment surface 64 of the base jaw 56. A third distance W3 is defined between the clamping surface 66 and the lower abutment surface 64. The third distance W3 decreases downwardly. The clamping jaw 52 is further provided with an insert stop surface 68 located at an upper end thereof and generally transverse to the clamping surface 66. The upper and lower abutment surfaces 62, 64 of the base jaw 56 and the clamping surface 66 of the clamping jaw 52 converge downwardly. A through hole 70 located rearwardly of the base jaw 56 is provided for receiving a key to aid in the insertion of the cutting insert 14 into the insert pocket 16 and for removal of

the cutting insert 14 from of the insert pocket 16, when used in conjunction with the recess 54.

Attention is now drawn to Fig. 6 in which additional features of the cutting insert 14 and the insert holder 12, 22 are shown. The insert stop surface 68 of the insert holder 12, 22 may be of a convex V-shape, and the lower locating surface 48 of the cutting insert 14 may be of a mating concave V-shape. Similarly, the abutment surface 58 of the insert holder 12, 22 may be of a convex V-shape, and the rear surface 40 of the cutting insert 14 may be of a mating concave V-shape. The mating convex and concave surfaces prevent lateral movement of the cutting insert 14 with respect to the insert holder 12, 22. The rake surface 30 may also be provided with a chip forming groove 72. Moreover, the cutting insert 14 may also be provided with side cutting edges 74, formed at the intersection of the side surfaces 42 with the rake surface 30.

Referring back to Fig. 3, it is seen that with the cutting insert 14 retained in the insert pocket 16, the abutment surfaces 62, 64 of the base jaw 56 abut the rear surface 40 of the cutting insert 14, the clamping surface 66 of the clamping jaw 52 abuts the forward locating surface 44 of the cutting insert 14 and the insert stop surface 68 of the clamping jaw 52 abuts the lower locating surface 48 of the cutting insert 14. To avoid the arrangement, of the two sets of convex-concave mating surfaces, from being over constrained, the clamping surface 66 is chosen to be flat and the forward locating surface 44 is chosen to be convex (as shown in Fig. 7). The width dimension W2 is generally greater than the width dimension W3, so that when the locating portion 26 is located in the insert pocket 16, the clamping jaw 52 is forced away from the base jaw 56 giving rise to a resilient force which clamps the locating portion 26 in the insert pocket 16.

During a rotary slot cutting operation a centrifugal force F operates on the cutting insert 14. It is clear from Fig. 3 that the clamping

surface 66 of the clamping jaw 52 opposes the force F thus preventing the cutting insert 14 from flying out of the insert pocket 16. On completion of a grooving operation, during withdrawal of the cutting tool 10 from a workpiece, the cutting insert 14 can come into contact with the groove walls giving rise to frictional forces F which operate to extract the cutting insert 14 from the insert pocket 16. However, the presence of the clamping surface 66 of the clamping jaw 52 prevents extraction of the cutting insert 14.

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. A cutting insert (14) comprising
a cutting portion (24) and a locating portion (26), the cutting portion
(24) comprising a cutting edge (28) formed at the intersection of a rake
5 surface (30) and a relief surface (32);
an upper surface(34), a lower surface (36) and a peripheral side
surface therebetween, the peripheral side surface comprising
opposing forward and rear surfaces (38, 40) and opposing side
surfaces (42) extending between the forward and rear surfaces (38, 40); the
10 relief surface (32) being located in the forward surface (38) and the rake
surface (30) being located in the upper surface (34); the locating portion
(26) extends downwardly from the cutting portion (24) away from the upper
surface(34); the locating portion (26) comprising opposing forward and rear
locating surfaces (44, 46), the rear locating surface (46) being located in the
15 rear surface (40) and the forward locating surface (44) being located in the
lower surface (36); and
a lower locating surface (48) located in the lower surface (36) and
opposing the upper surface (34), and extending between the forward surface
(38) and the forward locating surface (44).
- 20 2. The cutting insert (14) according to claim 1, wherein in a side
view of the cutting insert (14) the cutting portion (24) is wider than locating
portion (26).
3. The cutting insert (14) according to claim 1, wherein the forward
and rear locating surfaces (44, 46) converge downwardly.
- 25 4. The cutting insert (14) according to claim 1, wherein the rear
surface (40) is concave.
5. The cutting insert (14) according to claim 4, wherein the rear
surface (40) is concavely V-shaped.

6. The cutting insert (14) according to claim 1, wherein the lower locating surface (48) is concave.

7. The cutting insert (14) according to claim 6, wherein the lower locating surface (48) is concavely V-shaped.

5 8. The cutting insert (14) according to claim 1, wherein the rake surface (30) is provided with a chip forming groove (72).

9. The cutting insert (14) according to claim 1, wherein the cutting insert (14) is provided with side cutting edges (74) formed at the intersection of the side surfaces (42) with the rake surface (30).

10 10. A cutting tool (10, 20) comprising
an insert holder (12, 22) in which a cutting insert (14) in accordance with claim 1 is resiliently retained in an insert pocket (16), the insert holder (12, 22) comprising a clamping portion (50), the clamping portion (50) comprising a clamping jaw (52) resiliently connected to a base jaw (56) and
15 forming a single integral piece therewith,

the base jaw (56) has an abutment surface (58) and the clamping jaw (52) has a clamping surface (66) facing opposite a lower portion of the abutment surface (58), the clamping jaw (52) is further provided with an insert stop surface (68) that is generally transverse to the clamping surface
20 (66), and

the cutting insert (14) is retained in the insert pocket (16) with the abutment surface (58) of the base jaw (56) abutting the rear surface (40) of the cutting insert (14), the clamping surface (66) of the clamping jaw (52) abutting the forward locating surface (44) of the cutting insert (14) and the
25 insert stop surface (68) of the clamping jaw (52) abutting the lower locating surface (48) of the cutting insert (14).

11. The cutting tool (10, 20) according to claim 10, wherein the abutment surface (58) is convex.

12. The cutting tool (10, 20) according to claim 11, wherein the abutment surface (58) is convexly V-shaped.
13. The cutting tool (10, 20) according to claim 10, wherein the abutment surface (58) is divided by a base recess (60) into an upper
5 abutment surface (62) and lower abutment surface (64).
14. The cutting tool (10, 20) according to claim 10, wherein the insert stop surface (68) is convex.
15. The cutting tool (10, 20) according to claim 14, wherein the insert stop surface (68) is convexly V-shaped.
- 10 16. The cutting tool (10, 20) according to claim 10, wherein the base jaw (56) is connected to the clamping jaw (52) via a recess (54), and a through hole (70) is located rearwardly to the base jaw (56) for receiving a key.
17. The cutting tool (20) according to claim 10, wherein the cutting
15 tool (20) is a rotary slot cutting tool.
18. The cutting tool (10) according to claim 10, wherein the cutting tool (10) is a grooving, parting off or turning tool and the insert holder (12) is a holder blade.