

Description

This invention relates to a cutting insert according to the preamble of claim 1 (see JP-A-55-114588).

BACKGROUND OF THE INVENTION

Such cutting inserts are usually of the replaceable kind and are releasably clamped between the clamping jaws of a tool holder. In order to allow for the face grooving operation which results in the formation of a circular face groove, it is known to use circularly curved clamping jaws so as to allow for their unhindered insertion during grooving into the circular groove. In addition, it is known to curve the flank surfaces of the insert in order to facilitate the unhindered insertion of the insert into the circular groove. The production of inserts with such curved flank surfaces, however, gives rise to considerable problems when using conventional moulding techniques and it has recently been proposed, as an alternative to curving the flank surfaces, to have planar flank surfaces which taper by amounts and directions such as to provide clearance between the flank surfaces and the side walls of the groove being cut.

A problem which arises with replaceable grooving cutting inserts in general, and face grooving cutting inserts in particular, is associated with the provision of the insert with a pair of opposite cutting edges. Thus, the provision of such cutting inserts with opposite cutting edges is clearly advantageous, seeing that it leads to a saving in cutting insert material and allows for the rapid indexing of the insert so that a fresh cutting edge is available for use when the opposite cutting edge has become dulled by use. The provision of cutting inserts with a pair of opposite cutting edges, however, will tend to limit the depth of the grooving cut. Seeing that with grooving being effected by one cutting edge, any attempt to extend the depth of the cut so that the second, opposite cutting edge begins to penetrate this cut, results in this second, opposite edge becoming jammed within the circular groove.

There has been disclosed in the published EP-A-0150901, a double edged grooving insert designed for unlimited cutting depth, wherein a first cutting edge is located in a plane substantially at right angles to the second cutting edge. The production of such a grooving insert, especially when the cutting edges are to be provided with appropriate chip forming structures, gives rise to problems and requires the modification of normal moulding techniques.

In EP-A-0312223 there is disclosed a cutting insert comprising a central body portion having a

longitudinal plane of symmetry; a pair of oppositely directed, end portions formed integrally with said body portion and being respectively formed with rake and flank surfaces and with first and second end cutting edges of substantially equal width, the flank surfaces of each end portion tapering by amounts and in directions such as to provide clearance between the flank surfaces and the side walls of the groove being cut.

In JP-A-53-114588 there is disclosed a cutting insert comprising a central body portion having a longitudinal plane of symmetry; a pair of oppositely directed, end portions formed integrally with said body portion and being respectively formed with rake and flank surfaces and with first and second end cutting edges of substantially equal width, the flank surfaces of each end portion tapering by amounts and in directions such as to provide clearance between the flank surfaces and the side walls of the groove being cut; a plane normal to the midpoint of said first cutting edge being inclined, in a first sense, with respect to said plane of symmetry, by an angle α and a plane normal to the midpoint of said second cutting edge being inclined in a second and opposite sense with respect to said plane of symmetry by said angle α , whereby said planes normal to said edges are inclined with respect to each other by double said angle α .

It is an object of the present invention to provide a new and improved cutting insert in which the above-referred-to desiderata are substantially attained and the above-referred-to disadvantages are substantially reduced or overcome.

According to the present invention, there is provided a cutting insert comprising a central body portion having a longitudinal plane of symmetry; a pair of oppositely directed, end portions formed integrally with said body portion and being respectively formed with rake and flank surfaces and with first and second end cutting edges of substantially equal width, the flank surfaces of each end portion tapering by amounts and in directions such as to provide clearance between the flank surfaces and the side walls of the groove being cut; a plane normal to the midpoint of said first cutting edge being inclined, in a first sense, with respect to said plane of symmetry, by an angle α and a plane normal to the midpoint of said second cutting edge being inclined in a second and opposite sense with respect to said plane of symmetry by said angle α , whereby said planes normal to said edges are inclined with respect to each other by double the angle α , characterised in that each end portion is formed with a pair of side cutting edges located substantially normal with respect to the respective end cutting edges.

Such an insert, in accordance with the invention, is capable of ready production using known

moulding techniques, thereby substantially obviating the necessity for grinding of the insert after its sintering.

Since the insert is provided at each end portion thereof with a pair of side cutting edges located substantially normally with respect to the respective end cutting edges, cutting can be effected in directions transverse to the longitudinal axis of the insert. In the case of face grooving, the relative transverse displacement of the insert with respect to the workpiece, and face turning of up to the entire end face of the workpiece can be effected. In order to ensure that even the innermost central portion of the end face can be effectively turned, the tool holder designed to hold the insert in accordance with the invention is so arranged that the front cutting edge of the insert is located substantially along a line which extends normally with respect to the rotary axis of the workpiece.

BRIEF SUMMARY 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:

Fig. 1 is a perspective view of an end face grooving insert embodying the invention, juxtaposed with respect to the clamping jaws of a tool holder;

Fig. 2 is a perspective view of the insert when clamped in the tool holder;

Fig. 3a is a perspective view of the insert with the central raised portion thereof removed in the interests of clarity;

Fig. 3b is an end elevation of the insert shown in Fig. 3a;

Fig. 4 is a perspective view of a cylinder workpiece undergoing face grooving;

Fig. 5 is a perspective view of a cylindrical workpiece undergoing end face turning;

Fig. 6 is a cross-sectional view of the workpiece and cutting tool shown in Fig. 4, taken along the line VI-VI;

Fig. 7 is a view on an enlarged scale of a detail shown in Fig. 4; and

Fig. 8 is a diagrammatic view corresponding to that of Fig. 7 for the purposes of calculating minimum spacing of an insert in a groove.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

As seen in the drawings, a cutting insert 1 is constituted by an elongated element 2 whose lowermost portion 2a is of a rectangular cross-sectional shape and whose uppermost portion 2b includes a central body portion 3 whose sidewalls

are coplanar with the sidewalls of the lower portion 2a. The central body portion 3 is formed with an upper, longitudinally grooved surface 4, whilst the lower portion 2a is formed with a lowermost longitudinally grooved surface 5, the grooves of the upper and lower surfaces 4, 5 being oppositely directed and being formed about central longitudinal axial lines 6, 7 which are parallel to each other. The longitudinal axial lines 6, 7 lie in a plane of symmetry 16 seen in Figs. 3 and 5 of the drawings.

Integrally formed with the central body portion 3 are a pair of oppositely directed end portions 8a, 8b respectively provided with upper rake surfaces 9a, 9b, front planar surfaces 10, 10b and respective side flank surfaces 11a, 12a, and 11b, 12b. The rake surface 9a is bounded by a front cutting edge 13a and side cutting edges 14a, 15a whilst the rake surface 9b is formed with a front cutting edge 13b and side cutting edges 14b, 15b. The flank surfaces 11a, 12a, and 11b, 12b taper from the side cutting edges 14a, 15a, and 14b, 15b towards the lower portion 2a so as to provide clearance between these flank surfaces and the side walls of the groove being cut, as will be seen with reference to Fig. 5 of the drawings.

As can be seen from the drawings and particularly from Fig. 3, the rake surfaces 9a, 9b together with the cutting edges thereof, are respectively inclined in opposite senses with respect to the plane of symmetry 16. Thus, a normal to the midpoint of the cutting edge 13a is inclined with respect to the plane of symmetry 16 by an angle of α whilst a normal to the midpoint of the cutting edge 13b is inclined with respect to the plane of symmetry 16 by an angle of α . The cutting edges 13a and 13b are therefore inclined with respect to each other by an angle of 2α .

As seen in Figs. 1 and 2 of the drawings, the insert 1 is designed to be clampingly held between a pair of jaws 21, 22 of a tool holder 20 shown in Fig. 4 of the drawings. The lower surface of the jaw 21 is formed as a convex rib 23 designed to fit into the concave groove 4 of the insert 1, whilst the upper surface of the jaw 22 is formed as a convex rib 24 designed to fit into the concave groove 5 of the insert 1. The jaws 21, 22 are curved so that when viewed in the plane of the paper appear to be convex. In use, and as shown in Fig. 2 of the drawings, the insert 1 is inserted between the jaws 21, 22 so that the ribs 23 and 24 mate respectively in the grooves 4 and 5 and the jaws are then clamped together by means (not shown).

The use of the insert 1 when mounted in the tool holder as shown in Fig. 2 of the drawings, in the end face grooving and turning of a workpiece, will now be described respectively with reference to Figs. 4 and 5 of the drawings. As seen in Fig. 4,

a cylindrical workpiece 25, shown with an end quadrant removed in the interests of clarity, having an end face 26 is rotated in a clockwise sense about its longitudinal axis and with reference to the juxtaposed cutting insert 1 so as to form a circular groove 27.

As shown in Fig. 5 of the drawings, as the workpiece is rotated, the insert in the cutting tool is moved radially towards the centre of the workpiece thereby resulting in the end face turning of the workpiece.

Where end face grooving is to be effected, as shown in Fig. 4, differing inserts have to be employed for successive ranges of diameters. Where, however, end face turning is effected, a single insert can be employed over the entire facing seeing that as the insert moves towards the centre of the workpiece it is no longer juxtaposed to the outer groove wall.

Reference will now be made to Figs. 6 and 7 of the drawings for a detailed description of the location of the insert 1 with respect to the workpiece 25 and the way in which the insert is employed so as to achieve an unlimited depth of grooving. As can be clearly seen from Fig. 4 of the drawings, the curvature of the jaws 21, 22 enable the ready entry of the tool with the gripped insert into the groove 27. As can be seen from Fig. 7 of the drawings, the insert is mounted within the gripping jaws 21, 22 so that its front cutting edge 13a is located along a radius 28 of the rotational circle of the workpiece 25. In this position, the rear cutting edge 13b, which is angularly disposed with respect to the front cutting edge 13a, has a width when projected onto a line 29 parallel to the cutting edge 13a, which is considerably less than the width of the cutting edge 13a. If now the workpiece is rotated in a clockwise sense and the cutting edge is displaced inwardly and in the axial direction of the workpiece, the circular groove 27 is formed whose width corresponds to the width of the cutting edge 13a. By virtue of the provision of the tapering planar flank surfaces 11a, 12a, these flank surfaces are always clear of the sidewalls of the groove 27 and, as explained above, the rear cutting edge 13b has a width, when considered with respect to the width of the groove 27, which is considerably less than the width of the groove 27. Thus, the depth of the end face grooving is unlimited by the length of the insert.

In view of the fact that the insert is provided with side cutting edges 14a, 15a, transverse movement of the insert as shown in Fig. 5 of the drawings is effective in extending the width of the groove, and when this transverse movement is in the direction of the centre of the workpiece, the fact that the cutting edge 13a has been initially disposed along the radius of the workpiece ensures

that it is possible to turn the entire end face of the workpiece without leaving any residual central core.

Reference will now be made to Fig. 8 of the drawings, which essentially corresponds to Fig. 7 thereof, for an understanding as to how the particular construction of the insert and especially the geometry thereof is effective in ensuring not only the unhindered total insertion of the insert into the groove but also that the spacing between the walls of the groove and the rear cutting edge is always sufficient as to avoid the dangers of foreign bodies becoming jammed between the walls of the groove and the rear cutting edge.

As seen in Fig. 8

$W =$ width of the front and rear cutting edges 13a and 13b;

$W_1 =$ distance of intersection points of groove walls 27a and 27b with a line passing through the cutting edge 13b;

$\beta =$ angle subtended between the radius r_1 of the workpiece and passing through edge 13a and the radius r_2 which passes through the point of intersection of the line extending through the cutting edge 13b;

$2\alpha =$ angle subtended between the cutting edges 13a and 13b;

$\Delta W =$

$$\frac{W_1 - W}{2};$$

$\Delta G =$ effective spacing between groove walls 27a, 27b on the one hand and the circular paths 31a, 31b respectively traced by the opposite ends of the cutting edge 13b on the other hand.

Thus ΔG corresponds to the maximum dimension of a foreign body if it is not to become jammed between the trailing cutting edge 13b and the groove walls.

It can be shown that

$$\Delta G = \Delta W \cdot \cos (2\alpha - \beta)$$

Whilst the invention has been specifically described with reference to the use of the insert in end face grooving, it will be readily appreciated that the same insert can be used in longitudinal turning operations.

The provision of an insert with the geometry described above renders it possible to provide the insert with a pair of oppositely directed rake surfaces and cutting edges without any limitation on

the degree of depth of grooving and this clearly renders the production of these inserts much more economical.

Claims

1. A cutting insert (1) comprising a central body portion (3) having a longitudinal plane of symmetry (16); a pair of oppositely directed, end portions (8a, 8b) formed integrally with said body portion (3) and being respectively formed with rake (9a, 9b) and flank surfaces (11a, 12a; 11b, 12b) and with first and second end cutting edges (13a, 13b) of substantially equal width, the flank surfaces of each end portion (11a, 12a; 11b, 12b) tapering by amounts and in directions for providing clearance between the flank surfaces and the side walls of the groove (27) to be cut by said cutting insert; a plane normal to said first cutting edge (13a) at it's midpoint being inclined, in a first sense, with respect to said plane of symmetry (16), by an angle (α) and a plane normal to said second cutting edge (13a) at it's midpoint being inclined in a second and opposite sense with respect to said plane of symmetry (16) by said angle (α), whereby said planes normal to said edges (13a, 13b) are inclined with respect to each other by double said angle (α), characterised in that each end portion (8a, 8b) is formed with a pair of side cutting edges (14a, 15a; 14b, 15b) located substantially normal with respect to the respective end cutting edges (13a, 13b).
2. A cutting tool comprising a tool holder (20) in which is clamped a cutting insert according to claim 1 characterised in that the tool holder (20) has a pair of clamping jaws (21, 22) formed with engaging means (23, 24) designed to mate in corresponding engaging means (4, 5) formed in upper and lower surfaces of the central body portion (3) of said insert (1), said jaws (21, 22) being curved in shape so as to allow for insertion into a circular groove, said jaws (21, 22) being designed so as to clamp said insert (1) with an outermost cutting edge (13a) located normally with respect to a longitudinal axis of the tool holder (20).

Patentansprüche

1. Schneideinsatz (1) mit: einem Mittelkörperabschnitt (3) mit einer in Längsrichtung verlaufenden Symmetrieebene (16); einem Paar entgegengesetzt ausgerichteter Endabschnitte (8a, 8b), die mit dem Körperabschnitt (3) einstückig ausgebildet sind und in denen jeweils Spanflä-

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chen (9a, 9b) und Freiflächen (11a, 12a; 11b, 12b) und eine erste und eine zweite Endscheidkante (13a, 13b) mit im wesentlichen gleicher Breite ausgebildet sind, wobei die Freiflächen (11a, 12a; 11b, 12b) jedes Endabschnitts um einen derartigen Grad und in derartige Richtungen im Querschnitt abnehmen, daß zwischen den Freiflächen und den Seitenwänden der durch den Schneideinsatz zu schneidenden Nut (27) ein Zwischenraum gebildet wird, eine senkrecht zur ersten Schneidkante (13a) ausgerichteten Ebene, die am Mittelpunkt bezüglich der Symmetrieebene (16) um einen Winkel (α) in eine erste Richtung geneigt ist, und eine senkrecht zur zweiten Schneidkante (13b) ausgerichteten Ebene, die am Mittelpunkt um den Winkel (α) in eine zweite und entgegengesetzte Richtung bezüglich der Symmetrieebene (16) geneigt ist, und wobei die senkrecht zu den Schneidkanten (13a, 13b) ausgerichteten Ebenen relativ zueinander um den doppelten Betrag des Winkels (α) geneigt sind, **dadurch gekennzeichnet, daß** in Jeden Endabschnitt (8a, 8b) ein Paar Seitenschneidkanten (14a, 15a; 14b, 15b) ausgebildet sind, die bezüglich der Jeweiligen Endscheidkanten (13a, 13b) im wesentlichen senkrecht ausgerichtet sind.

2. Schneidwerkzeug mit einem Werkzeughalter (20), in dem ein Schneideinsatz gemäß Anspruch 1 eingespannt wird, **dadurch gekennzeichnet, daß** der Werkzeughalter (20) ein Paar Spannbacken (21, 22) mit Eingriffseinrichtungen (23, 24) aufweist, die so aufgebaut sind, daß sie mit entsprechenden, in der oberen und in der unteren Fläche des Mittelkörperabschnitts (3) des Einsatzes (1) ausgebildeten Eingriffseinrichtungen (4, 5) in Eingriff kommen, wobei die Spannbacken (21, 22) bogenförmig ausgebildet sind, um sie in eine kreisförmige Nut einführen zu können, und wobei die Spannbacken (21, 22) so aufgebaut sind, daß sie den Einsatz (1) festklemmen, wobei die äußerste Schneidkante (13a) bezüglich einer Längsachse des Werkzeughalters (20) senkrecht angeordnet ist.

Revendications

1. Élément de coupe rapporté (1) comportant une partie (3) formant corps central ayant un plan longitudinal de symétrie (16), deux parties d'extrémité (8a, 8b) dirigées de manière opposée venues de matière avec ladite partie (3) formant corps et étant munies respectivement de surfaces de dégagement (9a, 9b) et de surfaces de dépouille (11a, 12a; 11b, 12b) et



the degree of depth of grooving and this clearly renders the production of these inserts much more economical.

Claims

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2. A cutting tool comprising a tool holder (20) in which is clamped a cutting insert according to claim 1 characterised in that the tool holder (20) has a pair of clamping jaws (21, 22) formed with engaging means (23, 24) designed to mate in corresponding engaging means (4, 5) formed in upper and lower surfaces of the central body portion (3) of said insert (1), said jaws (21, 22) being curved in shape so as to allow for insertion into a circular groove, said jaws (21, 22) being designed so as to clamp said insert (1) with an outermost cutting edge (13a) located normally with respect to a longitudinal axis of the tool holder (20).

Patentansprüche

1. Schneideinsatz (1) mit: einem Mittelkörperabschnitt (3) mit einer in Längsrichtung verlaufenden Symmetrieebene (16); einem Paar entgegengesetzt ausgerichteter Endabschnitte (8a, 8b), die mit dem Körperabschnitt (3) einstückig ausgebildet sind und in denen jeweils Spanflä-

chen (9a, 9b) und Freiflächen (11a, 12a; 11b, 12b) und eine erste und eine zweite Endschneidkante (13a, 13b) mit im wesentlichen gleicher Breite ausgebildet sind, wobei die Freiflächen (11a, 12a; 11b, 12b) jedes Endabschnitts um einen derartigen Grad und in derartige Richtungen im Querschnitt abnehmen, daß zwischen den Freiflächen und den Seitenwänden der durch den Schneideinsatz zu schneidenden Nut (27) ein Zwischenraum gebildet wird, eine senkrecht zur ersten Schneidkante (13a) ausgerichteten Ebene, die am Mittelpunkt bezüglich der Symmetrieebene (16) um einen Winkel (α) in eine erste Richtung geneigt ist, und eine senkrecht zur zweiten Schneidkante (13b) ausgerichteten Ebene, die am Mittelpunkt um den Winkel (α) in eine zweite und entgegengesetzte Richtung bezüglich der Symmetrieebene (16) geneigt ist, und wobei die senkrecht zu den Schneidkanten (13a, 13b) ausgerichteten Ebenen relativ zueinander um den doppelten Betrag des Winkels (α) geneigt sind, **dadurch gekennzeichnet, daß** in Jeden Endabschnitt (8a, 8b) ein Paar Seitenschneidkanten (14a, 15a; 14b, 15b) ausgebildet sind, die bezüglich der Jeweiligen Endschneidkanten (13a, 13b) im wesentlichen senkrecht ausgerichtet sind.

2. Schneidwerkzeug mit einem Werkzeughalter (20), in dem ein Schneideinsatz gemäß Anspruch 1 eingespannt wird, **dadurch gekennzeichnet, daß** der Werkzeughalter (20) ein Paar Spannbacken (21, 22) mit Eingriffseinrichtungen (23, 24) aufweist, die so aufgebaut sind, daß sie mit entsprechenden, in der oberen und in der unteren Fläche des Mittelkörperabschnitts (3) des Einsatzes (1) ausgebildeten Eingriffseinrichtungen (4, 5) in Eingriff kommen, wobei die Spannbacken (21, 22) bogenförmig ausgebildet sind, um sie in eine kreisförmige Nut einführen zu können, und wobei die Spannbacken (21, 22) so aufgebaut sind, daß sie den Einsatz (1) festklemmen, wobei die äußerste Schneidkante (13a) bezüglich einer Längsachse des Werkzeughalters (20) senkrecht angeordnet ist.

Revendications

1. Élément de coupe rapporté (1) comportant une partie (3) formant corps central ayant un plan longitudinal de symétrie (16), deux parties d'extrémité (8a, 8b) dirigées de manière opposée venues de matière avec ladite partie (3) formant corps et étant munies respectivement de surfaces de dégagement (9a, 9b) et de surfaces de dépouille (11a, 12a; 11b, 12b) et



de premier et second bords de coupe formant extrémités (13a, 13b) de largeur pratiquement égales, les surfaces de dépouille de chaque partie d'extrémité (11a, 12a; 11b, 12b) étant inclinées sur des amplitudes et des directions destinées à fournir un jeu entre les surfaces de dépouille et les parois latérales de la gorge (27) à découper par ledit élément de coupe rapporté; un plan perpendiculaire audit premier bord de coupe (13a) situé au niveau du point médian de celui-ci étant incliné dans un premier sens par rapport audit plan de symétrie (16) d'un angle (α) et un plan perpendiculaire audit second bord de coupe (13a) situé au niveau du point médian de celui-ci étant incliné dans un second sens opposé par rapport audit plan de symétrie (16) d'un angle (α), de sorte que lesdits plans perpendiculaires auxdits bords (13a, 13b) sont inclinés l'un par rapport à l'autre du double dudit angle (α), caractérisé en ce que chaque partie d'extrémité (8a, 8b) est munie de deux bords latéraux de coupe (14a, 15a; 14b, 15b) situés à peu près perpendiculairement par rapport aux bords de coupe formant extrémités (13a, 13b) respectives.

2. Outil de coupe comportant un support (20) d'outil dans lequel est serré un élément de coupe rapporté selon la revendication 1, caractérisé en ce que le support (20) d'outil comporte deux mâchoires de serrage (21, 22) munies de moyens de prise (23, 24) conçus pour correspondre à des moyens de prise complémentaires (4, 5) formés dans les surfaces supérieure et inférieure de la partie (3) formant corps central dudit élément rapporté (1), lesdites mâchoires (21, 22) ayant une forme incurvée de manière à pouvoir être insérées dans une gorge circulaire, lesdites mâchoires (21, 22) étant conçues de manière à serrer ledit élément rapporté (1) ayant un bord de coupe (13a) le plus extérieur situé perpendiculairement par rapport à l'axe longitudinal du support (20) d'outil.

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