

Description

The invention relates to a lathe tool having a preferably cylindrical shaft and a tool head carrying an exchangeable indexable insert and resting with a contact surface on a support surface of the shaft, and having a securing screw connecting the tool head to the shaft, wherein the contact surface and the support surface are disposed at an acute angle to the shaft axis and have meshing spur toothings, and wherein the securing screw is aligned substantially at right angles to the support and contact surfaces, wherein the indexable insert is disposed countersunk in a substantially paraxial flat surface extending preferably through the shaft axis and delimiting a chip space, and wherein the parallel teeth of the spur toothing extend substantially parallel to the surface containing the indexable insert (see DE-C-30 26 513).

It is known to provide a separation point on lathe tools in order to enable different tool heads to be connected to a holder. It is further known to connect the tool heads to the separation point by means of screws, a plurality of screws distributed over the periphery mostly being provided, which upon tightening produce the force-locking connection. For the keyed connection, additional shaped elements such as, for example, pins, are usually used.

In a tool for boring and spot facing, it is further known to connect a tool head to a shaft by means of a spur toothing (DE-30 26 513 C2).

There, the parallel teeth of the spur toothing extend parallel to the direction of inclination of the support and contact surfaces. The toothing is so arranged that, by virtue of longitudinal displacement along the toothing, a change in the diameter of the cutter is achieved. To said end, the screws at one side engage through oblong holes, which are elongated

parallel to the toothing and define the adjustment range. An eccentric screw is moreover provided as an adjusting element.

The object of the invention is to develop a separation point for a lathe tool which enables various basic bodies and tool heads to be combined with one another and which, both from a static and a dynamic point of view, guarantees an adequately rigid connection and yet enables an easy and rapid change of tool head.

To achieve said object, in a lathe tool of the type described initially it is proposed according to the invention that the parallel teeth of the spur toothing extend at right angles to the direction of inclination of the support and contact surfaces and that the securing screw has a fit shank, with which it engages into a fitting bore passing substantially at right angles through the tool head and the shaft in the region of the contact and support surfaces. The advantage of said construction of the separation point is that the teeth of the spur toothing extend parallel to the direction of infeed of the cutter or the entire tool and hence at right angles to the direction of the main cutting force.

According to a preferred refinement of the invention, the paraxial surface containing the indexable insert verges at its shaft-side end into a surface substantially parallel to the contact surface, there being disposed in the region of said surface a vertical counterbore for the head of the securing screw, which counterbore in turn verges into the fitting bore for the securing screw.

The inclination of the separation point and the toothing angle are advantageously tuned to one another and combined in such a way that one of the two tooth flanks of the spur toothings is aligned substantially parallel to the paraxial surface containing the indexable insert. To said end, the tooth flanks of the spur toothing are disposed at an angle of 50° to

70°, preferably 60°, relative to one another, while the support surface normal is at an angle α of 15° to 45°, preferably 30°, relative to the shaft axis.

In order to obtain an adequate surface pressure over the entire contact surface in the region of the spur toothings, according to a preferred refinement of the invention it is proposed that the contact surface and/or the support surface has a concave curvature extending about an axis parallel to the teeth of the spur toothing. The radius R of the concave curvature is selected according to the equation

$$R = aD^2 \cos^{-2} \alpha,$$

where D is the shaft diameter, α is the angle of inclination of the support surface normal relative to the shaft axis and a is a parameter in the order of magnitude of 3 to 12 mm⁻¹, preferably 5 to 8 mm⁻¹. The effect thereby achieved is that the adjacent-lying contact and support surfaces in the unbraced state in the central region of penetration of the clamping screw are at a distance of 10 to 40 μ m from one another. A similar effect may be achieved by the tool head and/or the shaft having a relief-counterbore in the region of the contact and support surface penetrated by the fitting bore. To achieve a high dimensional stability and an adequately rigid connection, according to a further advantageous refinement of the invention the depth of the fitting recess at the side of the shaft should correspond to 0.5 to 1.5 times its diameter.

According to a further advantageous refinement of the invention, the fitting bore at the side of the tool head takes the form of an oblong hole elongated at right angles to the teeth of the spur toothing and having a size of fit in tooth direction. The oblong hole provides an additional degree of freedom which enables a precise fit of the tool head without

dimensional tolerances leading to an undesirable mutual locking between tool head and shaft.

A further advantageous refinement of the invention provides that the contact and support surfaces in the region of the spur toothing outside of the fitting bore are penetrated by a coolant channel, which in the region of the surface containing the indexable insert or the counterbore for the securing screw opens into the chip space and is directed there towards an effective cutting edge of the indexable insert and is charged with coolant from the shaft side. The effect thereby achieved is that the coiled chip produced during machining is acted upon at the point of origin by the coolant and, as a result of being cooled down, maintains its shape and is flushed out of the bore. The eccentric arrangement of the coolant bore in the penetration region outside of the fitting bore ensures that the coolant channel is adequately sealed off from the outside.

An advantageous development of the invention provides that there is disposed between shaft and tool head a transition piece which, at its end faces which are oblique relative to the shaft axis, is provided with spur toothings, which are complementary to the spur toothings of the shaft, on the one hand, and of the tool head, on the other hand, and which are penetrated in pairs by a fitting bore for the engagement of a fit shank of a securing screw. When the end faces of the transition piece are aligned parallel to one another, the transition piece performs the function of an extension of the fit shank. When, on the other hand, the end faces of the transition piece are arranged rotated through 180° about the shaft axis relative to one another, the transition piece assumes the function of an overhead adapter. It is therefore possible with the same basic holder and tool head to produce an overhead tool. When, in addition, the diameter of the shaft-side end face of the transition piece is greater than the diameter of the tool-head-side end face, the transition

piece is a reducing adapter or an overhead reducing adapter, which allows connection to a given basic holder of a tool head with a smaller diameter.

In order to enable a precise fit for the transition piece despite the existing tolerances, the shaft-side fitting bore of the transition piece takes the form of an oblong hole which is elongated at right angles to the teeth of the spur toothing and has a size of fit in tooth direction. Moreover, at least one of the opposing surfaces containing the spur toothings may have a concave curvature, which extends about an axis parallel to the teeth of the spur toothing and ensures that the surface pressure is greater in the region of the external diameter than in the central region, resulting in a greater flexural strength.

There follows a detailed description of the invention with reference to an embodiment which is diagrammatically illustrated in the drawings. The drawings show:

- Fig.1 a side view of a two-part lathe tool with an ABS basic holder (ABS is a trade mark of the company Komet Stahlhalter- und Werkzeugfabrik Robert Breuning GmbH);
- Fig.2 a view, rotated through 90° relative to Fig.1, of a two-part lathe tool with an NC basic holder;
- Fig.3 a side view according to Fig.2 with a round-shaft basic holder;
- Figs.4a and b a round shaft in two side views rotated through 90° relative to one another;
- Figs.5a to c a tool head in two side views rotated through 90° relative to one another and in plan view onto the contact surface;
- Fig.6 a side view of a transition piece in the form of an extension;

- Fig.7 a side view of a transition piece in the form of a reduction;
- Fig.8 a side view of a transition piece in the form of an overhead adapter.

The tools illustrated in the drawings are intended as vertical tools for use in lathes. They substantially comprise a cylindrical shaft 10 having a basic holder 12', 12", 12"' for connection to a lathe turret and having a tool head 18 which may be detachably fastened at a separation point 14 by means of a fit screw 16 to the shaft 10.

In the embodiment shown in Fig.1, the basic holder 12' takes the form of an ABS coupling part with alignment pin 20, self-aligning bolt 22 and plane annular surface 24, whereas in Figs.2 and 3 an NC receiver 12" and a round shaft 12"' are respectively provided as a basic holder.

The separation point 14 has a support surface 26 on the shaft side and a contact surface 28 on the tool head side, which surfaces are disposed at an acute angle of about 30° relative to the shaft axis. The support surface 26 and the contact surface 28 are moreover provided with meshing spur toothings 30, 32, which extend over the entire cross section of the shaft and the parallel teeth of which extend at right angles to the direction of inclination of the support and contact surfaces 26, 28. The tool head 18 carries an exchangeable indexable insert 36, which is secured by a clamping screw 34 and is disposed countersunk in a paraxial flat surface 38 of the tool head 18, said surface extending through the shaft axis and delimiting a chip space. The indexable insert 36 may in principle alternatively be fastened to the tool head by other clamping means, e.g. by clamping fingers or a chuck lever. The teeth of the spur toothings 30, 32 are aligned parallel to the surface 38 containing the indexable insert, the inclination of the separation point and the toothing angle being tuned to one another and combined in such a way that one

of the tooth flanks in the direction of infeed of the tool extends parallel to the tool axis and hence parallel to the indexable insert surface 38.

The fit screw 16 engages with its fit shank 40 into a fitting bore 42', 42" disposed in the tool head 18 and passing at right angles through the separation point and is screwed from the side of the tool head 18 into a tapped bore 44 of the shaft 10 adjoining the fitting bore 42". At its other end, the fit screw 16 is supported by its head 46 in a counterbore 48 of the tool head 18, said counterbore being disposed in the region of an oblique surface 50 of the tool head 18, which adjoins the indexable insert surface 38 of the tool head and is parallel to the contact surface 28. The fitting recess 42" at the shaft side has a depth corresponding to 0.5 to 1 times the screw diameter. As is evident from Fig.5c, the fitting recess 42' at the side of the tool head 18 takes the form of an oblong hole, which is elongated at right angles to the teeth of the spur toothing 32 and has a size of fit in tooth direction. The effect thereby achieved is that the f dimension, i.e. the length of projection of the cutting tip from the centre, is defined by the size of fit of the fit screw and the tip height, i.e. the dimension of the cutter tip relative to a defined transverse axis, is defined by the teeth of the spur toothing and so a precise fit of the tool head is guaranteed despite existing tolerances.

In order to obtain an adequately rigid surface connection over the entire separation point, the support surface 26 and/or the contact surface 28 has, in the manner of an internal gear, a concave curvature which extends at right angles to the toothing and ensures that said surfaces, in the unbraced state, in the region of the fit screw have a clearance of 10 to 30 μm , which is reduced by elastic deformation when the fit screw 16 is tightened. The effect thereby achieved is that the surface pressure is greater in the region of the external diameter than in the central region, which has an advantageous

effect upon the flexural strength. Instead of the curvature, a relief-counterbore may be provided in the central region around the screw. The spur toothings 30, 32 are advantageously ground into the solid by means of a profile-grinding wheel. The radius of curvature with the internal gear effect is introduced by the correspondingly shaped grinding wheel.

As is evident from Figs.6, 7 and 8, a transition piece 52', 52", 52''' may be disposed between the shaft 10 and the tool head 18, said transition piece having at its end faces, which are inclined relative to the shaft axis, spur toothings 58, 60 which are complementary to the spur toothings 30, 32 of the tool head 18, on the one hand, and of the shaft 10, on the other hand. The opposing spur toothings 32, 58 and 60, 30 are penetrated in pairs by a fitting bore 42', 42'' and 42^{IV}, 42" for the engagement of securing screws 16 having a fit shank 40. The fit screws are screwed with their external thread into a tapped bore 44' of the transition piece and a tapped bore 44 of the shaft respectively. The transition piece 52' according to Fig.6 is an extension piece of constant diameter, the transition piece 52" according to Fig.7 is a reducing piece and the transition piece 52''' according to Fig.8 is an overhead adapter.

The shaft 10, the tool head 18 and the possibly provided transition piece 52', 52", 52''' are, if necessary, provided with a coolant channel 62, 64, 66, which eccentrically penetrates the separation points in the region of the spur toothings and opens into the chip space formed by the surfaces 38 and 50 in such a way that the coolant supplied under pressure from the shaft end flows against the effective cutting edge 68 of the indexable insert 36 (cf. Figs.5b and 6).

In summary, the following may be stated. The described embodiment of the invention presents a lathe tool having a

cylindrical shaft 10 and a tool head 18, which lies with a contact surface 28 against a support surface 26 of the shaft 10. The tool head 18 is detachably connected in a force-locking manner by means of a fit screw 16 to the shaft 10. The contact surface 28 and the support surface 26 are disposed at an acute angle to the shaft axis and have meshing spur toothings 30, 32, which extend over the entire cross section of the shaft. The parallel teeth of the spur toothings 30, 32 are aligned at right angles to the direction of inclination of the support and contact surfaces 26, 28 and parallel to a paraxial surface 38 of the tool head 18 containing an indexable insert 36.

**Claims**

1. Lathe tool having a preferably cylindrical shaft (26) and a tool head (18) carrying an exchangeable indexable insert (36) and resting with a contact surface (28) against a support surface (26) of the shaft (10), and having a securing screw (16) connecting the tool head (18) to the shaft (10), wherein the contact surface (28) and the support surface (26) are disposed at an acute angle to the shaft axis and have meshing spur toothings (30, 32), wherein the securing screw (26) is aligned substantially at right angles to the support and contact surfaces (26, 28), wherein the indexable insert (36) is disposed countersunk in a substantially paraxial flat surface (38) extending preferably through the shaft axis and delimiting a chip space, and wherein the parallel teeth of the spur toothing (30, 32) extend substantially parallel to the surface containing the indexable insert (36), **characterized in that** the parallel teeth of the spur toothing (30, 32) extend at right angles to the direction of inclination of the support and contact surfaces (26, 28), and that the securing screw (16) has a fit shank (40), with which it engages into a fitting bore (42', 42") passing substantially at right angles through the tool head (18) and the shaft (10) in the region of the contact and support surfaces (28, 26).
2. Lathe tool according to claim 1, **characterized in that** the surface (38) containing the indexable insert (36) verges at its shaft-side end into a surface (50), which is substantially parallel to the contact surface (28) and has a vertical counterbore (48) for the head (46) of the securing screw (16), which counterbore in turn verges into the fitting bore (42') for the securing screw (16).
3. Lathe tool according to claim 1 or 2, **characterized in that** the contact surface (28) and/or the support surface



(26) has a concave curvature extending about an axis parallel to the teeth of the spur toothing (30, 32).

4. Lathe tool according to claim 3, **characterized in that** the radius of curvature (R) is selected according to the equation

$$R = aD^2 \cos^{-2} \alpha,$$

where D is the shaft diameter, α is the angle of inclination of the support surface normal relative to the shaft axis and a is a parameter in the order of magnitude of 3 to 12 mm⁻¹, preferably 5 to 8 mm⁻¹.

5. Lathe tool according to one of claims 1 to 4, **characterized in that** the depth of the fitting recess (42") at the side of the shaft corresponds to 0.5 to 1.5 times its diameter.
6. Lathe tool according to one of claims 1 to 5, **characterized in that** the tool head (18) and/or the shaft (10) has a relief-counterbore in the region of the contact and support surfaces (28, 26) penetrated by the fitting bore (42', 42").
7. Lathe tool according to one of claims 1 to 6, **characterized in that** the support surface normal is disposed at an angle (α) of 15° to 45°, preferably 30°, relative to the shaft axis.
8. Lathe tool according to one of claims 1 to 7, **characterized in that** the tooth flanks of the spur toothings (30, 32) are disposed at an angle of 50° to 70°, preferably 60°, relative to one another.
9. Lathe tool according to one of claims 1 to 8, **characterized in that** one of the tooth flanks of the spur



toothings (30, 32) is aligned substantially parallel to the paraxial surface (38) containing the indexable insert (36).

10. Lathe tool according to one of claims 1 to 9, **characterized in that** the fitting bore (42') at the side of the tool head (18) takes the form of an oblong hole, which is elongated at right angles to the teeth of the spur toothing (32) and has a size of fit in tooth direction.
11. Lathe tool according to one of claims 1 to 10, **characterized by** a coolant channel (62, 66, 64) which penetrates the contact and support surfaces in the region of the spur toothing (30, 32) outside of the fitting bores (42', 42''), opens in the region of the surface (38, 50) containing the indexable insert (36) or the counterbore (48) into the chip space and is directed there towards an effective cutter of the indexable insert (36) and may be charged with coolant from the shaft end.
12. Lathe tool according to one of claims 1 to 11, **characterized by** a transition piece (52', 52'', 52''') which is disposed between shaft (10) and tool head (18) and is provided at its end faces (54, 56), which are inclined relative to the shaft axis, with spur toothings (58, 60), which are complementary to the spur toothings (30, 32) of the shaft (10), on the one hand, and of the tool head (18), on the other hand, and are penetrated in pairs by a fitting bore for engagement of a fit shank of a securing screw.
13. Lathe tool according to claim 12, **characterized in that** the end faces (54, 56) of the transition piece (52', 52'') are aligned parallel to one another.



14. Lathe tool according to claim 12, **characterized in that** the end faces (54, 56) of the transition piece (52") are disposed rotated through 180° about the shaft axis relative to one another.
15. Lathe tool according to one of claims 12 to 14, **characterized in that** the shaft-side end face (56) of the transition piece (52") is greater than the tool-head-side end face (54).
16. Lathe tool according to one of claims 12 to 15, **characterized in that** the shaft-side fitting bore (42^{IV}) of the transition piece (52', 52", 52'') takes the form of an oblong hole, which is elongated at right angles to the teeth of the spur toothing (60) and has a size of fit in tooth direction.
17. Lathe tool according to one of claims 12 to 15, **characterized in that** at least one of the opposing surfaces containing the spur toothings has a concave curvature extending about an axis parallel to the teeth of the spur toothing, preferably with a radius of curvature according to claim 4.