Title: TOOL FOR CHIP REMOVING MACHINING

Abstract: A rotatable tool for chip removing machining comprising a shaft (1) and a cutting body (2), which is connected detachably to the shaft by means of a drawbar (4) which at a front end has a locking device (23) for mechanical engagement with the cutting body. The drawbar is axially movable by means of a tightening element (6) at a distance from the locking device. Inside the cutting body (2), there is a cavity (15), which is open via an opening in a rear part of the cutting body which has a smaller width than the cavity, the locking device having a larger width than said opening in order to be able to be pressed against the inside of said rear part of the cutting body after insertion in the cavity.
TOOL FOR CHIP REMOVING MACHINING

Technical Field of the Invention

This invention relates to a tool intended for chip removing machining the tool being of the type that comprises a shaft, which at a front end has a cutting body made of a hard material, which is connected detachably to the shaft by means of a drawbar arranged in a bore inside the shaft, which drawbar, at a front end, has a locking device for mechanical engagement with the cutting body and which is movable axially between a protruded position and a retracted position by means of a tightening element located at a distance from the locking device.

Prior Art

Cutting tools of the type that makes use of a cutting body detachable from a shaft may, in practice, be in the form of milling cutters, in particular shank-type cutters, drills or thread cutters, the shaft usually having a long narrow, cylindrical shape. In modern machine tools, said shafts are so sophisticated and expensive that they cannot, for economical reasons, be integrated with the wearing part of the tool, viz. the cutting body, while forming a single tool which may be discarded when the cutting body has been consumed. In other words, it is profitable to make the cutting body proper as a detachable unit, which may be replaced, while the expensive shaft may be used during a long period of time. A certain category of such tools (see e.g. US 5607263 and DE 3448086 C2) is based on the cutting body being fastened at the front end of the shaft by means of a short screw, which via a through hole in the cutting body is fastened in a female screw which opens up at the front end of the shaft. An aggravating disadvantage of this type of tool is, however, that cutting edges cannot be formed in the area of the front end of the cutting body, from which follows that the cutting body may be formed only for milling (e.g. milling of T-grooves), but not for drilling.

Another category of tools - to which the invention relates - uses a drawbar of the type mentioned initially in order to connect, detachably, the cutting body to the shaft. The front end of the drawbar may then be inserted from behind in the cutting body and by means of a locking device be brought into mechanical engagement with the cutting body. In this way, the front end of the cutting body will not be intersected by
any holes, and therefore cutting edges for drilling purposes or full radius edges for milling purposes may be formed on the front end of the cutting body. A tool employing a drawbar of this type has been described previously in EP 091101 A1. In this known tool, a drawbar extends through a through bore inside the tool shaft and is connected, at a rear end, to a nut by means of which the bar may be displaced axially inside the shaft between a protruding position, in which the cutting body may be connected to the front end of the drawbar, and a withdrawn position in which the cutting body is clamped against the front end of the shaft, more precisely by means of a locking device at the front end of the drawbar. However, in this known tool, the locking between the cutting body and the shaft is unreliable. Thus, the locking device consists of a ring-like bulge formed on the front end of the drawbar which interacts with an inner, cone-shaped surface on a neck protruding from the shaft, which in turn is inserted into a rearwardly open, cylindrical space in the cutting body, said neck expanding when the ring-like bulge of the drawbar is pulled therein; all while achieving a friction locking between the inside of said cylinder space and the outside of said neck. If a tool of this type is exposed to considerable cutting forces, there is, however, an obvious risk that the cutting head comes loose from the shaft or is displaced from the centred position thereof in relation thereto.

Aims and Features of the Invention

The present invention aims at obviating the above-mentioned inconveniences of the prior art and at providing an improved tool of the type mentioned initially. Thus, a primary aim of the invention is to provide a tool, the cutting body of which may be connected to an appurtenant shaft in an accurate and reliable way.

Another aim of the invention is to create a tool, which enables assembly and disassembly of the cutting body in a fast and simple way while ensuring an exact centring or positional determination of the cutting body in relation to the shaft. It is also an aim to provide a tool, which is structurally simple and may be manufactured by means of conventional manufacturing methods.

According to the invention, at least the primary aim is attained by the features defined in the characterizing clause of claim 1. Preferred embodiments of the invention are furthermore defined in the dependent claims.
Brief Description of Appended Drawings

In the drawings:

Fig 1 is a partially sectioned perspective view showing a tool according to the invention intended for milling,

Fig 2 is a longitudinal section through the tool according to fig 1,

Fig 3 is a section A-A in fig 2,

Fig 4 is an end view of a cutting body included in the tool, in the form of a cutting head,

Fig 5 is a section B-B in fig 4,

Fig 6 is an end view of a wall plate included in the cutting head according to fig 4,

Fig 7 is a cross-section C-C in fig 6,

Fig 8 is an enlarged longitudinal section showing the cutting head and a front portion of the shaft of the tool,

Fig 9 is a section D-D in fig 8, the cutting head being shown in a first angular position of rotation in relation to the shaft and a drawbar arranged therein,

Fig 10 is a cross-section corresponding to fig 9, but showing the cutting head turned 90° in relation to the position according to fig 9,

Fig 11 is a side view of an alternative embodiment of the cutting head of the tool,

Fig 12 is an end view of the cutting head according to fig 11,

Fig 13 is a partial cross-section E-E in fig 12,

Fig 14 is a side view of an additional alternative embodiment of a cutting body for drilling purposes,

Fig 15 is an end view from above of the cutting body according to fig 14,

Fig 16 is a side view of the cutting body in 90° angle to the side view according to fig 14,

Fig 17 is a side view of an additional alternative embodiment of a cutting body for drilling together with an appurtenant shaft,

Fig 18 is a side view in 90° angle to the side view according to fig 17.

Fig 19 is a partial longitudinal section through another alternative tool for turning purposes, the cutting body of the tool being shown in a locked position,
Fig 20 is a longitudinal section corresponding to fig 19 showing the cutting body in a released state,

Fig 21 is a planar view showing the cutting body included in the tool according to fig 19-20, and

Fig 22 is a partial longitudinal section illustrating an additional, alternative turning tool.

Detailed Description of Preferred Embodiments of the Invention

In figs 1-10, a tool in the form of a shank-type cutter is illustrated, which includes a shaft 1 and a cutting body in the shape of a cutting head 2, which is detachably mounted on a front end of the shaft. Inside the shaft, an axial and central through bore 3 extends, which receives a drawbar 4. The bore 3 widens in a rear cylinder cavity 5, which houses a nut 6, which with the female screw thereof is in engagement with a male screw 7 on the rear portion of the drawbar 4. At the transition section between the bore 3 and the wider cylinder cavity 5, there is a ring-shaped abutment surface 8 against which the front end of the nut 6 is pressed. At the front end of the shaft 1, adjacent to the bore 3, there is a number of axial grooves 9 in which chambers 10 on the drawbar 4 engage in order to make turning of the drawbar impossible relative to the shaft. In other words, the drawbar 4 is axially movable in relation to the shaft, but not turnable in relation thereto. As is seen in fig 1, a countersink with a flat bottom surface 11 is formed in the envelope surface of the shaft 1, which ensures a rigid connection between the shaft and an interacting tool holder. It should be noted that the shaft 1 in this case is formed with a rear part, which is thicker than the front part onto which the cutting head 2 is mounted. The diameter of the cutting head is larger than the diameter of at least the front, thin part of the shaft.

In the embodiment exemplified, in which the tool is in the form of a shank-type cutter, the head 2 has a number of tooth-like projections 12, which each have a cutting edge 13. In the example, the number of projections 12 amounts to six, the individual projections protruding approximately radially from a central body 14. In practice, the body 14 and the projections 12 are manufactured in the form of a single integrated body of conventional cemented carbide, which is produced by pressure moulding and sintering. In practice, powdered wolfram carbide is usually mixed and pressure-moulded together
with one or more binder metals, e.g. cobalt and then the pressed body is sintered.
However, it is also feasible to make the head of other hard materials, which in a suitable
way are workable.

Now reference is made especially to figs 4-7, which illustrate how a cavity
15 is formed inside the central body 14. At one, front end thereof, said cavity 15 is
closed, more precisely by means of the part of the body 14 that in fig 5 is designated 16.
At the opposite, rear end thereof, the cavity 15 is open, more precisely via an opening
17, which is formed in a rear cross wall 18, which - when the cutting head is ready-
constitutes an integrated part of the cutting head. As is clearly seen in fig 5, the cavity
15 has a generally larger width than the opening 17. This means that the cutting head
cannot be made in a single pressure moulding operation. In order to solve this problem,
the wall 18 together with the opening 17 positioned therein are produced by means of a
separate, substantially ring-shaped plate 18' of the type that is shown in figs 6 and 7.
This plate 18' is pressure moulded as a separate unit without being sintered, and the
body 14 and the appurtenant projection 12 are pressure moulded as another unit, also
without being sintered. Then the two units are put together, after which sintering is
executed. Thus, after the sintering has been completed, the plate 18 forms a wall in-
tegrated into the cutting head 2 in its entirety.

In fig 6 it can be seen that the pressure moulded plate 18' externally has
two opposite, circular envelope portions 19 and two opposite, planar envelope portions
20. The rear part of the cavity 15 that receives the plate 18' has the same profile, i.e.
comprises two planar opposite surfaces. By means of these planar surfaces, the opening
17 has its position determined in an exact way in relation to the body 14. As is
furthermore seen in fig 6, the opening 17 has a generally out of round profile. More
precisely, the opening is elongated and is delimited by two planar long side surfaces 21
and two curved end surfaces 22. As for the cavity 15, it should be pointed out that it is
to advantage if the same is delimited by three different partial surfaces, viz. a cylindrical
surface closest the wall 18, a frusta-conical partial surface as well as a final cone-shaped
surface at the front end of the cavity. By means of the cone-shaped surfaces, it is
ensured that the material in the front end of the cutting head is strongly dimensioned.

At the front end thereof (see fig 2), the drawbar 4 is formed with a locking
device 23, which like the opening 17 has an out of round shape. It is to advantage if the
locking device has a profile that is congruent with the profile of the opening 17, although the locking device is somewhat smaller. In this way, the locking device 23 may be inserted axially through the opening 17, more precisely at an angular position of rotation at which the locking device and the opening are flush with each other. When the locking device has been inserted into the cavity 15, the cutting head may be turned so that the locking device assumes another, opposing angular position of rotation in which the two opposite ends of the locking device may be pressed against the inside 24 of the wall 18. As is seen in figs 8-10, two stopping elements 25 in the form of shoulders are formed in the interior limiting surface of the cavity 15, which elements are so placed that the cutting head may be turned exactly 90° from the angular position of rotation illustrated in fig 9 in which the locking device may be inserted through the opening 17, to the locking angular position of rotation which is illustrated in fig 10.

As is seen in figs 1-4, a number of, more precisely three male elements 27 are formed on the rear end surface 26 of the cutting head 2, each of which elements interacts with the corresponding female elements in the form of countersinks 28 (see fig 3) in the front end surface 29 of the shaft 1. The male elements 27 as well as the countersinks 28 advantageously have a wedge-type tapering shape, and the countersinks are somewhat deeper than the male elements so that these cannot touch the bottom in the countersink. When the male elements engage the countersinks, a robust, rigid connection between the cutting head and the shaft is ensured. It should be noted that the three male elements 27, which like the countersinks 28 are equidistantly spaced-apart, are located opposite the countersinks when the cutting head has been turned to the angular position of rotation in which the locking device 23 has been pressed against the stopping elements 25 according to fig 10.

The Function of the Tool According to the Invention

When a cutting head 2 is to be assembled on the shaft 1, the drawbar 4 is brought to protrude a suitable distance from the front end of the shaft surface 29. This is something that is achieved by screwing the nut 6 a few turns rearwards along the drawbar. In the next step, the cutting head is threaded onto the free end of the drawbar, more precisely by pushing the locking device 23 through the elongate opening 17 in the state which is shown in fig 9. After this, the cutting head is turned 90° to the position
illustrated in fig 10 in which the locking device is pressed against the stopping elements 25 at the same time as the three male elements 27 are located opposite the appurtenant countersinks 28 in the front end of the shaft surface. When this has taken place, the drawbar 4 is drawn into the shaft by screwing the nut 6 forwards on the drawbar. When the nut is screwed fast, the male elements 27 are wedged in the appurtenant countersinks thus achieving a strong, rigid connection between the cutting head and the shaft.

At disassembly, the procedure is the opposite.

In this connection, it should be mentioned that it is to advantage if the drawbar 4 is spring-activated in order to project automatically from the front end of the shaft when the nut 6 is screwed rearwards. An elastic ring, e.g. an O-ring, may for instance be applied in the area behind the nut 6 which ring always aims to force the nut - and thereby the drawbar - in the forward direction.

Reference is now made to figs 11-13, which illustrate an alternative embodiment in which the plate 18' provided with holes is not countersunk inside the cavity 15, but rather applied with a front surface 30 against the rear end surface 26 of the cutting head. Also in this embodiment, the body of the cutting head and the plate 18' are individually pressure-moulded before finally being integrated with each other by being sintered together. In this connection, in order to determine the position of the plate 18' in relation to the body 14, one or more projections 31 having a frusta-conical shape may initially be formed in one of said units which are brought into engagement with one or more cone-shaped seats 32 in the second unit, however, without touching the bottom in said seats. Since the wall-forming plate 18' in the embodiment according to figs 11-13 may be given a larger diameter than the retracted wall plate in the previous embodiment, a larger contact surface between the cutting head and the shaft is obtained. In addition, a larger surface of the contact zone in which the sintering takes place is also obtained.

How the tool according to the invention may be made with a head or cutting body 2 for drilling purposes is shown schematically in figs 14-16. In this case, the cutting body 2 is formed with cutting edges 33 in the area of a front, tip-like end. Also in this case, the cutting body includes a cavity 15 which is open via an opening with an out of round, preferably elongated profile, a locking device 23 with a congruent
profile being insertable in the cavity. However, in this case the cutting body is composed of two similarly shaped, mirrored halves 34, 34' that are sintered in an axial planar 35. In the interface between the two halves that are sintered together after pressure moulding, it may be advantageous to form interacting pairs of projections and seats 31 and 32, respectively, of the type described previously.

In figs 17 and 18, an additional alternative embodiment is shown, according to which the cavity in a cutting body 2a intended for drilling consists of a laterally open, first channel 15', while the opening to this channel consists of a laterally open second channel 17', which is narrower than the channel 15'. The locking device 23 existing on the drawbar 4 of the shaft has an elongated shape and a width that is larger than the width of the channel 17'. In this case, the locking device is brought into the cavity 15' from the side and is centred by means of cone-shaped shoulders or male elements 27, which engage cone-shaped countersinks 28 in the front surface 29 of the shaft 1. In the example shown, the two channels 15', 17' are open at opposite ends. However, it is also feasible to form the cutting head so that the channels open only towards one side. In the example according to figs 18 and 19, the cavities/openings 15', 17' extend parallel to the flat plate of the cutting body, i.e. from short side to short side. It is, however, also feasible to locate channels perpendicularly to the planar of the cutting body, i.e. from long side to long side.

Reference is now made to figs 19-21, which illustrate a tool according to the invention intended for turning. In this case, the cutting body consists of a cutting insert for a turning lathe with a flat basic shape, which is placed in the immediate vicinity of the front end of the shaft 1, more precisely on one of the two opposite sides 36, 37 of the shaft. In this embodiment, the bore 3 for the drawbar 4 extends transversely to the longitudinal axis of the shaft, more precisely all through from the first side 36 to the second side 37. The cavity 15 inside the cutting body 2 is delimited by two cone surfaces diverging towards each other between which there may be a cylindrical surface. The locking device 23 of the drawbar 4 consists, in this case, of a head having an elongated basic shape, which is delimited by two opposite, planar, side surfaces which extend in the longitudinal direction of the head, as well as two partial cone-shaped end surfaces between the planar surfaces.
Like the embodiment according to figs 1-13, the cavity 15 opens in an opening 17 having an elongate shape. Therefore, the head 23 may be inserted into the cavity and be turned 90° before locking of the cutting body. Also in this case, the drawbar 4 interacts with a nut 6 being insertable in a cavity 5 at a rear end of the bore 3.

In order to ensure a rigid connection between the cutting body 2 and the shaft 1, there may be a suitable number of pairs of interacting male and female elements 27, 28 in the interface between the cutting body and the contact surface 36 of the shaft which elements internesh with each other when the nut 6 tightens the drawbar.

In fig 22, an alternative embodiment is shown in which the drawbar 4 is spring-activated. More precisely, a pressure spring 38 is arranged between, on the one hand, an abutment surface at the inner end of the cavity 5 and a washer 39 adjacent to the nut of the drawbar. In this embodiment, the cutting body 2 may be loosened by the simple measure of inserting the drawbar a distance in the appurtenant bore against the action of the spring 38, i.e. without needing to manipulate the nut 6.

A primary advantage of the tool according to the invention is that the cutting head may, in a reliable way, be rigidly connected to the shaft at the same time as assembly as well as disassembly may be carried out in a fast and simple way.

Feasible Modifications of the Invention

The invention is not solely restricted to the embodiments described and illustrated in the drawings. Thus, not only the cutting body but also the part of the tool holding the cutting body may be modified very considerably within the scope of the subsequent claims. Therefore, the concept "shaft" should be interpreted in the widest sense, so far that the shaft not necessarily has to have a marked long narrow shape. In particular, the shape of the shaft may be altered to a far-reaching extent when the tool is formed for turning purposes.
Claims

1. Tool for chip removing machining, including a shaft, which at a front end has a cutting body (2) made of a hard material, which is connected detachably to the shaft by means of a drawbar (4) arranged in a bore (3) inside the shaft, which drawbar has at a front end a locking device (23) for mechanical engagement with the cutting body and which is axially movable between a protruded position and a retracted position by means of a tightening element (6) located at a distance from the locking device (23), characterized in that there is a cavity (15,15') inside the cutting body (2), which cavity is open via an opening (17,17') in a rear part (18,18') of the cutting body which has a smaller width than the cavity, the locking device (23) having a larger width than said opening (17,17') in order to be pressed against the inside (24) of said rear part (18,18') after insertion in the cavity.

2. Tool according to claim 1, characterized in that said opening consists of a central opening (17) with an out of round cross-sectional shape and that also the locking device (23) has an out of round shape in order to be axially movable through the opening at a certain angular position of rotation, the cutting body (2) being turnable in relation to the locking device between this angular position of rotation and a second angular position of rotation in which the locking device may lock the cutting body axially relatively the shaft.

3. Tool according to claim 2, characterized in that at least one stopping element (25) is formed inside said cavity (15) against which element the locking device (23) is pressed in order to define a predetermined end angular position of rotation for locking.

4. Tool according to claim 3, characterized in that said stopping element (25) is so placed inside the cavity (15) that the same at turning of the cutting body may move 90° from a first angular position of rotation to a second end angular position of rotation for locking.
5. Tool according to any one of the preceding claims, characterized in that at least one pair of male and female elements (27, 28) act in an interface between a rear contact surface (26) on the cutting body (2) and a front contact surface (29) on the shaft which elements have the purpose of bringing about a rigid connection between the cutting body and the shaft when the contact surfaces are pressed against each other by tightening the drawbar (4).

6. Tool according to any one of the preceding claims, the cutting body (2) being made of a pressure moulded and sintered material, such as cemented carbide, characterized in that the cutting body is composed of at least two parts (14, 18'; 34, 34') which are sintered together.

7. Tool according to claim 6, characterized in that the cutting body is composed of a body (14), which is closed at a front end and in which a rearwardly opening recess (15) is formed, as well as a plate (18, 18') placed adjacent thereto, which extends transversely to the axis of rotation of the tool and in which the out of round opening (17) is formed.

8. Tool according to claim 6, characterized in that the cutting body is composed of two similarly shaped, although mirrored halves (34, 34'), which are sintered together in a central axial plane.

9. Tool according to claim 7 or 8, characterized in that there is initially at least one projection (31) in one of the two surfaces which are sintered together, which projection in connection with the sintering operation is brought into engagement with a seat (32) in the second surface.

10. Tool according to any one of the preceding claims, characterized in that the locking device (23) as well as the hole (27) for it have an elongated basic shape.
11. Tool according to claim 1, characterized in that the cavity consists of a laterally open first channel (15'), while the opening consists of a laterally open second channel (17') the width of which is smaller than the width of the first cavity.

12. Tool according to claim 1, characterized in that the same is intended for turning purposes and has a bore (3), which extends transversely to the shaft (1) and houses a drawbar (4), one end of which has a locking device for fixing a cutting insert for a turning lathe serving as a cutting body against a first side (36) of the shaft and the opposite end of which is accessible from an opposite, second side (37) of the shaft.

13. Tool according to claim 12, characterized in that the drawbar (4) is actuated by at least one spring (38), which always aims to hold the cutting body (2) pressed against said first side (36) of the shaft.
A. CLASSIFICATION OF SUBJECT MATTER

IPCG: B23B 31/113
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)

IPCG: 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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

Date of the actual completion of the international search: 2 February 2001

Date of mailing of the international search report: 13-02-2001

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