

The invention relates to a drilling tool which is equipped at its working end with exchangeable cutting tips and into whose shank a pilot drill extending co-axially to the longitudinal axis is inserted. Drills of this type are known and are described, for example, in DE-A-19 11 594 and DE-A-31 24 532. The cutting tips used are for example reversible cutting tips of hard metal or also of hard ceramic material. Their advantage is well known: it consists in particular in that the cutting speed, cutting power and tool life of the drilling tool can be considerably increased in comparison with conventional tools of high-speed steel.

The pilot drill is also of substantial importance to the tool life and in particular the smooth operation of the drilling tool. Depending on requirements, this drill is made of high-speed steel or hard metal. The pilot drill has a substantially smaller diameter than the drilling tool into which it is inserted. The ratio between the diameter of the pilot drill on the one hand and the diameter of the drilling tool on the other hand amounts for example to from 15 to 30%. The task of the pilot drill is to cut into the workpiece a small pilot bore by which transverse forces acting on the drill during the drilling of the main hole can be intercepted. Smooth operation and consequently also the transverse load and life of the drilling tool are thus considerably increased. Under unstable cutting conditions it is usual to select high-speed steel as the material for the pilot drill; under stable cutting conditions the choice will be hard metal.

Tools of the kind mentioned above are expensive precision instruments which are subjected to heavy loads when used for their intended purpose. In the designing of such tools it must therefore be ensured on the one hand that it will be easy to replace those parts of the tool which are subjected to particular stressing and heavy wear, that is to say primarily the previously mentioned cutting tips and the pilot drill. On the other hand,

however, care must also be taken to ensure that the chips produced during use and also the heat which is unavoidably released can be easily carried off and removed from the hole drilled without impediment.

5 Particularly good removal of chips and heat is achieved if a coolant is fed through the tool. A coaxial bore through the shank has been found to provide a particularly simple and economical method of passing the cooling lubricant to the cutting edge. At the front end
10 of the shank this bore converges with the bore provided to receive the pilot drill. On its periphery the pilot drill is provided with continuous grooves which extend parallel to the longitudinal axis and through which the cooling lubricant can reach the drill tip and thus the
15 cutting edges.

The foregoing shows that the requirements imposed on a drilling tool of this kind are partly contradictory. High loadability on the one hand and easy exchangeability of wearing parts, on the other hand, paired with good
20 removal of chips and heat, are the requirements which must be combined with one another.

From AT 383 070 B a drill tool is known which is equipped with reversible tips and in which the reversible tip holder is detachable. It is clamped relative to the
25 shank by means of holding screws with the aid of a flat end surface. Torque is transmitted there between the shank and the head part during drilling only through positive connection of the shank and the head part by means of the holding screws and by the friction which is
30 produced by the contact pressure acting in the end surface region. The centering of the head part is there effected by the holding means.

The object underlying the invention is that of further improving in a simple manner the previously known
35 drilling tools having exchangeable cutting tips and a pilot drill extending coaxially to the longitudinal axis, in order to increase the cutting power and life and also the operator-friendliness of these drills.

The way in which this object is achieved is the subject of Claim 1. Through a multipart configuration of the drilling tools in this way the effect is achieved that when wear has occurred, but particularly after a reversible tip has broken, the drilling head can be exchanged for a new one easily and with only a few manipulations, while the drilling head detached can then be regenerated. By "regeneration" of the drilling head, the replacement or regrouping of the cutting tips is understood here, for example of the reversible cutting tips. The opportunity can also be taken to clean and overhaul the entire drilling head and the pilot drill can also easily be replaced. The previously mentioned positive connection has the object of intercepting cutting moments produced during the use of the tool and transmitting them to the shank. The positive connection also provides the additional advantage that, within certain limits, drilling heads with different drilling diameters can be mounted on a given drill shank. A reduction of stockkeeping costs and great flexibility of production are thereby achieved. The centering of the drilling head is attended to by the pilot drill, as a result of which more expensive centering devices are dispensed with and simple positive connections can be used. So large an opening in the drilling head, through which the pilot drill protrudes, is selected that the drilling head is in all circumstances fully supported in the toothing. The resulting minimum clearance between the opening drill and the pilot drill results in a close diameter tolerance for the entire tool, it is true, but as a rule this is not a noteworthy problem, since with modern production methods very close tolerances can be achieved.

The drilling tool has yet another special feature, which consists in that a screw adjustable in the radial direction is disposed in the shank of the drilling tool and engages by its conical foot part in a notch which is formed in the pilot drill and has an inclined

5 wall, whereby the pilot drill is adjustable in the direction of its longitudinal axis. The pilot drill can thereby be brought into an optimum position, which varies in accordance with the transverse load that occurs. When the optimum position has been adjusted, the pilot drill is fastened in a manner known per se with the aid of a locking screw.

10 The positive connection between the cutting head and the shank advantageously consists of interengaging teeth which are disposed parallel to one another and which are held in engagement by at least one locking screw. It has been found that a parallel toothing, which is simple to manufacture, best satisfies the requirements imposed here. Parallel toothings can be produced with
15 relative freedom from problems on automatic machine tools; on the other hand the locking screw, which in any case is necessary, ensures a clean snug fit for the connection.

20 Because of the parallel toothing proposed, a rigid connection between the drilling head and the shank, without play, is ensured. This connection, with its high bearing percentage of its surface, ensures not only great accuracy but also low surface pressures and prevents the occurrence of vibrations.

25 As already stated, the chip guide flute is of increased importance in respect of the removal of chips and heat. It has been found appropriate and is hereby proposed to dispose only a single chip guide flute in the shank of the drilling tool, in contrast to previously
30 known drills of this type. The shank of the drill therefore resembles a single-flight conveyor worm. The disposal of only a single chip guide flute now makes it possible to give this flute an optimum shape without exceeding the loadability of the shank. For this purpose
35 it is proposed that the core of the shank should have a diameter of from 25% to a maximum of 50% of the diameter of the shank. A core having relatively great stiffness is thus obtained.

In addition, it is proposed that the helix angle of the chip guide flute should amount to from 45° to 60° . Even such an extremely large helix angle contributes to the rapid, undisturbed removal of the hot metal chips produced. Finally, it is proposed that the width of the chip guide flute should correspond to from 0.7 to 1.3 times the width of the shank land remaining between the flute turns. The single chip guide flute formed in the shank branches directly in front of the cutting head into two chip guide flutes having different helix leads, which ensures that all the chips will be introduced without disturbance into the flute. The noteworthy cooperation of the features mentioned, namely the multi-part configuration of the front part of the tool, on the one hand, and the special configuration of the chip guide flute, on the other hand, lead [sic] to a drilling tool which, despite its considerable length, has a distinctly lengthened life in comparison with known tools. The improvements are such that with tools of the kind described drilling depths of up to $8 \times d$ and in extreme cases even over $10 \times d$ are possible (d diameter). The design of the chip guide flute moreover provides particularly advantageous damping of vibrations in comparison with conventional multi-flute designs.

As mentioned, the positive connection between the cutting head and the shank is of considerable importance. In the context of the invention a parallel toothing between the two parts is preferred as the optimum. It must however be emphasised that other positive connections, for example Hirth-type toothings or other simple chip-and-groove [sic] connections are also possible, although as a rule they are not so advantageous, in either economic or technical respects, as the parallel toothing described.

The invention is explained more fully below with reference to the accompanying drawings, in which:

Figure 1 shows a view in perspective of one embodiment of the drilling tool according to the

invention,

Figures 2 and 3 show on a larger scale the drilling tool shown in Figure 1, with the cutting head removed,

5 Figure 4 shows on a larger scale in perspective a part of the drilling tool shank with a branched helical flute,

10 Figure 5 shows a longitudinal section of a part of the front shank end with an adjusting screw for the pilot drill.

 The drilling tool shown in the drawings is given the genral reference numeral (1). It consists of the shank (2) with its machine end (3) and its working end (4). The working end (4) is equipped with exchangeable
15 cutting tips (5), for example reversible cutting tips of hard metal, hard ceramic material or the like. In addition, a pilot drill (6) extending coaxially to the longitudinal axis is inserted into the shank. This pilot drill is placed in a precision-worked longitudinal bore
20 and is clamped fast by locking screws (7).

 According to the invention the cutting tips (5) are disposed in a detachable cutting head (9) which is coupled by a positive connection (10) to the shank (2) of the drilling tool. In the example of embodiment
25 illustrated this positive connection is a parallel toothing. It consists of interengaging teeth (11, 11') which are disposed parallel to one another and are held in engagement by at least one locking screw (12). In the embodiments shown on a larger scale in Figures 2 and 3
30 bores (13, 13' and 14, 14') are provided to receive two locking screws.

 For the accurate positioning of the cutting head (9) on the working end of the shank (2) the arrangement is such that the pilot drill (6) passes through an
35 opening (15) in the cutting head, the inside diameter of the opening (15) being adapted with close tolerance to the outside diameter of the pilot drill and the cutting head being positioned thereby.

In Figure 1 it can be seen that the shank (2) of the drilling tool has only a single chip guide flute (16). This chip guide flute is however divided at the front end of the shank into two individual flutes, each of which leads to a cutting point. The division of the flute is illustrated in Figure 4.

The chip guide flute (16) is dimensioned in a special manner, so that optimum removal of even large amounts of chips is ensured. The essential features of the dimensioning consist in that the core (17) has a diameter of from 25% to a maximum of 50% of the diameter of the shank. In addition, the helix angle of the chip guide flute (16) amounts to from 45° to 60°. Finally, the width (18) of the chip guide flute corresponds to from 0.7 to 1.3 times the width (19) of the shank land (20) remaining between the flute turns.

Figure 5 shows once again schematically the front end of the shank (2). The pilot drill (6) is fastened in the shank by means of the locking screw (7). In the shank a screw (8) is also disposed which is adjustable in the radial direction and by its conical foot part (21) engages in a notch (22) which is formed in the pilot drill (6) and has an inclined wall, whereby the pilot drill is adjustable in the direction of its longitudinal axis. The adjustment is obviously made with the locking screw (7) loosened; when the desired position of the pilot drill has been obtained, it is fixed by tightening the locking screw (7).

Patent Claims

1. Drilling tool (1), which is equipped at its working end with exchangeable cutting tips (5) and into whose shank (2) a pilot drill (6) extending coaxially to
5 the longitudinal axis is inserted, characterised in that the cutting tips (5) are disposed in a detachable cutting head (9) which is coupled by a positive connection (10) to the shank (2) of the drilling tool, in that the pilot drill (6) passes through an opening (15) in the cutting
10 head (9), the inside diameter of the opening (15) being adapted with close tolerance to the outside diameter of the pilot drill (6), and in that in the shank (2) a screw (8) is disposed which is adjustable in the radial direction and by its conical foot part (21) engages in a
15 notch (22) which is formed in the pilot drill (6) and has an inclined wall, whereby the pilot drill is adjustable in the direction of its longitudinal axis.
2. Drilling tool according to Claim 1, characterised in that the positive connection (10) consists of inter-
20 engaging teeth (11, 11') which are disposed parallel to one another and which are held in engagement by at least one locking screw (12).
3. Drilling tool according to Claim 1 or 2, characterised in that the shank (2) of the drilling tool
25 (1) has only a single chip guide flute (16), which directly in front of the cutting head branches into two chip guide flutes having different helix leads.
4. Drilling tool according to Claim 3, characterised in that the core (17) of the shank (2) has a diameter of
30 from 25% to a maximum of 50%, preferably 30% to 40%, of the diameter of the shank.
5. Drilling tool according to Claim 3 or 4, characterised in that the helix angle of the chip guide
flute (16) amounts to from 45° to 60°.
- 35 6. Drilling tool according to one of Claims 3 to 5, characterised in that the width (18) of the chip guide flute (16) corresponds to from 0.7 to 1.3 times the width (19) of the shank land (20) remaining between the flute





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