

DRILL BIT

The invention relates to a drill bit of the type having a shank to which is connected a detachable cutting plate of hexagonal form in which the sides define three obtuse angles and three acute. Such commercially available and practically employed drill bits are ideal for producing bores of 14 to 18 mm diameter. In this respect, the cutting plate is so disposed that two cutting edges which define an obtuse angle with each other cut simultaneously and are in each case orientated to the shank axis at an angle which is other than 90 degrees to the axis of the shank.

An object of the invention is to provide a drill bit of the type mentioned but which is suitable for diameters of 12 to 14 mm, achieving a high drilling quality and permitting of high cutting outputs.

According to the invention there is provided a drill bit comprising a shank having an elongate chip clearance recess formed therein extending in the direction of the longitudinal axis of the shank and having only a single cutting plate mounted at a surface of said recess, said plate having six cutting edges disposed symmetrically about a central axis forming three obtuse-angled corners and three acute-angled cutting corners, the latter each being radiused over an angle of more than 90 degrees, wherein said cutting

plate
is

located on said surface in such a position that one cutting edge projects beyond the distal end of the shank and extends radially of the shank, said one cutting edge being orientated at a right-angle to the longitudinal axis of the shank.

The resultant cutting edge geometry and disposition leads to a smooth cutting action and a chip form which can be carried away largely without problem. Furthermore, the forces reacting against the feed force are largely compensated so that lateral deflection of the shank is minimised. It is possible therefore even to provide a more slender shank while increasing the drilling quality and therefore also machine diameters of 12 to 14 mm. The chip runs off parallel with the drill bit axis. The chip clearance opens to the rear and gives the chip a straight and free run outwards from the bore hole. It is possible to achieve bore holes to a depth of $2.2 \times$ the bit diameter, whereas in the prior art only 1.5 times the bit diameter is possible.

While conventional drills can be used up to a drilling depth which is 1.5 times the drill bit diameter, the ~~solid~~ drill bit according to the invention can be used to drill to a depth of 2 to 3 times the bit diameter as a result of this design of the chip clearance.

The invention is explained in greater detail

hereinafter with reference to an embodiment illustrated in the accompanying drawings, in which:

FIGURE 1 shows an elevation of a drill bit according to the invention;

5 FIGURE 2 shows the front part of the shank in Figure 1, on an enlarged scale;

FIGURE 3 is a view in the direction of the arrow 3 in Figure 2, simplified in that only the details in the region of the end face are shown;

10 FIGURE 4 shows the cutting edge area of the drill bit according to Figure 1 at the commencement of the cutting process;

FIGURE 5 is a view corresponding to that in Figure 4 but with the cutting process rather more advanced,
15 and

FIGURE 6 is a view corresponding to Figure 5 when the cutting process is well advanced.

The drill bit according to Figure 1 consists of a shank 11, the construction of which may vary in known
20 manner and which is designed to be gripped in a chuck or other housing in a machining unit. This is followed by an axially extending portion 12 of the shank with a cutting plate 13 located in a recess in the end of the shank portion 12.

25 An axial bore 14 is provided in the shank 11 communicating with an oblique bore 16 in the shank portion 12. Cooling liquid is carried to the cutting

zone through these bores. Also constructed in the shank portion 12 is an elongate chip space or clearance 17, the configuration of which is described hereinafter with reference to Figures 2 and 3.

5 According to Figure 2, the chip clearance recess 17 has as the first defining wall a first planar surface 18 which is offset by approximately 0.2 mm from a central plane of the shank portion 12 and into which the cutting plate 13 is let so as to be substantially
10 flush with the surface thereof at its cutting edges. The cutting plate 13 is secured by a screw 19 which engages a threaded bore 21 in the shank portion 12. The first surface 18 extends in a substantially radial direction over about 5/8ths of the shank portion
15 diameter and is widened out further by some 1 to 2 mm towards the end of the shank portion 12. The recess is also defined by a second planar surface 22 which is offset by some 1.2 mm from the central plane. This surface 22 is defined by a rectilinear edge at the
20 longitudinal surface of the shank portion 12 and a terminator substantially in the form of a portion of a circle having a radius of 15 to 20 mm. At the point 23 of its greatest radial extension the terminator penetrates somewhat further into the shank than the
25 radial extension of the first planar surface 18. This construction results in what is apparently only a negligible widening out of the chip face at a critical

location, but the result is significant in the efficacy of the tool. The axial distance from the location 23 to the end of the shank portion 12 corresponds approximately to the drilling depth and in this example amounts to about 2 - 3 times the nominal drilling diameter.

The chip clearance recess 17 is further defined by a third planar surface 24 orientated at an angle of some 115 degrees in relation to the first surface 18, said surface 24 being contiguous with a wall inclined to the surface 22 and extending around part of the terminator, the surface 24 and the inclined wall forming approximately the form of an elongated J in the view in Figure 2. In contrast to conventional spirally twisted chip clearance spaces, there is thus on the one hand a flexion resistant form of the shank portion 12 and on the other the chips are carried away without changing direction.

The cutting plate 13 has in axial elevation thereof the form of a hexagon wherein at every second cutting corner 26 the adjacent cutting edges 27 and 28 enclose an obtuse angle of, for instance, 158 degrees. The other cutting corners 29 have a small radius of some 0.6 mm considered in axial elevation of the plate extending over a sector of approximately 98 degrees. The cutting edges 27 and 28 are each straight over a length of approximately 4 mm. The cutting plate 13 is

approximately 2.5 mm thick. A fillet 31 approximately 1 mm wide and approximately 0.3 mm deep is formed in the marginal region of the cutting plate along the cutting edges 27, 28 and cutting corners 29, 26. The cutting plate 13 seats in a recess of similar profile to that of the plate 13 formed in the planar surface 18. The plate 13 is so located that the cutting edge 27 protruding at the end and extending in each case to whichever is the radially outermost cutting corner 29 is at a right-angle to the longitudinal axis 32 of the shank.

The outermost edge of the radially outermost cutting corner 29 is at a radial distance of 6 to 7 mm from the longitudinal axis 32 of the shank, according to the drilling diameter desired. Preferably, the radial distance of the outermost edge differs in steps of 0.25 mm each according to orientation of the plate. Following known principles, the plate 13 is made of hard metal.

Figures 4 to 6 show the cutting plate 13 on the end face of the shank 12 of a drill bit according to Figure 1 enlarged to the scale according to Figure 2 and in various phases of the cutting process. In the initial phase according to Figure 4, virtually only the cutting edge 27 is engaged with the workpiece 33. Since the cutting edge 27 is directed at a right-angle to the longitudinal axis 32 of the shank, no laterally

deflecting forces occur in the zone of the cutting edges. As cutting proceeds (Figure 5), both the cutting corner 29 and also a small part of the cutting edge 28 will become active. Here, transverse forces occur which are, however, largely self-compensating. When finally the initial phase is completed, the cutting edge 28 has approximately half of its length working and the resulting transverse deflection is compensated by the fully engaged cutting corner 29.

10 It could be deduced from the view in Figure 6 that the leftwardly acting transverse deflection resulting from the greater proportion of the cutting edge 28 would exceed the oppositely directed transverse deflection at the cutting corner 29. However, a wedge effect

15 becomes operative in the region of the rounding of the cutting corner 29 and this provides a compensating influence.

In current metal cutting technology, choosing an optimum cutting edge geometry, a suitable material or material alloy can ensure that the chip breaks as

20 quickly as possible because short, schale-like chips can be carried out without complication. Nevertheless, skimming off the individual chips has a decided significance with regard to drilling quality.

25 As Figure 6 illustrates, the chip cut off by the cutting edge 27 is lifted off in the direction of feed, guided parallel with the tool axis and is thus carried

away without trouble.

From the point of view of patent law, it is not necessary to indicate a theory underlying the advantages achieved. However, the foregoing remarks
5 are intended to provide a guide for better illustration. The static and above all dynamic conditions which occur during the cutting process are so complicated that they cannot be dealt with in the short space available.

10 When using the bit drill in a machining unit in which the drill bit is stationary and the workpiece rotates, it has been shown to be expedient so to locate the drill bit that the first defining wall is horizontally aligned, the second defining wall
15 projecting upwardly therefrom. The chips are better carried off in this way and the risk of some of them finding their way into the gap between the shank portion 12 and the wall of the bore hole is avoided. With this type of operation, the longitudinal axis 32
20 of the shank may be offset by up to 0.5 mm eccentrically in relation to the axis of rotation (drilling axis), so that a greater drilling diameter is achieved.

It is possible with the ~~solid~~ drill bit according
25 to the invention to drill holes with a form error of only 5 μ m and with a roughness of 3 to 5 μ m depth.

Producing the chip clearance 17 presents no

difficulty and can be made for example with a correspondingly shaped milling tool, a so-called Igel cutter, which simultaneously machines the first and second defining walls.



CLAIMS:

1. A drill bit comprising a shank having an elongate chip clearance recess formed therein extending in the direction of the longitudinal axis of the shank and having only a single cutting plate mounted at a surface of said recess, said plate having six cutting edges disposed symmetrically about a central axis forming three obtuse-angled corners and three acute-angled cutting corners, the latter each being radiused over an angle of more than 90 degrees, wherein said cutting plate is located on said surface in such a position that one cutting edge projects beyond the distal end of the shank and extends radially of the shank, said one cutting edge being orientated at a right-angle to the longitudinal axis of the shank.

2. A drill bit as claimed in claim 1, wherein the outermost edge of the radially outermost acute angled cutting corner (29) is at a radial distance of 6 to 7 mm from the longitudinal axis (32) of the shank.

3. A drill bit as claimed in claim 2, wherein the radial distance differs by steps of 0.25 mm each according to the orientation of the plate.

4. A drill bit as claimed in claim 1 or 2, wherein the radius at each acute angled cutting corners (29) of the plate (13) measures about 0.6 mm.

5. A drill bit as claimed in any one of Claims 1 - 4, wherein the radius extends over an angle of about



(21)

98 degrees.

6. A drill bit as claimed in any one of claims 1 - 5, wherein the obtuse angle is about 158 degrees.

7. A drill bit as claimed in any one of claims 1 - 5 6, wherein the cutting edges (27, 28) are each straight over a length of about 4 mm.

8. A drill bit as claimed in any one of claims 1 - 7, wherein the cutting plate (13) is about 2.5 mm thick.

10 9. A drill bit as claimed in any one of claims 1 - 8, wherein a fillet (31) of about 1 mm width and about 0.3 mm depth is formed in the marginal region of the cutting plate along the cutting edges and cutting corners.

15 10. A drill bit as claimed in any one of claims 1 - 9, wherein said chip clearance recess is defined by a first planar surface which is offset by ^{about} ~~approximately~~ 0.2 mm from a central plane of the shank portion and into which said cutting plate is let so as to be
20 substantially flush with the surface thereof at its cutting edges, said first planar surface extending in substantially a radial direction over about 5/8ths of the shank diameter and being widened out by 1 to 2 mm towards the end of the shank portion, and a second
25 planar surface which is offset by about 1.2 mm said central plane, said second planar surface being defined by a rectilinear edge at the longitudinal



surface of the shank and a terminator substantially in the form of a portion of a circle, said terminator, at the point of its greatest radial extension, penetrating further than the radial extension of the first planar surface.

11. A drill bit as claimed in claim 10, wherein said chip clearance recess is further defined by a third planar surface (24) orientated at an angle of about 115 degrees in relation to said first planar surface, said third surface being contiguous with a wall inclined to the second planar surface and extending around part of the terminator.

12. A drill bit as claimed in claim 10 or 11, wherein the point (23) of greatest radial extension of the second planar surface (22) is positioned at an axial distance from the distal end of the shank corresponding substantially to 2 to 3 times the nominal drilling diameter.

13. A drill bit as claimed in claim 10, 11 or 12, wherein the radius of the portion of a circle measures 15 to 20 mm.

14. A drill bit substantially as herein described with reference to the accompanying drawings.
