Provided is a drill head for deep-hole drilling which does not generate such a disc that clogs a cutting chip discharge port when a head main body of the drill head penetrates a work material. The drill head is mounted with a central cutting blade tip 6 at the head center portion so as for a blade edge 6a thereof to be inclined downward toward the head center portion, a circumferential cutting blade tip 7 at a circumferential portion so as for a blade edge 7a thereof to be inclined upward toward the head center portion, and an intermediate cutting blade tip 8 therebetween so as for a blade edge 8a thereof to be inclined upwardly and inwardly toward the head center portion, while the cutting blade tips face a cutting chip discharge port 4 or 5. The drill head includes a head main body 2 having an interior hollow portion 3 serving as a cutting chip discharge passage which communicates with the discharge ports 4 and 5. A disc breaker 12 composed of a surface inclined downwardly and inwardly toward the head center portion is formed at a head center side end portion of a flank 8b of the intermediate cutting blade tip 8.
DRILL HEAD FOR DEEP-HOLE DRILLING

RELATED APPLICATIONS


TECHNICAL FIELD

[0002] The present invention relates to a drill head for deep-hole drilling in which a central cutting blade tip is mounted at a center portion, a circumferential cutting blade tip at a circumferential portion and an intermediate cutting blade tip therebetween while facing a cutting chip discharge port opened at a distal end surface of a head main body, and in which an interior of a hollow portion thereof serves as a cutting chip discharge passage communicating with the cutting chip discharge port.

BACKGROUND ART

[0003] FIG. 5 illustrates a deep-hole drilling work state by a conventional deep-hole drilling apparatus. Drilling work is carried out by coupling a proximal end side of a boring bar 41 which holds a drill head 31 at a distal end portion thereof to a spindle of a machine tool or the like via a tool chucks (not shown) to be rotatively driven or otherwise rotate a work material W. Herein, a coolant is supplied in the manner of an external supply system, and a coolant supply jacket 13 encompassing the hollow boring bar 41 oil-tightly is used. While the jacket 13 is press-converted with the work material W via a seal ring 14, the coolant C is supplied from an introduction port 15 into the jacket 13. The coolant C is then supplied to a distal end side of a head main body 32 of the drill head 31 through a gap T between an outer peripheral surface of the boring bar 41 and an inner circumferential surface of a cutting hole H. As seen from FIG. 7(a), the coolant C flows from cutting chip discharge ports 34 and 35 of the head main body 32 (see FIG. 6 and FIG. 7) into a cutting chip discharge passage 40 within the boring bar 41 and is discharged outside, together with cutting chips S generated in a cutting region. Further, as shown in FIG. 6 and FIG. 7(a), the head main body 32 is mounted with a central cutting blade tip 36 at the central portion, a circumferential cutting blade tip 37 at a circumferential portion and an intermediate cutting blade tip 38 therebetween, all of which face the cutting chip discharge ports 34, 35 opened at a distal end surface 32a. In FIG. 6 and FIG. 7, a reference symbol 16 denotes a guide pad provided to a distal end side on an outer periphery of the drill head 31, and a reference symbol 17 denotes a clamp groove provided slightly near the middle on the same outer periphery of the drill head 31.

[0004] Supply systems of a coolant to a cutting region include an internal supply system (double tube system) such as a so-called ejector system as shown in FIG. 7(b) other than the external supply system (single tube system) such as a so-called BTA system as shown in FIG. 5 and FIG. 7(a) as described above. A coolant in the internal supply system is introduced into a coolant supply passage 40a between outer and inner tubes 42 and 43 at a proximal end side of a double-tube boring bar 41 as shown by arrows in FIG. 7(b). The coolant flows outside at a distal end side of the boring bar 41 from a coolant discharge port 46 provided on a circumferential wall of the drill head 31, thereby being supplied to a cutting region side. Together with cutting chips S generated in the cutting region, the coolant is caused to flow from the cutting chip discharge ports 34 and 35 of the drill head 31 into a discharge passage 40b composed of the inside of the inner tube 43, and then the coolant is discharged outside.

[0005] On the other hand, at the time when deep-hole drilling work of a work material W is carried out by the drill head 31 at the distal end portion of the boring bar 41 as described above, cutting chips S of the work material W which are cut by cutting blade tips 36 to 38 are fragmented into pieces smaller than diameters of the cutting chip discharge ports 34 and 35 of the drill head 31 as shown in FIG. 7(a) and FIG. 7(b) and flow from the cutting chip discharge ports 34 and 35 into the inside cutting chip discharge passage 40 or 41b and then are discharged outside until the drill head 31 penetrates the work material W. However, at the time when the drill head 31 penetrates the work material W, that is, when the drill head 31 cuts and breaks through a distal end wall Wo of the work material W as shown by virtual lines in FIG. 5, cutting chips of the work material W having been cut by three of central, circumferential and intermediate cutting blade tips 36 to 38 of the drill head 31 become disc-shaped uncut block pieces called discs Sa to Sd as shown in FIGS. 8(a-1), 8(a-2) to 8(d-1), 8(d-2). The cutting chips are left at the distal end surface side of the head main body without being discharged from the cutting chip discharge ports 34 and 35. It does not much matter when the work material W comprises a single work material, since the uncut block pieces are discharged forward and fall from a hole of the penetrated work material W. On the other hand, there was a problem when a plurality of work materials W1 to W5 are overlaid and subjected to deep-hole drilling work as shown in FIG. 9, when attempting to drill a second work material W2 after a first work material W1 is drilled, discs Sa to Sd are blocked at an exit of a hole of the first work material W1 and the cutting chip discharge ports are clogged, which renders the drilling work unperformable.

[0006] FIG. 8(a-1) and FIG. 8(a-2) are front and cross sectional views of a conical disc Sa generated by the central cutting blade tip 36 of the drill head 31 provided with three of central, circumferential and intermediate cutting blade tips 36 to 38, FIG. 8(b-1) and FIG. 8(b-2) are front and cross sectional views of a toroidal disc Sc generated by the intermediate cutting blade tip 38, FIG. 8(c-1) and FIG. 8(c-2) are front and cross sectional views of a larger diameter toroidal disc Sb generated by the circumferential cutting blade tip 37. FIG. 8(d-1) and FIG. 8(d-2) are front and cross sectional views of a hat-shaped disc Sd generated by the central cutting blade tip 36 and the intermediate cutting blade tip 38 and integrally combined by the disc Sa and the disc Sc.

[0007] The present invention was made in view of the foregoing problem, and an object thereof is to provide a drill head for deep-hole drilling which can fragment cutting chips into small pieces without generating such a disc that clogs a cutting chip discharge port when a head main body of the drill head penetrates a work material, and can discharge the cutting chips from the cutting chip discharge port reliably.

SUMMARY OF THE INVENTION

[0008] Means for solving the above-described problem will be described with reference symbols of embodiments which will be described later. A first aspect of the present invention is a drill head for deep-hole drilling comprising a head main
body 2 having a rotation axis G extending through a head center portion 24 thereof, cutting chip discharge ports 4 and 5 opened at a distal end surface 2a of the head main body 2, a central cutting blade tip 6 mounted at the head center portion so as for a blade edge 6a thereof to be inclined downwardly and inwardly toward the head center portion, a circumferential cutting blade tip 7 mounted at a circumferential portion so as for a blade edge 7a thereof to be inclined upwardly and inwardly toward the head center portion, an intermediate cutting blade tip 8 mounted therebetween so as for a blade edge 8a thereof to be inclined upwardly and inwardly toward the head center portion, the cutting blade tips facing the cutting chip discharge port 4, 5, an interior of a hollow portion 3 of the head main body 2 serving as a cutting chip discharge passage communicating with the cutting chip discharge ports 4 and 5. A disc breaker 12 is provided at a head center side end portion of a forward facing flank 8b of the intermediate cutting blade tip 8. The forward facing flank 8b has a major flank surface 21 which is inclined upwardly and inwardly toward the head center portion connected to a minor flank surface 12 which is inclined downwardly and inwardly toward the head center portion. The minor flank surface 12, which constitutes the disc breaker 12, comprises a truncated distal end surface side of the forward facing flank 8b. In one embodiment, the disc breaker 12 extends along an overlapping region OL where the intermediate cutting blade tip 8 circumferentially overlaps with the central cutting blade tip 6. In another embodiment, the disc breaker 12 extends along an expanded region M which comprises the aforementioned overlapping region OL plus an additional region which extends in a direction away from the head center portion and the rotation axis G.

A second aspect is characterized in that the disc breaker 12 is inclined at an angle θ of between 0 to 60 degrees with respect to a plane Q orthogonal to a rotation axis G of the head main body 2, as seen in FIGS. 2(b) and 3.

Effects by solving means of the present invention will be described with reference symbols of embodiments which will be described later. According to the first aspect of the present invention, the distal end surface side of the forward facing flank 8b in the overlapping region OL or in the expanded region M is truncated to form the disc breaker 12 which comprises a surface that is inclined downwardly and inwardly toward the head center portion. Thus, particularly the border between a cutting chip which is cut by the central cutting blade tip 6 and a cutting chip which is cut by the intermediate cutting blade tip 8 is cut by the disc breaker 12, whereby uncut block pieces to be formed between respective cutting blade tips 6 to 8 and a distal end wall portion of a work material W are fragmented and crushed when the drill head 1 penetrates the work material W. The fragmented and crushed cutting chips flow from the cutting chip discharge ports 4 and 5 into the interior cutting chip discharge passage 3 and are discharged outside.

Accordingly, also in a case where a plurality of work materials W1 to W5 are overlaid and subjected to deep-hole drilling work, uncut block pieces to be formed between respective cutting blade tips 6 to 8 and the distal end wall portion of the work material W are fragmented and crushed at the time of penetrating the first work material W1. Since the fragmented and crushed cutting chips flow from the cutting chip discharge ports 4 and 5 into the interior cutting chip discharge passage 3 and are discharged outside, clogging of the cutting chip discharge ports 4 and 5 of the head main body 2 is eliminated, and normal cutting is carried out on and after the second work material. Thus, deep-hole drilling work of a plurality of overlaid work materials can be carried out properly.

[0012] The disc breaker 12 is preferably formed into such an inclined surface that an angle θ with respect to a plane Q orthogonal to a rotation axis G of the head main body 2 in the overlapping region OL or the expanded region M is in the range of 0 to 60 degrees as in the second aspect of the present invention. When the angle θ is below 0 degrees, that is, a negative angle, the border between the cutting chip which is cut by the central cutting blade tip 6 and the cutting chip which is cut by the intermediate cutting blade tip 8 is resistant to cutting, and there is a concern of not serving the role as the disc breaker 12. When the angle θ exceeds 60 degrees, a peripheral edge of the disc breaker 12 becomes too acute and may possibly be damaged.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1(a) is a front view showing a drill head for deep-hole drilling according to the present invention, and FIG. 1(b) is a plan view thereof.

[0014] FIG. 2(a) is an enlarged partial view of FIG. 1(a), and FIG. 2(b) is a further enlarged partial view thereof.

[0015] FIG. 3 is an enlarged partial view showing another embodiment of a disc breaker according to the present invention, similar to FIG. 2(b).

[0016] FIG. 4(a) is a perspective view showing the drill head according to the present invention, and FIG. 4(b) is a perspective view showing a conventional drill head.

[0017] FIG. 5 is a longitudinal sectional view showing a deep-hole drilling work state by a deep-hole drilling apparatus provided with the conventional drill head.

[0018] FIG. 6 is a plan view showing the conventional drill head.

[0019] FIG. 7 shows the conventional drill head during deep-hole drilling work by a deep-hole drilling apparatus provided with the conventional drill head, and FIG. 7(a) is a cross sectional view along an axis direction in a coolant external supply system and FIG. 7(b) is a cross sectional view along an axis direction in a coolant internal supply system.

[0020] FIG. 8 shows uncut block pieces called discs which are formed by cutting blade tips of the drill head when the drill head penetrates a work material, and FIGS. 8(a-1) to 8(d-1) are front views and FIGS. 8(a-2) to 8(d-2) are cross sectional views.

[0021] FIG. 9 is a cross sectional view of a state where a plurality of work materials are overlaid and subjected to deep-hole drilling work.

DESCRIPTION OF REFERENCE SYMBOLS

[0022] 1: Drill head
[0023] 2: Head main body
[0024] 2a: Distal end surface of head main body
[0025] 3: Hollow portion of head main body (cutting chip discharge passage)
[0026] 4, 5: Chip discharge port
[0027] 6: Central cutting blade tip
[0028] 7: Circumferential cutting blade tip
[0029] 8: Intermediate cutting blade tip
[0030] 8a: Blade edge
[0031] 8b: Flank
[0032] 8c: Cutting Face
[0033] 12: Minor flank surface or Disc breaker

[0034] 21: Major flank surface

[0035] 22: Forward end of head main body

[0036] 23: Ridge

[0037] 24: Head center portion

DETAILED DESCRIPTION

Hereinafter, preferred embodiments of the present invention will be described based on the drawings. FIG. 1(a) is a front view showing a drill head 1 for deep-hole drilling according to the present invention, and FIG. 1(b) is a plan view thereof. FIG. 2(a) is an enlarged partial view of FIG. 1(a), and FIG. 2(b) is a further enlarged partial view thereof. FIG. 3 is an enlarged partial view showing another embodiment of the present invention, similar to FIG. 2(b). FIG. 4(a) is a perspective view showing the drill head 1 according to the present invention, and FIG. 4(b) is a perspective view showing a conventional drill head. In FIG. 4(a), the drill head 1 for deep-hole drilling includes a substantially cylindrical head main body 2 having a distal side end formed into a substantially obtuse conical shape. An interior of the head main body 2 forms a hollow portion 3 (FIG. 1) and a lower end side of the head main body 2 is opened entirely.

[0039] The substantially obtuse conical distal end surface 2a of the head main body is formed with a large and a small cutting chip discharge port 4 and 5 axially to each other and communicating with the hollow portion 3. At an opening edge along a head diameter direction of the large cutting chip discharge port 4, the central cutting blade tip 6 and the circumferential cutting blade tip 7 are braided to depressions 9 to 11 provided to the head respectively, whereas at an opening edge along a head diameter direction of the small cutting chip discharge port 5, the intermediate cutting blade tip 8 is braided to depressions 9 to 11 provided to the head.

[0040] As shown in FIG. 1(a), FIG. 2 and FIG. 4(a), the central cutting blade tip 6 is mounted so as for a blade edge 6a thereof to be inclined downwardly and inwardly toward the head center portion 24. Thus, a forward facing flank 6b is also inclined downwardly and inwardly toward the head center portion 24. The circumferential cutting blade tip 7 is mounted so as for a blade edge 7a thereof to be inclined upwardly and inwardly toward the head center portion 24, and thus a forward facing flank 7b is also inclined upwardly and inwardly toward the head center portion 24. The intermediate cutting blade tip 8 is mounted so as for a blade edge 8a thereof to be inclined upwardly and inwardly toward the head center portion 24 in the same manner as the circumferential cutting blade tip 7, and thus a major flank surface 21 of a forward facing flank 8b is also inclined upwardly and inwardly toward the head center portion 24. In FIG. 2 and FIG. 3, reference symbols 6c, 7c and 8c denote cutting faces, and reference symbols 6d, 7d and 8d denote cutting chip breakers. Further, in FIGS. 1 to 3, reference symbol G denotes a rotation axis of the head main body 2.

[0041] At its forward end 22, the drill head 1 according to the present invention is characterized by the intermediate cutting blade tip 8 having a forward facing flank 8b, the forward facing flank 8b comprising a major flank surface 21 associated with the blade edge 8a connected to a minor flank surface 12, the minor flank surface 12 being closer to the rotation axis G than the major flank surface 21 and serving as a disc breaker 12. The disc breaker 12 constitutes a truncated portion of the forward facing flank 8b along at least an overlapping region OL where the intermediate cutting blade tip 8 circumferentially overlaps with the central cutting blade tip 6. The disc breaker 12 comprises a surface that is inclined downwardly and inwardly toward the head center portion 24, at a head center side end portion of the forward facing flank 8b of the intermediate cutting blade tip 8 whose major flank surface 21 is inclined upwardly and inwardly toward the head center portion 24, as seen from FIG. 2(a) and FIG. 2(b). In FIG. 2(b), the truncated region of the intermediate cutting blade tip 8 is filled with black and denoted by symbol K. More accurately, the term disc breaker is used for convenience by the present applicant in order to precisely represent a role as a breaker of transversely fragmenting and crushing discs Sa to Sd (FIG. 8) which are disc-shaped uncut block pieces formed by the central cutting blade tip 6, circumferential cutting blade tip 7, and intermediate cutting blade tip 8.

[0042] Thus, the forward facing flank 8b of the intermediate cutting blade tip 8 comprises a major flank surface 21 which is inclined upwardly and inwardly toward the head center portion 24 and a minor flank surface 12 which is inclined downwardly and inwardly toward the head center portion 24, the minor flank surface serving as the disc breaker. The major flank surface 21 and the minor flank surface 12 meet at a ridge 23.

[0043] In this embodiment, the disc breaker 12 comprises an inclined surface having an angle 0 of 20 degrees with respect to a plane Q orthogonal to the rotation axis G of the head main body 2 in the aforementioned overlapping region OL as shown in FIG. 2(b). In this case, an angle 0 between the blade edge 8a which is inclined upwardly and inwardly toward the head center portion 24 and the orthogonal plane Q is 20 degrees.

[0044] In the embodiment shown in FIGS. 2(a) and 2(b), the forward facing flank 8b of the intermediate cutting blade tip 8 is truncated only in the overlapping region OL where the intermediate cutting blade tip 8 circumferentially overlaps with the central cutting blade tip 6, to form the disc breaker 12.

[0045] However, the disc breaker 12 according to the present invention is not restricted only to the overlapping region OL. The disc breaker 12 can comprise a surface that extends beyond the overlapping region OL in a direction away from the head center portion 24. Such an embodiment is shown in FIG. 3. In the embodiment shown in FIG. 3, the disc breaker 12 extends into an expanded region M which comprises the aforementioned overlapping region OL along with a further region which extends in a direction away from the head center portion 24 and the rotation axis G. The further region may, for example, be about a half to a third of a width of the overlapping region OL). In the expanded region M, the disc breaker 12 again comprises a surface that is downwardly inclined toward the head center portion 24 from the upwardly inclined major flank surface 21 of the forward facing flank 8b of the intermediate cutting blade tip 8.

[0046] In the embodiment shown in FIG. 3, along the entire length of the region M, the downwardly and inwardly inclined disc breaker 12 forms an angle 0 with respect to the plane Q orthogonal to the rotation axis G of the head main body 2. In one embodiment, angle 0 is about 20 degrees. As also seen in the embodiment of FIG. 3, the upwardly and inwardly inclined blade edge 8a of the intermediate cutting blade tip 8 and the orthogonal plane Q form an angle 0, which in one embodiment is about 20 degrees.
FIG. 4(b) shows a conventional drill head 31. As seen from a comparison with the drill head 1 according to the present invention, the central cutting blade tip 36 and the circumferential cutting blade tip 37 of the conventional drill head 31 are of the same structure with the central cutting blade tip 6 and the circumferential cutting blade tip 7 of the drill head according to the present invention, respectively. However, the intermediate cutting blade tip 38 is formed such that a blade edge 38 and flank 38/ thereof are upwardly inclined upward from a head periphery end portion to a head center side end portion. As seen from reference to FIG. 2(b), the truncated region K at the distal end surface side of the region OL where the intermediate cutting blade tip 8 circumferentially overlaps with the central cutting blade tip 6 is left as is. Accordingly, the cutting tip Sa cut by the central cutting blade tip 6 and the cutting tip Sc cut by the intermediate cutting blade tip 8 are connected in the remaining region K (FIG. 2(b)) and cannot be broken off.

As a result, cutting chips of the work material W cut by the central, circumferential and intermediate cutting blade tips 36 to 38 of the conventional drill head 31 become uncut block pieces called discs Sa to Sd as shown in FIG. 8. When the drill head 31 penetrates the work material W, that is, when the drill head 31 cuts and breaks through a distal end wall portion W0 of the work material W as shown by virtual lines in FIG. 5. Consequently, the cutting chips are left at the distal end surface side of the head main body without being discharged from the cutting chip discharge ports 34 and 35. It does not matter as much when the work material W comprises work material having unitary one-piece construction, since the cutting chips are discharged forward and fall from the far end of a hole formed in the penetrated work material W. On the other hand, drilling work becomes impossible when a plurality of work materials W1 to W5 are overlaid and subjected to deep-hole drilling work as shown in FIG. 9. Since the discs Sa to Sd are blocked at an exit of a hole of a first work material W1 and the cutting chip discharge ports are clogged when attempting to drill a second work material W2 after the first work material W1 is drilled.

According to the drill head 1 of the present invention, the intermediate cutting blade tip 8 has a forward facing flank 80 comprising a major flank surface 21 which is upwardly inclined towards the head center portion 24 and connects to a disc breaker 12 (minor flank surface) which is downwardly inclined towards the head center portion 24. The disc breaker 12 extends on the head center portion side of the intermediate cutting blade tip 8 along either just the overlapping region OL (embodiment of FIGS. 2(a) and 2(b)). In the region M which includes the region OL and a further region extending in a direction away from the head center portion 24 and the rotation axis G. Therefore, the border between the cutting chip which is cut by the central cutting blade tip 6 and the cutting chip which is cut by the intermediate cutting blade tip 8 is cut by the disc breaker 12, and so is the border between the cutting chip which is cut by the central cutting blade tip 8 and the cutting chip which is cut by the circumferential cutting blade tip 7. As a result, uncut block pieces to be formed between respective cutting blade tips 6 to 8 and the distal end wall portion of the work material W are fragmented and crushed when the drill head 1 penetrates the work material W. The fragmented and crushed cutting chips flow from the cutting chip discharge ports 4 and 5 into the interior cutting chip discharge passage 3 to be discharged outside.

Accordingly, even when a plurality of work materials W1 to W5 are overlaid and subjected to deep-hole drilling work as shown in FIG. 9, uncut block pieces to be formed between respective cutting blade tips 6 to 8 and the distal end wall portion of the work material W are fragmented and crushed at the time of penetrating the first work material W1. The fragmented and crushed cutting chips flow from the cutting chip discharge ports 4 and 5 into the interior cutting chip discharge passage 3 and are discharged outside. As a result, clogging of the cutting chip discharge ports 4 and 5 of the head main body 2 is eliminated, and normal cutting is carried out and after the second work material. Thus, deep-hole drilling of a plurality of overlaid work materials can be performed properly.

The afore-described inclined disc breaker 12 is preferably formed such that an angle θ with respect to the plane Q orthogonal to the rotation axis G of the head main body 2 is in the range of 0 to 60 degrees. When the angle θ is below 0 degrees, that is, a negative angle, the border between the cutting chip which is cut by the central cutting blade tip 6 and the cutting chip which is cut by the intermediate cutting blade tip 8 is resistant to cutting, and there is a concern of not serving the role as the disc breaker 12. When the angle θ exceeds 60 degrees, a periphery edge side of the disc breaker 12 becomes too acute and may possibly be damaged.

What is claimed is:

1. A deep-hole drilling drill head comprising: a head main body having a forward end and a rotation axis (G) extending through a head center portion thereof; at least one cutting chip discharge port opened at a distal end surface of the head main body; a central cutting blade tip mounted at the head center portion so as for a blade edge thereof to be inclined downwardly and inwardly toward the head center portion; a circumferential cutting blade tip mounted at a circumferential portion so as for a blade edge thereof to be inclined upwardly and inwardly toward the head center portion; an intermediate cutting blade tip mounted between the central and circumferential cutting blade tips, the intermediate cutting blade tip having a blade edge inclined upwardly and inwardly toward the head center portion, the central cutting blade tip, the circumferential cutting blade tip and the intermediate cutting blade tip each facing the at least one cutting chip discharge port; an interior of a hollow portion of the head main body serving as a cutting chip discharge passage communicating with the at least one cutting chip discharge port; and a disc breaker provided at a head center side end portion of a forward facing flank of the intermediate cutting blade tip, the disc breaker extending along at least an overlapping region (OL) where the intermediate cutting blade tip circumferentially overlaps with the central cutting blade tip, the disc breaker comprising a surface that is inclined downwardly and inwardly toward the head center portion.

2. The deep-hole drilling drill head according to claim 1, wherein the disc breaker forms a first angle (θ) with respect to a plane (Q) orthogonal to the rotation axis (G), said first angle (θ) being in the range of 0 to 60 degrees.

3. The deep-hole drilling drill head according to claim 2, wherein said first angle (θ) is about 20 degrees.

4. The deep-hole drilling drill head according to claim 2, wherein the upwardly and inwardly inclined blade edge of the
intermediate cutting blade tip forms a second angle (α) with respect to a plane (Q) orthogonal to the rotation axis (G), said second angle (α) being about 20 degrees.

5. The deep-hole drilling drill head according to claim 1, wherein the disc breaker extends along an expanded region (M) which comprises the aforementioned overlapping region (OL) plus an additional region which extends in a direction away from the head center portion and the rotation axis G.

6. The deep-hole drilling drill head according to claim 5, wherein, along the entire expanded region (M), the disc breaker forms a first angle (θ) with respect to a plane (Q) orthogonal to the rotation axis (G), said first angle (θ) being in the range of 0 to 60 degrees.

7. The deep-hole drilling drill head according to claim 6, wherein the upwardly and inwardly inclined blade edge of the intermediate cutting blade tip forms a second angle (α) with respect to a plane (Q) orthogonal to the rotation axis (G), said second angle (α) being about 20 degrees.

8. The deep-hole drilling drill head according to claim 1, wherein:

the forward facing flank of the intermediate cutting blade tip comprises a major flank surface which is inclined upwardly and inwardly toward the head center portion, and a minor flank surface which is inclined downwardly and inwardly toward the head center portion;

the major flank surface is connected to the minor flank surface at a ridge; and

the minor flank surface constitutes the disc breaker.

9. The deep-hole drilling drill head according to claim 8, wherein:

the major flank surface is associated with the upwardly and inwardly inclined blade edge;

the minor flank surface forms a first angle (θ) with respect to a plane (Q) orthogonal to the rotation axis (G), said first angle (θ) being in the range of 0 to 60 degrees; and

the major flank surface forms a second angle (α) with respect to a plane (Q) orthogonal to the rotation axis (G), said second angle (α) being about 20 degrees.

10. A deep-hole drilling drill head comprising:

a head main body having a forward end and a rotation axis (G) extending through a head center portion thereof;

at least one cutting chip discharge port opened at a distal end surface of the head main body;

a central cutting blade tip mounted at the head center portion so as for a blade edge thereof to be inclined downwardly and inwardly toward the head center portion;

a circumferential cutting blade tip mounted at a circumferential portion so as for a blade edge thereof to be inclined upwardly and inwardly toward the head center portion;

the intermediate cutting blade tip mounted between the central and circumferential cutting blade tips, the intermediate cutting blade tip having a blade edge inclined upwardly and inwardly toward the head center portion,

the central cutting blade tip, the circumferential cutting blade tip and the intermediate cutting blade tip each facing the at least one cutting chip discharge port;

an interior of a hollow portion of the head main body serving as a cutting chip discharge passage communicating with the at least one cutting chip discharge port;

the intermediate cutting blade tip has a forward facing flank comprising:

major flank surface associated with the blade edge and inclined upwardly and inwardly toward the head center portion; and

a minor flank surface connected to the major flank surface and inclined downwardly and inwardly toward the head center portion, the minor flank surface being closer to the rotation axis than the major flank surface;

and

the minor flank surface constitutes a disc breaker which extends along at least an overlapping region (OL) where the intermediate cutting blade tip circumferentially overlaps with the central cutting blade tip.

11. The deep-hole drilling drill head according to claim 10, wherein the disc breaker forms a first angle (θ) with respect to a plane (Q) orthogonal to the rotation axis (G), said first angle (θ) being in the range of 0 to 60 degrees.

12. The deep-hole drilling drill head according to claim 11, wherein said first angle (θ) is about 20 degrees.

13. The deep-hole drilling drill head according to claim 11, wherein the upwardly and inwardly inclined blade edge of the intermediate cutting blade tip forms a second angle (α) with respect to a plane (Q) orthogonal to the rotation axis (G), said second angle (α) being about 20 degrees.

14. The deep-hole drilling drill head according to claim 10, wherein the disc breaker extends along an expanded region (M) which comprises the aforementioned overlapping region (OL) plus an additional region which extends in a direction away from the head center portion and the rotation axis G.

15. The deep-hole drilling drill head according to claim 14, wherein, along the entire expanded region (M), the disc breaker forms a first angle (θ) with respect to a plane (Q) orthogonal to the rotation axis (G), said first angle (θ) being in the range of 0 to 60 degrees.

16. The deep-hole drilling drill head according to claim 15, wherein the upwardly and inwardly inclined blade edge of the intermediate cutting blade tip forms a second angle (α) with respect to a plane (Q) orthogonal to the rotation axis (G), said second angle (α) being about 20 degrees.

17. The deep-hole drilling drill head according to claim 10, wherein:

the major flank surface is connected to the minor flank surface at a ridge.

18. The deep-hole drilling drill head according to claim 10, wherein:

the minor flank surface forms a first angle (θ) with respect to a plane (Q) orthogonal to the rotation axis (G), said first angle (θ) being in the range of 0 to 60 degrees; and

the major flank surface forms a second angle (α) with respect to a plane (Q) orthogonal to the rotation axis (G), said second angle (α) being about 20 degrees.

* * * * *