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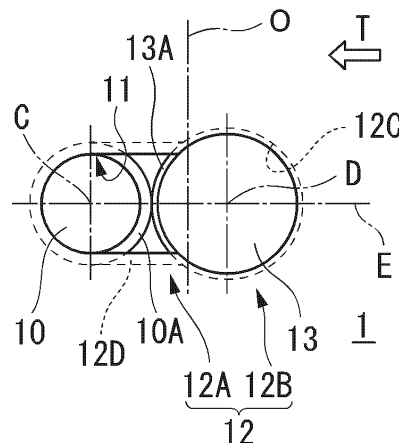
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(54) **EXCAVATION TOOL**

(57) A drilling tool has a tool main body including a fitting hole portion and a striking force being applied to a tip side in an axial, and a fitting member including a fitting shaft portion, wherein the fitting shaft portion has a recessed groove, a locking pin is inserted into a pin hole provided in the tool main body, and is locked by the recessed groove, a fixing member for retaining the locking pin is fitted to an opening portion of the pin hole, a locking portion for locking the fixing member in a pin hole center line direction is provided in the opening portion, a recess

is provided on an outer peripheral surface of the tool main body adjacent to the opening portion of the pin hole, the recess has an auxiliary member having a side surface capable of coming into contact with a side surface facing the recess of the fixing member and maintaining a locked state between the fixing member and the locking portion, and when viewed in a center line direction of the pin hole, a straight line connecting a center of the recess and a pin hole center line to each other extends in a direction intersecting an axis of the tool main body.

FIG. 5



Description

Technical Field

[0001] The present disclosure relates to a drilling tool that has a tool main body configured to be rotated around an axis, and an impelling force and a striking force being applied toward a tip side of the drilling tool in a direction of the axis, and a fitting member including a fitting shaft portion to be inserted into a fitting hole portion open at a position eccentric from the axis of a tip portion of the tool main body and to be detachably fitted to the tool main body.

Background Art

[0002] As the drilling tool configured in this way, a so-called extendable bit or under-reaming bit is known in which the fitting hole portion is open at the position eccentric from the axis of the tip portion of the tool main body (device) rotated around the axis, the fitting shaft portion is inserted into the fitting hole portion, and a drilling unit having a hard tip is disposed in a tip of the fitting member (bit head) detachably fitted to the tool main body. In the extendable bit configured in this way, as the tool main body is rotated, the fitting member is rotated around a center line of the fitting shaft portion, and a radius from the axis of the drilling unit is enlarged and reduced. In an enlarged state of the radius, a large diameter bore hole is provided, and the fitting member can be pulled out and recovered in a state where an inner diameter of a casing pipe inserted into the bore hole is reduced.

[0003] In order to insert the fitting shaft portion into the fitting hole portion in this way and to fit the fitting member into the tool main body so as to not only be detachable but also rotatable around the center line of the fitting shaft portion, for example, PTL 1 discloses the following drilling tool. A recessed groove intersecting an extending direction of the fitting shaft portion is provided on an outer peripheral surface of the fitting shaft portion. A pin hole extending in a direction intersecting an extending direction of the fitting hole portion and penetrating the fitting hole portion is provided in the tool main body. A locking pin engaging with the recessed groove of the fitting shaft portion is inserted into the pin hole. The recessed groove is provided in an L shape when viewed in a rotational axis direction of the fitting shaft portion, and the fitting member engages with the locking pin by way of the L-shape provided by the recessed groove so as to be rotatable and retainable. The locking pin is pulled out from the pin hole, thereby enabling the fitting member to be removed from the tool main body.

[0004] In addition, in PTL 1, the following has been proposed. As means for fixing the locking pin to the pin hole except when the fitting member is removed, a disk-shaped fixing member made of a rigid body and fixing the locking pin by coming into contact with an end surface of the locking pin, and a locking portion locking and fixing

the fixing member in the extending direction of the pin hole are disposed in an opening portion of the pin hole. Furthermore, in PTL 1, the following has also been proposed. A disk-shaped auxiliary member made of an elastic body such as synthetic rubber and maintaining a locked state between the fixing member and the locking portion is located in the tool main body.

[0005] Here, a slide groove for the fixing member to slide thereon is provided in the tool main body so as to extend parallel to the axis of the tool main body when viewed in a center line direction of the pin hole. In one end of the slide groove, the pin hole is open, and the locking portion is provided therein. In addition, an insertion portion of the fixing member is disposed in the other end of the slide groove. The fixing member inserted from the insertion portion is slid to one end of the slide groove and is locked by the locking portion. Thereafter, the auxiliary member is fitted to the insertion portion and presses the fixing member. In this manner, the fixing member is prevented from being moved, and the locked state is maintained between the fixing member and the locking portion.

Citation List

Patent Literature

[0006] [PTL 1] Japanese Patent No. 4957440

Summary of Invention

Technical Problem

[0007] Incidentally, when the bore hole is provided using drilling tool such as the above-described extendable bit, together with a rotating force for rotating the tool main body around the axis, an impelling force acting toward towards the tip side in the axial direction and a striking force similarly acting toward the tip side in the axial direction are applied to the tool main body. A bedrock is crushed using the hard tip fitted to the fitting member or the tip of the tool main body. Then, due to an impact caused by the striking force, the fixing member tries to vigorously slide between the tip side and a posterior end side inside the slide groove extending in the axial direction of the tool main body.

[0008] However, according to the drilling tool disclosed in PTL 1, sliding of the fixing member is prevented by the auxiliary member pressing the fixing member by as described above. However, the slide groove extends parallel to the axis of the tool main body, and the opening portion of the pin hole and the insertion portion of the auxiliary member are aligned with each other in the axial direction when viewed in the center line direction of the pin hole. Accordingly, it is inevitable that a pressing force acts on the auxiliary member when the fixing member tries to slide. Moreover, the fixing member has the disk shape, and the auxiliary member also has the disk shape.

Consequently, the auxiliary member presses the fixing member by coming into point contact with the fixing member.

[0009] Therefore, even if the auxiliary member tries to prevent movement of the fixing member by pressing the fixing member, the pressing force received by the auxiliary member when the fixing member tries to move inside the slide groove concentrates on one point oriented in the axial direction of the auxiliary member, thereby causing a possibility that the auxiliary member made of a soft elastic body may be subjected to abrasion from this one point. Then, if this abrasion occurs once in this way and a gap is provided between the fixing member and the auxiliary member, the fixing member vigorously slides in the axial direction in the gap. Consequently, the abrasion is progressively accelerated, and the gap spreads instantaneously. In some cases, the auxiliary member is detached from the insertion portion, and thus, the locked state cannot be maintained between the fixing member and the locking portion.

[0010] The present disclosure is made in view of the above-described circumstances, and an object thereof is to provide a drilling tool which can prevent abrasion of an auxiliary member by reducing a pressing force generated when a fixing member tries to vigorously slide between a tip side and a posterior end side in an axial direction of a tool main body, and which can perform stable excavation by maintaining a locked state between the fixing member and a locking portion even when long-term excavation tasks are carried out.

Solution to Problem

[0011] According to an aspect of the present disclosure, in order to achieve this object by solving the above-described problem, there is provided a drilling tool including a tool main body configured to be rotated around an axis thereof and to receive a striking force acting toward a tip side thereof in a direction of the axis; and a fitting member including a fitting shaft portion to be inserted into a fitting hole portion which is open in a tip portion of the tool main body so as to be detachably fitted to the tool main body. An outer peripheral surface of the fitting shaft portion has a recessed groove provided along a virtual plane orthogonal to a center line of the fitting shaft portion. A pin hole, which is partially open on an inner peripheral surface of the fitting hole portion by extending from an outer peripheral surface to an inner peripheral side of the tool main body along the virtual plane of the fitting shaft portion inserted into the fitting hole portion, is formed in the tool main body. A locking pin is inserted into the pin hole so as to be locked by the recessed groove of the fitting shaft portion inserted into the fitting hole portion. A fixing member for retaining the locking pin by coming into contact with the locking pin is fitted to an opening portion of the pin hole on the outer peripheral surface of the tool main body, and a locking portion for locking the fixing member in a center line direction of the pin hole is

provided in the opening portion. The outer peripheral surface of the tool main body adjacent to the opening portion of the pin hole has a recess which communicates with the opening portion of the pin hole. The recess has an auxiliary member which has a side surface capable of coming into contact with a side surface facing the recess of the fixing member and which maintains a locked state between the fixing member and the locking portion. When viewed in the center line direction of the pin hole, a straight line connecting a center of the recess and a center line of the pin hole to each other extends in a direction intersecting the axis.

[0012] According to the drilling tool configured in this way, when viewed in the center line direction of the pin hole, the straight line connecting the center of the recess in which the auxiliary member is located and the center line of the pin hole in which the fixing member is fitted to the opening portion extends in the direction intersecting the axis of the tool main body. Accordingly, a component force acting in the axial direction out of the pressing force acting when the fixing member tries to move due to the striking force applied to the tool main body toward the tip side in the axial direction can be received and stopped by the tool main body having the opening portion. In this manner, it is possible to reduce a pressing force received by the auxiliary member. Therefore, it is possible to prevent abrasion in the auxiliary member which is caused by the pressing force. In this manner, the fixing member can be stably locked by the locking portion over a long period of time by preventing a gap between the fixing member and the auxiliary member from spreading instantaneously due to the abrasion occurring once.

[0013] When viewed in the center line direction of the pin hole, the straight line connecting the center of the recess and the center line of the pin hole to each other may extend in the direction obliquely intersecting the axis. However, if the straight line extends in a direction orthogonal to the axis, almost of the all pressing force generated by the striking force can be received and stopped by the tool main body, and it is possible to more reliably prevent the abrasion of the auxiliary member. In addition, when viewed in the center line direction of the pin hole, if the straight line connecting the center of the recess and the center line of the pin hole to each other extends in the direction orthogonal to the axis, it is possible to shorten a length in the axial direction of a portion where the recess and the pin hole are provided in the tool main body. Accordingly, it is possible to achieve reduced manufacturing cost of the tool main body.

[0014] Furthermore, if the recess extended from the opening portion of the pin hole to a side opposite to a rotation direction of the tool main body, the pressing force acting in the rotation direction of the fixing member which is generated when the striking force is applied to the tool main body while the tool main body is rotated can be received and stopped by the tool main body. Accordingly, it is possible to further prevent the abrasion of the auxiliary member.

[0015] Therefore, according to this configuration, the tool main body has the fitting hole portion which is open at a position eccentric from the axis of the tip portion. The fitting member is a bit head in which a drilling unit having a hard tip is disposed in a tip of the fitting shaft portion and is rotated around the center line of the fitting shaft portion so that a radius from the axis of the drilling unit is enlarged and reduced in response to rotation of the tool main body. This configuration is applied to the drilling tool such as the above-described extendable bit. In this manner, it is possible to prevent the abrasion of the auxiliary member due to the impact caused by the striking force on tip side in the axial direction. Therefore, it is more preferable to adopt this configuration.

Advantageous Effects of Invention

[0016] As described above, according to the present disclosure, it is possible to prevent abrasion of an auxiliary member even when long-term excavation tasks are carried out, and it is possible to maintain a locked state between a fixing member and a locking portion. Therefore, stable excavation can be performed.

Brief Description of Drawings

[0017]

FIG. 1 is a side sectional view illustrating an embodiment of the present disclosure.

FIG. 2 is a front view when a bit head in a state of being enlarged in diameter is viewed from a tip side according to the embodiment illustrated in FIG. 1 (however, a casing pipe and a casing top are not illustrated).

FIG. 3 is a front view when the bit head in a state of being reduced in diameter is viewed from the tip side according to the embodiment illustrated in FIG. 1 (however, the casing pipe and the casing top are not illustrated).

FIG. 4 is a sectional view taken along line Z-Z in FIG. 1 (however, the casing pipe and the casing top are not illustrated).

FIG. 5 is a partially enlarged side view when viewed in a direction of an arrow X in FIG. 4.

FIG. 6 is a plan view of a fixing member according to the embodiment illustrated in FIG. 1.

FIG. 7 is a side sectional view of the fixing member illustrated in FIG. 6.

FIG. 8 is a plan view of an auxiliary member according to the embodiment illustrated in FIG. 1.

FIG. 9 is a side sectional view of the auxiliary member illustrated in FIG. 8.

FIG. 10 is a view for describing a fixing method of a locking pin according to the embodiment illustrated in FIG. 1.

Description of Embodiments

[0018] FIGS. 1 to 10 illustrate an embodiment according to the present disclosure. The embodiment shows a case when the present disclosure is applied to an extendable bit as described above. In the present embodiment, a tool main body 1 is a device of this extendable bit, which is provided of a steel material in a columnar shape having an outer shape of substantially multi-stages whose axis O serves as a center. A posterior end portion thereof (right side portion in FIG. 1) is a shank portion 1A having the smallest diameter.

[0019] In the drilling tool configured in this way, a striking force is applied to a tip side of the tool main body 1 in a direction of the axis O by a down-the-hole hammer H connected to the above-described shank portion 1A. A rotating force acting around the axis O and an impelling force acting on the tip side in the direction of the axis O are applied in a tool rotation direction T from an excavation device (not illustrated) connected via a drill rod (not illustrated) to the down-the-hole hammer H, thereby excavating the ground (bedrock) so as to form a bore hole.

[0020] On a tip side (left side in FIG. 1) of the shank portion 1A of the tool main body 1, a step portion 1B having the largest diameter is provided, and the tool main body 1 is provided in a cylindrical shape having a constant outer diameter on the further tip side from the step portion 1B. In addition, on an outer periphery of the tool main body 1, a casing pipe P having a slightly larger inner diameter than that of the step portion 1B is located. A casing top Q having a slightly larger inner diameter than an outer diameter of the tool main body 1 on the further tip side from the step portion 1B is fitted to a tip of the casing pipe P. The step portion 1B comes into contact with a posterior end of the casing top Q, thereby applying the impelling force and the striking force to the tip side in the direction of the axis O. In this manner, the casing pipe P is inserted into the bore hole provided by the drilling tool.

[0021] The tip portion of the tool main body 1 has a recessed portion 2 which is open on a tip surface and an outer peripheral surface of the tool main body 1 so as to be located on the further tip side from the casing top Q, in a state where the step portion 1B is in contact with the posterior end of the casing top Q as described above. The recessed portion 2 has a bottom surface 2A facing the tip side of the tool main body 1 and perpendicular to the axis O, a flat wall surface 2B extending parallel to the axis O from the bottom surface 2A to the tip surface of the tool main body 1 and oriented in a tool rotation direction T, and a flat wall surface 2C facing an outer peripheral side of the tool main body 1. A corner portion 2D where the wall surfaces 2B and 2C intersect each other is provided in a recessed cylindrical shape having a center line parallel to the axis O. According to the present embodiment, three recessed portions 2 are provided at an equal distance in a circumferential direction.

[0022] Furthermore, a fitting hole portion 3 according to the present embodiment is provided from the bottom

surface 2A to the posterior end side of the recessed portions 2. The fitting hole portion 3 is provided in a circular cross-sectional shape having a constant inner diameter, in which the center is set as a hole portion center line L1 parallel to the axis O and eccentric from the axis O to the outer peripheral side. The hole portion center line L1 is located coaxially with the center line of the recessed cylindrical surface provided by the corner portion 2D of the recessed portion 2, and the inner diameter (diameter) of the fitting hole portion 3 is slightly smaller than the diameter of the recessed cylindrical surface provided by the corner portion 2D.

[0023] The fitting member 5 detachably fitted to the tool main body 1 by inserting a fitting shaft portion 4 into the fitting hole portion 3 in this way is a bit head of the extendable bit, and the present embodiment adopts a configuration in which a drilling unit 6 is integrally provided in the tip of the fitting shaft portion 4. The tip surface of the drilling unit 6 and the tip surface the recessed portions 2 of the tool main body 1 have multiple embedded hard tips 7 made of a cemented carbide alloy which is harder than the tool main body 1 or the fitting member 5 made of steel. The ground is crushed by the hard tips 7 so as to perform excavation.

[0024] The fitting shaft portion 4 is provided in a cylindrical shaft shape having a shaft portion center line L2 as the center, and its outer diameter is provided so as to be slightly smaller than the inner diameter of the fitting hole portion 3, and is provided so that a length thereof is approximately equal to a depth of the fitting hole portion 3. Therefore, the fitting shaft portion 4 is slidably fitted into the fitting hole portion 3, and is inserted such that the shaft portion center line L2 is coaxial with the hole portion center line L1. When a posterior end surface thereof comes into contact with a bottom surface of the fitting hole portion 3, the posterior end surface of the drilling unit 6 comes into contact with a bottom surface 2A of the recessed portion 2. In this way, in an inserted state where the fitting shaft portion 4 is inserted into the fitting hole portion 3, the fitting member 5 is rotatable around the hole portion center line L1.

[0025] In addition, when viewed from the tip, the drilling unit 6 includes two flat side surfaces which are substantially parallel to each other as illustrated in FIGS. 2 and 3 or which are closer to each other as both of these face the fitting shaft portion 4 side at an angle smaller than an angle formed between the wall surfaces 2B and 2C of the recessed portion 2, and two side surfaces having a protruded cylindrical surface extending on the fitting shaft portion 4 side and the side opposite to the fitting shaft portion 4 between both the flat side surfaces. The side surfaces are provided so as to be parallel to the shaft portion center line L2, that is, so as to be parallel to the axis O of the hole portion center line L1 and the tool main body 1 in the above-described inserted state. With regard to the side surfaces, the side surface having the protruded cylindrical surface on the fitting shaft portion 4 side is a cylindrical surface having the shaft portion center line

L2 as the center. A radius of the cylindrical surface is slightly smaller than a radius of the recessed cylindrical surface provided by the corner portion 2D of the recessed portion 2, and the cylindrical surface can come into sliding contact with the corner portion 2D in the above-described inserted state.

[0026] Therefore, when the tool main body 1 is rotated in the tool rotation direction T during the excavation in the inserted state, due to resistance from the ground, the fitting member 5 is rotated around the hole portion center line L1 to the side opposite to the tool rotation direction T, and the radius from the axis O is enlarged. As illustrated in FIG. 2, the fitting member 5 is positioned at a location where the flat side surface of the drilling unit 6 facing the side opposite to the tool rotation direction T comes into contact with the wall surface 2B facing the tool rotation direction T of the recessed portion 2. In this case, the side surface having the protruded cylindrical surface on the side opposite to the fitting shaft portion 4 of the drilling unit 6 is located on the cylindrical surface having the larger outer diameter than that of the casing pipe P having the axis O of the tool main body 1 as the center. In this manner, the bore hole into which the casing pipe P can be inserted is provided by the hard tip 7 located on the tip side.

[0027] Also, if the tool main body 1 is rotated to the side of the opposite to the tool rotation direction T set during the excavation after the excavation is completed, due to the resistance from the ground, the fitting member 5 is rotated around the hole portion center line L1 in the tool rotation direction T, and the radius from the axis O is reduced. As illustrated in FIG. 3, the fitting member 5 is positioned at a location where the flat side surface of the drilling unit 6 facing the inner peripheral side of the tool main body 1 comes into contact with the wall surface 2C facing the outer peripheral side of the recessed portion 2 in the tool main body 1. In this case, the drilling unit 6 is accommodated inside the cylindrical surface having an outer diameter equal to an outer diameter of a cylinder provided by a portion on the further tip side from the step portion 1B of the tool main body 1. Together with the above-described down-the-hole hammer H and the drill rod, the tool main body 1 and the fitting member 5 as well are moved rearward to the posterior end side in the direction of the axis O, and can be pulled out from the inside of the casing pipe P.

[0028] Furthermore, the outer peripheral surface of the fitting shaft portion 4 of the fitting member 5 has a recessed groove 4A along a virtual plane orthogonal to the shaft portion center line L2, that is, a virtual plane A orthogonal to the hole portion center line L1 in the above-described inserted state. The recessed groove 4A is provided on a side surface side having a protruded cylindrical surface on the fitting shaft portion 4 side of the drilling unit 6 when viewed in a direction of the shaft portion center line L2. According to the present embodiment, a cross section along the virtual plane A is provided in an L-shape. However, this portion bent in the L-shape is pro-

vided in a protruded arc shape whose center is the shaft portion center line L2 which comes into contact with a linearly extending portion on both sides thereof. In addition, in a cross section along the shaft portion center line L2, the recessed groove 4A is provided in a semicircular oval shape extending in the direction of the shaft portion center line L2 as illustrated in FIG. 1.

[0029] On the other hand, a pin hole 8, which is provided along the virtual plane A orthogonal to the hole portion center line L1 in the same inserted state, is formed in the tool body 1. The pin hole 8 is circular in cross section according to the present embodiment, and each pin hole 8 has a pin hole center line C extending so as to substantially come into contact with the inner peripheral surface of the three fitting hole portions 3 provided at an equal distance in the circumferential direction, from the side opposite to the tool rotation direction T. The pin hole 8 is provided in a blind hole shape facing the inner peripheral side, which is open on the outer peripheral surface of the tool main body 1. Therefore, the pin holes 8 is partially open to the inner peripheral surface of the fitting hole portion 3 at a portion where the pin hole center line C substantially comes into contact with the inner peripheral surface of the fitting hole portion 3.

[0030] A radius of the pin hole 8 is substantially equal to a depth from the outer peripheral surface of the fitting shaft portion 4 to the groove bottom of the recessed groove 4A and the depth of a groove bottom of the recessed groove 4A in a portion in contact with the inner peripheral surface of the two fitting hole portions 3. An opening portion of the pin hole 8 to the outer peripheral surface of the tool main body 1 is open on the outer peripheral surface of the tool main body 1 while the radius is maintained without any change except for a locking portion to (be described later). Then, a locking pin 9 having a cylindrical shaft shape whose outer diameter is slightly smaller than the inner diameter of the pin hole 8 is inserted into the pin hole 8, and one end surface of the locking pin 9 which faces the inner peripheral side of the tool main body 1 is brought into contact with a bottom surface of the pin hole 8. In this manner, the locking pin 9 is locked by the recessed groove 4A of the fitting shaft portion 4 of the fitting member 5 inserted into the fitting hole portion 3.

[0031] Furthermore, a fixing member 10 which comes into contact with the other end surface of the locking pin 9 and locks the locking pin 9 at the opening portion of the pin hole 8 in the pin hole center line C is fitted to the opening portion of the pin hole 8, and a locking portion 11 for locking the fixing member 10 itself in the center line C direction of the pin hole 8 is provided in the opening portion of the pin hole 8. Furthermore, a recess 12 communicating with the opening portion of the pin hole 8 is provided on the outer peripheral surface of the tool main body 1 adjacent to the opening portion of the pin hole 8. The recess 12 has an auxiliary member 13 for maintaining a locked state between the fixing member 10 and the locking portion 11.

[0032] Here, the recess 12 is provided so as to communicate with the opening portion of the pin hole 8 as illustrated in FIGS. 4 and 5, and includes an extension portion 12A extending with a width equal to a diameter of a circle provided by the opening portion, and a circular portion 12B which has a center line parallel to the pin hole center line C on a side of the extension portion 12A opposite to the pin hole 8 and which has a larger diameter than the pin hole 8. A distance between a center D and the pin hole center line C of the circular portion 12B is set to be slightly larger than the sum of the radius of the circular portion 12B and the radius of the pin hole 8.

[0033] Grooves are provided in the pin hole 8 and the inner peripheral portion of the recess 12 at a slight distance from the outer peripheral surface of the tool main body 1. Out of the grooves, the groove provided in the inner peripheral portion of the pin hole 8 serves as the locking portion 11 according to the present embodiment. Furthermore, the groove provided in the inner periphery of the circular portion 12B in the recess 12 serves as a recess side locking portion 12C according to the present embodiment, and the groove provided in the extension portion 12A serves as a slide groove 12D according to the present embodiment.

[0034] The locking portion 11, the recess side locking portion 12C, and the slide groove 12D are provided along one virtual plane orthogonal to the pin hole center line C. That is, two groove wall surfaces facing each other in the direction of the pin hole center line C are respectively provided to be flush among the locking portion 11, the recess side locking portion 12C, and the slide groove 12D. In addition, the two groove wall surfaces are provided to be perpendicular to the pin hole center line C, and a groove bottom surface facing inward of the pin hole 8 and the recess 12 between the groove wall surfaces is provided to be perpendicular to the groove wall surface, that is, to be parallel to the pin hole center line C. The locking portion 11, the recess side locking portion 12C, and the slide groove 12D are provided so that a cross section along the pin hole center line C has a rectangular shape.

[0035] A groove depth of the groove provided by the locking portion 11, the recess side locking portion 12C, and the slide groove 12D, that is, a depth from the pin hole 8, the extension portion 12A of the recess 12, and the inner periphery of the circular portion 12B to the groove bottom surface is provided so that the locking portion 11 and the slide groove 12D have a constant and mutually equal depth. In contrast, the recess side locking portion 12C is provided so as to have a constant groove depth which is shallow than a groove depth of the locking portion 11 and the slide groove 12D.

[0036] In this configuration, the fixing member 10 locked by the locking portion 11 is provided in a disk shape as illustrated in FIGS. 6 and 7 by using a rigid body such as a steel material, similarly to the tool main body 1. However, a flange portion 10A is provided on the bottom surface (lower surface in FIG. 7) side of the side

surface. In the flange portion 10A, the thickness from the bottom surface of the fixing member 10 is slightly smaller than a groove width between the two groove wall surfaces of the groove provided by the locking portion 11 and the slide groove 12D. The flange portion 10A is provided in a rectangular cross-sectional shape having a constant protrusion amount equal to the groove depth of the locking portion 11 and the slide groove 12D from the side surface, and is provided on the entire periphery of the disk provided by the fixing member 10. In addition, on the upper surface (upper surface in FIG. 7) side from the flange portion 10A, the fixing member 10 is provided so that the radius is slightly smaller than the radius of the pin hole 8.

[0037] Therefore, the fixing member 10 provided in this way can be inserted into the recess 12 by causing the bottom surface to face the inner peripheral side of the tool main body 1 as will be described later in FIG. 10(b). When the flange portion 10A coincides with the locking portion 11 and the slide groove 12D in the direction of the pin hole center line C, the flange portion 10A is slid to the opening portion side of the pin hole 8 along the slide groove 12D. In this manner, the flange portion 10A can be fitted to the opening portion of the pin hole 8 by locking the flange portion 10A to the locking portion 11 and the slide groove 12D in the direction of the pin hole center line C.

[0038] On the other hand, the auxiliary member 13 located in the recess 12 is also provided in a disk shape as illustrated in FIGS. 8 and 9 by using an elastic body such as urethane rubber and synthetic rubber according to the present embodiment. A flange portion 13A having a slightly larger diameter than the upper surface (upper surface in FIG. 9) side is also provided on the bottom surface (lower surface in FIG. 9) side of the auxiliary member 13. The diameter of the flange portion 13A is provided to be approximately equal to the inner diameter of the recess side locking portion 12C on the upper surface side and to gradually decrease toward the bottom surface side. The diameter of the side surface of the auxiliary member 13 on the further upper surface side from the flange portion 13A is approximately equal to the inner diameter of the circular portion 12B of the recess 12.

[0039] Then, a straight line E connecting the center D of the recess 12 to which the auxiliary member 13 is fitted and the pin hole center line C extends in the direction intersecting the axis O of the tool main body 1 when viewed in the direction of the pin hole center line C as illustrated in FIG. 5. That is, the extension portion 12A of the recess 12 extends in the direction intersecting the axis O from the opening portion of the pin hole 8, and reaches the circular portion 12B. In particular, according to the present embodiment, the extension portion 12A extends in the direction orthogonal to the axis O. In addition, the recess 12 extends to a side opposite to the tool rotation direction T from the opening portion of the pin hole 8 in a circumferential direction of the tool main body 1.

[0040] Here, distance in the direction of the straight line E between the pin hole center line C and the center D of the recess 12 is equal to the sum of the radius of the flange portion 10A of the fixing member 10 and the radius on the upper surface side of the flange portion 13A of the auxiliary member 13. In this manner, the flange portion 13A of the auxiliary member 13 can be brought into contact with the side surface of the flange portion 10A facing the recess 12 of the fixing member 10, thereby maintaining a locked state between the fixing member 10 and the locking portion 11.

[0041] In the outer peripheral portion on the tip side from the step portion 1B of the tool main body 1, three discharge grooves 14 for discharging excavation chips generated during the excavation are provided to be open on the side in the tool rotation direction T of the fitting hole portion 3 on the bottom surface 2A of the respective three recessed portions 2. The bottom surface 2A in the opening portion has a step so as to slightly move rearward to the posterior end side in the direction of the axis O on the outer peripheral side as illustrated in FIG. 1. Furthermore, in the tool main body 1, a supply hole 15 for supplying a fluid such as compressed air fed from the above-described excavation device side extends along the axis O as illustrated in FIG. 1. The supply hole 15 is branched in the tip portion of the tool main body 1, and is open to the rearward moved portion of the bottom surface 2A of the recessed portion 2, the wall surface 2C, and the outer peripheral surface of the tool main body 1.

[0042] In the drilling tool configured in this way, the fitting member 5 serving as the bit head of the fitting shaft portion 4 is inserted into the fitting hole portion 3 of the tool main body 1 serving as the device. The drilling unit 6 is accommodated in the recessed portion 2. The locking pin 9 is inserted into the pin hole 8 as illustrated in FIG. 10(a), and is locked by the recessed groove 4A of the fitting shaft portion 4, thereby retaining the fitting member 5. Furthermore, as illustrated in FIG. 10(b), after the fixing member 10 inserted into the recess 12 is slid and locked by the locking portion 11 of the opening portion of the pin hole 8. Thereafter, as illustrated in FIG. 10(c), the auxiliary member 13 which is an elastic body is pushed into the recess 12 while the auxiliary member 13 is elastically deformed. In this manner, when the flange portion 13A enters the recess side locking portion 12C, the flange portion 13A spreads and closely adheres to the flange portion 10A of the fixing member 10, thereby retaining the fixing member 10.

[0043] The drilling tool configured in this way is inserted into the casing pipe P in a state where the drilling unit 6 of the fitting member 5 is reduced in diameter. In a state where the step portion 1B of the tool main body 1 comes into contact with the casing top Q, the rotating force acting around the axis O is applied to the drilling unit 6 as described above so as to be enlarged in diameter. Furthermore, the impelling force and the striking force are applied to the tip side in the direction of the axis O. In this manner, the bore hole is provided, and the casing pipe

P is inserted into the bore hole. In addition, if the bore hole is provided to reach a predetermined depth and the casing pipe P is inserted into the bore hole, the drilling unit is reduced in diameter by rotating the tool main body 1 to the side opposite to the tool rotation direction T as described above, and the drilling unit can be pulled out and collected from the casing pipe P.

[0044] Then, in the drilling tool having the above-described configuration, when viewed in the direction of the pin hole center line C, the straight line E connecting the center D of the recess 12 where the auxiliary member 13 is located and the pin hole center line C to each other extends in the direction intersecting the axis O of the tool main body 1. Out of the pressing force acting when the fixing member 10 fitted to the opening portion of the pin hole 8 tries to move to the tip side in the direction of the axis O due to the striking force, the component force acting in the direction of the axis O can be received and stopped by the tool main body 1 itself having the opening portion of the pin hole 8.

[0045] Therefore, the pressing force received by the auxiliary member 13 can be reduced, and the abrasion of the soft auxiliary member 13 made of an elastic body can be prevented. An open gap between the fixing member 10 and the auxiliary member 13 can be prevented from spreading instantaneously due to the abrasion occurring. In this manner, the locked state between the fixing member 10 and the locking portion 11 can be reliably maintained, and it is possible to prevent slippage of the auxiliary member 13 or subsequent falling of the fixing member 10 and the locking pin 9. Therefore, the fixing member 10 can be stably locked by the locking portion 11 of the opening portion the pin hole 8 over a long period, and the excavation can be smoothly performed.

[0046] In particular, according to the present embodiment, when viewed in the direction of the pin hole center line C, the straight line E connecting the center D of the recess 12 and the pin hole center line C to each other extends in the direction orthogonal to the axis O of the tool main body 1. Accordingly, substantially all of the pressing force generated by the striking force applied to the tool main body 1 can be received and stopped by the tool main body 1, and the abrasion of the auxiliary member 13 can be more reliably prevented. In addition, the straight line E is orthogonal to the axis O, a space in the direction of the axis O which is required for the tool main body 1 to form the recess 12 is sufficiently settled only using a size of the recess 12 itself. Therefore, it is possible to minimize the length of the tool main body 1 in the direction of the axis O, and it is possible to reduce the manufacturing cost of the tool main body 1.

[0047] According to the present embodiment, when viewed in the direction of the pin hole center line C in this way, the straight line E extends in the direction orthogonal to the axis O. However, the straight line E may extend in a direction obliquely intersecting the axis O.

[0048] However, in a case where the straight line E extends in the direction obliquely intersecting the axis O

when viewed in the direction of the pin hole center line C, if an inclination angle of the straight line E with respect to the direction orthogonal to the axis O is too large, the component force acting in the direction of the axis O of the pressing force of the fixing member 10 which is generated by the striking force cannot be sufficiently received and stopped by the tool main body 1, thereby causing a possibility that the abrasion of the auxiliary member 13 may not be prevented. Accordingly, it is desirable that the inclination angle formed between the straight line E and the direction orthogonal to the axis O falls within 60% or smaller toward the tip side or the posterior end side in the direction of the axis O from the opening portion of the pin hole 8, even in a case where the recess 12 extends to the side of the opposite to the tool rotation direction T from the opening portion of the pin hole 8 as in the above-described embodiment, or even in a case where the recess 12 extends in the tool rotation direction T. That is, it is desirable that the inclination angle with respect to the axis O of the straight line E falls within 30° or greater and 150° or less.

[0049] In addition, according to the present embodiment, the recess 12 extends from the opening portion of the pin hole 8 to the side opposite to the tool rotation direction T. Therefore, the pressing force acting in the tool rotation direction T of the fixing member 10 which is caused by the impact when the tool main body 1 receives the striking force on the tip side in the direction of the axis O while being rotated around the axis O can also be received and stopped by the opening portion of the pin hole 8 provided in the tool main body 1. Therefore, it is possible to prevent the abrasion of the auxiliary member 13 which is caused by the pressing force acting in the tool rotation direction T.

[0050] Therefore, the above-described configuration according to the present embodiment is effectively applicable to the drilling tool as follows. The drilling tool is the device in which the impact occurs in this way due to the striking force applied to the tool main body 1 during the excavation and the tool main body 1 is rotated around the axis O. The fitting hole portion 3 is open at the position eccentric from the axis O of the tip portion, the pin hole 8 is open on the outer peripheral surface of the tool main body 1, and the fitting member 5 is the bit head in which the drilling unit 6 having the hard tip 7 is disposed in the tip of the fitting shaft portion 4. The drilling tool is the extendable bit rotated around the shaft portion center line L2 so that the radius from the axis O of the drilling unit 6 is enlarged and reduced in response to the rotation of the tool main body 1.

Industrial Applicability

[0051] According to the drilling tool of the present disclosure, it is possible to prevent abrasion of an auxiliary member even when long-term excavation tasks are carried out, and it is possible to maintain a locked state between a fixing member and a locking portion. Therefore,

stable excavation can be performed.

Reference Signs List

[0052]

- 1: tool main body
- 2: recessed portion
- 3: fitting hole portion
- 4: fitting shaft portion
- 4A: recessed groove
- 5: fitting member
- 6: drilling unit
- 7: hard tip
- 8: pin hole
- 9: locking pin
- 10: fixing member
- 10A: flange portion of fixing member 10
- 11: locking portion
- 12: recess
- 12C: recess side locking portion
- 13: auxiliary member
- 13A: flange portion of auxiliary member 13
- O: axis of tool main body 1
- T: tool rotation direction
- A: virtual plane having recessed groove 4A and pin hole 8
- C: pin hole center line (center line of pin hole 8)
- D: center of recess 12 (center of circular portion 12B)
- E: straight line connecting center of recess 12 and pin hole center line C to each other when viewed in direction of pin hole center line C
- L1: hole portion center line (center line of fitting hole portion 3)
- L2: shaft portion center line (center line of fitting shaft portion 4)

Claims

1. A drilling tool comprising:

a tool main body configured to be rotated around an axis thereof and to receive a striking force acting toward a tip side thereof in a direction of the axis; and

a fitting member including a fitting shaft portion to be inserted into a fitting hole portion which is open in a tip portion of the tool main body so as to be detachably fitted to the tool main body, wherein an outer peripheral surface of the fitting shaft portion has a recessed groove provided along a virtual plane orthogonal to a center line of the fitting shaft portion,

a pin hole, which is partially open on an inner peripheral surface of the fitting hole portion by extending from an outer peripheral surface to an inner peripheral side of the tool main body along

the virtual plane of the fitting shaft portion inserted into the fitting hole portion, is formed in the tool main body,

a locking pin is inserted into the pin hole so as to be locked by the recessed groove of the fitting shaft portion inserted into the fitting hole portion, a fixing member for retaining the locking pin by coming into contact with the locking pin is fitted to an opening portion of the pin hole on the outer peripheral surface of the tool main body, and a locking portion for locking the fixing member in a center line direction of the pin hole is provided in the opening portion,

the outer peripheral surface of the tool main body adjacent to the opening portion of the pin hole has a recess which communicates with the opening portion of the pin hole,

the recess has an auxiliary member which has a side surface capable of coming into contact with a side surface facing the recess of the fixing member and which maintains a locked state between the fixing member and the locking portion, and

when viewed in the center line direction of the pin hole, a straight line connecting a center of the recess and a center line of the pin hole to each other extends in a direction intersecting the axis.

- 2. The drilling tool according to claim 1, wherein when viewed in the center line direction of the pin hole, the straight line connecting the center of the recess and the center line of the pin hole to each other extends in a direction orthogonal to the axis.
- 3. The drilling tool according to claim 1 or 2, wherein the recess extends from the opening portion of the pin hole to a side opposite to a rotation direction of the tool main body.
- 4. The drilling tool according to any one of claims 1 to 3, wherein the tool main body has the fitting hole portion which is open at a position eccentric from the axis of the tip portion, and wherein the fitting member is a bit head in which a drilling unit having a hard tip is disposed in a tip of the fitting shaft portion, and is rotated around the center line of the fitting shaft portion so that a radius from the axis of the drilling unit is enlarged and reduced in response to rotation of the tool main body.

FIG. 1

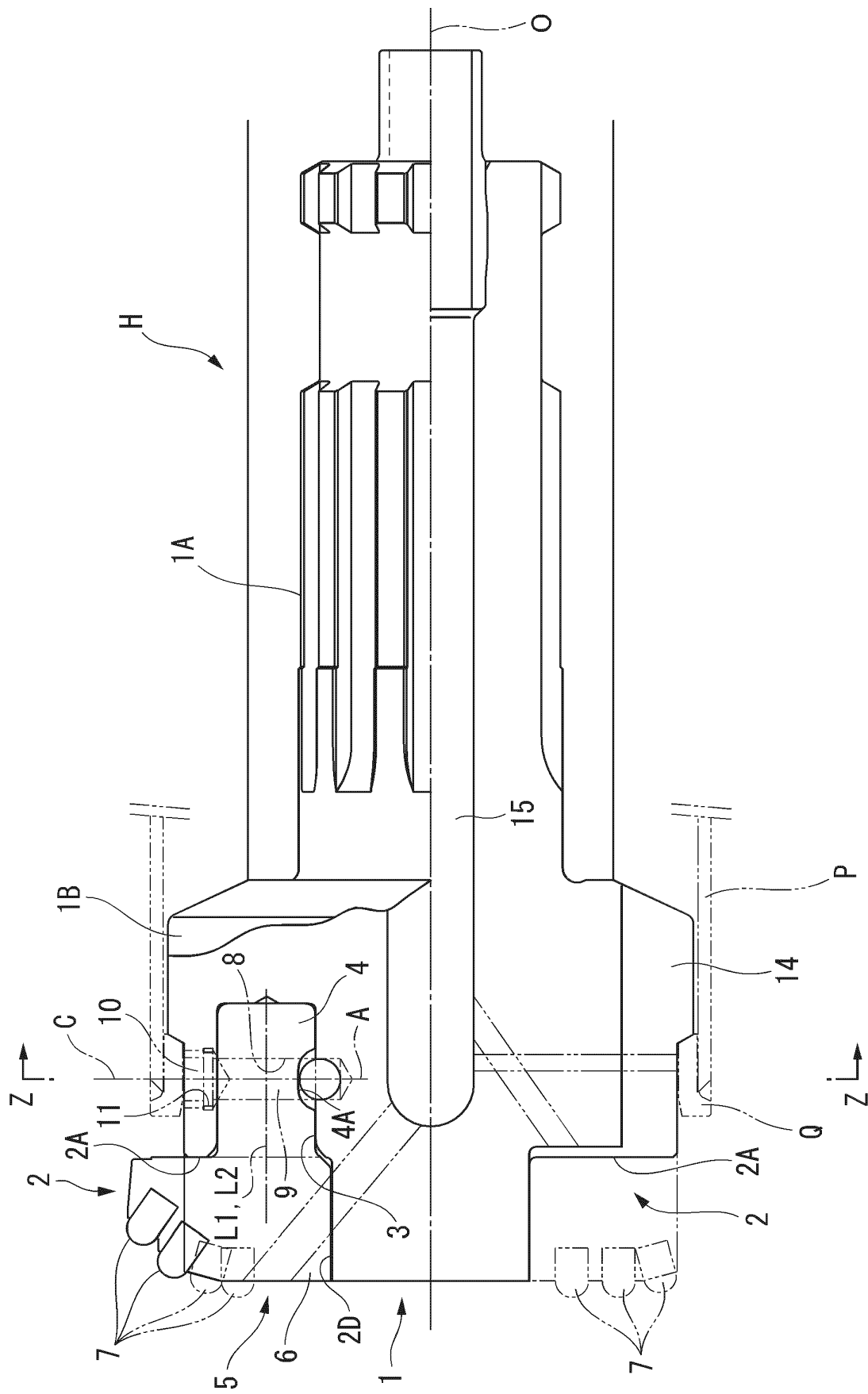


FIG. 2

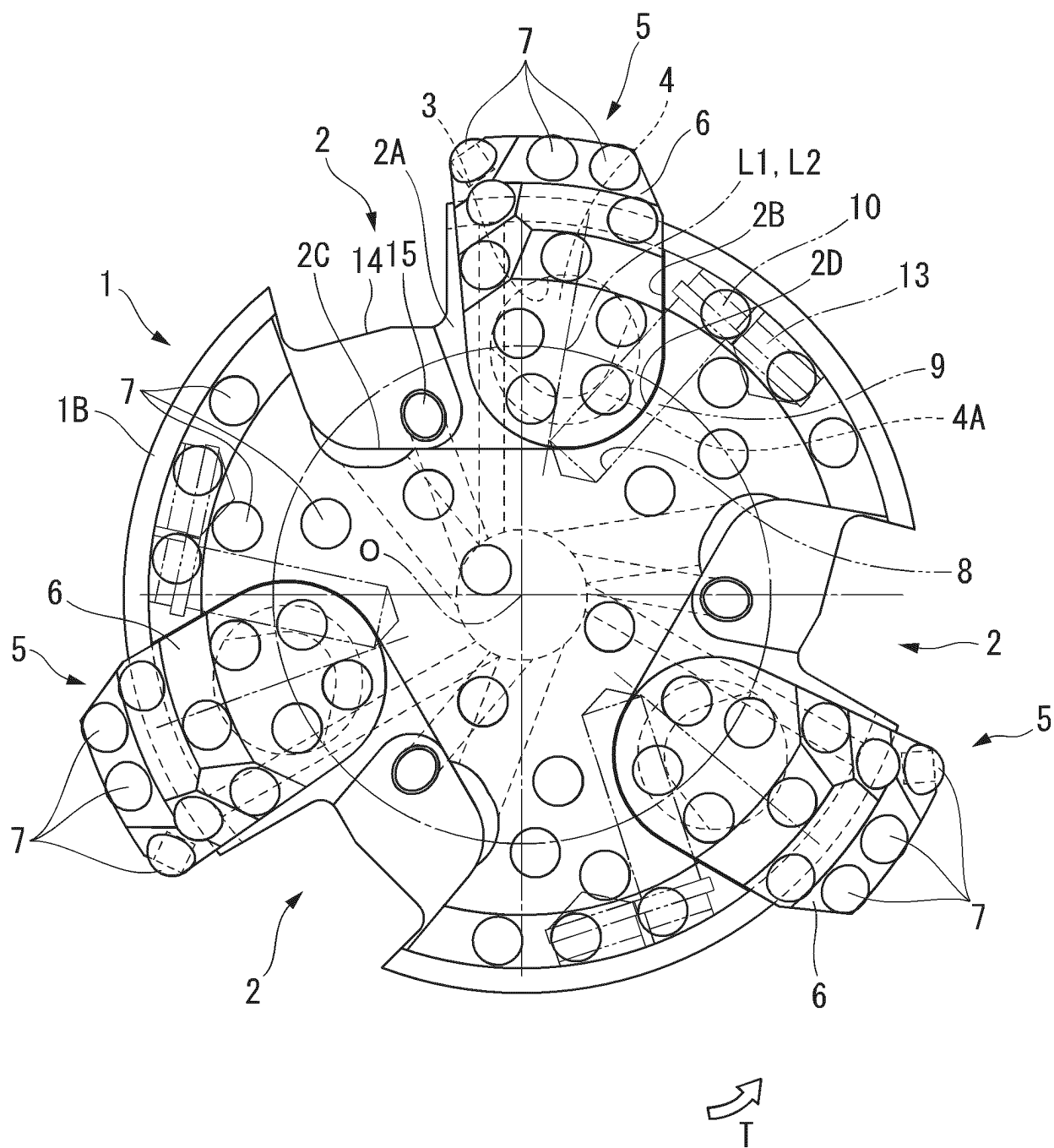


FIG. 3

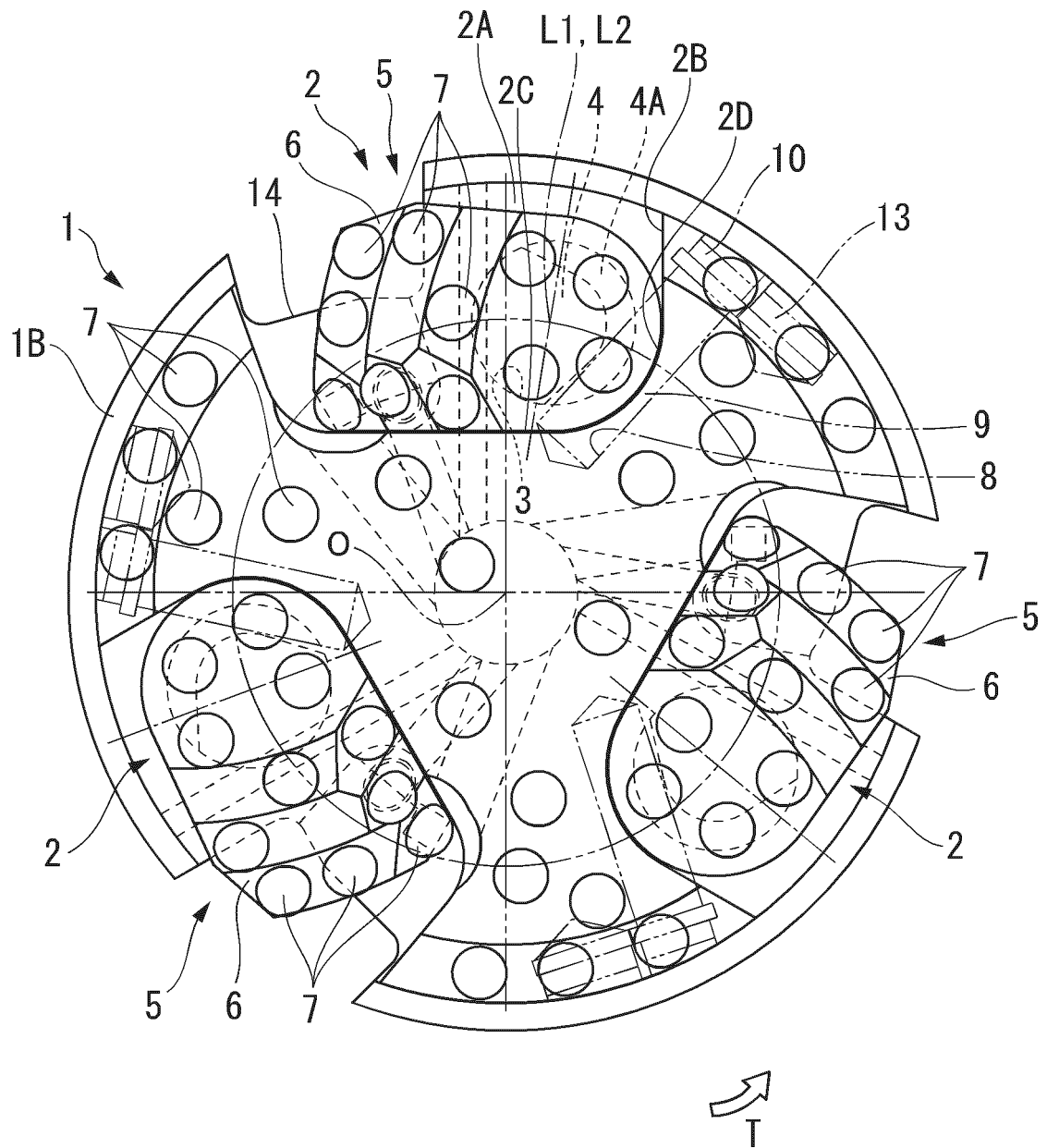


FIG. 4

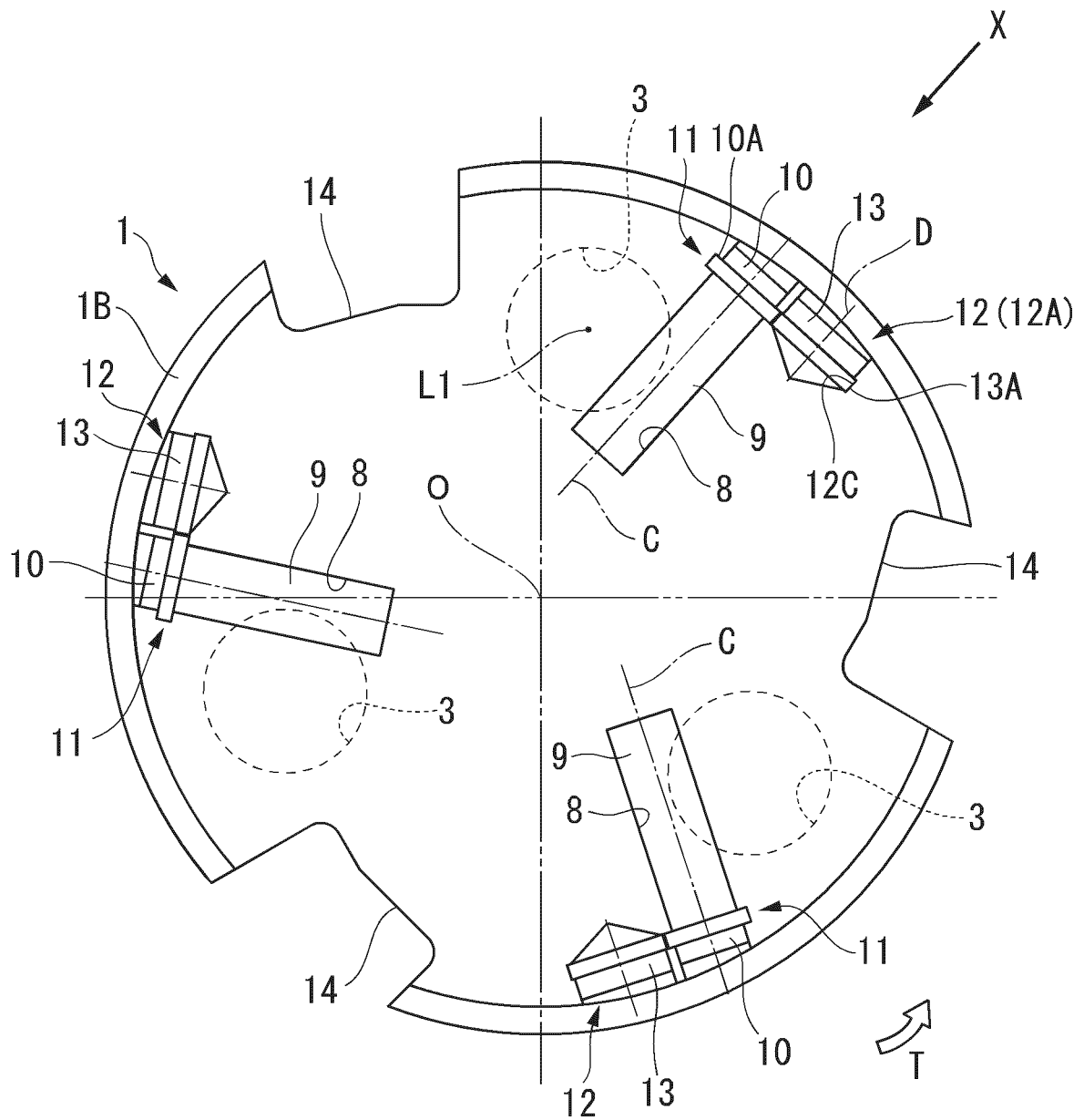


FIG. 5

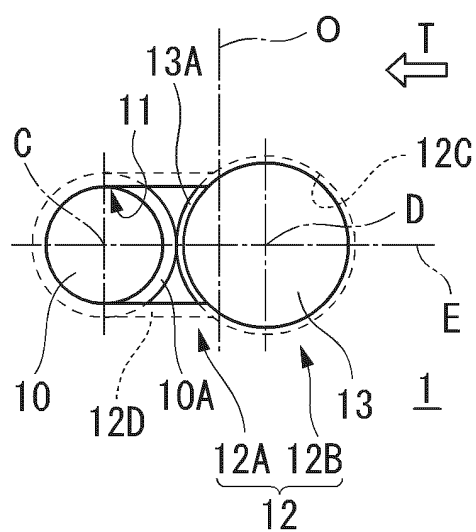


FIG. 6

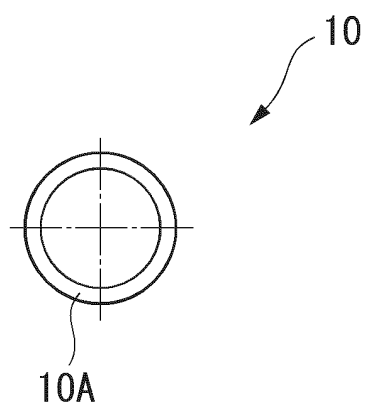


FIG. 7

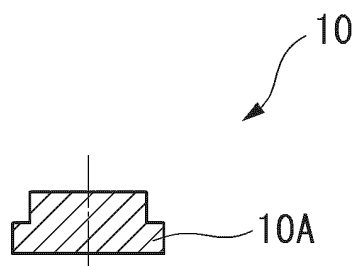


FIG. 8

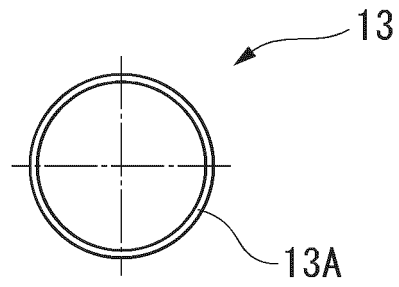


FIG. 9

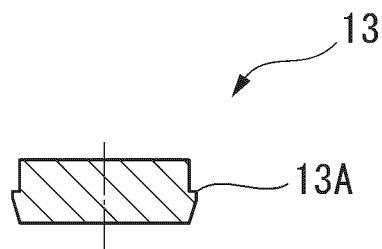
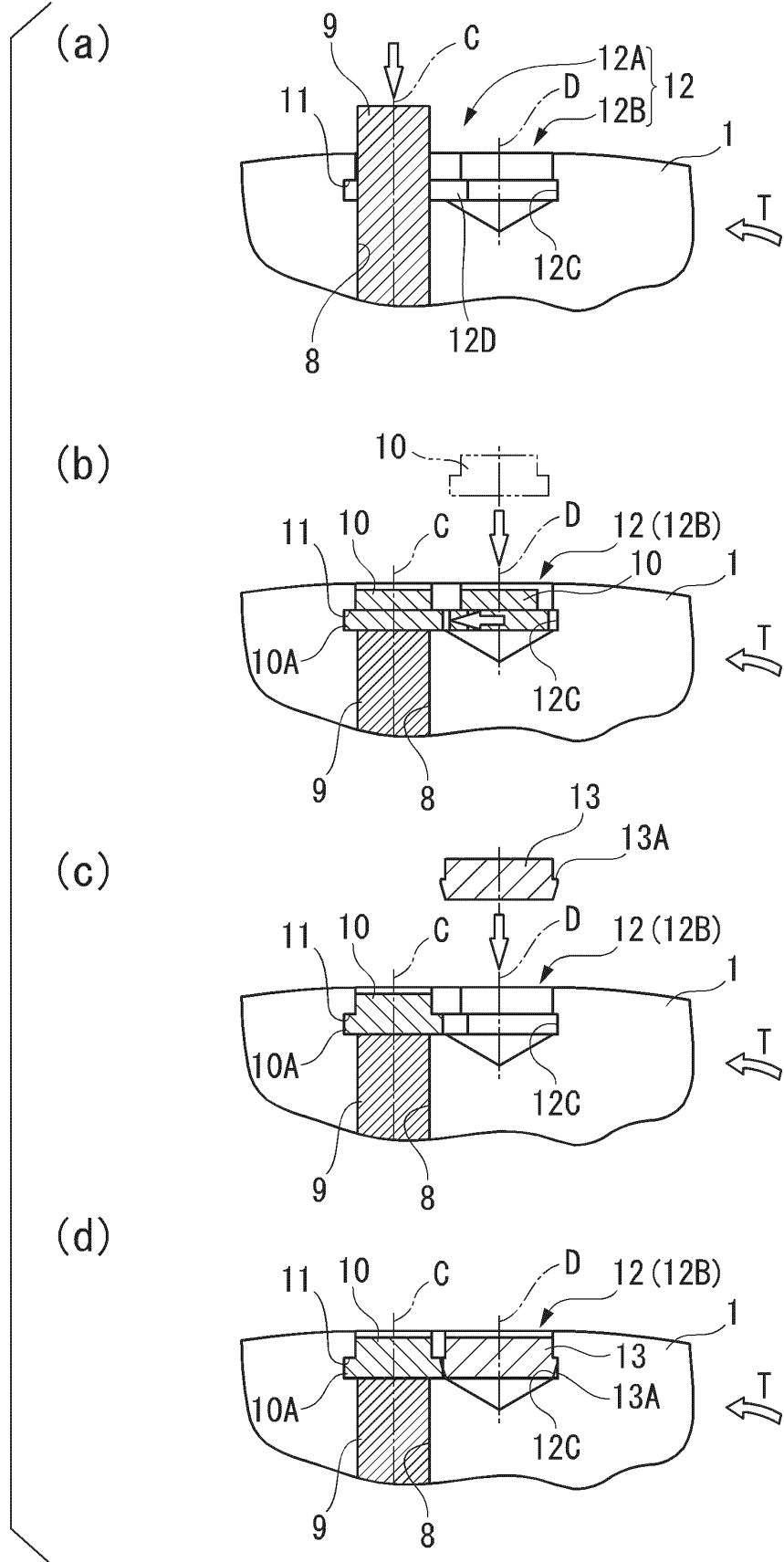


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/078016

A. CLASSIFICATION OF SUBJECT MATTER

E21B17/04(2006.01)i, E21B10/32(2006.01)i

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)

E21B17/04, E21B10/32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016

Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 4957440 B2 (Mitsubishi Materials Corp.), 20 June 2012 (20.06.2012), paragraphs [0016] to [0039]; fig. 1 to 12 & US 2010/0236831 A1 paragraphs [0073] to [0121]; fig. 1 to 12 & WO 2009/019999 A1 & KR 10-2010-0035654 A & CN 101772616 A	1-4
A	WO 2016/027739 A1 (Mitsubishi Materials Corp.), 25 February 2016 (25.02.2016), paragraphs [0020] to [0042]; fig. 1 to 3 (Family: none)	1-4
A	JP 2004-076370 A (Mitsubishi Materials Corp.), 11 March 2004 (11.03.2004), paragraphs [0020] to [0025]; fig. 1 (Family: none)	1-4

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search
05 December 2016 (05.12.16)Date of mailing of the international search report
20 December 2016 (20.12.16)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

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Patent documents cited in the description

- JP 4957440 B [0006]