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(71) Applicant: **MITSUBISHI MATERIALS CORPORATION**
Chiyoda-ku,
Tokyo (JP)

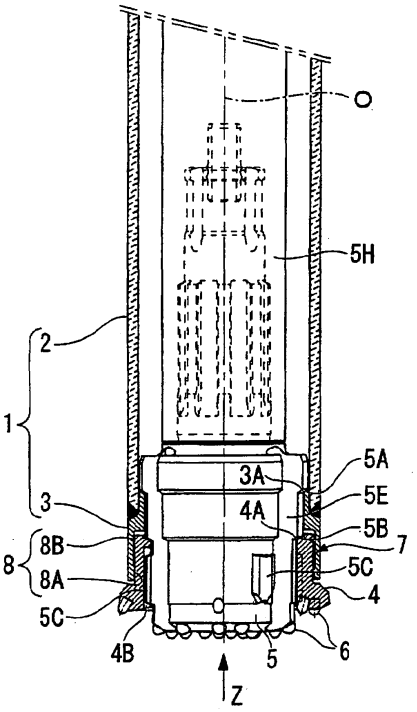
(72) Inventors:
- **Nakamura, Kazuyoshi**
  Anpachi-gun
  Gifu-ken (JP)
- **Hisada, Masaya**
  Anpachi-gun
  Gifu-ken (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) Drilling tool and drilling method

(57) There are provided a drilling tool and a drilling method, the drilling tool including a ring bit 4 inserted into a tip portion of a casing pipe (1) to be rotatable around an axis line, and latched in a tip side in the direction of an axis line (O) by a latching means (7) and mounted to be moved in the direction of the axis line (O); an inner bit (5) inserted into the casing pipe (1) to be contacted toward the tip side of the casing pipe (1) and the ring bit (4), the said inner bit being engaged around the axis line (O) by an engaging means with respect to the ring bit (4); and a pull-out mechanism which pulls out the ring bit (4) to the tip side with respect to the casing pipe (1) in the latching means (7).

Fig. 1



EP 1 837 481 A1

Description

BACKGROUND

1. Field of the Invention

[0001] The present invention relates to, a drilling tool having a ring bit is attached to a tip of a casing pipe and an inner bit is attached to a tip of a transmission member transmitting a striking force, a torque and a thrust such as an inner rod inserted in the casing pipe, and an drilling method using the same.

2. Description of the Related Art

[0002] As an drilling tool having a said ring bit and inner bit, the drilling tool in which a contact portion capable of relatively rotating and preventing each other's omission is installed in a coupling part of a casing shoe on a tip portion of a casing pipe and a ring bit is described in JP-A-9-158656. In addition, the drilling tool and the drilling method which proceeds to drill with only an inner bit after stopping the drilling and pulling-out of a casing pipe by means of an outer bit and a protective tube (a casing pipe) by pulling out the outer bit (the ring bit) from an inner bit (an inner bit) in a desired position are described in JP-T-10-510601. Furthermore, the drilling tool in which a drilling head is constituted by the ring bit and the inner bit, and the inner bit engaged to a ring lost bit is inserted in the casing shoe is further described in JP-A-11-173057.

[0003] However, first, in a drilling tool described in JP-A-9-158656, since a casing pipe and a ring bit are accommodated by a contact portion, After an drilling hole can be secured by performing the drilling with the casing pipe in a soft formation which is easy to collapse, and the drilling cannot be efficiently performed only by the inner bit in a hard formation which is difficult to collapse. More particularly, in case that the transmission member and the inner bit are pulled out from the casing pipe, and the member, like an anchor, is inserted within an drilling hole, an outer diameter of the member is limited to less than an inner diameter of a part on which an inclined surface of the ring bit which is transmitted a striking force from the inner bit to a tip side, while since the inner and outer diameter of the ring bit or the casing pipe must be raised to insert the member having a predetermined outer diameter, it is inefficient and uneconomic.

[0004] In addition, in the drilling tool described in JP-T-10-510601, which can proceed to drill only with the inner bit after having formed the first hole to a predetermined depth with the ring bit and the inner bit, as described above, a second drilling hole can be formed in succession only by the inner bit without the casing pipe in the hard formation. However, the second hole formed by this configuration has the inner diameter smaller than the inner diameter of the first excavation hole. Besides, since the outer diameter of member, like an anchor in the second hole must be also limited to less than the inner diameter of a protruding part formed on the inner surface of the ring bit to be transmitted the rotation and striking force from the inner bit, the inner and outer diameter of the ring bit or the casing pipe cannot avoid being raised with respect to the outer diameter of the said member similar to the drilling tool described in JP-A-9-158656.

[0005] By this configuration, in the drilling tool described in JP-A-11-173057, the member having the outer diameter as large as the inner diameter of a stepped portion which is transmitted the striking force from the inner bit can be said in the hole through the casing pipe by removing the ring bit from the inner bit and pulling out the inner rod and the inner bit from the casing pipe after terminating the drilling. However, even by the drilling tool described in JP-A-11-173057, the second drilling hole described above cannot be formed without the casing pipe and the ring bit is installed in the tip of the casing pipe to be merely rotatble. Accordingly, for example, in case that the hole is formed downward, since there was a hollow on the ground, when the striking force is transmitted to the ring bit being not contact with the bottom of hole, engaging with the inner bit comes off and the ring bit falls off within the hole by the impact, whereby the later drilling becomes impossible in itself.

SUMMARY

[0006] Under the above circumstances, an object of the present invention is to provide the drilling tool and an drilling method using the same which are efficient so that the drilling is performed by the casing pipe and then, drilling the second drilling hole having a same diameter can be performed without the casing pipe, which are economic so that the outer diameter of the member, like an anchor inserted through the casing pipe can be significantly secured, that is, in case that the members, like an anchor having the same outer diameter are inserted, the diameter of the casing pipe or the ring bit can be lowered, and in which the ring bit never fall off during drilling with respect to all drilling tools having a ring bit and inner bit.

[0007] To achieve the object by solving the above problem, an drilling tool comprises a cylindrical casing pipe; annular ring bits inserted in a tip portion of the cylindrical casing pipe to be rotatable around an axis line of the casing pipe by opposing inner and outer peripheral surfaces thereof to each other; latching means constituted by a concave portion formed in at least one peripheral surface of the inner and outer peripheral surfaces opposed to each other to be extended axially with having annular shape around the axis line, and a convex portion formed in the other peripheral surface to be accommodated in the concave portion, the ring bit being latched on a tip side in the direction of the axial line of the casing pipe by the latching means and mounted to be advanced or retreated in the direction of the axial line; and an inner bit mounted on a tip of a transmission member inserted

within the casing pipe, wherein a first contact portion which can be contacted to a contact portion of the casing pipe side protruded on an inner periphery of the tip portion of the casing pipe toward the tip side of the direction of the axial line and a second contact portion which can be contacted to a contact portion of the ring bit side formed at the ring bit and having an inner diameter smaller than that of the contact portion of the casing pipe side toward the tip side of the direction of the axial line are formed on the outer peripheral surface of the inner bit, wherein the inner bit can be engaged around the axis line with respect to the ring bit by engaging means, and wherein the latching means has a pull-out mechanism which pulls out the ring bit to the tip side of the direction of the axial line with respect to the casing pipe.

[0008] Accordingly, the drilling method using the drilling tool of the present invention comprise the steps of applying to the inner bit, the striking force onto the tip side in the direction of the axial line and the torque around the axis line, to form a first hole having a predetermined depth while transmitting the striking force to the casing pipe and the ring bit via the first and second contact portions, the contact portion of the casing pipe side and the contact portion of the bit side, and transmitting the torque only to the ring bit by engaging means; retreating the inner bit and a transmission member to pull out from the casing pipe; mounting a second inner bit having the outer diameter smaller than the inner diameter of the contact portion of the casing pipe and having the second contact portion and the engaging means without the first contact portion onto the tip of the transmission member; inserting the second inner bit in the inner periphery of the ring bit through the casing pipe; pulling out the ring bit to the tip side in the direction of the axial line with respect to the casing pipe by the pull-out mechanism; and applying to the second inner bit, the striking force onto the tip side in the direction of the axial line and the torque around the axis line to form a second hole at a tip end side of the first hole while transmitting the striking force to the ring bit via the second contact portion and the contact portion of the ring bit side and transmitting the torque to the ring bit by the engaging means.

[0009] That is, when the first hole is formed, since the torque and the striking force which could have been applied to the inner bit is transmitted to the ring bit and the only striking force is transmitted to the casing pipe to form the hole, the first hole can be secured on the soft formation and then, the ring bit is latched to the tip portion of the casing pipe toward the tip side in the axis direction by the latching means, even if null is hit, the ring bit can be prevented from falling off. Moreover, after the first hole reaches the hard formation, the second hole having the same diameter as the that of the first hole can be effectively formed without the casing pipe by the torque and the striking force from the second inner bit by exchanging the inner bit for the above-described second inner bit and pulling out the ring bit from the tip portion of the casing pipe by the pull-out mechanism having the latching means.

[0010] Accordingly, by retreating after the second hole is formed, the second inner bit and the transmission member to pull out from the casing pipe in a state that the ring bit is left within the second hole, and inserting the member, like an anchor having the outer diameter smaller than the inner diameter of the contact portion of the casing pipe and larger than the inner diameter of the contact portion of the ring bit within the casing pipe to said within the hole, for example, even though it is compared with the drilling tool and the drilling method which can drill the second drilling hole described in JP-T-10-510601 or the drilling tool described in JP-A-9-158656, the outer diameter of the member, like an anchor which can be built-up to the second drilling hole can be raised, in other words, when the member, like an anchor having the same outer diameter is built-up, the diameter of the hole or the casing pipe can be lowered, so that it is economic.

[0011] In addition, the drilling method using the drilling tool of the present invention, comprises the steps of: applying to the inner bit, the striking force onto the tip side in the direction of the axial line and the torque around the axis line via the transmission member, to form a first hole having a predetermined depth while transmitting the striking force to the casing pipe and the ring bit via the first and second contact portions, the contact portion of the casing pipe side and the contact portion of the bit side, and transmitting the torque only to the ring bit by engaging means; retreating the inner bit and a transmission member to pull out from the casing pipe; pulling out the ring bit to the tip side in the direction of the axial line with respect to the casing pipe by the pull-out mechanism; and inserting the member, like an anchor having the outer diameter smaller than the inner diameter of the contact portion of the casing pipe and larger than the inner diameter of the contact portion of the ring bit within the casing pipe to build up within the hole. Accordingly, in this case, the fall-off of the ring bit similar to the drilling tool described in JP-A-11-173057 can be prevented by the latching means. Further, the member, like an anchor having the diameter larger than that in the drilling tool or the drilling method described in JP-A-9-158656 and JP-T-10-510601, can be built up, and in this case, the hole and the casing pipe diameter can be smaller than above the drilling too or the drilling method.

[0012] Here, as described above, when drilling with the casing pipe, by the latching means constituted by the concave and convex portions formed the inner and outer peripheral surfaces of the tip portion of the casing pipe and the ring bit opposed to each other, to certainly latch the ring bit to the casing pipe in the tip side of the direction of the axis line, and when the second hole without the casing pipe is formed, to pull out the ring bit from the casing pipe by the pull-out mechanism, in the latching means, the annular convex portions are formed in a tip portion of a peripheral surface of the casing pipe side and a rear end portion of a peripheral surface of the ring

bit side and the concave portions accommodating the convex portions in the other peripheral surfaces are formed in a rear end portion of a peripheral surface of the casing pipe side and a tip portion of the peripheral surface of the ring bit side along the direction of the axial line on the inner and outer peripheral surfaces, and wherein the pull-out mechanisms are a male screw portion and a female screw portion formed on the inner and outer peripheral surfaces of the convex portion to be threaded with each other.

[0013] That is, in the latching means and the pull-out mechanism configured as described above, since the inner diameter of the thread of the female screw portion is smaller than the outer diameter of the thread of the male screw portion in the male and female screw portions screwed with each other, the ring bit is certainly latched to the tip side in the direction of the axis line at a location where the convex portion of the tip portion of the peripheral surface of the casing pipe and the convex portion of the rear end side of the peripheral surface of the ring bit side contact each other, and the ring bit is rotatable around the axis line and can be moved along the axis line in the range of the concave portions arranged in the convex portions thereof. In addition, the rotational direction of the ring bit with respect to the casing pipe at the time of drilling is set to the direction where the male and female screw portions of the convex portion contacted as described above are not screwed. When the ring bit is pulled out by the pull-out mechanism, if the ring bit is relatively rotated with respect to the casing pipe in the direction opposite to the rotational direction on drilling, since the male and female screw portions are screwed together, and the ring bit is discharged to a side opposite to the inserted direction and screwing is released, to pull out the ring bit. Accordingly, according to the latching means and pull-out mechanism, the ring bit is rotated by the inner bit via the engaging means or the ring bit is rotated by the second inner bit described above, whereby the ring bit can be pulled out certainly and easily.

[0014] In addition, instead of the latching means and the pull-out mechanism, in the latching means, the concave portion is formed on one peripheral surface, and a latching member urged toward the one peripheral surface side is annularly disposed on the other peripheral surface to be the convex portion, out of the inner and outer peripheral surfaces, and in the pull-out mechanism, an inclined surface is formed on an annular surface which is contacted to the latching member when the ring bit is pulled out with respect to the tip portion of the casing pipe and is directed toward a direction that the inner and outer peripheral surfaces oppose as being directed toward a direction that the latching member is contacted onto the annular surface. In the latching means described above, when the convex portion where the latching member disposed in the other peripheral surface is biased to the concave portion of one peripheral surface to be protruded pulls out the ring bit with respect to the tip portion of the casing pipe, the ring bit is latched to the tip side in the direction of the axis line by contacting the latching member to one annular surface of one pair of annular surfaces which is directed toward the direction of the axis line formed in both end portions in the direction of the axis line of the concave portion and the ring bit can be moved in the direction of the axis line with respect to the casing pipe within the range where the convex portion overpasses the one annular surface.

[0015] Further, in the pull-out mechanism with which the latching means is equipped, in a state that the ring bit is latched toward the tip side in the direction of the axis line, as the ring bit is directed toward the direction where the latching member is contacted, since the inclined surface which is directed toward the direction where the inner and outer peripheral surfaces oppose as being directed toward a direction where the latching member is contacted, in a state that the convex portion is contacted to the annular surface where the inclined surface is formed, for example, the second inner bit or the member, like an anchor described above is inserted to be contacted to the contact portion of the ring bit side, and the striking force or the thrust force is applied toward the tip side or the casing pipe is relatively retreated with respect to the ring bit, so that the latching member constituting the convex portion is guided to the inclined surface, the latching thereof being loosen, whereby the ring bit can be pulled out to the tip side. Furthermore, in order to mount the ring bit which is equipped with the latching means and the pull-out mechanism onto the tip portion of the casing pipe, in a state that the latching member is retreated within the peripheral surface by resisting the biasing force on the contrary thereto, it is preferable to insert the ring bit into the tip portion of the casing pipe.

[0016] Meanwhile, by means of the latching means and the pull-out mechanism, in the latching means, the convex portions are formed on the tip portion of the peripheral surface of the casing pipe side and the rear end portion of the peripheral surface of the ring bit side, and the concave portions accommodating the convex portions in the other peripheral surfaces are formed in a rear end portion of a peripheral surface of the casing pipe side and a tip portion of the peripheral surface of the ring bit side along the direction of the axial line, out of the inner and outer peripheral surfaces, and in the pull-out mechanism, an inclined surface is formed at a surface toward the direction of the axial line which is formed at a portion where the concave portion and the convex portion of each of the inner and outer peripheral surfaces are connected and is directed toward a direction that the inner and outer peripheral surfaces are opposed as being directed toward the direction of the axial line opposite to the direction that the inclined surface is directed. In the latching means described above, out of the inner and outer periphery surfaces of the ring bit and the tip portion of the casing pipe opposed to each other, the convex portion is formed the tip portion of the peripheral surface of the casing pipe side and the rear end portion of the peripheral surface of the ring bit side, and the concave portion where the con-

vex portion of the ring bit side is accommodated is formed in the rear end portion of the peripheral surface of the casing pipe side, while the concave portion where the convex portion of the casing pipe side is accommodated is formed in the tip portion of the peripheral surface of the ring bit side. Therefore, the ring bit is rotatable and can be moved in the direction of the axis line in the range of the concave portion thereof, and the ring bit is latched to the tip side in the direction of the axis line at a location where the convex portions of both peripheral surfaces are contacted.

[0017] In addition, in the pull-out mechanism with which the latching means is equipped, an inclined surface, which is directed toward a direction where the inner and outer peripheral surfaces oppose, is formed on the surface which directed toward the direction of the axis line arranged in from the convex portion to the concave portion contacted in a state that the ring bit is latched to the tip side in the direction of the axis line, as directed toward a side opposite to the direction of the axis line where the surface is directed. Since the inclined surface which is directed toward the direction where the inner and outer peripheral surfaces oppose, the second inner bit or the said member is inserted and the striking force or the thrust force is relatively applied to the ring bit toward the tip side in the direction of the axis line with respect to the casing pipe, so that the inclined surfaces thereof can be guided each other. Therefore, out of the ring bit and the tip portion of the casing pipe, a side where the concave and convex portions are formed on the inner peripheral surface is enlarged the diameter, a side where the concave and convex portions are formed on the outer peripheral surface is reduced the diameter, or both sides are enlarged and reduced the diameter, the deformation occurs elastically and by this configuration, each convex portion is pulled out from the concave portion having been accommodated to pull out the ring bit to the tip side. Here, it is preferable to use, for example, a shrinkage-fitted method, that is, inserting the other by heating and expanding one where the concave and convex portions are formed on the inner peripheral surface out of the ring bit and the tip portion of the casing pipe so that the inner diameter of the convex portion is larger than the outer diameter of the other convex portion.

[0018] Meanwhile, in the drilling tool described above, for example, the ring bit is inserted by opposing the outer peripheral surface thereof to the inner peripheral surface of the tip portion of the casing pipe, in the engaging means, the protrusion extended in the direction of the axial line is formed on the outer periphery of the inner bit and the groove accommodating the protrusion is formed on the inner periphery of the ring bit to be opened to a rear end of the ring bit, and the groove of the engaging means and at least one of the concave portion and the convex portion formed on the outer peripheral surface of the ring bit in the latching means are formed so that at least a part thereof is overlapped in the direction of the axial line. Therefore, since the axial length of the ring bit can be reduced and the mass thereof can be reduced, it is economic, and even if the ring bit is drawn out to the tip side when the striking force is transmitted by the inner bit to the ring bit being not contact with the bottom of hole, the inertia can be reduced, so that the dropout of the ring bit can be more certainly prevented.

[0019] In addition, similarly, in the engaging means, for example, the protrusion extended in the axis line direction is formed on an outer periphery of the inner bit and the groove capable of accommodating the protrusion and having a width circumferentially larger than that of the protrusion is formed on the inner periphery of the ring bit to be opened to the rear end of the ring bit, wherein a convex wall portion capable of being contacted to the rear end of the protrusion accommodated in the groove toward the tip side in the direction of the axial line is formed in a rear end opening of the groove at a side of rotational direction of the inner bit upon drilling, and wherein in a state that the first contact portion is contacted to a contact portion of the casing pipe side and the convex wall portion is contacted to the rear end of the protrusion, the convex portions of the latching means are accommodated within the concave portions at both ends in the direction of the axial line with interval therebetween. Therefore, even if the striking force is transmitted to the ring bit being not contact with the bottom of hole and is drawn out to the tip side at the time of drilling, before the convex portion of the latching means is collided with the concave portion of the latching means, the convex wall portion formed in the rear end of the ring bit is contacted to the rear end of the protrusion of the inner bit, so that the extension of the life of the tool can be achieved by preventing the concave and convex portions of the latching means from being damaged.

[0020] Furthermore, regardless of the pull-out mechanism or not, the configuration can be applied to the drilling tool having the ring bit just latched to the tip side of casing pipe by the latching means and the effect described above can be achieved. Accordingly, the drilling tool comprises a cylindrical casing pipe; annular ring bits inserted in a tip portion of the cylindrical casing pipe to be rotatable around an axis line of the casing pipe by opposing an inner peripheral surface thereof to an outer peripheral surface of the tip portion of the casing pipe; latching means constituted by a concave portion formed in at least one peripheral surface of the inner and outer peripheral surfaces opposed to each other to be extended axially with having annular shape around the axis line, and a convex portion formed in the other peripheral surface to be accommodated in the concave portion, the ring bit being latched on a tip side in the direction of the axial line of the casing pipe by the latching means and mounted to be moved in the direction of the axial line; and an inner bit mounted on a tip of a transmission member inserted within the casing pipe, wherein a first contact portion which can be contacted to a contact portion of the casing pipe side protruded on an inner periphery of the tip portion of the casing pipe toward the tip side of

the direction of the axial line and a second contact portion which can be contacted to a contact portion of the ring bit side formed at the ring bit and having an inner diameter smaller than that of the contact portion of the casing pipe side toward the tip side of the direction of the axial line are formed on the outer peripheral surface of the inner bit, wherein the inner bit can be engaged around the axis line with respect to the ring bit by engaging means, wherein, in the engaging means, a protrusion extended in the direction of the axial line is formed on an outer periphery of the inner bit and a groove accommodating the protrusion is formed on the inner periphery of the ring bit to be opened to the rear end of the ring bit, and wherein, the groove of the engaging means and at least one of the concave portion and the convex portion formed on the ring bit side in the latching means are formed so that at least a part thereof is overlapped in the direction of the axial line.

[0021] Moreover, an the drilling tool of the present invention, comprises a cylindrical casing pipe; annular ring bits inserted in a tip portion of the cylindrical casing pipe to be rotatable around an axis line of the casing pipe by opposing inner and outer peripheral surfaces thereof to each other; latching means constituted by a concave portion formed in at least one peripheral surface of the inner and outer peripheral surfaces opposed to each other to be extended axially with having annular shape around the axis line, and a convex portion formed in the other peripheral surface to be accommodated in the concave portion, the ring bit being latched on a tip side in the direction of the axial line of the casing pipe by the latching means and mounted to be moved in the direction of the axial line; and an inner bit mounted on a tip of a transmission member inserted within the casing pipe, wherein a first contact portion which can be contacted to a contact portion of the casing pipe side protruded on an inner periphery of the tip portion of the casing pipe toward the tip side of the direction of the axial line and a second contact portion which can be contact to a contact portion of the ring bit side formed at the ring bit and having an inner diameter smaller than that of the contact portion of the casing pipe side toward the tip side of the direction of the axial line are formed on the outer peripheral surface of the inner bit, wherein the inner bit can be engaged around the axis line with respect to the ring bit by engaging means, wherein in the engaging means, the protrusion extended in the axis line direction is formed on an outer periphery of the inner bit and the groove accommodating the protrusion and having a width circumferentially larger than that of the protrusion is formed on the outer periphery of the inner bit to be opened to the rear end of the ring bit, wherein the convex wall portion capable of being contacted to the rear end of the protrusion accommodated in the groove toward the tip side in the direction of the axial line is formed in a rear end opening of the groove at a side of rotational direction of the inner bit upon drilling, and wherein in a state that the first contact portion is contacted to a contact portion of the casing pipe side and the convex wall portion is contacted to the rear end of the protrusion, the convex portions of the latching means are accommodated within the concave portions at both ends in the direction of the axial line with interval therebetween.

[0022] Consequently, according to the drilling tool and the drilling method using the same of the present invention, in case that the second hole having a same diameter of the first hole is formed after the first hole is formed by a predetermined depth by preventing the dropout of the ring bit until the latching means and pulling out the ring bit from the casing pipe by the pull-out mechanism, or after the drilling is terminated, the outer diameter of the member, like an anchor built up in the drilling hole can be enlarged, or in case that the member, like an anchor having the same diameter is built up, the outer diameter of the casing pipe and drilling hole can be reduced, thereby being efficient or economic. In addition, regardless of the pull-out mechanism, according to the drilling tool of the present invention, the dropout or the damage of the concave and convex portions in the latching means can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Fig. 1 is a cross-sectional side view showing a first embodiment of a drilling tool of the present invention.

[0024] Fig. 2 is a front view showing the embodiment shown in Fig. 1 viewed from a tip side (the direction of an arrow Z in Fig. 1) in the direction of an axis line.

[0025] Fig. 3 is an enlarged cross-sectional side view of the tip portion in a state that a contact portion 3A of a casing pipe side and a contact portion 4A of a ring bit side are contacted to a first contact portion 5A and a second contact portion 5B of an inner bit 5 in the embodiment shown in Fig. 1.

[0026] Fig. 4 is an enlarged cross-sectional side view of the tip portion in a state that the contact portion 3A of the casing pipe side and a convex wall portion 4C of the ring bit 4 are contacted to the first contact portion 5A and a protrusion 5C of the inner bit 5, respectively, in the embodiment shown in Fig. 1.

[0027] Fig. 5 is a side view showing a second inner bit 9 according to a first embodiment of a drilling method of the present invention using the embodiment shown in Fig. 1.

[0028] Fig. 6 shows the first embodiment of the drilling method of the present invention using the embodiment shown in Fig. 1.

[0029] Fig. 7 shows a second embodiment of the drilling method of the present invention using the embodiment shown in Fig. 1.

[0030] Fig. 8 is an enlarged cross-sectional view of a part of a rear end portion of a ring bit 4 inserted into an inner periphery of a tip portion of a casing top 3 showing a second embodiment of a drilling tool of the present invention.

[0031] Fig. 9 is an enlarged cross-sectional view of a

part of a rear end portion of a ring bit 4 inserted into an inner periphery of a tip portion of a casing top 3 showing a third embodiment of a drilling tool of the present invention.

[0032] Fig. 10 is an enlarged cross-sectional view of a part of a rear end portion of a ring bit 4 inserted into an inner periphery of a tip portion of a casing top 3 showing a fourth embodiment of a drilling tool of the present invention.

[0033] Fig. 11 is an enlarged cross-sectional view of a part of a rear end portion of a ring bit 4 inserted into an inner periphery of a tip portion of a casing top 3 showing a fifth embodiment of a drilling tool of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0034] Figs. 1 to 4 show a first embodiment of the present invention. A drilling tool of this embodiment is mounted in a drilling rig not shown and, for example, is used for a vertical drilling, a horizontal drilling or a diagonal drilling in a civil engineering, a construction foundation, a water well, a drainage, a pipe roof, a piling, anchoring, and a micro piling.

[0035] According to this embodiment, a casing pipe 1 has a tubular pipe body 2 sequentially added as needed and a cylindrical casing top 3 concentrically mounted on a tip of the tubular pipe body 2 by welding. In addition, transmission members such as an inner rod not shown which transmit a striking force, a torque and a thrust are inserted concentrically to an axis center line O of the casing pipe 1 in an inner periphery of the casing pipe 1 and the transmission members are sequentially added as needed. An utmost rear end of the transmission member is connected to the drilling rig which applies the torque around an axis line O and the thrust toward a tip side in the direction of the axis line O to the transmission member at the time of drilling. Further, a annular ring bit 4 is mounted on the tip of the casing top 3 of the tip of the casing pipe 1 and an inner bit 5 is mounted on the tip of the transmission member via a down-the-hole hammer 5H which is a part of the transmission member for applying the striking force toward the tip side in the direction of the axis line O and is inserted in the inner periphery of the ring bit 4.

[0036] In the casing top 3, a rear end portion thereof is formed to be reduced smaller than the inner and the outer diameter with respect to the tip portion, and a tapered portion gradually enlarged toward the rear end is formed on an edge of the rear end and to be a contact portion 3A of the casing pipe. And the rear end portion is inserted in the inner periphery of the pipe body 2 of the utmost tip, and the rear end of the tip portion is mounted by welding to the tip of the pipe body 2. In addition, in the tip portion of the casing top 3, the outer diameter thereof is substantially similar to that of the pipe body 2 and the inner diameter thereof is slightly larger than that of the pipe body 2. However, the outer diameter of the tip portion of the casing top 3 may be larger than that of the pipe body 2.

[0037] In the ring bit 4 mounted on the tip side of the casing top 3, the rear end portion thereof is inserted in the inner periphery of the tip portion of the casing top 3 to be rotatable around an axis line of the casing pipe concentrically to the axis line O. Further, an outer diameter of the tip portion of the ring bit 4 is enlarged, whereby the outer diameter thereof is larger than the outer diameter of the casing top 3 or the pipe body 2. Accordingly, in this embodiment, the ring bit 4 is inserted into the casing top 3 so that the outer peripheral surface of the rear end portion of the ring bit 4 is diametrically opposed to the inner peripheral surface of the tip portion in the casing top 3 of the tip of the casing pipe 1. In addition, the inner peripheral surface of the ring bit 4 has the inner diameter slightly smaller than the inner peripheral surface of the rear end portion of the casing top 3, and a tapered portion which is gradually enlarged as it is directed toward the rear end, is formed on a part reduced smaller than the inner diameter of the rear end portion of the casing top 3 of the rear end portion to be a contact portion 4A of the ring bit.

[0038] In addition, in this embodiment, the tip surface of the ring bit 4 includes a flat annular surface perpendicular to the axis line O and two tapered portions slanting toward the rear end as they are arranged in the inner and outer peripheries of the annular surface. A plurality of inserts 6 made of hard material such as cemented carbide are implanted in an annular surface and a tapered portion of the inner and outer peripheries, respectively. Moreover, a plurality of concaves 4B parallely extended to the axis line O are formed on the inner peripheral surface of the tip side of the ring bit 4 at even intervals and are formed not to interfere with the inserts implanted on the tapered surface of the inner peripheral side of the tip of the ring bit 4. In such concaves 4B, a rear part in a rotational direction T of the inner bit 5 at the time of drilling is opened by passing through the contact portion 4A of the ring bit from the tapered surface of the inner periphery of the ring bit 4 at the time of drilling. Meanwhile, a convex wall portion 4C having a wall surface perpendicular to the axis line O is formed on a rear end side of a part in rotational direction T of the inner bit at the time of drilling, and thereby being not passed through the contact portion 4A of the ring bit.

[0039] Meanwhile, after the inner bit 5 is enlarged from the tip toward the rear end in two steps, the inner bit 5 has the profile multi-step cylindrical shape in which the inner bit 5 is reduced stepwise. The outer diameter of a first-step part has a size capable of loosely being inserted into the inner periphery of the ring bit 4, the outer diameter of a second-step part has the size capable of loosely being inserted into the inner periphery of the rear end portion of the casing top 3 and the outer diameter of a largest third-step part has a size capable of loosely being inserted into the inner periphery of the pipe body 2, respectively. In addition, an outer peripheral portion of the

tip surface in the first-step part of the inner bit 5, that is, an outer peripheral portion of the tip surface of the inner bit 5, and a portion between the first step and the second step, and a portion of the second step and the third step are formed on the tapered portions conically enlarged toward the rear end as toward the outer periphery, respectively. Among them, the tapered portion between the second step and the third step, and the tapered portion between the first step and the second step have the same angle as the contact portion 3A of the casing pipe and the contact portion 4A of the ring bit, whereby they are the first contact portion 5A and the second contact portion 5B of the inner bit 5 in this embodiment, respectively. As shown in Figs. 1 to 3, the tip of the inner bit 5 is set to be protruded more than the tip of the ring bit 4 in a state that the first and second contact portions 5A and 5B are contacted to the contact portion 3A of the casing pipe and the contact portion 4A of the ring bit.

[0040] Moreover, protrusions 5C as many as the grooves 4B protruded on the outer periphery rather than the outer diameter which can be loosely inserted in the inner periphery of the ring bit 4 as described above is formed peripherally at even intervals and are extended through the a front part of the second contact portion 5A at a position retreated slightly from the tip surface of the inner bit 5 in the direction of the axis line O. The protrusions 5C can be loosely inserted into the opening of the contact portion 4A of the ring bit side of the groove 4B of the ring bit 4 from the rear end. Therefore, as described above, the contact portion 3A of the casing pipe is contacted by the first contact portion 5A and the contact portion 4A of the ring bit is contacted by the second portion 5B to be accommodated within the groove 4B by spacing between the rear end of protrusions 5C and the convex wall portion 4C of the groove 4B as shown in Fig. 3.

[0041] Accordingly, in the inner bit 5 in which the protrusion 5C is accommodated in the groove 4B and inserted into the inner periphery of the ring bit 4, and the first contact portion 5A is contacted to the contact portion 4A of the ring bit side, the protrusions 5C are contacted to either side walls of the groove 4B in the case of the rotation of the axis line O, whereby engaging means in this embodiment is constituted b5C are contacted to the side wall of the groove 4B by rotating the inner bit 5 in the rotational direction at the time of drilling by means of the drilling tool, the protrusion 5C is accommodated in the front side of the convex wall portion 4C by moving from the tip side of the opening of the groove 4B as shown Fig. 2. That is, the width of the groove 4B is larger than the width of the protrusion 5C, and the width of the convex wall portion 4C is substantially similar to the width of the protrusion 5C. However, the width of the convex wall portion may be larger or smaller than the width of the protrusion 5C.

[0042] Furthermore, a part in which the diameter is reduced on the rear end side of the inner bit 5 is a shank mounted onto the down-the-hole hammer 5H. In addition, in case that a hammer applying the striking force to the inner bit 5 is so called a top hammer, the shank is fitted to by the inner rod, screw and the like which are the transmission member. In addition, a supplying hole 5D for supplying compressed air sent via the down-the-hole hammer 5H or the transmission member toward the tip side along the axis line O from the rear end is formed within the inner bit 5. The supplying hole 5D is branched into flushing holes extended to the tip side as it is directed toward the outer periphery side of the inner bit 5. Some flushing holes are opened in the tip surface of the inner bit 5, and the other flushing holes are opened in a position substantially facing the tip surface of the ring bit 4 in a state that the second contact portion 5B is contacted to the contact portion 4A of the ring bit on the first-step outer peripheral surface of the inner bit 5.

[0043] In addition, grooves 5E for discharging the cuttings as many as the protrusions 5C and the grooves 4B are formed to be adjacent to the rear side of the rotational direction T of the protrusion 5C, to be extended radially in the tip surface of the inner bit 5, to be opened in the third-step part parallel to the axis line O in the outer peripheral surface and to have a maximum outer diameter of the inner bit 5 on the outer peripheral surface from the tip surface of the inner bit 5. In groove 5E, the depth of the groove is provided to be gradually lowered toward the inner periphery side in the inner peripheral surface of the inner bit 5 and the part of ejection holes branched from the supplying.hole 5D is formed to have rectangular shape which is opened within the discharging groove 5E on the tip surface and opened on the outer periphery side in the outer peripheral surface of the inner bit 5 as shown in Fig. 2.

In a state that the protrusion 5C accommodated in the groove 4B is positioned in the front side of the convex wall portion 4C as described above, the protrusion 5C is peripherally matched with a part unifying with the opening of the groove 4B. A through-hole unifying with the tubular space within the casing pipe 1 from the tip of the ring bit 4 and the inner bit 5 is partially formed. Moreover, a lot of inserts 6 made of the hard material such as cemented carbide are implanted in a position not interfere with the discharging groove 5E through the outer peripheral portion which is the tapered portion in the tip surface of the inner bit 5.

[0044] As described above, the concave portion 7A having an annular shape around the axis line O and extended in the direction of the axis line O is formed on one peripheral surface in the outer peripheral surface of the rear end portion of the ring bit 4 and the inner peripheral surface of the tip portion of the casing top 3 inserted to be opposed to each other. In addition, a convex portion 7B which can be accommodated in the concave portion 7A is formed on the other peripheral surface. The ring bit 4 is latched on the tip side in the direction of the axis line O with respect to the casing top 3 (the casing pipe 1) by the concave portions 7A and the convex portion 7B, and latching means 7 which can be moved in the direction of the axis line O in the range of the convex portion 7B is

constituted. Moreover, the latching means 7 comprises the pull-out mechanism which can pull out and remove the ring bit 4 latched and accommodated onto the tip side in the direction of the axis line O with respect to the casing top 3 as needed.

[0045] Here, in this embodiment, the concave portion 7A and the convex portion 7B are formed on both the peripheral surface of the tip portion of the casing top 3 and the outer peripheral surface of the ring bit 4 opposed to each other by the latching means 7, respectively. That is, in the inner peripheral surface of the tip portion of the casing top 3, the convex portion 7B which becomes the convex in the inner peripheral side of the tip is annularly formed in the periphery of the axis line O and the concave portion 7A is lined on the convex portion 7B from the convex portion 7B to a portion in a part in which the rear end portion of the casing top 3 on the rear end side in the direction of the axis line O is slightly reduced rather than the tip portion thereof in inner diameter.

[0046] In addition, on the outer peripheral surface of the ring bit 4, the convex portion 7B which becomes the convex in the outer peripheral side of the rear end also is annularly formed in the periphery of the axis line O and the concave 7A is lined on the convex portion 7B from the convex portion 7B to a portion in a part in which the tip portion of the ring bit 4 is slightly enlarged rather than the rear end portion thereof in outer diameter. Accordingly, in this embodiment, with respect to the concave 4B in the engaging means formed in the inner periphery of the rear end portion of the ring bit 4, and the concave and convex portions 7A and 7B in the latching means formed in the outer periphery of the rear end of the ring bit 4, the concave and convex portions 7A and 7B are formed to be overlapped with a part of the concave 4B in the direction of the axis line O, that is, the concave 4B, and the concave and convex portions 7A and 7B are formed in both the inner periphery and the outer periphery in the rear end portion of the cylindrical ring bit 4.

[0047] Further, the inner diameter of the convex portion 7B on the casing top 3 is slightly large to be loosely inserted into the concave portion 7A on the ring bit 4 side and is slightly smaller than the outer diameter of the convex portion 7B on the ring bit 4 side and the outer diameter of the convex portion 7B on the ring bit 4 side is slightly small to be loosely inserted into the concave portion 7A on the casing top 3. In addition, the concave portions 7A and the convex portions 7B on the inner peripheral surface of the tip portion of the casing top 3 and the outer peripheral surface of the rear end portion of the ring bit 4 are formed approximately in a same length. Furthermore, the concave portion 7A is longer than the convex portion 7B and a bottom surface (inner and outer peripheral surfaces) of the concave portion 7A is the cylindrical surface having a constant diameter along the axis line O.

[0048] Moreover, the pull-out means 8 in this embodiment is constituted by the male and female thread portions 8A and 8B which screw each other and are formed on both the inner and outer peripheral surfaces of the convex portion 7B on the casing top 3 side and the ring bit 4 side of the latching means 7. That is, the female thread portions 8A having a constant diameter are provided on the inner peripheral surface of the convex portion 7B formed the tip on the inner peripheral surface of the tip portion of the casing top 3 and the male thread portions 8B having a constant diameter which can be inserted into the female thread portions 8A are formed on the outer peripheral surface of the convex portion 7B formed in the rear end on the outer peripheral surface of the rear end portion of the ring bit 4. Further, the inner and outer diameters of the convex portion 7B are the diameter of the thread in the male and female thread portions 8A and 8B, and the thread form of the male and female thread portions 8A and 8B are the trapezoidal screw.

[0049] In the latching means 7 having the pull-out mechanism 8, the male thread portion 8B formed on the outer periphery of the convex portion 7B of the ring bit 4 is screwed the female screw portion 8A formed on the inner periphery of the convex portion 7B of the casing top 3 from the tip side, the ring bit 4 is inserted with respect to the casing top 3 by relatively rotating, the convex portion 7B of the ring bit 4 is accommodated in the concave portion 7A of the casing top 3, and the convex portion 7B of the casing top 3 is accommodated in the concave portion 7A of the ring bit 4, respectively, when the male thread portion 8B is pulled out to the rear end side of the female thread portion 8A. In this state, the convex portion 7B of the ring bit 4 is latched to the concave portion 7A of the casing top 3 from the rear end side by contacting toward the tip side of the direction of the axis line O. Furthermore, the direction of the relative rotation of the ring bit 4 to the casing top 3 is the same as the rotational direction (the rotational direction viewed from the direction of arrow Z in Fig. 1) T, that is, the male and female thread portions 8A and 8B are not screwed together by the rotation of the ring bit 4 at the time of drilling, so that the male and female thread portions 8A and 8B are not inserted in the direction in which the ring bit 4 is pulled out.

[0050] In addition, a distance L1 in the direction of the axis line O between the tip of the convex portion 7B of the ring bit 4 and the rear end of the convex portion 7B of the casing top 3 respectively accommodated in the concave portion 7A as shown above is larger than a distance L2 in the direction of the axis line between the front wall surface of the convex wall surface 4C formed in the rear end portion of the concave 4B of the ring bit 4 and the rear end surface of the protrusion 5C of the inner bit 5 accommodated the concave 4B in a state that the first and second contact portions 5A and 5B are contacted to the contact portion 3A of the casing pipe side and the contact portion 4A of the ring bit side, respectively, as shown in Figs. 1 and 3 in this embodiment.

[0051] Accordingly, in a state that the protrusion 5C is accommodated in the tip side in the direction of the axis line O of the convex wall portion 4C of the concave 4B by rotating the inner bit 5 in the rotational direction T at

the time of drilling, when the ring bit 4 is advanced to the tip side, the convex wall portion 4C is contacted to the rear end of the protrusion 5C before the tip of the convex portion 7B of the ring bit 4 is contacted to the rear end of the convex portion 7B of the casing top 3 as described above. Therefore, a distance α between L1 and L2 is generated between both convex portions 7B, that is, the convex portions 7B are disposed on both the tip side and the rear end side in the direction of the axis line O with the concave portion 7A which accommodates the convex portions 7B at intervals.

[0052] Besides, as described above, the male and female thread portions 8A and 8B of the pull-out mechanism are screwed together to the opposite direction when the convex portion 7B is screwed to be respectively accommodated in the concave portion 7A, and the ring bit 4 is relatively rotated to the opposite direction above described with respect to the casing top 3 and advanced to the direction of tip side of the casing top 3. Therefore, the male thread portion 8B pass through the female portion 8A, so that the ring bit 4 latched by the latching means 7 can be pulled out.

[0053] Further, in case that the drilling tool is being used downward, the convex portions 7B are contacted to each other by removing the rear end of the protrusion 5C from the tip wall surface of the convex wall portion 4C by rotating the inner bit 5 in the direction opposite to the rotational direction T in drilling, the male and female thread portions 8A and 8B are screwed together by means of the ring bit 4's own weight and rotating the inner bit 5, and the ring bit 4 is advanced to the tip side (downward), the ring 4 can be pulled out as described above. However, for example, by using a second inner bit 9 shown in Fig. 5 used for the first embodiment of the drilling method according to the present invention described below, the ring bit 4 can be further certainly pulled out.

[0054] Though the tip portion of the above described inner bit 5 has a multi-step cylindrical shape enlarged from the tip to the rear end in two steps, a tip portion of a second inner bit 9 has a multiple cylindrical shape enlarged in one step. A third-step outer diameter which is the maximum outer diameter of the tip portion of the inner bit 5 has the same diameter as the second-step outer diameter, is smaller than the inner diameter of the casing top 3 and larger than the inner diameter of the ring bit 4, that is, the first contact portion 5A has not been formed, so that the second inner bit 9 can be contacted to the contact portion 4A of the ring bit side and passed through the contact portion 3A of the casing pipe side. Further, since the second inner bit 9 shown in Fig. 5 is short not to have the third-step part of the tip portion with the inner bit 5 shown in Fig. 1 and the other parts are configured similar to the inner bit 5, the descriptions of the parts common to the inner bit 5 are omitted by giving the same reference numerals in Fig. 6.

[0055] That is, the drilling tool according to the present invention in which the second inner bit 9 is mounted comprises a cylindrical casing pipe 1; annular ring bits 4 inserted in a tip portion of the cylindrical casing pipe 1 to be rotatable around an axis line of the casing pipe 1 by opposing inner and outer peripheral surfaces thereof to each other; latching means 7 constituted by a concave portion 7A formed in at least one peripheral surface of the inner and outer peripheral surfaces opposed to each other to be extended axially with having annular shape around the axis line, and a convex portion 7B formed in the other peripheral surface to be accommodated in the concave portion 7A, the ring bit 4 being latched on a tip side in the direction of the axial line of the casing pipe 1 by the latching means 7 and mounted to be moved in the direction of the axial line; and a second inner bit 9 mounted on a tip of a transmission member inserted within the casing pipe 1, having the outer diameter which can pass through the contact portion 3A of casing pipe side protruded on an inner periphery of the tip portion of the casing pipe 1 and a second contact portion 5B which can be contacted to a contact portion 4A formed at the ring bit 4 having an inner diameter smaller than that of the contact portion 3A of the casing pipe 1 side is formed on the outer peripheral surface of the second inner bit 9 toward the tip side of the direction of the axial line, wherein the second inner bit 9 can be engaged around the axis line with respect to the ring bit 4 by engaging means, and wherein the latching means 7 has a pull-out mechanism 8 which pulls out the ring bit 4 to the tip side of the direction of the axial line with respect to the casing pipe 1.

[0056] (a) to (e) in Figs. 6 show the first embodiment of the drilling method of the present invention in the case of pulling out the ring bit 4 by the second inner bit 9 in forming the drilling hole by using the drilling tool of the first embodiment. In this embodiment, first, as shown in Figs. 1 to 3, the ring bit 4 is mounted in the casing top 3 and the inner bit 5 is inserted within the casing top 3 and the ring bit 4 through the casing pipe 1. The first and second contact portions 5A and 5B are contacted to the contact portion 3A of the casing pipe side and the contact portion 4A of the ring bit side, and the inner bit 5 is engaged with the ring bit 4 by rotating the inner bit 5 in the rotational direction T. A first hole H1 is formed by the insert 6 of the tip surfaces of the ring bit 4 and the inner bit 5 as shown in Fig. 6a. The casing pipe 1 is said in the first hole H1 with the ring bit 4 and the inner bit 5 by applying the striking force to the casing pipe 1 via the casing top 3.

[0057] After the first hole H1 has been formed to a predetermined depth, for example, the depth which reached to a hard formation through a soft formation which is easy to collapse, the inner bit 5 is rotated to a opposite side of the rotational direction T so that the protrusion 5C is broken out from the concave 4B, the inner bit 5 is pulled out from the casing pipe 1 with down-the-hole hammer 5H or transmission member. Next, the second inner bit 9 is mounted in the down-the-hole hammer 5H and inserted within the casing pipe 1, the second inner bit 9 is inserted into the inner periphery of the ring bit 4 as shown in Fig. 6(B) by rotating the protrusion 5C in the rotational

direction T and positioning the protrusion 5C in the tip side of the convex wall portion 4C after the protrusion 5C is inserted into the concave 4B of the ring bit 4.

[0058] In addition, from this state, the drilling tool is slightly raised and the second inner bit 9 is advanced toward the tip side as shown in Fig. 6(C), the contact portion 4A of the ring bit side is contacted to the second contact portion 5B of the second inner bit 9 and the convex portion 7B of the outer peripheral surface of the rear end portion is contacted to the convex portion 7B of the inner peripheral surface of the tip portion of the casing top 3, the ring bit 4 is rotated in a direction opposite to the rotational direction T with the inner bit 5. Consequently, as described above, the male and female thread portions 8A and 8B of the convex portions 7B are screwed together, and the male thread portion 8B is broken out to the tip side of the female screw portion 8A, and then, the ring bit 4 is pulled out to the tip side of the casing top 3 with the second inner bit 9.

[0059] Thus, from this state, after advancing the second inner bit 9 and the ring bit 4 and being contacted the second inner bit 9 and the ring bit 4 onto a hole bottom of the first hole H1, as shown in Fig. 6(D), the second hole H2 is formed in a hard bedrock in series of the tip side of the first hole H1. Accordingly, the second hole H2 formed as described above has the same drilling diameter as the first hole H1.

[0060] As described above, when the second hole H2 has been formed to a predetermined depth, in this embodiment, after the protrusion 5C is removed from the tip side of the convex wall portion 4C of the concave 4B by rotating the second inner bit 9 to the opposite side of the rotational direction T, the second inner bit 9 is pulled out from the ring bit 4 and in addition, pulled out from the casing pipe 1 down-the-hole hammer and transmission member. Next, the member, like an anchor D is inserted within the first and second holes H1 and H2 through the casing pipe 1 as shown in Fig. 6(e).

[0061] Then, since the ring bit 4 is left in the bottom of the second hole H2 and the minimum inner diameter of the casing pipe 1 is the inner diameter of the contact portion 3A of the casing pipe side of the casing top 3, a member, like an anchor D having an outer diameter smaller than the inner diameter of the contact portion 3A of the casing pipe side and larger than the inner diameter of the contact portion 4A of the ring bit side can be inserted into the first hole H1 and the second hole H2. Furthermore, accordingly after the member, like an anchor is inserted as described above, the casing pipe 1 is pulled out with casing top 3 from the first hole H1, whereby the casing pipe 1 may be reused.

[0062] As shown above, according to the above-described tool and the method, after the first hole H1 is formed as preventing the collapse of the overburden with the casing pipe 1 and reaches the bedrock, the ring bit 4 is pulled out to the tip side and the second hole H2 having the same diameter as the first hole H1 can be formed by the ring bit 4 and the second inner bit 9. Therefore, the second hole H2 can be efficiently formed without advancing the casing pipe 1 and a large diameter can be secured for the second hole H2.

[0063] Moreover, similarly to the drilling method of this embodiment, even in case that the member, like an anchor D is built up in the second hole H2 formed as described above, since the ring bit 4 is pulled out to the tip side and removed from the casing pipe 1, the member, like an anchor D having an outer diameter larger than the inner diameter of the ring bit 4 can be inserted to the second hole H2 to be built up. In other words, if comparing with the case that the member, like an anchor having the same outer diameter is built up, since the outer diameter of the casing pipe 1 or the ring bit 4, that is, the diameters of the holes H1 and H2 can be reduced smaller than that of conventional holes, it is economy. On the contrary, if the outer diameter of the member, like an anchor D is the same as the diameters of the holes H1 and H2, the thickness between the outer diameter of the casing pipe 1 and the inner diameter of the ring bit 4 can be enlarged. Therefore, since the area of the contact portion 3A of the casing pipe side or the area of the contact portion 4A of the ring bit side can be significantly secured, the improvement of the life thereof can be achieved, for example, it is available to pull out and reuse the casing pipe 1.

[0064] In addition, in the drilling tool, when the second hole H2 is formed as described above, the ring bit 4 can be certainly pulled out to the tip side by the pull-out mechanism. Further, when the first hole H1 is formed with the casing pipe 1, the ring bit 4 is certainly latched in the tip side by the latching means 7 by means of the concave and convex portions 7A and 7B formed on the inner and outer peripheral surfaces of the casing top 3 and the ring bit 4, which are opposed to each other to prevent the omission. Accordingly, the drilling can be achieved smoothly without the omission of ring bit 4.

[0065] Moreover, in the drilling tool of this embodiment, since the pull-out mechanisms 8 with which the latching means 7 is equipped are the male and female thread portions 8A and 8B which are threaded in the convex portion 7 formed on both the inner and outer peripheral surfaces, the rotational direction of the male and female thread portions 8A and 8B when the ring bit 4 is pulled out is set to be opposed to the rotational direction T at the time of drilling to prevent dropout of the ring bit 4 more certainly. In addition, since the male and female thread portions 8A and 8B can be formed easily and the other member is not required. Further, since the ring bit 4 can be mounted simply onto the casing pipe 1, more economic advantage can be achieved.

[0066] Furthermore, in the drilling method of the first embodiment, as described above, after the inner bit 5 is inserted within the ring bit 4 and the first hole H1 is formed, the second inner bit 9 is inserted within the ring bit 4 and the second hole H2 is formed. After then, the member, like an anchor D is inserted and built up within the second hole H2, similarly to the drilling method of the second embodiment of the present invention, the first hole H1 is

formed with the casing pipe 1 (Fig. 7A) and the inner bit 5 and the transmission member are pulled out from the casing pipe 1 (Fig. 7B). Next, the member, like an anchor D is inserted directly into the casing pipe 1 without forming the second hole H2 by inserting the second inner bit 9, and then, the ring bit 4 is pulled out to the tip side in the direction of the axis line O with the casing pipe by the pull-out mechanism and the member, like an anchor D may be said within the first hole H1 (Fig. 7C).

[0067] Even in the method of the second embodiment, since there can be inserted and built up the said member D having an outer diameter smaller than the inner diameter of the contact portion 3A of the casing pipe side and larger than the inner diameter of the contact portion 4A of the ring bit side similar to the first embodiment, same effect as the first embodiment can be achieved. Furthermore, in this case, the second contact portion 5B similar to the inner bit 5 and the protrusion 5C of the engaging means are formed in the tip portion of the member, like an anchor D, so that the pull-out of the ring bit 4 can be further certainly achieved. In addition, even in the second embodiment, after the member, like an anchor D is built up, the casing pipe 1 is pulled out from the first hole H1 and may be reused.

[0068] Further, in the drilling method of the first and second embodiments, even if there is inserted and built up the member, like an anchor D having an outer diameter smaller than the inner diameter of the contact portion 3A of the casing pipe side and larger than the inner diameter of the contact portion 4A of the ring bit side, the member, like an anchor having the outer diameter smaller than the inner diameter of the contact portion 4A of the ring bit side may be inserted. In this case, the ring bit 4 is pulled out and may be left within the holes H1 and H2, and the ring bit 4 is pulled out from the holes H1 and H2 with the casing pipe 1 without pulling out the ring bit 4, thereby being reused.

[0069] In addition, in the first embodiment, after the inner bit 5 is pulled out, instead of forming the second hole H2 having the same diameter as the first hole H1 by the inserting the second inner bit 9, the inner bit having an outer diameter smaller than the inner diameter of the contact portion 4A of the ring bit side is inserted into the ring bit 4, and then the hole having a diameter smaller than the first hole H1. After then, similarly, the member, like an anchor having the outer diameter smaller than the inner diameter of the contact portion 4A of the ring bit side is inserted and may be said in the drilling hole thereof.

[0070] Meanwhile, in the drilling tool of the present invention, for example, similar to the drilling tool of the second embodiment of the present invention shown as Fig, 8, in the latching means 11, one of the inner and outer peripheral surfaces of the ring bit 4 and the casing top 3 which are opposed to each other, a concave portion 11A is formed on one peripheral surface and the latching member 12 is annularly disposed on the other peripheral surface, so that the latching member 12 becomes a convex portion 11B which can be accommodated in the concave 11A. In this case, in stead of the pull-out mechanism 8 by the male and female thread portions 8A and 8B as described in the first embodiment, the pull-out mechanism 13 may be serve as an inclined surface 13A which faces the direction to which the inner and peripheral surfaces are opposed since the latching member 12 faces the contacted direction and the mechanism is formed on a circular surface in the surfaces which face the direction of the axis line O formed in the convex portion 11A, which is contacted with the latching member 12 when the ring bit 4 is pulled out with respect to the casing top 3. Furthermore, the reference numerals the same as the first embodiment is given for the common parts in the second embodiment and third to fifth embodiments described after the description thereof will be abbreviated.

[0071] That is, in the drilling tool of the second embodiment, similarly to the first embodiment, the ring bit 4 is inserted by opposing the outer peripheral surface of the rear end portion to the inner peripheral surface of the tip portion of the casing top 3. The concave portion 11A which has an annular shape around an axis line and extends to the direction of the axis line O is formed on the inner peripheral surface (one of peripheral surfaces) of the casing top 3. A surface which is located in the tip side and faces the rear end side in the direction of the axis line O from the annular surfaces facing the direction of the axis line O of the concave portion 11A is the inclined surface 13A. However, in this embodiment, a surface facing the tip side in the direction of the axis line O opposite the inclined surface 13A also is the inclined surface facing the direction to which the inner and outer peripheral surfaces are opposed facing the rear end side in the direction of the axis line O.

[0072] Meanwhile, in a state that the first and second contact portions 5A and 5B of the inner bit 5 are contacted to the contact portion 3A of the casing pipe side and the contact portion 4A of the ring bit side, an annular groove 11C having a sectional rectangular shape is formed on the rear end of outer peripheral surface (the other of peripheral surfaces) of the ring bit 4 so that it is located in a rear end side than the concave portion 11A. The latching member 12 inserted in the circular groove 11C such as a ring having the sectional-rectangular shape is set in the inner peripheral surface of the casing top 3 by reducing the outer diameter of it, and is elastically and closely contacted to the inner peripheral surface side of the casing top 3.

[0073] In the latching means described above, the ring bit 4 at the time of drilling is freely rotated in a state that the latching member 12 is closely contacted to the inner peripheral surface with respect to the casing top 3 by rotating the inner bit 5 engaged around the axis line O by the engaging means. In the tip side in the direction of the axis line O, the latching member 12 is accommodated within the concave portion 11A as the convex portion 11B since the outer diameter of the latching member 12 enlarge by elasticity thereof when the latching means is

advanced at the position of the concave portion 11A, and the convex portion 11B is latched at the position contacted to the inclined surface 13A of the tip side, being moved in the direction of the axis line O in the range of up to the inclined surface 13A.

[0074] Accordingly, in this embodiment, the inclined surface 13A is inclined to the direction to which the inner and outer peripheral surfaces are opposed, that is, the inner peripheral side toward the direction in which the latching member 12 is contacted, that is, the tip side of the axis line O. In addition, in the pull-out mechanism 13. of this embodiment by the inclined surface 13A, for example, similarly to the drilling method of the first embodiment, the inner bit 5 is exchanged with the second inner bit 9 and inserted within the ring bit 4. Further, under a state that the convex portion 11B (latching member 12) is contacted to the inclined surface 13A, the latching member 12 is reduced the outer diameter to be guided to the inclined surface 13A and the ring bit 4 is advanced by applying the striking force or the thrust force toward the tip side to the ring bit 4 via the second contact portion 5B and the contact portion 4A of the ring bit side, so that the ring bit 4 can be pulled out to the tip side from the casing top 3.

[0075] In addition, in the latching means 7, similarly to the first embodiment, in case that the convex portion 7B is formed the tip portion of the peripheral surface of the casing pipe 1 side and the rear end portion of the peripheral surface of the ring bit 4 side of the inner and outer peripheral surfaces of the tip portion of the casing pipe 1 and the ring bit 4 opposed to each other respectively, the concave portions 7A capable of accommodating the convex portions 7B, as extended in the convex portions 7B thereof in the direction of the axis line O, are formed in the tip end portion of the peripheral surface of the casing pipe 1 side and the rear end portion of the peripheral surface of the ring bit 4 side, similar to the drilling tool of the third embodiment of the present invention shown in Fig. 9, as the pull-out mechanism 14, surfaces which face the direction of the axis line O formed in a part in which the concave and convex portions 7A and 7B may become the inclined surfaces 14A which is inclined to the direction to which the inner and outer peripheral surfaces are opposed toward the direction opposite to these surfaces.

[0076] Here, in the third embodiment, the rear end portion of the ring bit 4 is inserted within the inner peripheral surface of the tip portion of the casing top 3 similar to the first and second embodiments, and the convex portion 7B is formed in the rear end of the outer peripheral surface of the rear end portion of the ring bit 4 and the circular concave portion 7A is formed in the tip side in the direction of the axis line O in series. On the other hand, in the tip portion of the casing top 3, the convex portion 7B is formed in the tip of the inner peripheral surface thereof and the concave portion 7A is formed in the rear end side in the direction of the axis line O in series as the latching means. Accordingly, a surface which faces the tip side in the direction of the axis line O is formed in a part in which the concave and convex portions 7A and 7B of the outer peripheral surface of the ring bit 4 side. In this embodiment, as the surface heads the rear end side in the direction of the axis line O opposite to the tip side, the surface becomes the inclined surface 14A which inclines the direction to which the inner and outer peripheral surfaces are opposed, that is, the outer peripheral side. In addition, a surface which heads the rear end side in the direction of the axis line O is formed in a part in which the concave and convex portions 7A and 7B of the inner peripheral surface of the casing top 3 side. As the surface which heads the tip side in the direction of the axis line O opposite to the rear end side, the surface becomes the inclined surface 14A which faces the direction to which the inner and outer peripheral surfaces are opposed, that is, the inner peripheral side.

[0077] In the third embodiment, the ring bit 4 can be moved in the direction of the axis line O within the range of the concave portion 7B and is freely rotated, and the ring bit 4 is latched in the tip side in the direction of the axis line O at a portion at which both convex portions 7B are contacted. In addition, the pull-out mechanism 14 with which the latching means is equipped, in a state that both convex portions 7B are contacted and the ring bit is latched, since a surface extended from the convex portion 7B to the concave portion 7A heads the tip side each other becomes the inclined surface 14A, the second inner bit 9 or the member, like an anchor D is inserted similar to the second embodiment and the striking force or the thrust force toward the tip side is applied to the ring bit 4 with respect to the casing pipe 1, being guided to the inclined surface 14A, so that the rear end portion of the ring bit 4 can be relatively reduced the outer diameter and the tip portion of the casing top 3 can be relatively enlarged the inner diameter. By this configuration, the ring bit 4 can be pulled out to the tip side of the casing pipe 1.

[0078] Accordingly, even in the second and third embodiments, the same effect as the first embodiment can be achieved. In addition, since operating the pull-out of the ring bit 4 is not complicated as screwly providing the male and female thread portions 8A and 8B by the rotation of the ring bit 4 similar to the pull-out means 8 of the first embodiment, and the ring bit 4 is pulled out by inserting the second inner bit 9 or the member, like an anchor D, the advantage that the ring bit 4 can be further certainly pulled out easily is achieved. Here, in the second embodiment, when the ring bit 4 is mounted onto the tip of the casing top 3, the outer diameter of the latching member 12 is reduced, the rear end portion of the ring bit 4 is inserted in the inner periphery of the tip portion of the casing top 3. In addition, in the third embodiment, for example, after the tip portion of the casing top 3 is enlarged by heating, it is preferable that the rear end portion of the ring bit 4 is inserted in the inner periphery thereof.

[0079] Furthermore, in the drilling tools of the first to third embodiments, as described above, even if the rear end portion of the ring bit 4 is inserted in the inner pe-

riphery of the casing top 3 and is opposed to the inner peripheral surface of the tip portion of the casing top 3, on the contrary, the tip portion of the casing top 3 (casing pipe 1) is smaller than the rear end portion of the ring bit 4, and then, the tip portion of the casing top 3 is inserted in the inner periphery of the rear end portion of the ring bit 4, whereby the inner peripheral surface of the ring bit 4 and the outer peripheral surface of the casing top 3 can be configured to be opposed to each other.

[0080] However, in that case, in the rear end portion of the circular ring bit 4, the thickness or the length becomes bigger, so that the mass thereof is increased, for example, when the striking force is transmitted to the ring bit 4 being not contact with the bottom of the hole, big inertia is occured. Thus, since the ring bit 4 may be fallen off, it is preferable that the ring bit 4 is mounted by inserting the rear end portion thereof in the inner periphery of the tip portion of the casing top 3 as described in the first to third embodiments.

[0081] Further, as described above again, when the ring bit 4 is inserted so that the outer peripheral surface thereof is opposed to the inner peripheral surface of the tip portion of the casing top 3 (casing pipe 1), in case that the engaging means which engages the inner bit to the ring bit 4 around the axis line is constituted the protrusion 5C formed in the outer periphery of the inner bit 5 and extended in the direction of the axis line O, and the concave 4B formed to accommodate the protrusion 5C in the inner periphery of the ring bit 4 as described above, it is preferable that a part of the concave 4B of the engaging means in the ring bit 4, and at lest one of the concave and convex portions 7A and 7B, or at least a part of the concave portion 11A and the convex portion 11B in the latching means 7 and 11 is formed to be overlapped. That is, by this configuration, since the length of the ring bit 4 in which the concave 4B, and the concave and convex portions 7A, 7B, 11A and 11B of the latching means are formed can be further shorter, it is possible to prevent the dropout of the ring bit 4 more certainly.

[0082] In addition, in the first to third embodiments, the concave 4B formed in the inner periphery of the ring bit 4 as the engaging means as described above is broader than the protrusion 5C of the inner bit 5 in the direction of the around axis O and in an opening of the rear end of the concave 4B, the convex wall portion 4C is formed in the rotational direction of the inner bit 5 at the time of drilling. Further, the first and second contact portions 5A and 5B of the inner bit 5 are contacted to the contact portion 3A of the casing pipe side and the contact portion 4A of the ring bit side at the time of drilling. In a state that a space L2 between the rear end of the protrusion 5C and the tip wall surface of the convex wall portion 4C is smaller than an L1 between the convex portions 7B in the latching means 7 of the first embodiment, an L1 between the tips of the convex portion 11B (latching member 12) and inclined surface 13A of the concave portion 11A in the latching means 11 as shown in Fig. 8 in the second embodiment, and an L1 between both ends of the inclined surface 14A of the concave and convex portions 7A and 7B in the latching means as shown in Fig. 9 in the third embodiment, respectively.

[0083] Accordingly, in the first to third embodiments, in a state that the first and second contact portions 5A and 5B are contacted to the contact portion 3A of the casing pipe side and the contact portion 4A of the ring bit side, even if the striking force is transmitted to the ring bit 4 not being contact with the bottom or the ring bit 4 is drawn out to the tip side, for example, as shown in Fig. 4, before the convex portions 7A of the latching means 7 or the inclined surfaces 14A of the pull-out mechanism 14, or the convex portion 11B of the latching means 11 and the inclined surface 13A of the pull-out mechanism 13 are contacted each other, since the convex wall portion 4C is contacted to the rear end of the protrusion 5C, the life of the tool can be extended by preventing latching means or pull-out mechanism the ring bit 4 from being damaged, and the dropout of the ring bit 4 can be more certainly prevented.

[0084] Meanwhile, in the first to third embodiments, even the configuration that if all the latching means 7 and 11 has the pull-out mechanisms 8, 13 and 14, and can pull out the ring bit 4 to the tip side, at least a part of the groove 4B of the engaging means in the ring bit 4 described above, and at least one of the concave and convex portions 7A, 7B, 11A and 11B formed the ring bit 4 side in the latching means 7 and 11 is overlapped, or the configuration that in a state that the first contact portion 5A of the inner bit 5 is contacted to the contact portion 3A of the casing pipe side, the convex portions 7B and 11B in the latching means 7 and 11 are accommodated within the concave portions 7A and 11A which accommodate the convex portions 7B and 11B at both ends of the direction of the axis line O at intervals can be applied to the drilling tool having the latching means 7 and 11 which are equipped with the pull-out mechanisms 8, 3 and 14 as shown above.

[0085] In the four and fifth embodiments of the present invention shown in Figs. 10 and 11, in case that the latching means 11 and 17 in the second and third embodiments are equipped without the pull-out means 13 and 14, such configuration is applied thereto, and the same reference numerals are given to parts common to the second and third embodiments. That is, in the fourth and fifth embodiments, instead of the inclined surface 13A constituted by the pull-out mechanism 13 in the second embodiment or the inclined surface 14A constituted by the pull-out mechanism 14 in the third embodiment, they serve as a flat annular surface 15 perpendicular to the axis line O. Accordingly, in the fourth embodiment, in a state that the latching member 12 which serves as the convex portion 11B is contacted to the flat surface of the concave portion 11A, the ring bit 4 is latched to the tip side and in the fifth embodiment, in a state that the flat surfaces 15 in a part where the concave and convex portions 7A and 7B contact each other, the ring bit 4 is latched to the tip side, but even if the thrust force or the

striking force is applied to the ring bit 4 toward the tip side in the state, the ring bit 4 is not pulled out in the tip side.

[0086] However, even in the fourth and fifth embodiments as described above, since the mass and inertia of the ring bit 4 can be reduced or the damage by the collision of the flat surface 15 and the convex portion 11B or the flat surfaces 15 can be prevented regardless of the pull-out mechanisms 13 and 14 by adopting the configuration described above, smooth drilling can be achieved or the extension of the life of the tool can be promoted by preventing the unnecessary pull-out or the dropout of the ring bit 4 similar to the first to third embodiments. In addition, in the first embodiment where the pull-out mechanism 8 is included by the male and female thread portions 8A and 8B, as described above, the ring bit 4 can be provided at the time of drilling without pulling out the ring bit 4a and even in such case, the same effect can be achieved by adopting the configuration.

Claims

1. An drilling tool, comprising:

a cylindrical casing pipe;
annular ring bits inserted in a tip portion of the cylindrical casing pipe to be rotatable around an axis line of the casing pipe by opposing inner and outer peripheral surfaces thereof to each other;
latching means constituted by a concave portion formed in at least one peripheral surface of the inner and outer peripheral surfaces opposed to each other to be extended axially with having annular shape around the axis line, and a convex portion formed in the other peripheral surface to be accommodated in the concave portion, the ring bit being latched on a tip side in the direction of the axial line of the casing pipe by the latching means and mounted to be moved in the direction of the axial line; and
an inner bit mounted on a tip of a transmission member inserted within the casing pipe,

wherein a first contact portion which can be contacted to a contact portion of the casing pipe side protruded on an inner periphery of the tip portion of the casing pipe toward the tip side of the direction of the axial line and a second contact portion which can be contacted to a contact portion of the ring bit side formed at the ring bit and having an inner diameter smaller than that of the contact portion of the casing pipe side toward the tip side of the direction of the axial line are formed on the outer peripheral surface of the inner bit,
wherein the inner bit can be engaged around the axis line with respect to the ring bit by engaging means, and
wherein the latching means has a pull-out mechanism which pulls out the ring bit to the tip side of the direction of the axial line with respect to the casing pipe.

2. The drilling tool according to Claim 1,
wherein, in the latching means, the annular convex portions are formed in a tip portion of a peripheral surface of the casing pipe side and a rear end portion of a peripheral surface of the ring bit side and the concave portions accommodating the convex portions in the other peripheral surfaces are formed in a rear end portion of a peripheral surface of the casing pipe side and a tip portion of the peripheral surface of the ring bit side along the direction of the axial line, out of the inner and outer peripheral surfaces, and
wherein the pull-out mechanisms are a male thread portion and a female thread portion formed on the inner and outer peripheral surfaces of the convex portion to be threaded with each other.

3. The drilling tool according to Claim 1,
wherein, in the latching means, the concave portion is formed on one peripheral surface, and a latching member urged toward the one peripheral surface side is annularly disposed on the other peripheral surface to be the convex portion out of the inner and outer peripheral surfaces, out of the inner and outer peripheral surfaces, and
wherein, in the pull-out mechanism, an inclined surface is formed on an annular surface which is contacted to the latching member when the ring bit is pulled out with respect to the tip portion of the casing pipe and is directed toward a direction that the inner and outer peripheral surfaces oppose as being directed toward a direction that the latching member is contacted onto the annular surface.

4. The drilling tool according to Claim 1,
wherein, in the latching means, the convex portions are formed on the tip portion of the peripheral surface of the casing pipe side and the rear end portion of the peripheral surface of the ring bit side, and the concave portions accommodating the convex portions in the other peripheral surfaces are formed in a rear end portion of a peripheral surface of the casing pipe side and a tip portion of the peripheral surface of the ring bit side along the direction of the axial line, out of the inner and outer peripheral surfaces, and
wherein, in the pull-out mechanism, an inclined surface is formed at a surface toward the direction of the axial line which is formed at a portion where the concave portion and the convex portion of each of the inner and outer peripheral surfaces are connected and is directed toward a direction that the inner and outer peripheral surfaces are opposed as being

directed toward the direction of the axial line opposite to the direction that the inclined surface is directed.

5. The drilling tool according to any one of Claims 1 to 4, wherein the ring bit is inserted by opposing the outer peripheral surface thereof to the inner peripheral surface of the tip portion of the casing pipe,
wherein in the engaging means, a protrusion extended in the direction of the axial line is formed on the outer periphery of the inner bit and a groove accommodating the protrusion is formed on the inner periphery of the ring bit to be opened to a rear end of the ring bit, and
wherein the groove of the engaging means and at least one of the concave portion and the convex portion formed on the outer peripheral surface of the ring bit in the latching means are formed so that at least a part thereof is overlapped in the direction of the axial line.

6. The drilling tool according to any one of Claims 1 to 5, wherein in the engaging means, a protrusion extended in the direction of axis line is formed on an outer periphery of the inner bit and a groove accommodating the protrusion and having a width circumferentially larger than that of the protrusion is formed on the inner periphery of the ring bit to be opened to the rear end of the ring bit,
wherein a convex wall portion being contacted to the rear end of the protrusion accommodated in the groove toward the tip side in the direction of the axial line is formed in a rear end opening of the groove at a side of rotational direction of the inner bit upon drilling, and
wherein in a state that the first contact portion is contacted to a contact portion of the casing pipe side and the convex wall portion is contacted to the rear end of the protrusion, the convex portions of the latching means are accommodated within the concave portions at both ends in the direction of the axial line with interval therebetween.

7. An drilling tool, comprising:

a cylindrical casing pipe;
annular ring bits inserted in a tip portion of the cylindrical casing pipe to be rotatable around an axis line of the casing pipe by opposing an inner peripheral surface thereof to an outer peripheral surface of the tip portion of the casing pipe;
latching means constituted by a concave portion formed in at least one peripheral surface of the inner and outer peripheral surfaces opposed to each other to be extended axially with having annular shape around the axis line, and a convex portion formed in the other peripheral surface to be accommodated in the concave portion, the ring bit being latched on a tip side in the direction of the axial line of the casing pipe by the latching means and mounted to be moved in the direction of the axial line; and
an inner bit mounted on a tip of a transmission member inserted within the casing pipe,

wherein a first contact portion which can be contacted to a contact portion of the casing pipe side protruded on an inner periphery of the tip portion of the casing pipe toward the tip side of the direction of the axial line and a second contact portion which can be contacted to a contact portion of the ring bit side formed at the ring bit and having an inner diameter smaller than that of the contact portion of the casing pipe side toward the tip side of the direction of the axial line are formed on the outer peripheral surface of the inner bit,
wherein the inner bit can be engaged around the axis line with respect to the ring bit by engaging means,
wherein, in the engaging means, a protrusion extended in the direction of the axial line is formed on an outer periphery of the inner bit and a groove accommodating the protrusion is formed on the inner periphery of the ring bit to be opened to the rear end of the ring bit, and,
wherein, the groove of the engaging means and at least one of the concave portion and the convex portion formed on the ring bit side in the latching means are formed so that at least a part thereof is overlapped in the direction of the axial line.

8. An drilling tool, comprising:

a cylindrical casing pipe;
annular ring bits inserted in a tip portion of the cylindrical casing pipe to be rotatable around an axis line of the casing pipe by opposing inner and outer peripheral surfaces thereof to each other;
latching means constituted by a concave portion formed in at least one peripheral surface of the inner and outer peripheral surfaces opposed to each other to be extended axially with having annular shape around the axis line, and a convex portion formed in the other peripheral surface to be accommodated in the concave portion, the ring bit being latched on a tip side in the direction of the axial line of the casing pipe by the latching means and mounted to be moved in the direction of the axial line; and
an inner bit mounted on a tip of a transmission member inserted within the casing pipe,

wherein a first contact portion which can be contacted to a contact portion of the casing pipe side protruded on an inner periphery of the tip portion of the casing pipe toward the tip side of the direction of the axial line and a second contact portion which can be

contacted to a contact portion of the ring bit side formed at the ring bit and having an inner diameter smaller than that of the contact portion of the casing pipe side toward the tip side of the direction of the axial line are formed on the outer peripheral surface of the inner bit,
wherein the inner bit can be engaged around the axis line with respect to the ring bit by engaging means,
wherein in the engaging means, a protrusion extended in the direction of the axis line is formed on an outer periphery of the inner bit and a groove accommodating the protrusion and having a width circumferentially larger than that of the protrusion is formed on the inner periphery of the ring bit to be opened to the rear end of the ring bit,
wherein a convex wall portion being contacted to the rear end of the protrusion accommodated in the groove toward the tip side in the direction of the axial line is formed in a rear end opening of the groove at a side of rotational direction of the inner bit upon drilling, and
wherein in a state that the first contact portion is contacted to a contact portion of the casing pipe side and the convex wall portion is contacted to the rear end of the protrusion, the convex portions of the latching means are accommodated within the concave portions at both ends in the direction of the axial line with interval therebetween.

9. An drilling method using the drilling tool according to any one of Claims 1 to 6, comprising the steps of:

applying to the inner bit, the striking force onto the tip side in the direction of the axial line and the torque around the axis line, to form a first hole having a predetermined depth while transmitting the striking force to the casing pipe and the ring bit via the first and second portions, the contact portion of the casing pipe side and the contact portion of the bit side, and transmitting the torque only to the ring bit by engaging means;
retreating the inner bit and a transmission member to pull out from the casing pipe;
mounting a second inner bit having the outer diameter smaller than the inner diameter of the contact portion of the casing pipe and having the second contact portion and the engaging means without the first contact portion onto the tip of the transmission member;
inserting the second inner bit in the inner periphery of the ring bit through the casing pipe;
pulling out the ring bit to the tip side in the direction of the axial line with respect to the casing pipe by the pull-out mechanism; and
applying to the second inner bit, the striking force onto the tip side in the direction of the axial line and the torque around the axis line to form a second hole at a tip end side of the first hole while transmitting the striking force to the ring bit via the second contact portion and the contact portion of the ring bit side and transmitting the torque to the ring bit by the engaging means.

10. The drilling method according to Claim 9, further comprising the steps of:

retreating after the second hole is formed, the second inner bit and the transmission member to pull out from the casing pipe in a state that the ring bit is left within the second hole, and
inserting the member, like an anchor having the outer diameter smaller than the inner diameter of the contact portion of the casing pipe and larger than the inner diameter of the contact portion of the ring bit within the casing pipe to said within the hole.

11. An drilling method using the drilling tool according to any one of Claims 1 to 6, comprising the steps of:

applying to the inner bit, the striking force onto the tip side in the direction of the axial line and the torque around the axis line via the transmission member, to form a hole having a predetermined depth while transmitting the striking force to the casing pipe and the ring bit via the first and second contact portions, the contact portion of the casing pipe side and the contact portion of the ring bit side, and transmitting the torque only to the ring bit by engaging means;
retreating the inner bit and a transmission member to pull out from the casing pipe;
pulling out the ring bit to the tip side in the direction of the axial line with respect to the casing pipe by the pull-out mechanism; and
inserting the member, like an anchor having the outer diameter smaller than the inner diameter of the contact portion of the casing pipe and larger than the inner diameter of the contact portion of the ring bit within the casing pipe to said within the hole.

Fig. 1

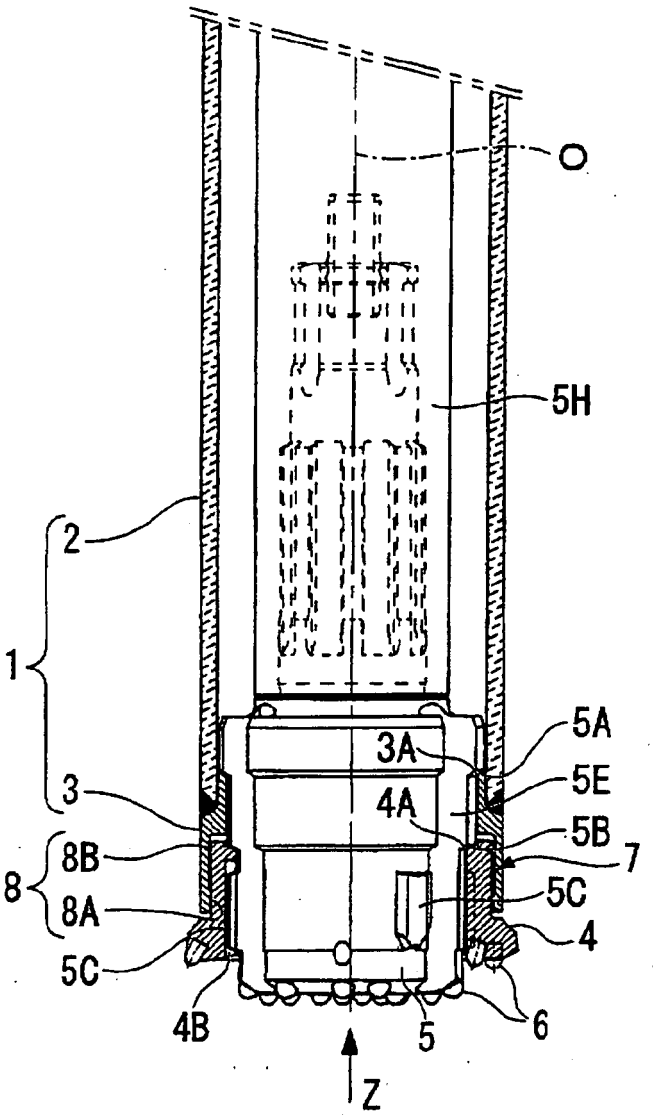


Fig. 2

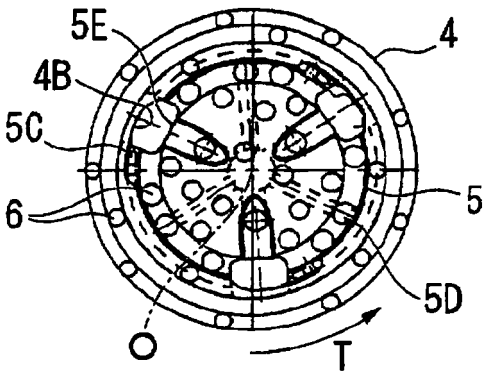


Fig. 3

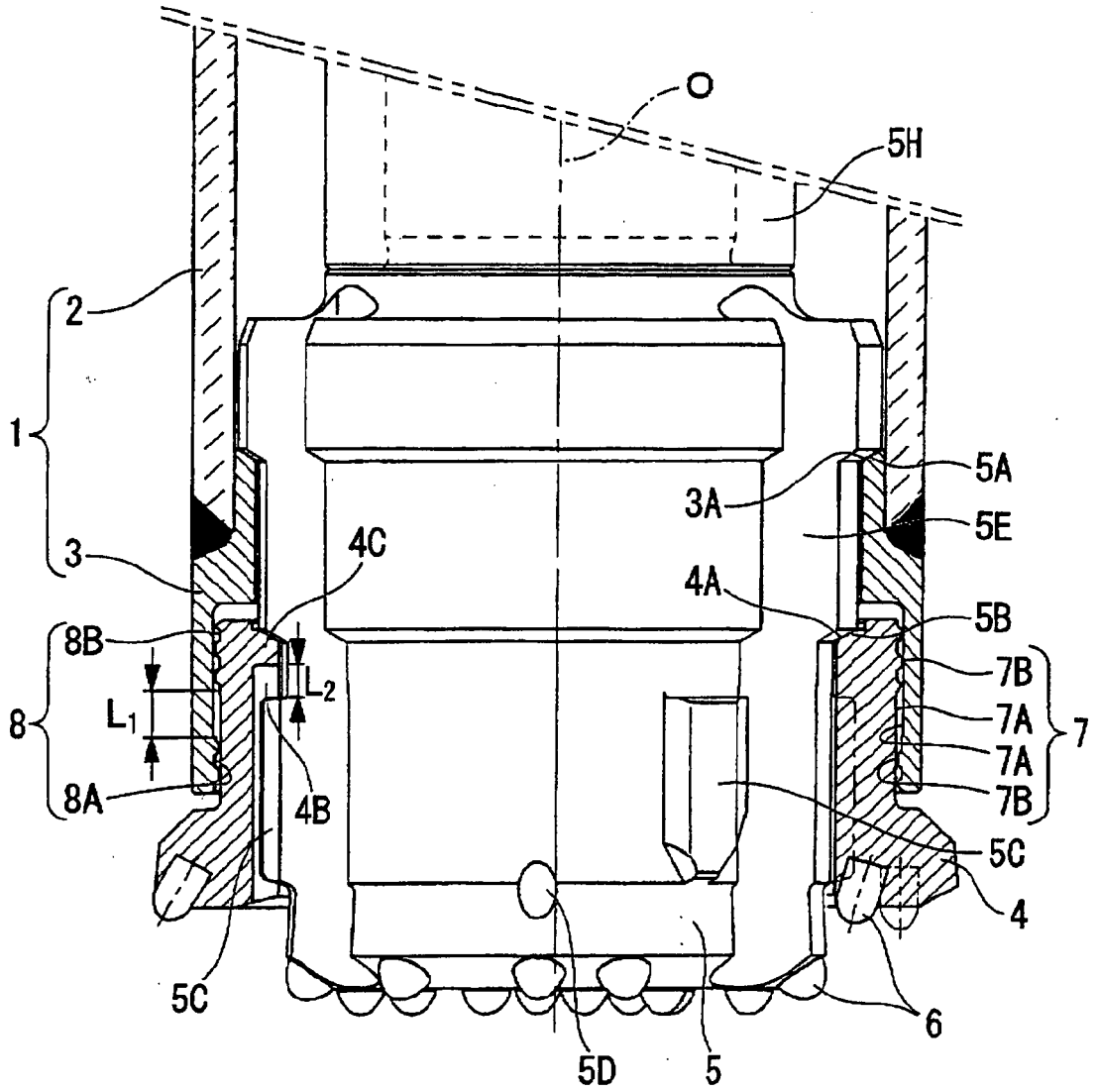


Fig. 4

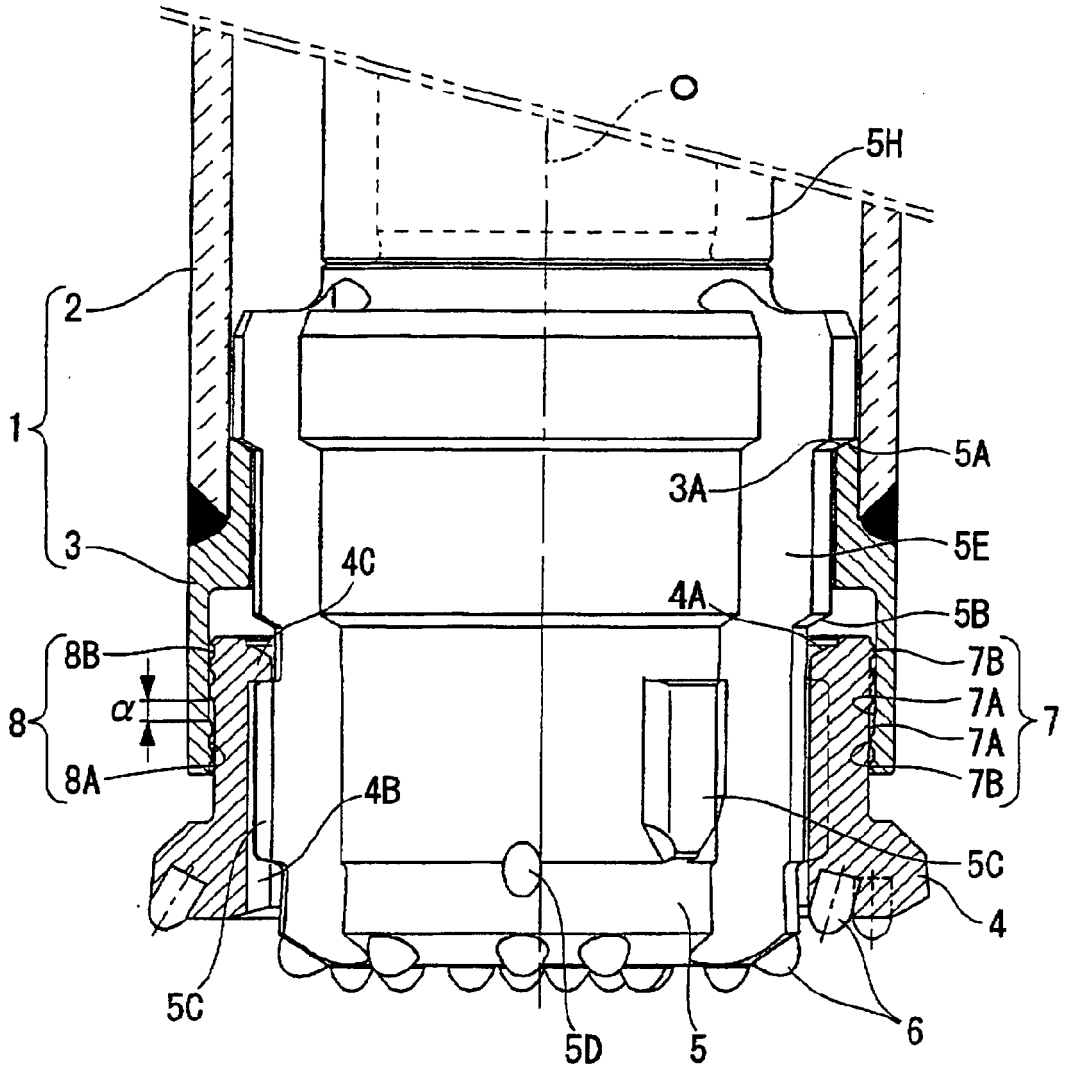


Fig. 5

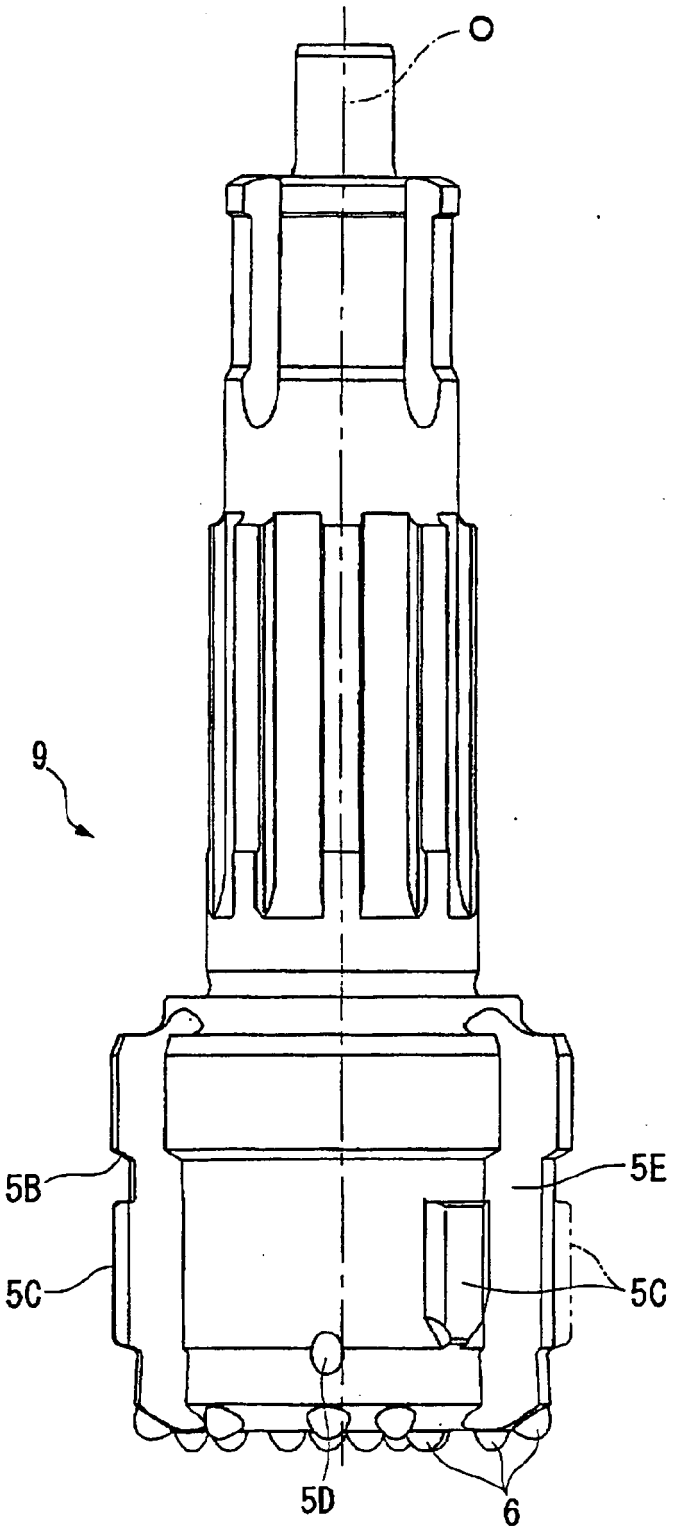


Fig. 6

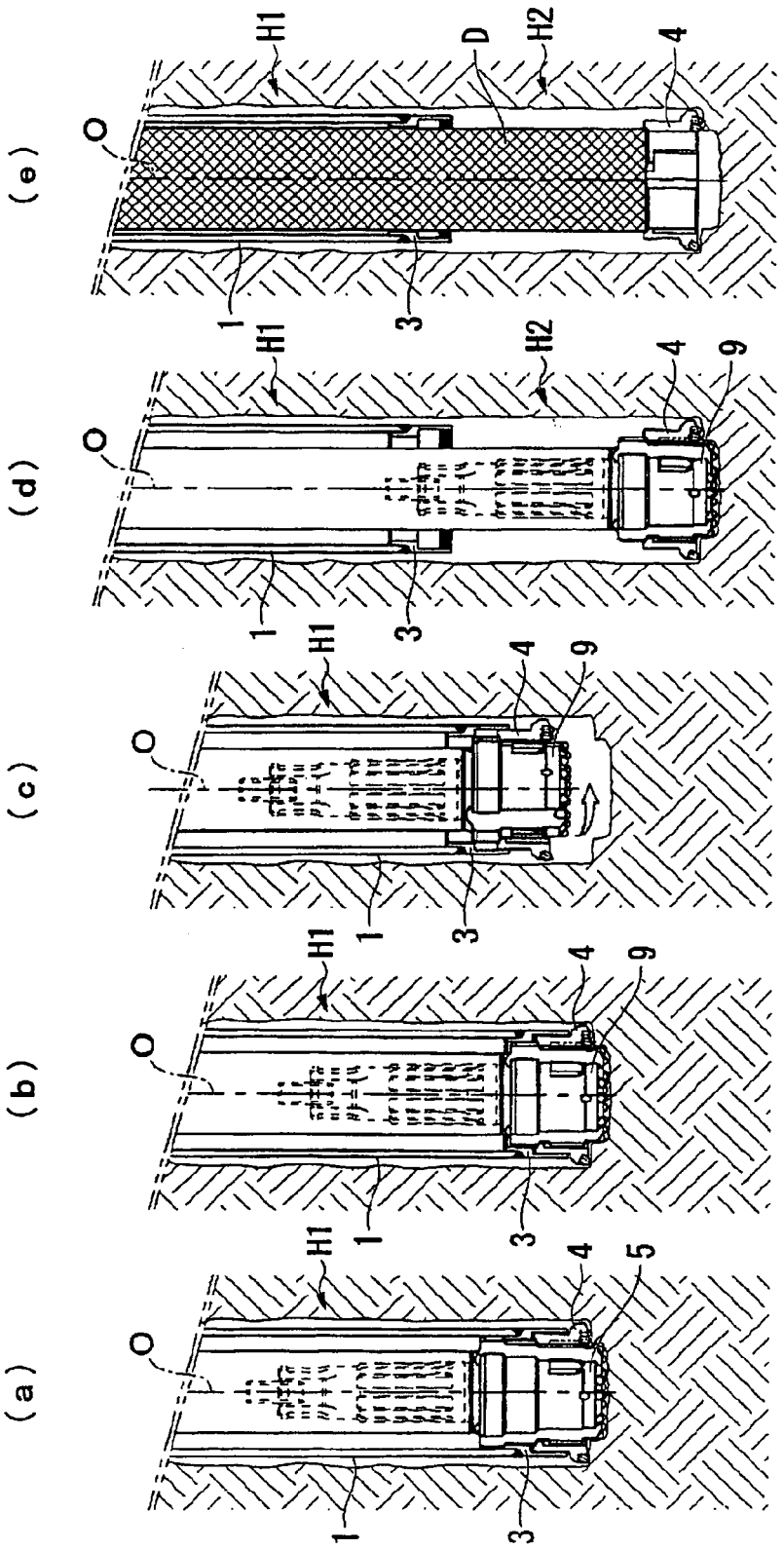


Fig. 7

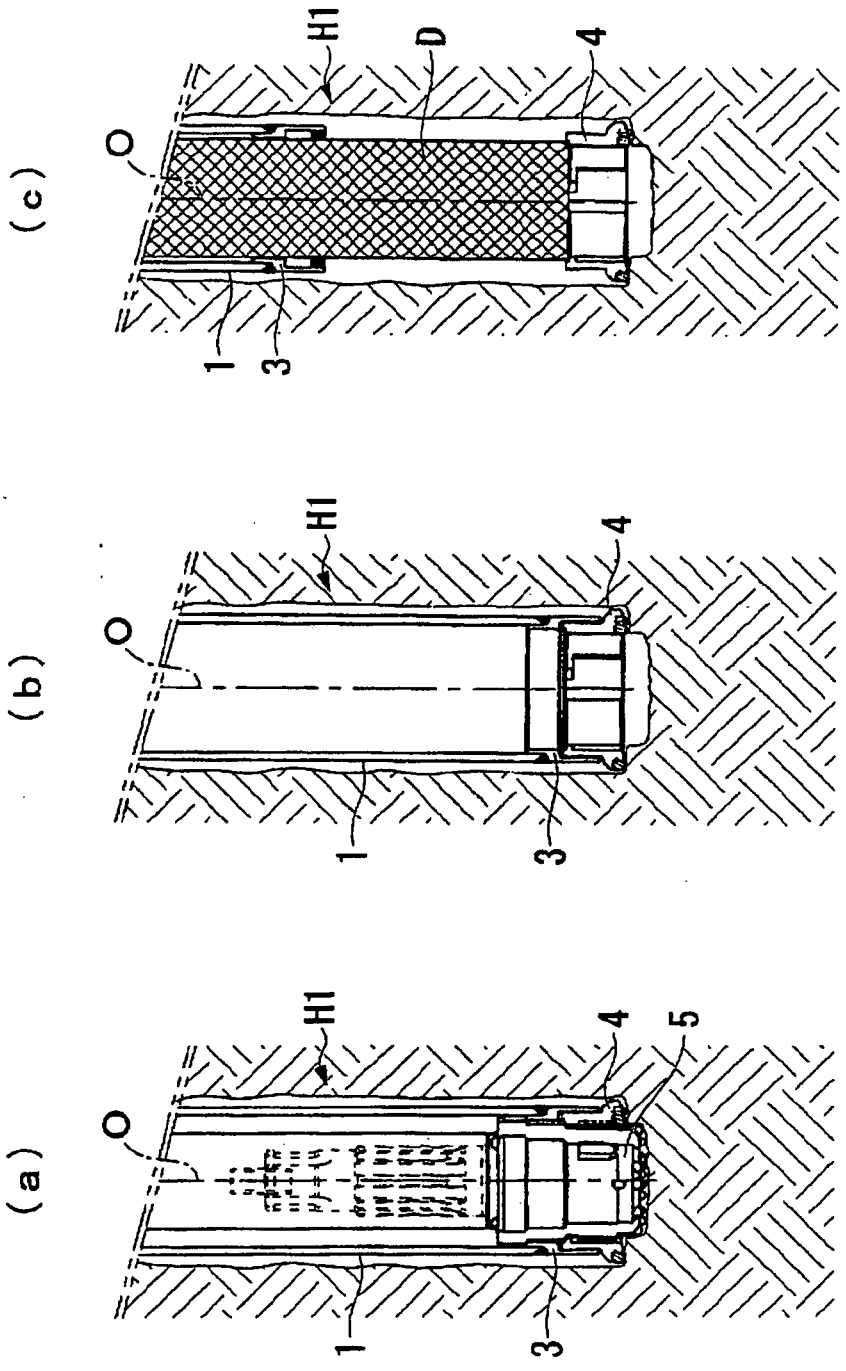


Fig. 8

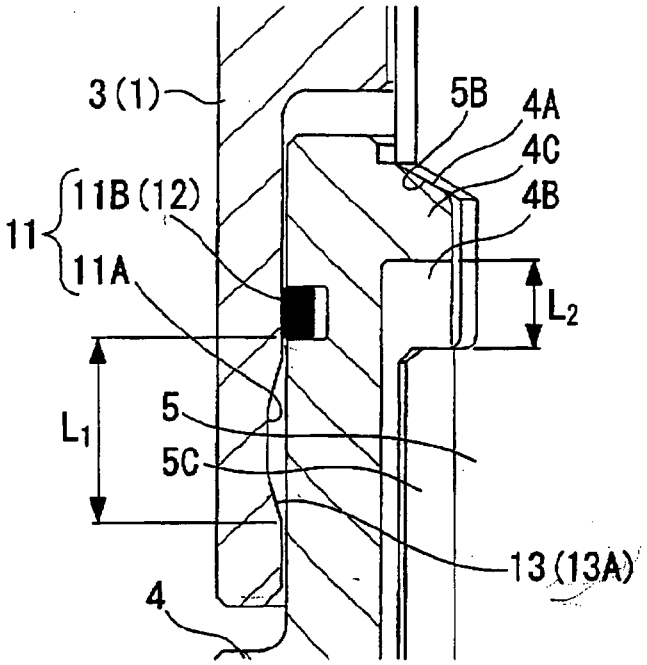
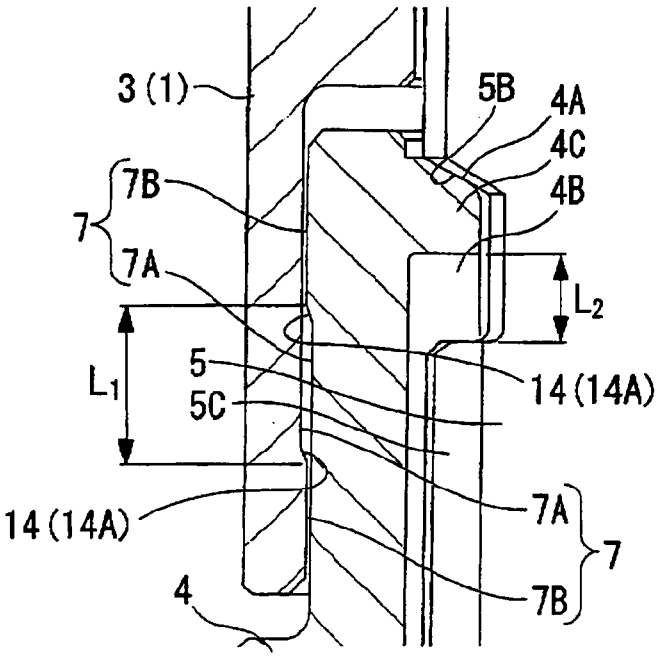

3(1)
5B
4A
4C
4B
11
11B(12)
11A
L2
L1
5
5C
13(13A)
4

Fig. 9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5B
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4B
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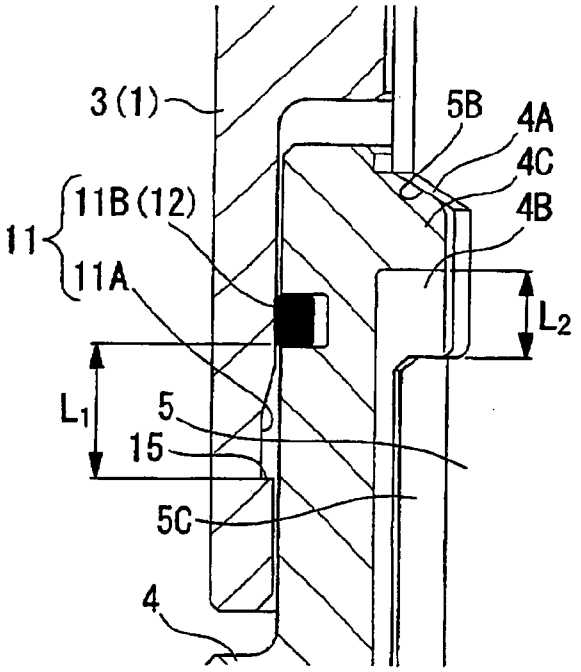
14(14A)
7A
7
7B
4

Fig. 10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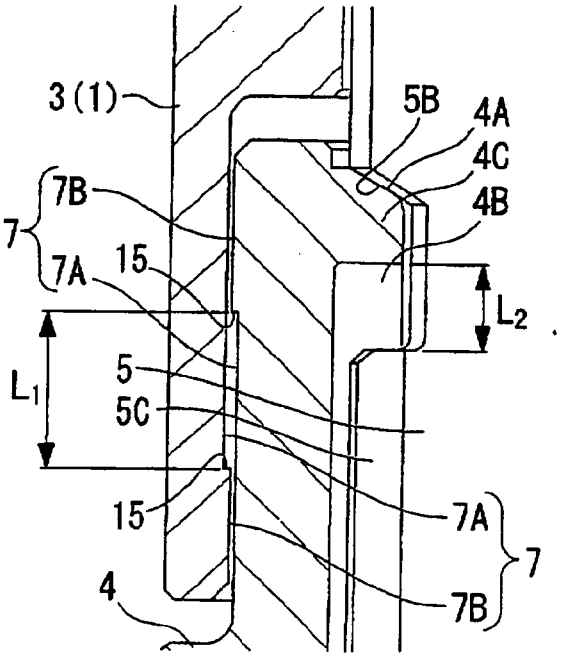
4C
4B
11
11B(12)
11A
L2
L1
5
15
5C
4

Fig. 11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7B
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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 00 5240

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 5 472 057 A (WINFREE MICHAEL B [US]) 5 December 1995 (1995-12-05) * column 4, line 47 - column 5, line 24; figure 2 *	1,7-9,11	INV. E21B7/20 E21B4/10 E21B10/64
A	CA 2 496 199 A1 (TESCO CORP [CA]) 17 August 2005 (2005-08-17) * page 6, line 5 - page 7, line 4; figure 1 *	1,7-9,11	
A	WO 02/081856 A (JAERVELAE JORMA [FI]; JAERVELAE VESA [FI]) 17 October 2002 (2002-10-17) * the whole document *	1,7-9,11	
A	NL 6 410 471 A (NYA ASFALT AB) 12 March 1965 (1965-03-12) * figures 1-5 *	1,7-9,11	
			TECHNICAL FIELDS SEARCHED (IPC) E21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 June 2007	Manolache, Iustin

CATEGORY OF CITED DOCUMENTS

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