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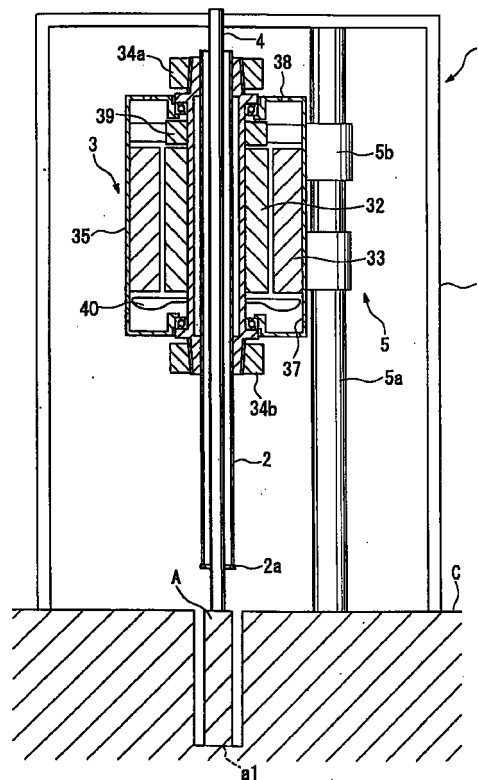
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(54) **Excavation equipment**

(57) The excavation equipment 1 has the cylindrical rotor 32 which is prepared the core bit 2 penetrably, the cylindrical stator 33 which is prepared at the periphery side of said rotor, the stationary portions 34a, 34b which are prepared at the both sides of said rotor and makes to rotate the core bit 2 with rotation of said rotor 32 by fixing the periphery side of the core bit 2 which is prepared in the cylindrical inside of said rotor 32, and the pressing down pole 4 which is inserted into the cylindrical inside of the rotor 32 and fits on the surface of the core A where is the inside portion of core bit 2 in the concrete C.

By this way, it is possible to generate high torque, to exchange easily the wasted core bit and, in addition, to prevent the fitting core A to the inside of the core bit 2.

FIG. 1



Description

Field of the Invention

[0001] This invention relates to the excavation equipment having cylindrical core bits for excavation of the work materials circularly.

Prior Art

[0002] As a method for reinforcing an already built concrete wall, the method for reinforcing the whole wall is known, i.e., boring a large hole on the wall at first, constructing an iron brace (reinforcing) in the opening space of the bored hole and consolidating with concrete said brace and an anchor which is constructed on the inner face of said hole. In this time, the anchor is constructed by holding on the holes which are prepared at the inner circumference face of the opening space.

The hole to construct the anchor is made by the equipment which is comprising the core bit 80 having the cylindrical core bit 80a, which is made by a cylindrical component and diamonds or cemented carbides at the top end of said component, and the driving motor 81 which rotates the core bit around the axial line.

That is, the cylindrical core 83 is made by rotating the bit 80a prepared on the top end of the core bite 80 with fitting on the concrete 82 which is the work material. Then, the core bit 80 is pulled out from the concrete 82 after breaking the root 83a of the remained core 83. Then, the hole for constructing the anchor having, for example, 20-35mm diameter and 200mm in depth is made.

[0003] By the way, when the core bit 80 is pulled out from the concrete 82, there was a case that the cylindrical core 83 is pulled out together with core bit 80, where said core is fitted, by breaking the root 83a of the core 83.

In this case, it becomes difficult to pull out the core 83 from the inside of core bit 80, and as the result, there was a problem to make decreasing the workability.

Moreover, when such a hole is made in the concrete 82, the core bit 80 is necessary to have high torque generation and the structure to be able to exchange the wasted core bit 80 easily.

[0004] Moreover, since the motor 81 has gears to transmit the torque, there are such problems as the weight is heavy, the handling nature is difficult, and the noise is loud (90 dB or more). Moreover, even when it is at high speed, the rotational frequency is low such as about 1500 rpm, and even if the special motor, about 3000 to 3900 rpm is the maximum. Therefore, there is a problem that the excavation time attains a long time.

In addition, in the case of an ultrasonic excavation equipment which excavates with ultrasonic wave, its noise is relatively low but excavation speed is low and there also is a problem that the working time becomes a long time.

[0005] Therefore, the object of this invention is to offer an excavation equipment, which has high torque and rotational frequency to be able to excavation in short time, and can be easily exchanged the wasted core bit. In addition, it also offers the equipment where it is difficult to fit the core to the inside of the core bit, and its noise generation is low.

Summary of the Invention

[0006] The excavation equipment of this invention is the excavation equipment which has a cylindrical core bit for excavation of the work materials circularly and a hollow type motor rotating said core bit.

The hollow type motor mentioned above comprises,

a cylindrical rotor in which the core bit mentioned above is prepared penetrably,

a cylindrical stator which is prepared at the periphery side of the rotor, and stationary portions which are prepared at the both ends of said rotor and makes to rotate said core bit with the rotation of said rotor, by fixing the periphery face of said core bit which is prepared in the cylindrical inside of said rotor.

Therefore, this core bit, which is penetrated in the cylindrical inside of the rotor and is fixed by the stationary portions connected in one with said rotor, directly receives the rotation of the rotor. That is, since the rotation of the rotor is directly transmitted to the core bit through the stationary portion, the core bit can generate high torque. Moreover, since the construction of this equipment is that the rotation of the rotor directly transmits to the core bite through the stationary portion, the parts, such as gears, etc., are not necessary and the generated noise is reduced. Furthermore, since the construction of this equipment is that the stationary portions fix the periphery face of the core bit, the holding the core bit is easily opened by opening this fixing. Therefore, since the maintenance, such as an exchange of the core bit, etc., can be easily done, the workability increases. Moreover, since the core bit is interchangeable, it is possible to select various cutting teeth which have various thickness or shapes.

Moreover, since the hollow motor is the direct type motor which directly rotates the core bit having bits, the vibration of the core bit which the rotational axis is very small, thereby, it becomes possible to excavate with high speed rotation. Therefore, it becomes possible to increase the excavation speed remarkably in comparison with conventional low speed excavation.

Thereby, the boring machining can be done rapidly and it can be attained that the necessary work period of the each operation of the boring is shortened and becomes easy.

Moreover, since the direct motor is used, the noise can be remarkably reduced (about 70dB) in comparison

with the case using an engine, a hydraulic motor or electric motor having gears. Furthermore, since the number of parts is small, the maintenance cost can be remarkably reduced.

[0007] Moreover, the excavation equipment of this invention is the equipment which has a cylindrical core bit for excavation the work materials circularly and a hollow type motor rotating said core bit.

The hollow type motor mentioned above comprises,

a cylindrical rotor in which the cylindrical rotation axis having the core bit mentioned above at the top end is penetrated,

a cylindrical stator which is constructed around the periphery face of said rotor, and

a rotary joint which is connected possible to rotate with the back end of the rotation axis, and in which the flow rout is formed to guide the coolant supplied from the source of the coolant.

The coolant, which is sent into the penetrated hole of the above-mentioned rotation axis which is rotating with the above-mentioned rotor through the above-mentioned rotary joint, is flowed from the back end to the top end of the above-mentioned rotation axis, and cools said rotation axis without cooling fans.

Therefore, when the excavation of the work material is done by rotating core bit with the rotation axis in which the coolant is sent in at the end of said rotation axis through the rotary joint, the heat of inside of the hollow type motor is absorbed by flowing said coolant along the inner circumference face of the penetrated hole mentioned above. Then, the heat of inside of the hollow type motor is cooled favourably.

That is, since the motor is, so called, the direct type motor which directly rotates the rotation axis on which the core bit is attached, it is possible to rotate the axis with high speed, and thereby, the coolant, which is sent into the end of the rotation axis, can be flowed along the inner circumference face of the penetrated hole in the rotation axis which is rotating with high speed. Then, the cooling efficiency can be increased remarkably by the coolant. Therefore, the remarkable cooling efficiency is obtained in comparison with only sending air into the hollow type rotation axis.

In addition, since the cooling fan is not necessary, the excavation equipment, which is very quiet without wind end sound, small and light weight, is obtained. Moreover, since cutting chips or dust powders are not sucked in comparison with the air cooling type by fan, the failure of such reason can be prevent.

Moreover, when the rotation axis is stopped, the cooling is continued by the coolant which is sent into the back end of the rotation axis. Therefore, the damage which is induced immediately after a stop of rotation can be prevented.

Moreover, after cooling of the hollow type motor by flowing along the inner circumference face of the penetrated

hole of the rotation axis, the coolant is sent in the core bit and then, is fed to the excavation place where the bit is excavating the work material. Therefore, the excavating place by the bit can be cooled and furthermore, it becomes possible to excavate smoothly by using the coolant as the lubricant at the excavating place.

[0008] Moreover, the hollow type motor of this invention is the motor which comprises,

a cylindrical rotor having the hollow portion in which the rotation axis is penetrated,

a cylindrical stator which is prepared around the periphery face of said rotor, and

the stationary portion which rotates said rotation axis with the rotation of said rotor by fixing the periphery face of said rotation axis penetrated into said hollow portion.

Therefore, the rotation axis, which is penetrated into the hollow portion of the rotor and fixed by the stationary portions connected in one with said rotor, directly receives the rotation of said rotor. That is, since the rotation of the rotor is directly transmitted to the rotation axis through the stationary portion, the high torque can be obtained on said rotation axis without transmission losses, such as gears, etc. Moreover, since the stationary portion is the structure which fixes the periphery face of the rotation axis, the holder of said rotation axis is opened by opening said fixing. Thereby, since the maintenance, such as the exchange of said rotation axis, can be done easily, the workability increases.

[0009] Moreover, the hollow type motor in this invention has the rotor formed as a hollow type and the cylindrical stator prepared at the periphery side of said rotor. A boring tool is fixed at the one end of the rotor mentioned above.

Thereby, since the boring tool is directly rotated by the rotation of the rotor, high torque can be obtained without the transmission losses, such as gears, etc. Moreover, number of the constructive components can be lessened as much as possible.

Brief Description of the drawings

[0010]

Figure 1 shows the cross sectional drawing of one example of the excavation equipment of this invention.

Figure 2 shows the cross sectional drawing of the hollow type motor for explanation of the structure of the hollow type motor used in this excavation equipment.

Figure 3 shows the cross sectional drawing of the excavation equipment for indication of the other example of the excavation equipment.

Figure 4 show the cross sectional drawing of the hollow type motor for explanation of the structure of

the other hollow type motor used in the excavation equipment.

Figure 5 shows the side drawing of the excavation equipment for indication of one example of the other excavation equipment of this invention.

Figure 6 shows the cross sectional drawing of the hollow type motor for explanation of the structure of the hollow type motor used in the other excavation equipment.

Figure 7 shows the cross sectional drawings of the rotation axis and one portion of the rotor which explain the coolant flow in the rotation axis of the hollow type motor used in the other excavation equipment.

Figure 8 shows the cross sectional drawing of the excavation equipment for explanation of the structure of the conventional excavation equipment.

Detailed Description of the Preferred Embodiment of the Present Invention

[0011] Hereafter, one example of the excavation equipment of this invention is explained with reference to drawings.

Figure 1 shows the side cross sectional drawing indicating the one example of the operation form of this invention. And, Figure 2 shows the enlarged drawing of the important portion of the hollow type excavation equipment.

In Figure 1, the excavation equipment 1 has,

the cylindrical core bit 2 having the bit 2a at the top end of said core bit 2 for excavating circularly the concrete C which is a work material,
the hollow type motor 3 to rotate said core bit 2,
the pressing down pole 4 (the pressing down portion) which is penetrated inside of the cylinder of said core bit 2, and
the sending device 5 which transfers said hollow type motor 3 to the direction which approaches or departs toward the surface of the concrete C.

Then, these are constructed in the outer cover 6 which has the removable roof and the cylindrical wall prepared at the outer of the radial direction of the core bit 2.

As shown in Figure 2, the hollow type motor 3 in these comprises,

the rotor 32 having the hollow type portion in which the core bit 2 can be penetrated,
the cylindrical stator 33 prepared at the periphery side of side rotor, and
the stationary portions 34a, 34b which are prepared at the both ends of the rotor 32.

In these, the rotor 32 and the stator 33 is held in the housing 35 which has the upper wall 35a and the lower wall 35b.

The core bit 2 has the bit 2a which is diamonds or cemented carbides, at the end of the cylindrical component and excavates the concrete C by rotating to be able to form the columnar core A.

The rotor 32 prepared inner side of the stator 33 is formed hollowed cylindrically, and has the cylinder 32a and the cylindrical rotation supporter 32b, which is fixed at the inner circumference face of the cylinder 32a and is formed to the lengthening direction of the core bit 2. Then, at the inner circumference rotation supporter 32b, the hollowed portion 32c which the penetrated hole to penetrate the core bit 2 is formed to the axial direction. At the inside of the upper wall 35a and lower wall 35b of the housing 35, the bearings 36a, 36b are each installed for supporting the rotor 32 to rotate freely. That is, the bearings 36a, 36b support the vertical ends of the rotation supporter 32b of the rotor 32 and has the structure which can receive the strengths of the thrust direction and radial direction which act to the core bit 2 and rotor 32 connected with said core bit.

At the outer side of the cylinder 32a of the rotor 32, the stator 33 is prepared. The stator 33 has the cylinder form having the same length of the cylinder 32a and is fixed to the inner circumference face of the housing 35.

At the vertical ends of the rotation supporter 32b of the rotor 32, the stationary portions 34a, 34b are installed to fix the core bit 2 which is in the hollowed portion 32c. These stationary portions 34a, 34b are each prepared at the each out side of the upper wall 35a and lower wall 35b and each fixed in one to the vertical ends of the rotation supporter 32b of the rotor 32.

This stationary portions 34a, 34b has the chuck structure, i.e., for example, a drill chuck or a scroll chuck, and fixes the core bit 2 by clamping the periphery face of said core bit 2 which is penetrated in the hollowed portion 32c of the rotor 32.

That is, the core bit 2 is connected in one with the rotor 32 by the stationary portions 34a, 34b and the rotation of the rotor 32 directly transmits to the core bit through said stationary portion 34a, 34b. Therefore, the core bit 2 fixed to the stationary portions 34a, 34b can be rotated with the rotation of the rotor 32.

Moreover, in the hollowed type motor, the cooling fan 40 is prepared at the top end of the rotation supporter 32b and the cooling air is drawn from the suction port 37 formed at the top side of the housing 35 and is blown into the hollowed type motor 3 by rotation of the rotation supporter 32b. Then, the cooling air mentioned above passes through the clearance between the stator 33 and the rotor 32, or the space portion between the stator 33 and the housing 35, and is exhausted out from the exhaust port 38 formed at the upper wall 36a of the housing 35.

[0012] In addition, the code 39 is the brush portion which is prepared to contact the rotation supporter 32 at the direction of the circumference of said rotation supporter 32b in the upper side of the housing 35 of the hollowed type motor 3. The driving current is supplied from

the brush portion 39 to the coil of the rotor 32.

In addition, the hollowed type motor 3 having these rotor 32 and stator 33 may be any type either a brush motor or a brush-less motor. Moreover, the rotor 32 has the coil where current is flown, the stator 33 is made by a magnet, and, on the other hand, when the cylinder 32a of the rotor 32 is made by a magnet, the stator 33 has the coil where current is flown.

In addition, either the rotor 32 or the stator 33, which has a magnet, may use the rare-earth high density magnet, such as a Nd-Fe-B type or a Sm-Co type, as a magnet.

The sending device 5 is the device, which transfers the top end of the core bit 2 connected with the hollow type motor 3, to the direction which approaches or departs toward the surface of the concrete C, and is connected one part of the hollow type motor 3. This sending device 5 has the rack 5a and the pinion 5b, and the upper end of said rack 5a is connected with the loaf of the outer cover 6 and lower end is supported on the surface of the concrete C.

Then, the hollow type motor 3 and the core bit 2 connected with said motor 3 can be driven up and down in the outer cover 6 by driving the pinion 5b connected with the driving sources, such as a motor, etc.

That is, when the core bit 2 which is connected with the hollow type motor 3 goes down by the sending device 5, the concrete C is excavated cylindrically since the pressure of the bit 2a of said core bit 2 is increased to the concrete C.

On the other hand, when the core bit 2 goes up with the hollow type motor 3 by the sending device 5, the core bit 2 is pulled out from the concrete C.

The pressing down pole 4 is penetrated cylindrical inside of core bit 2 formed cylindrically and its lower end is prepared to fit at the core A where is an inside portion of the core bit 2 in the concrete C.

This pressing down pole 4 is prepared independently to the hollow type motor 3 which can be moved up or down by the sending device 5 and the core bit 2 connected with said motor. Therefore, when the core bit 2 and the hollow type motor 3 is moved up or down, the position of the pressing down pole 4 is not changed.

The top end of this pressing down pole 4 projects out from the outer cover 6 and can be held down from upper side by hand, etc. In addition, it is possible to fix the pressing down pole 4 to the loaf portion of the outer cover 6.

[0013] When the concrete C is excavated by the excavation equipment 1 which has the constitution mentioned above, first, the stationary portions 34a, 34b, which is the chuck structure, is released to be the state in which the core bit 2 can penetrate to the hollow portion 32c of the rotor 32. Next, the core bit 2 is inserted to the hollow portion 32c as preparing its bit 2a at the outer side of the lower stationary portion 34b.

Then, after preparing the core bite 2 at the desired position where is the inner side of the hollow portion 32c, the

two periphery faces of the core bit 2 are bound tight to be fixed by the stationary portions 34a, 34b which comprise the chuck structures at the both ends of said hollow portion 32b.

5 Then, the rotor 32 which is connected with the stationary portions 34a, 34b is rotated by sending current in the coil which is prepared at the stator 33 (or rotor 32). The core bit 2 fixed to the stationary portions 34a, 34b is rotated in one as rotating of the rotor 32.

10 Then, the bit 2a of the core bit 2 is fitted to the surface of the concrete C. In this time, the pressing down pole 4 is penetrated into the cylindrical inside of the core bit 2 and the lower end of said pole is also fitted to the surface of the concrete C where is at the inside position of the core bit 2.

15 Simultaneously, the pinion 5b of the sending device 5 is driven to go down the core bit 2 with the hollow type motor 3. As going down the core bit 2, the pressure of said core bit 2 to the surface of the concrete C increases and thereby, said concrete C is excavated circularly.

20 Then, when the concrete C is excavated to the desired depth by the core bit 2, the core bit is gone up with the hollow type motor 3 by the sending device 5 a, to pull out the core bit 2 from the concrete C. In this time, the core bite is pulled out as pushing down the end of the pressing down pole 4 from the upper side to the surface of the core A.

25 In this time, when the core bit 2 is pulled out from the concrete C, since the pressing down pole 4 is pushed down to the core A as mentioned above, it can be prevented that the columnar formed core A is pulled out together with the core bit 2 in which the core A is fitted, if said core A is cut at the root a1. Thereby, only the core bit is pulled out from the excavated concrete C and the core A is remained in the concrete C.

30 In addition, it is possible to excavate by connecting the coolant water feeding method at the upper side of the core bit 2 and feeding said coolant water to the core bit 2a through the inside of the cylindrical core bit 2. The tool life of the core bit 2 is prolonged since the heating of the core bit 2a is reduced by the fed coolant water and it also be possible to reduce the scattering of the produced concrete powder dust.

40 Furthermore, it is also possible to excavate with evacuating the produced powder dusts or chips, etc. by inserting the tube which is connected to the vacuum device, into the cylindrical core bit 2 from the upper end to the bit 2a.

45 Then, after pulling out the core bit 2 from the concrete C, the hole is formed by fracturing the root a1 of the remained core A in the concrete C by hand, etc. and pulling out it.

50 Moreover, when the bit 2a of the core bit 2 are worn by the excavation, it is possible to exchange the new core bit 2 by releasing the holder of the stationary portion 34a, 34b.

55 **[0014]** Thereby, the core bit 2 which is penetrated in the cylindrical inside of the rotor 32 and fixed by the sta-

tionary portion 34a, 34b which is connected one with said rotor 32, directly receives the rotation of the rotor 32. That is, since the hollow type motor 3 is the direct type motor which directly rotate the core bit 32, the rotation of the rotor 32 is directly transmitted to the core bit 2 through the stationary portions 34a, 34b and the core bit 2 can generate the high torque.

Therefore, the excavation of the concrete C is steadily done. Moreover, since the rotation of the rotor 2 is directly transmitted to the stationary portions 34a, 34b and there are not parts, such as gears, etc., the noise generation is decreased. Furthermore, since the stationary portions 34a, 34b fix the periphery face of the core bit 2, the core bit holding is opened by only releasing this fixing.

Therefore, since the maintenance, such as the exchange of the core bit 2, can be done easily, the workability increased. Moreover, since the core bit 2 is changeable, it becomes possible to select the various thickness or forms of the bit 2a.

Moreover, since this excavation equipment has the hollow type motor 3 which directly rotates the core bit 2 having the bit 2a and is, so-call, a high rigidity direct type motor, the vibration of the core bit 2, which is the rotation axis, is very small. Thereby, it becomes possible to excavate at high rotation and the excavation speed can be remarkably increased in comparison with the case of conventional low rotation.

Thereby, the boring manipulation can be done rapidly and it is possible that the work periods of various operations is shorten and easily.

Moreover, since the direct type motor is used, the noise can be decreased remarkably (about 70 db) in comparison with the case of using a hydraulic motor or an electric motor having gears. Moreover, since the number of the parts is small, the labour cost of the maintenance work can be remarkably decreased.

In addition, when the core bit 2 is pulled out from the concrete C, only the core bit 2 is pulled out to remain the core A in the concrete C since the penetrated pressing down pole 4 inside of the cylinder of the core bit 2, pushes down the surface of the core A where is inside portion of the core bit 2. Therefore, since the core A is not fitted at the inside of the cylinder of the core bit 2, the conventional difficult work to take out the core A from the inside of said cylinder is not necessary and the workability increases.

Since the core bit 2 excavates the concrete C with moving up or down by guiding of the sending device 5 which has the rack 5a and pinion 5b, the steady formed core A is obtained. Therefore, the form of the obtained hole becomes also the steady form.

The scattering of the produced dust or chip of the concrete C at the excavation is prevented and the generated noise at such time is reduced by constructing the outer cover 6.

[0015] Moreover, since the magnet which is used in either the rotor 32 or the stator 33 is the high density

rare earth magnet which is a Nd-Fe-B type or a Sm-Co type, the size of the rotor 32 or the stator 33 can be made small and thereby, it is possible that the motor can be more small size and light weight.

[0016] In Figure 3, the other example of the excavation equipment 1 of this invention. This excavation equipment 1 has the pressing down pole 4 of which the top end is the positioning part 4a which is formed in taper configuration having acute angle.

In the excavation equipment 1 having this pressing down pole 4, the boring operation is done in the situation in which the positioning part 4a of said pole 4 is fitted into the mark M which is formed on the concrete C as a positioning hole.

That is, in this excavation equipment 1, the boring manipulation can be done with very sufficient accuracy by fitting the positioning part 4a of the pressing down pole 4 to the mark M of the concrete C for positioning. In addition, in this time, the core A which is remained in the centre is surely held by the pressing down pole 4 and the vibration of the core A is certainly prevented.

Then, the fault which is made by the interferes between the core A and the core bit 2it, can be certainly prevent, by boring with holding the core A in such a way mentioned above. And, as the result, the good excavation operation can be done.

[0017] Next, the other hollow type motor 3 used in the excavation equipment 1 is explained.

As shown in Figure 4, in this hollow type motor 3, one end of the rotation supporter 32b consisting the rotor 32 is projected and this projected rotation supporter 32b is named as the connector 41. Then, the cylindrical core bit 2A having the bit 2a at its top end is directly connected with the connector 41 of the rotation supporter 32b.

At this connector 41, the adapter 42 for direct connection to core bit 2A is prepared, and the connector 41 of the rotation supporter 32b in the rotor 32 is directly connected with the core bit 2A by said adapter 42.

Then, also in this hollow type motor 3, the core bit 2A, which is directly connected with the connector 42 of the rotation supporter 32b in the rotor 32, is rotated in one with rotation of the rotor 32, by sending current to the coil prepared in the stator 33 (or the rotor 32). Thereby, work materials, for example, concrete, etc., can be excavated by fitting the bit 2a prepared at the top of core bit 2 to said work materials.

Then, in the hollow type motor 3 mentioned above, since the rotation of the rotor 32 is directly transmitted to the boring tool which comprises the cylindrical core bit 2A where the bit 2a as is prepared at its top end, the core bit 2a can be rotated with high torque without transmission loss by gears, etc.

[0018] Moreover, since the core bit 2A is directly fixed to the rotor 32 as a tool, it is possible to lessen the number of prepared parts as much as possible.

[0019] Next, the other excavation equipment is explained by referencing drawings.

In Figure 5 and Figure 6, code 51 is the excavation equipment and code 52 is the hollow type motor prepared in said excavation equipment 51. This excavation equipment 51 has the structure which has the pole 54 which stands on the base stand 53 and supports the hollow type motor 52 mentioned above though the sending device 55, and said hollow type motor can be transferred along said pole 54.

The hollow type motor 52 has the cylindrical rotation axis 61 in own centre and the core bit 63 is connected possible for attaching or detaching with the top end of said rotation axis 61 through the adapter 62. This core bit 63 has the structure in which the bit 65 made by diamond bits is prepared in one for the circumference direction at the top end of the hollow type tube 54.

That is, this hollow type motor 52 is the direct type motor, which rotates the core bit 63 being the tool combined to the rotation axis 61.

The bit 65, which constitutes the core bit 63, is the diamond bit which is made, for example, by solidifying diamond abrasion particles with binders such as metals or resins.

The hollow type motor 52 has the rotor 67, which is fixed in one with inserted rotation axis 61, and the cylindrical stator 66, which is prepared at the periphery side of said rotor 67, in the housing 66.

At the inside of the upper wall 66a and lower wall 66b, the bearings 69a, 69b are each prepared for supporting the rotation of the rotor 62 freely. That is, the bearings 69a, 69b support the neighbourhood of the upper and lower ends of the rotation axis 61, which is inserted at the centre of the rotor 67, and has the structure which can receive the strength for thrust direction and radial direction, which act to said rotation axis 61 and the rotor 67.

At the back end of the hollow type motor 52, the rotary joint 71 is prepared. This rotary joint 71 is fixed at the upper wall 66a of the housing 66 and is connected with the back end of the rotation axis 61 in the condition of the liquids tightness and rotational free.

At the rotary joint 71, the flow route 72, which connects with the centre penetrated hole of the rotation axis 61, is formed and is opened to the side of said rotary joint 71. The tube 74 is connected with this open portion 73 and the cooling water (cooling liquid) is sent into the rotary joint 71 from said tube 74.

Then, the cooling water, which is sent into the flow route 72 in the rotary joint 71 from the tube 74, flows the route 72 in the rotary joint 71 and is led to the penetrated hole 61a of the rotation axis 61. After then, the cooling water is sent into the tube 64 of the core bit 63, which is connected with the top end of the rotation axis 61 though the adapter 62.

[0020] In addition, code 75 is the brush, which is prepared to contact to the rotation axis 61 at the circumference direction of said rotation axis 61, at the upper side of the housing 56 of the hollow type motor 52. Then, the driving current is supplied from this brush 75.

Moreover, according to the hollow type motor 52, which has these rotor 62 and stator 63, either a brush motor or a brush-less motor is available. Furthermore, when the rotor 67 has a coil, the stator 68 may have either a magnet or a coil. On the other hand, when the rotor 67 has a magnet, the stator 68 may have a coil.

In addition, in either the rotor 67 or the stator 68, which has a magnet, a high density rare earth magnet, such as a Nd-Fe-B type or a Sm-Co type, is used.

[0021] Next, it is explained when the concrete C, which is a work material, is bored by using the excavation equipment 51 mentioned above.

First, the hollow type motor 52, which is at the upper side of the supporting pole 54, is positioned at the predetermined boring position of the concrete C so that the axial line of the rotation axis 61 may be in agreement, and the stand 53 is fixed on the concrete C.

After preparing the excavation equipment 51 on the concrete C, electric current is sent to the coil of the rotor 67 (or the stator 68) of the hollow type motor and the rotor 67 is rotated at high speed, i.e., about 4000 rpm. Then, the cooling water is sent into the equipment from the cooling water supplying device, which is not drawn in this figure, (the cooling water source) through the tube 74.

By this way, the cooling water, which is sent from the cooling water supplying device through tube 74, is sent into the penetrated hole 61a of the rotation axis 61 through flow route 72 in the rotary joint 71.

Then, in this condition, the bit 65 of the core bit 63, which is connected with the top end of the rotation axis 61, is fitted to the surface of the concrete C by going down the hollow type motor 52 in use of the sending device 55. Thereby, the circular hole H is formed on the concrete C by the highly rotating bit 65.

At this time, in the hollow type motor 52, the cooling water, which is sent into the penetrated hole 61a of the rotation axis 61, flows to the top end direction along the inner circumference face of said penetrated hole 61a of said rotation axis 61, as the result of high rotation of said rotation axis 61.

That is, the cooling water, which flows in the penetrated hole 61a of the rotation axis 61, is transferred to the top end of said hole 61a with absorbing the inner heat of the hollow type motor 52 through said rotation axis 61, by flowing along the inner circumference face of said penetrated hole 61a of said rotation axis 61. Consequently, the inner side of the hollow type motor 52 the is cooled remarkably well.

[0022] Furthermore, after cooling the hollow type motor 52 by flowing along the inner circumference face of the penetrated hole 61a of the rotation axis 6, the cooling water is sent into the tube 54 of the core bit 63, and then, is supplied to the place where the bit 65 excavates the concrete C.

Thereby, in the bit 65, the excavating place is cooled by the cooling water, and furthermore, this cooling water is used as a lubricant at said excavation place to do good

excavation, and is exhausted out with the chip.

By this way, according to the excavation equipment 51 mentioned above, the cooling water, which is supplied from the coolant supplying device being not drawn, is sent into the penetrated hole 61a of the rotation axis 61 though the rotary joint 71, from the back end of said rotation axis 61 penetrated in the rotor 67 by inserting, and the rotation axis 61 is rotated. Then, the concrete C is excavated by bit 65 of the core bit 63, and the cooling water flows along the inner circumference face of the penetrated hole 61a. Thereby, the heat in the hollow type motor 52 is absorbed through the rotation axis 61, and, as a result, inner space of the hollow type motor is cooled very well.

That is, since the direct motor, which directly rotates the rotation axis 61 on which the core bit 63 is fixed, is used as a driving motor, the rotation axis can be rotated at high speed. Thereby, it is possible to flow the cooling water from the back end of the rotation axis 61 along the inner circumference face of the penetrated hole 61a of said rotation axis 61, which is rotating at high speed, and the cooling efficiency can be increased remarkably. Therefore, the remarkable high cooling efficiency can be obtained in comparison with the method in which the cooling air is only fed into the hollow space of the rotation axis.

In addition, since the cooling fan is not necessary, the excavation equipment 51, which is very quiet without wind end sound, very small and light weight, can be obtained. Moreover, since the chip or powder dust is not absorbed in comparison with the air cooling type motor by fan, the failure induced by such absorption can be reduced.

Moreover, when the rotation of the rotation axis 61 is stopped, since cooling is continued by the cooling water fed from the back end of said rotation axis 61, the damage induced by not cooling at immediately after the stop can be prevented.

Moreover, after cooling the hollow type motor 52 by flowing along the inner circumference face of the penetrated hole 61a of the rotation axis 61, since the cooling water is sent into the core bit 63, and after then, is supplied to the excavating place on the concrete C by the bit 65, it becomes possible to cool excavating place by the bit 65. Moreover, the cooling water is used as a lubricant at the excavating place and makes to obtain the smooth excavation.

Moreover, since the rotor 67 is fixed in one with the rotation axis 61, the heat in the hollow type motor 52 can be easily transferred from the rotor 67 to the rotation axis 61. Therefore, the heat in the hollow type motor 52 can be easily and certainly transferred to the cooling water, which flows along the inner circumference face of the penetrated hole 61a of the rotation axis 61.

Moreover, since the hollow type motor 52 has the configuration sealed by the housing 66 and is cooled by the cooling water set into the penetrated hole 61a of the rotation axis 61, it can certainly prevent to be entered by

chips or powder dust into said hollow type motor 52, with keeping the high cooling efficiency. Therefore, the excavation equipment 51 with few failures can be obtained.

In addition, in the examples mentioned above, water is used as a coolant. However, of course, the further cooling effect can be obtained by using the liquid excellent in cooling effect other than water.

Claims

1. An excavation equipment comprising;

a cylindrical core bit having a bit which excavates the work materials circularly,
a hollow type motor which rotates said core bit and;
said hollow type motor comprising;
a cylindrical rotor in which said core bit is prepared penetrably,
a cylindrical stator which is prepared in the periphery side of said rotor,
a stationary portion which is prepared at both ends of said rotor and makes to rotate said core bit with the rotation of said rotor by fixing the periphery face of said core bit which is prepared in the cylindrical inside of said rotor.

2. An excavation equipment of claim 1 comprising;

a pressing down portion which is penetrated in the cylindrical inside of the core bit mentioned above and fits on the surface of the work materials mentioned above of the inside portion of said core bit.

3. An excavation equipment of claim 2 comprising;

a positioning portion which is formed as taper shape in which the diameter of the top end of the pressing down portion is gradually reduced, and is inserted to the positioning hole which is previously formed on the work materials mentioned above.

4. An excavation equipment of claim 1 comprising;

a sending device which transfers the hollow type motor mentioned above to the axial direction, and makes the bit of the core bit mentioned above to approach or depart to the work materials mentioned above.

5. An excavation equipment of claim 1 comprising;

a cylindrical outer cover which is prepared at the outer side of the radial direction of the core bit mentioned above.

6. An excavation equipment of claim 1 comprising;

either the rotor or stator of the hollow type motor mentioned above, has a magnet which is a Nd-Fe-B type or a Sm-Co type.

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7. An excavation equipment comprising;

a cylindrical core bit having a bit which excavate work materials circularly,
a hollow type motor which rotates said core bit, and

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a said hollow type motor comprising;

a cylindrical rotor in which the cylindrical rotation axis, on which the core bit mentioned above is fixed at the top end, is penetrated,
a cylindrical stator which is prepared at the periphery side of said rotor,

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a rotary joint which is connected possible to rotate at the back end of the rotation axis and in which the flowing route, which guides a coolant supplied from a coolant source to said rotation axis, is formed,

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a coolant, which is sent into the penetrated hole of said rotation axis which is rotating with said rotor through said rotary joint, is flowed from the back end to the top end of said rotation axis along the inner circumference face of said penetrated hole, and cools said rotation axis without cooling fans.

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8. An excavation equipment of the claim 7 comprising;

the rotor and the rotation axis mentioned above are fixed in one.

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9. An excavation equipment of the claim 7 comprising;

the periphery side of the hollow type motor mentioned above is sealed by a housing.

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10. An excavation equipment of the claim 7 comprising;

a sending device which transfers the hollow type motor mentioned above to the axial direction and makes the bit of the core bit mentioned above to approach or depart to the work materials mentioned above.

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11. An excavation equipment of the claim 7 comprising;

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either the rotor or the stator of the hollow type motor mentioned above has a rare earth magnet which is a Nd-Fe-B type or a Sm-Co type.

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12. A hollow type motor comprising;

a rotor having a hollow portion in which a rota-

tion axis is penetrated,

a cylindrical stator which is prepared at the periphery side of said rotor,
a stationary portions which are prepared at the end of said rotor and makes to rotate a rotation axis with the rotation of said rotor, by fixing the periphery face of said rotation axis which is penetrated in said hollow portion.

13. A hollow type motor of claim 12 comprising;

the rotation axis mentioned above is formed penetrably and cylindrically,
the stationary portions is prepared at the both ends of rotor mentioned above.

14. A hollow type motor of claim 12 comprising;

either the rotor or the stator mentioned above has a rare earth magnet which is a Nd-Fe-B type or a Sm-Co type.

15. A hollow type motor comprising;

a rotor which is formed hollow type
a cylindrical stator which is prepared at the periphery side said rotor,
a boring tool is directly fixed at one end of said rotor.

16. A hollow type motor of claim 15 comprising;

a rotor which is penetrated by a cylindrical rotation axis,
a rotary joint which is connected possible to rotate with the back end of said rotation axis, and in which a flow route, which guides a coolant supplied from a coolant source into the penetrated hole of said rotation axis, is formed,
a coolant, which is sent into said rotation axis which is rotating with said rotor through said rotary joint, is flowed from the back end to the top end of said rotation axis along the inner circumference face of said penetrated hole, and cools said rotation axis without cooling fans.

17. A hollow type motor of claim 16 comprising;

the rotor and the stator mentioned above are fixed in one.

18. A hollow type motor of claim 16 comprising;

a periphery side of said motor is sealed by a housing.

19. A hollow type motor of claim 15 comprising;

the boring tool mentioned above is a cylindrical core bit in which bits are prepared at the top end of said core bit.

20. A hollow type motor of claim 15 comprising; 5

either the rotor or the stator mentioned above has a rear earth magnet which is a Nd-Fe-B type or Sm-Co type.

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FIG. 1

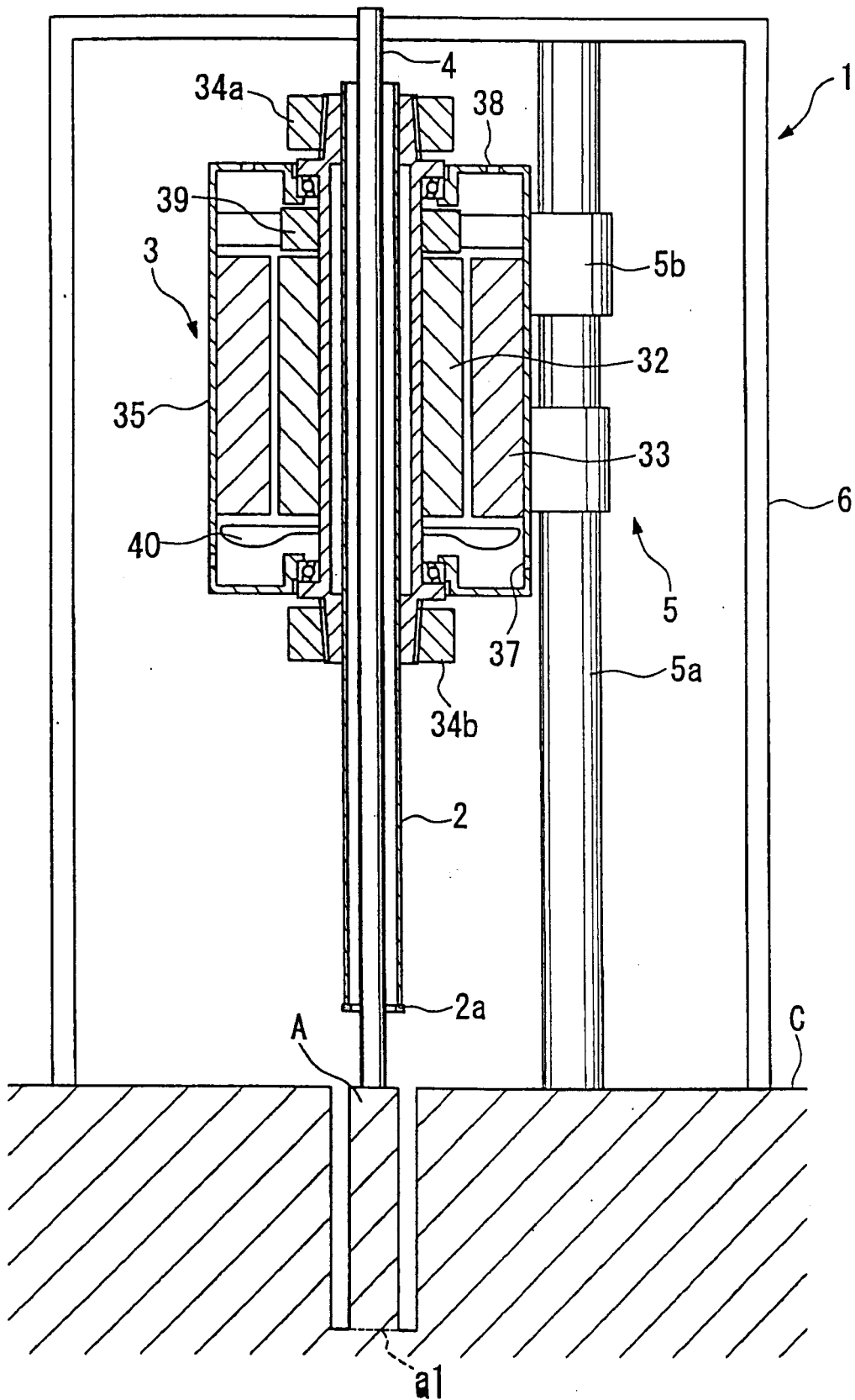


FIG. 2

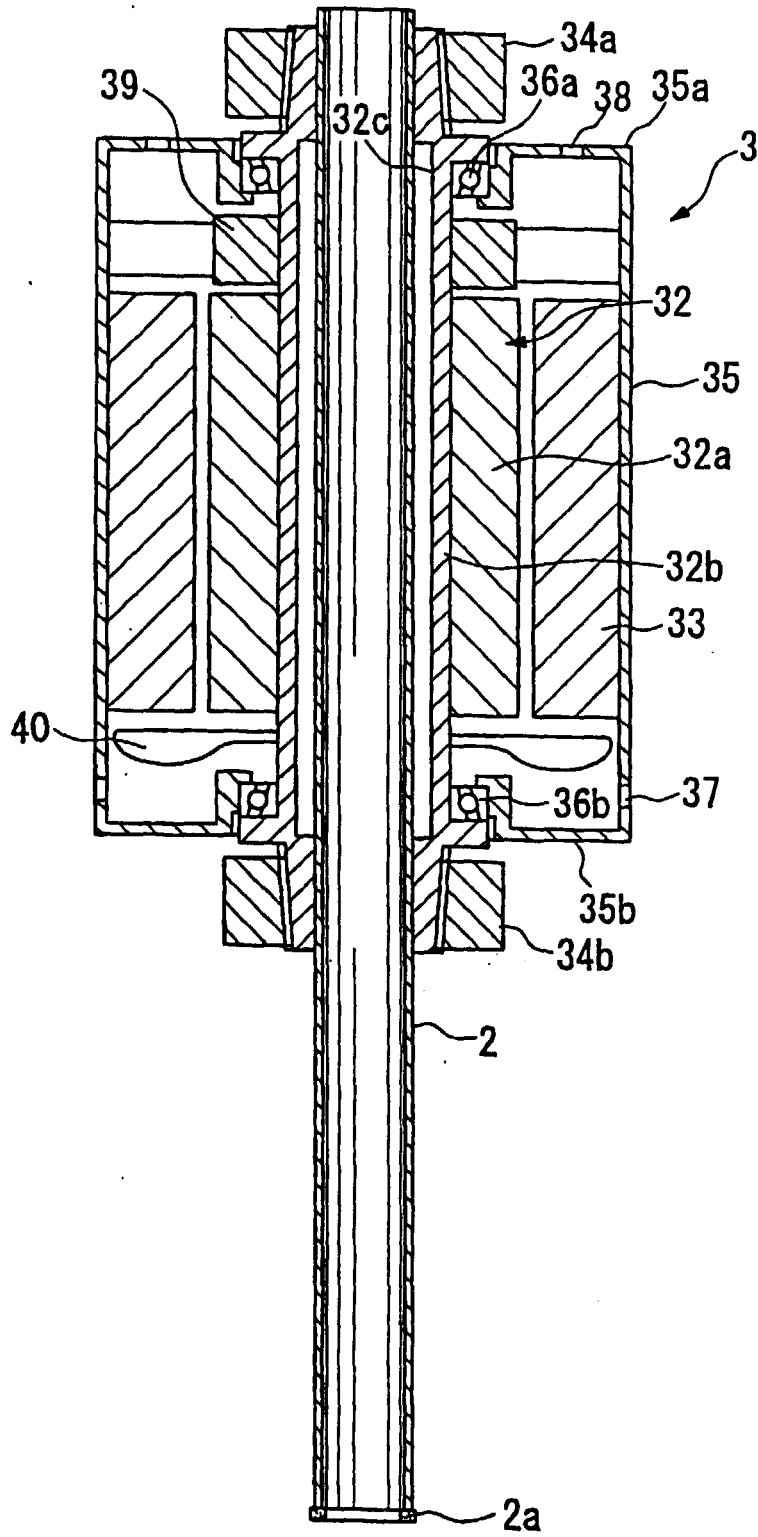


FIG. 3

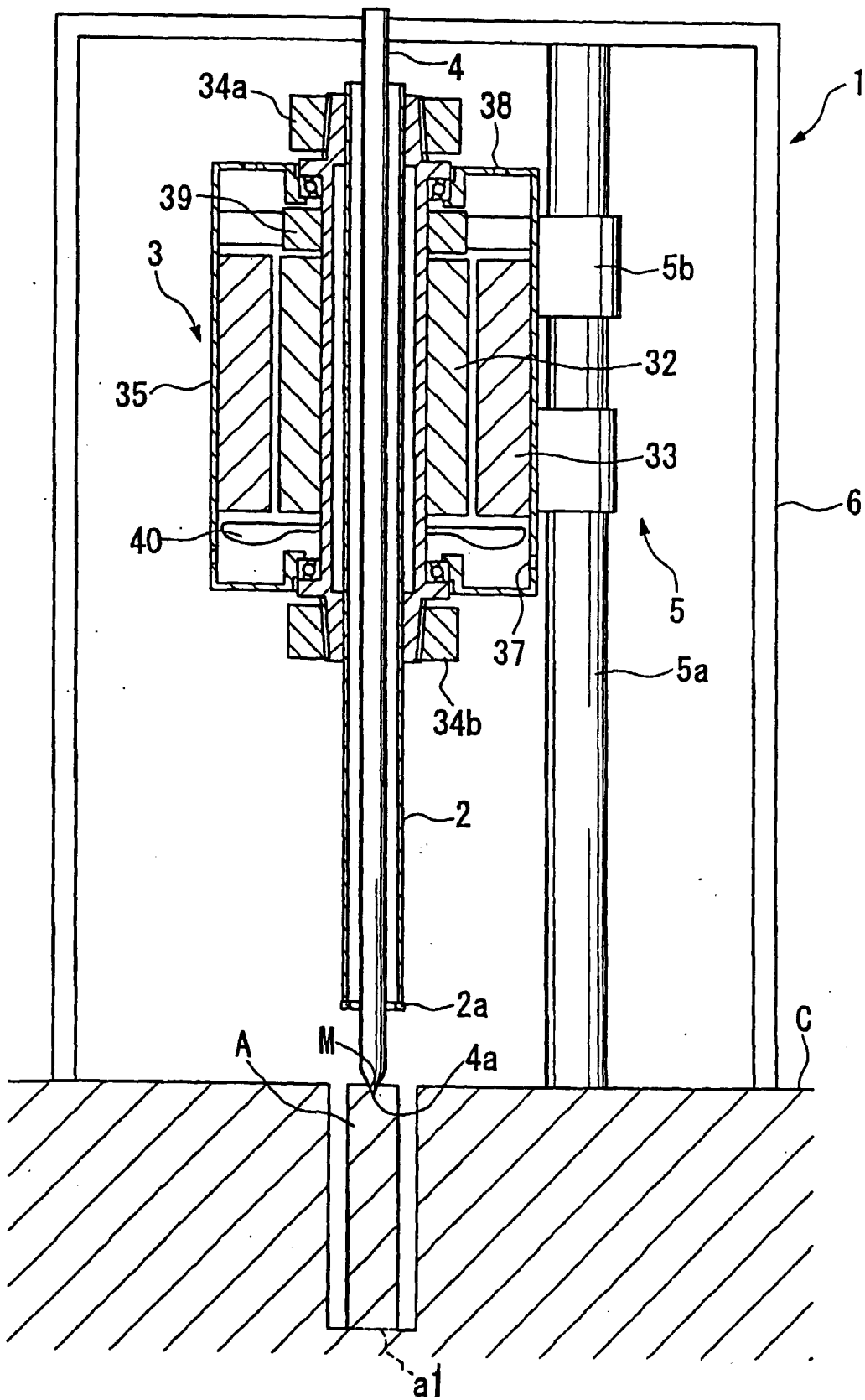


FIG. 4

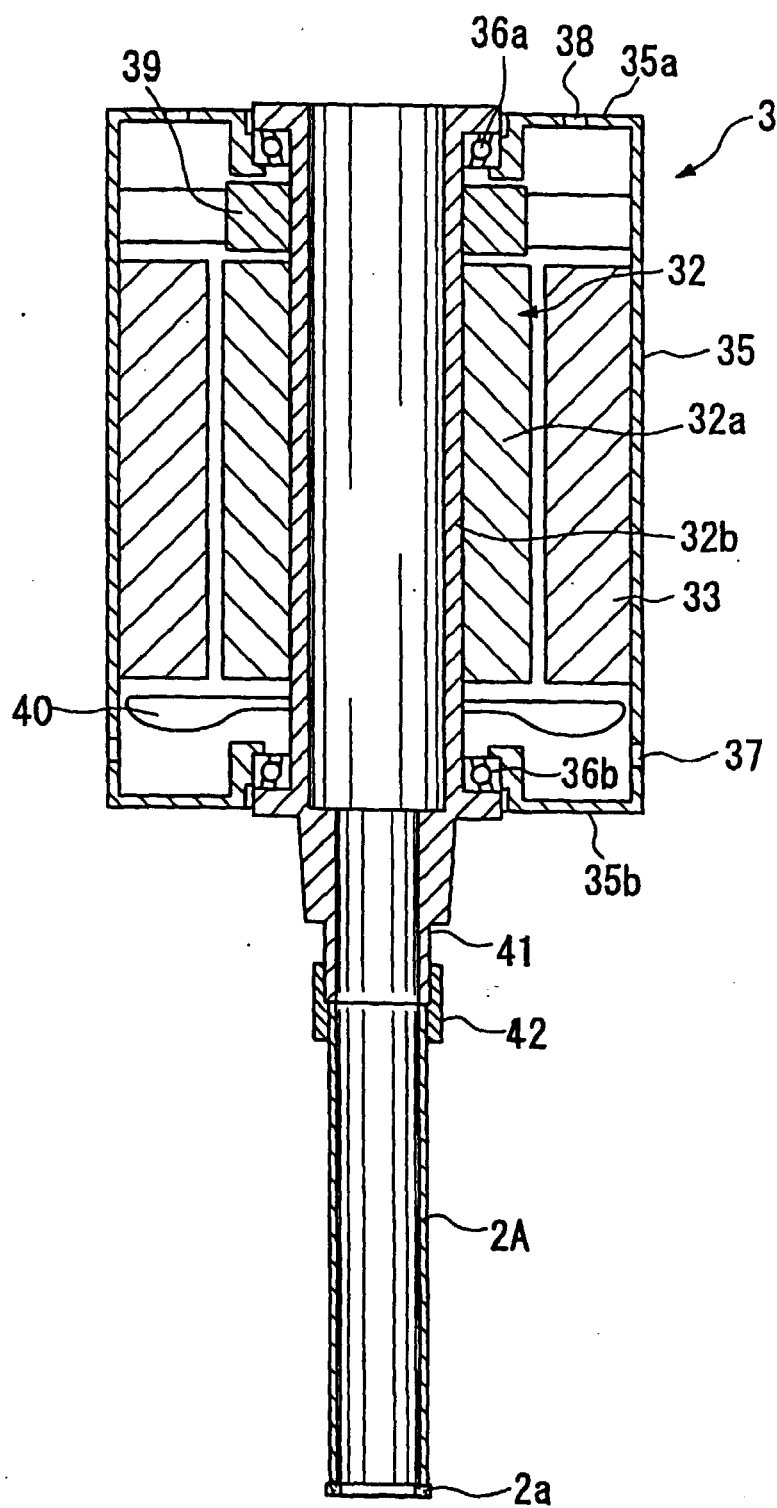


FIG. 5

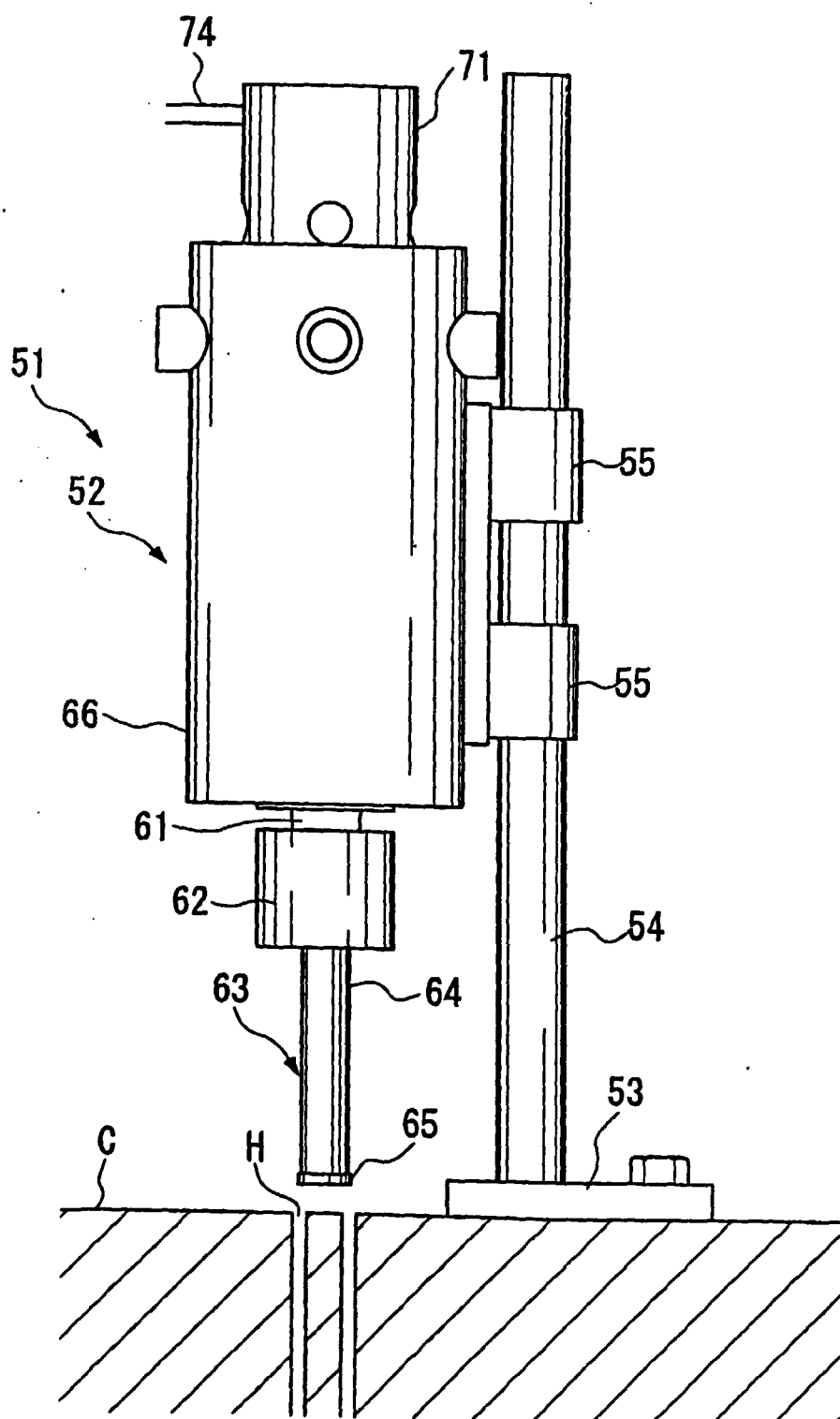


FIG. 6

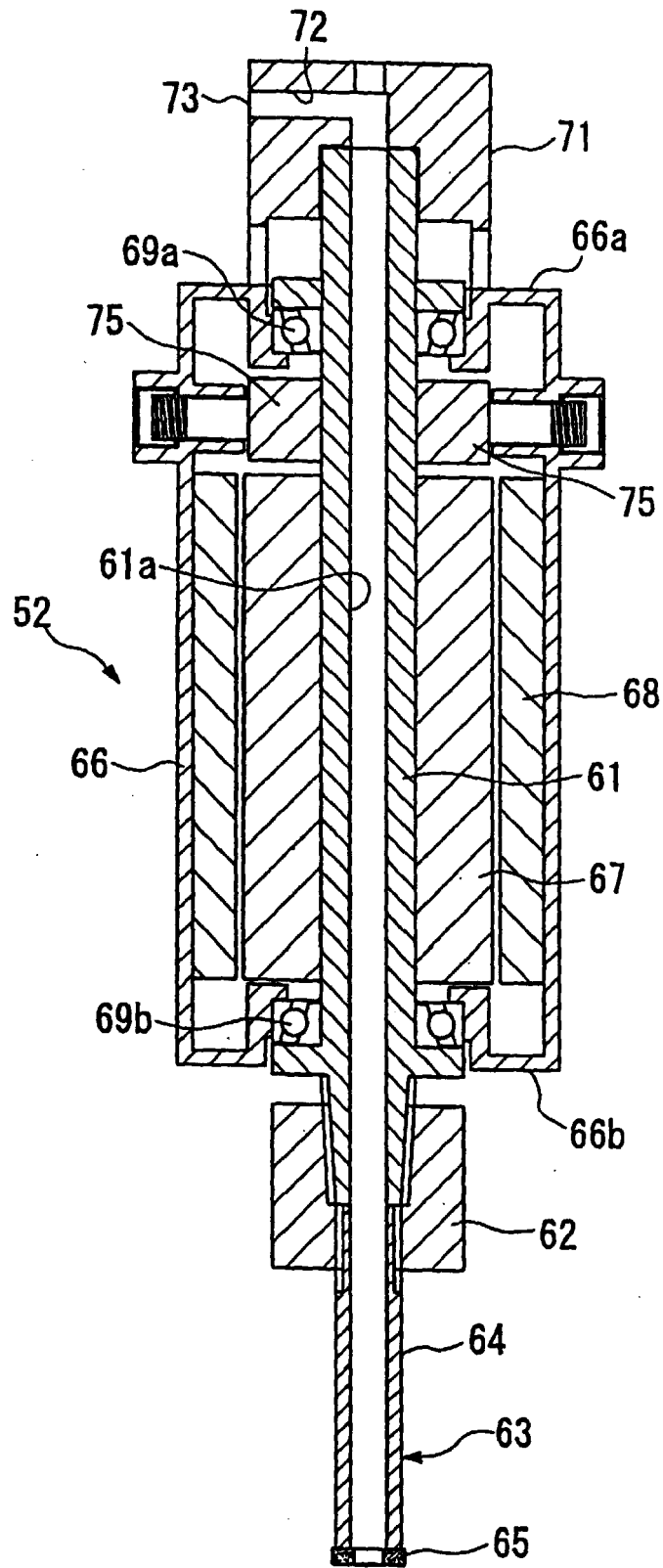


FIG. 7

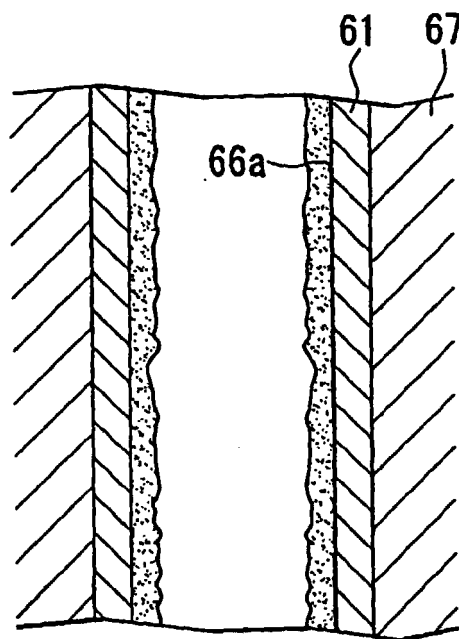


FIG. 8

