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(73) Patenthaver: **Mauerspecht GmbH, An der Walze 15, 01640 Coswig, Tyskland**

(72) Opfinder: **Galinsky, Volker, Auerstraße 185, 01640 Coswig, Tyskland**

(74) Fuldmægtig i Danmark: **RWS Group, Europa House, Chiltern Park, Chiltern Hill, Chalfont St Peter, Bucks SL9 9FG, Storbritannien**

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Description

The invention relates to a method for carrying out core drilling in a material by means of a drilling apparatus that uses a drill bit. It also relates to such drill bits which are configured with a hollow cylindrical core barrel and have, at the front end of the core barrel serving for the abrasion of material, abrasion elements which are secured on the surface of the core barrel and distributed on said surface in a ring shape. The invention furthermore relates to devices for eliminating adherences at the inner face of channels by means of high-pressure blasting, said devices having such a drill bit.

Drill bits are known as a tool of a drilling machine, said tool being used to introduce a ring-shaped gap into a solid material, for example concrete, natural stone, masonry, ceramic or others, then to detach the centrally remaining drilling core from the material and remove it from the hole.

To generate the ring-shaped drill hole, the drill bit comprises a hollow cylindrical body, which is referred to as core barrel. The core barrel has, at its front end, cutting or grinding elements which are distributed on the surface and which, in terms of material, shape and distribution, are suitable for abrading material in the required manner and extent. In the following text, the grinding and cutting elements will be referred to generally as abrasion elements. The abrasion elements can be arranged on the annular top face of the core barrel and/or on a suitably long front portion of the inner and/or outer lateral face of the core barrel. The rear end of the drill bit can be coupled to the tool holder of an external supply unit of the drilling apparatus, which uses the drill bit, in a known manner by way of suitable connection means. The supply unit and further components of the drilling apparatus, which are used for the operation and control of the drilling apparatus, are adapted to the respective application and are not per se part of the drill bit. The connection means are configured correspondingly to the tool holder, such that the drill bit can be operated and in particular rotated at the desired speed. Geometry and materials of the core barrel and of the abrasion elements of the drill bit are configured correspondingly to the material to be drilled and to the hole size and hole depth. With the known drill bits, drill holes of a few centimetres up to several 10s of centimetres and more can be produced.

Wet and dry drilling are possible. In wet drilling, a flushing agent flows within the core barrel and/or along the outside of the core barrel into the drill hole, and therefore the abraded drill cuttings can be flushed away and the drill bit can be cooled.

The drilling core or portions thereof can be removed from the drill hole in various ways. The core is frequently broken into short portions mechanically or as a result of its intrinsic load, said short portions being able to be removed more easily, also with the aid of the flushing agent. CN 106907121 A has disclosed a drill bit which is cooled by means of low-pressure water and which additionally has a high-pressure water supply and high-pressure nozzles in order to cut a drilling core generated in the drill bit at the front end of the drill bit.

CN 106907121 A discloses a method according to the preamble of Claim 1 and a drill bit according to the preamble of Claim 7.

As the diameter of the drilling core increases, the breaking or shortening of the drilling core becomes more uncontrollable, and also more difficult and necessary more frequently, such that the result and efficiency of the core drilling become unsatisfactory or, instead of core drilling, a lengthy hole milling operation is carried out, since the drilling core cannot be managed. Said use of hole milling is known for example from sewer rehabilitation if there is a complete closure of a sewer, which can sometimes extend over several metres.

There is therefore the need for a core drilling method and a drill bit which can be used therefor, which make improved management of the drilling core, and more efficient drilling, possible. In addition, it is intended for the method and the drill bit to also be usable for non-vertical boreholes, such as, for example, in virtually horizontal boreholes, as they are oriented in the case of sewer rehabilitation.

There is also a need for a method and device which can be employed for various materials and both for vertical and for horizontal drilling methods, and also for drill hole sizes up to approximately 1 m and greater.

These objects are achieved by a method according to Claim 1 and a drill bit according to Claim 7.

The concept of the devices described below and of the methods which can be performed therewith can be described to the effect that a combined abrasion of material takes place, and specifically mechanical abrasion with formation of a drilling core, which is located in the interior of the drill bit, in conjunction with an abrasion of material using a high-pressure blasting medium in order to also abrade material at the drilling core.

High pressure for liquid blasting media is here intended to refer to pressures which lie in the range of approximately 80 bar to approximately 6000 bar and thus significantly above the pressures at which wet drilling is performed. The upper pressure range of greater than 500 bar is also referred to as ultra high pressure. Pumps are currently known with which liquid pressures of up to 6000 bar can be achieved, however, at these extreme pressures, there may be limitations as a result of the medium inlet to the nozzles. Such extreme pressures are used for example in stationary liquid jet devices, which are used for severing or cutting hard substances. In the case of flexible liquid guides, such as, for example, reinforced plastic hoses, the upper limit of the liquid conductible at maximum through said flexible liquid guide is currently approximately 3000 bar. With further development thereof, higher pressures are certainly also possible and usable with the methods and devices described below. The methods and the devices used therefor are in particular also suitable for the use of ultra high pressure, such that reference to high pressure below also includes the use of ultra high pressure.

Method and device features which are used to realize the concept are described below.

To perform the core drilling method, use is made of a drill bit which is configured with a hollow cylindrical main body, designated below as core barrel, and has, at the front end of the core barrel serving for the abrasion of material, abrasion elements. The abrasion elements can for example be cutting or grinding elements, or other elements which are suitable for the abrasion of material. Said elements are secured at the front edge on the surface of the core barrel and distributed on said surface such that they form a ring of abrasion elements, which lies at the front end drill bit and covers the front side of the drill bit. As an alternative or in addition, it is also possible for abrasion elements to be arranged on a narrow front ring of the outer lateral face, optionally also of the inner lateral face.

The terms "from" and "rear" or "front side and rear side", or terms analogous thereto, refer to the direction of the mechanical abrasion of material and thus coincides with the axis of the drilling core and of the drill bit.

The rear end of the drill bit, said rear end lying opposite the front end, is formed by a closure plate, which closes off the drill bit toward the rear and can be configured in various ways. Said closure plate can be of circular or annular form, or have some other form, such that it ensures the stability of the drill bit, and also the rotational and forward movement of the drill bit, in the resulting hole.

On the closure plate or the core barrel, there are arranged suitable connection means which are suitable for producing a mechanical connection to a supply unit of the drilling apparatus. The connection to the supply unit is such that the drill bit is rotatable. Depending on the design of the drilling apparatus or complementary components, various connection means are suitable, such as, for example, sockets, bearings, flanges, or others.

The drill bit also has at least two, optionally also more than two, high-pressure jet nozzles. Said nozzles are connected via suitable connectors to a suitable high-pressure source, which provides a high-pressure, possibly also ultra-high-pressure, blasting medium and conducts the latter to the high-pressure jet nozzles via the connectors.

A nozzle is a tubular, fluid-directing device which has a cross section which tapers towards the nozzle outlet in order to increase the velocity of the fluid. Jet nozzle refers to a nozzle which has one or more openings for generating a jet composed of a high-pressure or ultra-high-pressure blasting medium, such that the jet follows a directed jet path.

Jet path is understood here to mean a central axis of the jet, said axis indicating the predominant propagation direction of the fluid and being determined in a regular manner by the axis of the tubular part of the nozzle. Depending on the material to be drilled, solid particles can be added to the blasting medium in order to enhance the abrasive action.

For the use in the drill bit, suitable high-pressure jet nozzles are those which deliver the desired jet form, for example a fanned-out or concentrated form, multiple jets, or other forms, or make it possible to vary the jet form and which are adapted to the blasting medium used and to the pressure used.

Evidently, the high-pressure jet nozzles are arranged in such a way that none of the high-pressure jet nozzles project beyond the inner radius of the abrasion elements, designated here as ring inner radius, that is to say none of said nozzles have a smaller distance from the axis of the core barrel than the abrasion means. Otherwise, the high-pressure jet nozzles would collide with the drilling core in the course of drilling.

Structurally, this can be realized in a variety of ways. The high-pressure jet nozzles can be sunk in the inner lateral face of the core barrel, such that they do not project beyond the inner lateral face. As an alternative or in addition, the ring inner radius can be smaller than the inner radius of the core barrel, such that the jet nozzles can project beyond the inner lateral face of the core barrel by an amount which is smaller than the difference between the barrel inner radius and the ring inner radius.

It is evident that the inlet of the blasting medium, just as described in relation to the jet nozzles, also do not project beyond the ring inner radius and analogously also do not project beyond the ring outer radius, in order not to collide with the wall of the drilling core or of the drill hole.

The high-pressure jet nozzles are directed into the interior of the core barrel in order to abrade material there at the drilling core, in that said drilling core is for example divided into portions, or destroyed, in a defined manner or the two variants of machining the drilling core are combined with one another.

A variety of orientations of the high-pressure jet nozzles makes it possible to influence the location and the extent of the abrasion of material. In accordance with one configuration, the blasting direction of the high-pressure jet nozzles can be variable in order to adapt the abrasion of material to the respective application.

With regard to the number, the position, and the orientation of the high-pressure jet nozzles, it is also possible to take account of the jet form, in addition to the location and the extent of the abrasion of material. The variation of said parameters makes it possible to perform the abrasion of material in a wide variety of ways and to include further conditions for the method to be performed. By way of example, the high-pressure jet nozzles can be oriented such that the jet impacts only on the inner lateral face of the core barrel. In this way, it is ensured that, when the jet breaks through the material to be abraded, damage to the channel wall lying behind said material is precluded.

In order to remove the excavated matter, which can result from the abrading of material by the high-pressure jets in the drill bit, from the interior of the drill bit, the drill bit has outflows, wherein said outflows are coordinated with the inlets of the blasting medium on or in the core barrel. The outflows are designed and arranged in accordance with the amount and the viscosity of the excavated matter, a mixture of abraded material and blasting medium.

By way of example, a passage, or a plurality thereof, is formed in the closure plate. In addition, apertures can also be arranged in the core barrel.

A discharge of the excavated matter can, if necessary, be supported by channel-like depressions in the outer lateral face of the core barrel. In said depressions, a discharge of the excavated matter outside of the drill bit is supported. Optionally, apertures in the core barrel can open into said depressions and/or the depressions can run in a spiral-shaped manner.

Similarly, the inlets to the high-pressure jet nozzles, in which the blasting medium is conducted to the high-pressure jet nozzles, can be configured as channels in the wall of the core barrel. Such a line routing formed in a solid component has the advantage, particularly in the case of high-pressure blasting medium, that rigid inlets which are susceptible to failure can be avoided. The routing from a static, non-rotating inlet into an inlet in a rotatable part can be realized in a reliable manner by means of rotary leadthroughs. The same is also true of the embodiment variant in which the inlets are guided through or into the closure plate to high-pressure jet nozzles arranged there. With regard to such inlets which are configured in the wall of components and such required rotary leadthroughs, reference is made to EP 3 305 425 A1, in which various embodiments are described to that end.

The inlets of the blasting medium can alternatively also be configured outside of the wall. If the differences between ring inner radius or ring outer radius and core barrel inner radius or core barrel outer radius, respectively, allow, during drilling, for a sufficient distance to be produced between the wall of the drilling core or of the drill hole and the inner wall or the outer wall of the core barrel, respectively, inlets of the blasting medium to the jet nozzles can be arranged, for example, on the wall of the core barrel.

For carrying out the core drilling method, the drill bit is set in rotational movement about the axis of the drill bit by means of a drive, typically the drive of the external supply unit, and executes a forward movement. As a result thereof, annular abrasion of material takes place, which corresponds to the ring of the abrasion means at the front end of the drill bit. With advancing forward movement and continuous rotational movement, a cylindrical drilling core forms, which projects increasingly into the core barrel.

At the same time or as of a desired length of the drilling core, jets of high-pressure blasting medium can be generated and directed into the interior and thus onto the drilling core by means of the high-pressure jet nozzles of the drill bit. Consequently, from the time at which the abrasive jets impact on the drilling core, abrasion of material takes place at the drilling core. The material detached from the drilling core mixes with the blasting medium and is conveyed from the drilling core into the existing channel by means of the outflows described above.

The abrasion of material can be achieved to the desired extent and in the desired form by means of the type, number, position, and orientation of the high-pressure jet nozzles.

The type of the jet nozzles makes it possible to vary, for example, the concentration of the jet and thus the intensity and the extent, that is to say depth and area, of the abrasion generated by a jet. The same can also be achieved as a result of the number and the position of the high-pressure jet nozzles. The abrasion can thus be effected over a relatively large surface or at selected points by uniform action of the jets of a plurality of distributed high-pressure jet nozzles.

By way of example, one or more high-pressure jet nozzles can be arranged behind the abrasion elements on the inner lateral face of the core barrel. In this case, if the jets of said nozzles are directed to the axis of the drilling core in that the blasting directions have an angle or the same angle β to the normal of the inner lateral face at the nozzle outlet in the range of -45° to +45°, a circumferential gap can thus be introduced into the drilling core, said gap being able to be guided as far as the centre of the drilling core and thus until a part of the drilling core is cut off. For this purpose, after the desired length of the drilling core has been reached, the drilling operation, or at least the advance of the drill bit, is ended and a cut is introduced into the drilling core by means of the jet nozzles and the high-pressure or ultra-high-pressure blasting medium. In the alternative of the drill bit which continues to rotate, without advance, it is possible to obtain a more uniform cutting result at the circumference than in the case of a stationary drill bit. It is also the case that, owing to the rotation of the jet nozzles, which are not moved in the direction of the drill hole depth, fewer nozzles are required.

In such a method variant, but also when a drilling core which projects far into the drill bit is formed, it can be advantageous for the drilling core to be stabilized during the abrasion of material and/or to be fixed in place after a portion has been cut off. For this purpose, the core barrel has holding means which hold the drilling core. Said holding means can hold the drilling core proceeding from the closure plate or from the core barrel. By way of example, it is possible for springs or a pressure pad, or a plurality thereof, to be arranged at the inner lateral face. Said pads expand in the direction towards the drilling core as a result of being filled with a fluid, the blasting medium or another fluid, and press against the drilling core. The blasting medium under consideration makes it possible to fill a pressure pad or a plurality thereof, for example. As an alternative, it is also possible to use another medium, for example compressed air, for such a pressure pad. The holding force to be applied can be varied by means of contact pressure and contact surface. In a further configuration, grooves of differing arrangement can be introduced into the drilling core by means of a ring of high-pressure jet nozzles, or individual ones thereof, the holding means being able to engage into said grooves.

As an alternative or in addition, high-pressure jet nozzles can also be directed over a large area and with such abrasion performance onto the rear part of the drilling core, that is to say its free end, that said rear part is continuously abraded. Such abrasion advancement can correspond to the advance of the drill bit in accordance with the mechanical abrasion.

Further designs are possible, for example various combinations of the operation of the jet nozzles with a rotational movement and/or forward movements are possible. By way of example, the abrasion of material can take place even in the case of a halt of the rotational movement and thus a halt of the mechanical abrasion.

In a further configuration of the method, the mechanical abrasion of material at the front end of the core barrel can be supplemented by an abrasion by means of blasting medium. For this purpose, at least one high-pressure jet nozzle can be arranged on the front side of the core barrel and is oriented in the drilling direction. In this case, the orientation can also deviate from the drilling direction by a few degrees, such that a wider ring-shaped gap and narrower drilling core are produced. Here, too, intensity and width of the abrasion by means of blasting medium depend on the application.

The combination of the mechanical abrasion with the use of jet nozzles makes it possible for the jet nozzles to be able to be used with the blasting medium, alternatively also with another flushing medium, at a reduced pressure of at most a few 10s of bar for cooling and/or flushing purposes.

The described method can be used for ground boreholes in geology, geothermal energy, the construction industry, or other applications where both vertical and horizontal drill holes are required. One application is for example the opening of complete or partial closures of closed channels, said closures having arisen as a result of adherences at the inner face of said closed channels. Instead of using channel milling to completely abrade the material clogging the channel, by means of the described drill bit, only ring holes with an outer diameter which is the same as or only slightly smaller than the inner diameter of the channel are introduced and the remaining drilling core is removed. This reduces the outlay for such a channel opening to a fractional amount.

For this purpose, the drill bit is operated along with a channel-cleaning device, by means of which the advance and the rotational movement of the drill bit are executed and the high-pressure blasting medium is fed.

Such a device comprises, at its front end, the above-described drill bit, a suitable moving means for moving and positioning the drill bit in the channel, and a medium inlet for supplying the high-pressure jet nozzles with the high-pressure blasting medium. Various embodiments are suitable as moving means, for example hand-operated or machine-operated advancing rods or traction means. Remote-controlled carriages or other embodiments are also usable. It is evident that the moving means and the drill bit are configured in such a way that both can be positioned and moved, at least along one side, at a distance from the wall of the channel.

Methods and devices will be explained in more detail below with exemplary embodiments in an exemplary, but non-limiting, manner. In the associated drawings:

Fig. 1 shows a sectional illustration of a drill bit with a drilling apparatus, as an example a channel-cleaning device,

Fig. 2 shows a detail illustration of the abrasion elements of the drill bit,

Fig. 3 shows the front view of the drill bit according to Fig. 1, and

Fig. 4 shows an alternative configuration of a drill bit.

The following figures show the devices merely schematically for better understanding and make no claim to completeness and truth to scale.

The drill bit 1 has a hollow cylindrical core barrel 5 with an axis 5. At the front end 16 of the core barrel 5, abrasion elements 4 are secured on the front side 9 (Fig. 2), such that a ring-shaped arrangement of the abrasion elements 4 is configured on the front side 9. A closure plate 13 is arranged at the rear end of the core barrel 5.

The closure plate 13 has, on its surface facing away from the core barrel 5, a central cutout 15 which is used as connection means for producing a mechanical connection to the supply unit 20 of the drilling apparatus, said unit being arranged behind the drill bit 10. The supply unit 20 is used to move the drill bit 1, to supply it with the blasting medium 3, to supply the drive 21 with energy and to control said drive.

A shaft 12 leads to the cutout 15 of the drill bit and is assembled with a flange 22 against the closure plate 13. The shaft 12 transmits the rotational movement of a drive 21 of the supply unit 20 onto the closure plate 13 of the drill bit 1. The drive 21 can utilize various drive means, for example electric, hydraulic, or others.

The closure plate 13 furthermore has two high-pressure jet nozzles 2 whose blasting directions (illustrated as dashed lines) are oriented at a shallow angle, as measured with respect to the surface of the closure plate 13, onto the inner lateral face 6 of the core barrel 5. The jet nozzles 2 are sunk into the surface of the closure plate 13 in order to ensure an unobstructed jet propagation even in the case of such a shallow angle.

The jet nozzles 2 are connected to a high-pressure source 30 of a blasting medium 3. The inlets 11 from the high-pressure source 30 to the jet nozzles 2 run in channels or lines through the supply unit 20, through the shaft 12 thereof, via a central the distributor 19 in the closure plate 13, to the high-pressure jet nozzles 2. Other embodiments of the inlets 11 and of the connection to the high-pressure source 30 are possible.

Fig. 3 illustrates the view into the drill bit 1. The two jet nozzles 2 are arranged radially and mutually opposite in the closure plate 13. The closure plate has four uniformly distributed annular segments, which form outflows 14 for the excavated matter (not illustrated) which arises in the drill bit. The outflows 14 are configured as apertures extending through the closure plate 13.

The device according to Fig. 1 can for example be a device for eliminating adherences at the inner face of channels, in particular of closed channels. In that case, the supply unit 20 can have suitable moving means (not illustrated), such as wheels, chains, runners, or others. If the drill bit 1, as illustrated in Fig. 1, is larger in at least one extent than the supply unit 20, suitable measures can be taken to centre the drill bit 1 in the channel. Suitable spacers can be used, or the moving means are arranged around the device in such a way that centring can be effected using the moving means.

Fig. 4 illustrates an alternative configuration of a drill bit. The drill bit has a plurality of jet nozzles 2 for the blasting medium 3, said nozzles being arranged, as seen from the front end of the drill bit, behind the abrasion elements 4 (illustrated schematically as blocks) and distributed on a circumference of the inner lateral face 6 of the core barrel 5. The arrangement of the jet nozzles 2 will also be referred to below as nozzle ring. The blasting direction thereof extends into the hollow cylinder of the core barrel 5. The blasting direction of the jet nozzles 2 can be oriented perpendicularly with respect to the surface of the inner lateral face 6 in the direction to the axis 7 of the core barrel 5. As an alternative, said blasting direction can also deviate from the direction by an angle of up to +/- 45°, that is to say can extend to a greater extent towards the front end 16 or rear end 17. Larger deviations therefrom are possible if this appears suitable for the application. The angular orientation of the blasting direction can be variable by means of the jet nozzles 2.

The jet nozzles 2 are arranged in such a way that none of the jet nozzles 2 project beyond the inner radius of the abrasion elements 4, that is to say has a smaller distance from the axis 7 of the core barrel than the abrasion elements. Otherwise, the jet nozzles 2 would collide with the drilling core 8 in the course of drilling. Structurally, this can be realized in a variety of ways. The jet nozzles 2 can be sunk in the inner lateral face 6 of the core barrel 5, such that they do not project beyond the inner lateral face 6. As an alternative or in addition, the inner diameter of the ring of the abrasion elements 4 (cutting inner diameter, correspondingly cutting inner radius R_{SI}) can be smaller than the inner diameter of the core barrel 5 (core barrel inner diameter, correspondingly core barrel inner radius R_{RI}), such that the jet nozzles 2 can project beyond the inner lateral face 6 of the core barrel 5 by an amount which is smaller than the difference between the barrel inner radius and the cutting inner radius R_{SI}.

The circumferentially distributed high-pressure jets of an abrading blasting medium 3, which are directed to the axis 7 of the drill bit 1, allow the drilling core 8 to be cut to a desired length, at maximum the inner free length of the drill bit 1.

The distance of a nozzle ring from the front end 16 of the drill bit 1 in this case defines the maximum cutting length of the drilling core 8. In the illustrated exemplary embodiment, the nozzle ring is arranged at the front end of the core barrel 5 so as to be as close as possible behind the abrasion elements 4. A greater distance from the front end 16, or a plurality of nozzle rings, are alternatively possible.

On the core barrel 5, and with direction of effect into the core barrel 5 and thus towards the drilling core 8, there are arranged holding means 18, for example leaf springs, which are suitable for holding the drilling core 8, and/or fixing it in place, with such force that the drilling core 8 can be removed along with the drill bit 1 from the drill hole 10. Evidently, the force to be applied for this purpose and, accordingly, the suitable holding means 18 are dependent on the size, weight, and stability of the drilling core 8.

The drill bit 1 has a shaft 12 with which it can be mechanically connected to a suitable drilling apparatus (not illustrated). The inlet 11 of the blasting medium to the high-pressure jet nozzles 2 runs in channels through the shaft 12 and the wall of the core barrel 5. The drill bit 5 also has outflows (not illustrated) for discharging the excavated matter, as presented in the general description.

To illustrate the functional relationships of the components of the drill bit and of the drilling apparatus, the method, taking the example of machining channel walls using the device according to Fig. 1, will be explained in an exemplary manner. With the device described above, machining of closed channels can be carried out with the following fundamental steps:

- moving the drilling apparatus in the channel 50 as far as an obstacle to be eliminated or an adherence to be eliminated.

- activating the drive 21 and generating a rotation of the drill bit 1 with continual forward movement of the drilling apparatus 40 in the channel 50, but with substantially slower speed and

- generating two directed, concentrated high-pressure jets by means of the two jet nozzles 2 by supplying the liquid high-pressure blasting medium 3 to the jet nozzles 2.

- cutting a drilling core 8 by means of the abrasion elements 4 at the front end 16 of the drill bit 1 and

- abrading the drilling core 8 in the drill bit 1 by means of the high-pressure jets until the adherence has been broken through.

- During the cutting and abrading, the excavated matter is discharged through the closure plate 13 behind the drill bit and into the open region of the channel 50.

The rotation of the drill bit and the advance of the drilling apparatus, and also the blasting medium, can be controlled by means of a suitable control unit (not illustrated). To monitor the abrasion and control the method, the surroundings of the device can also be recorded by means of a camera.

In accordance with various alternative configurations of the device, a variety of variations of the method are possible.

Patentkrav

1. Fremgangsmåde til udførelse af kerneboringer i et materiale ved hjælp af boreapparater, som anvender en borekrone (1), der er udformet med et hult cylindrisk grundlegeme, i det følgende betegnet som kernerør (5), og ved kernerørets (5) forreste ende (16), som tjener til materialefjernelsen, har elementer til materialefjernelse (4), der er fastgjort kransformet fordelt på kernerørets (5) overflade, omfattende følgende fremgangsmådetrin:
- udførelse af en fremadgående bevægelse af borekronen (1) kombineret med en drejebevægelse af borekronen (1) omkring sin akse (7) ved hjælp af en drivanordning (21) med henblik på den cirkulært ringformede materialefjernelse på materialet og udformning af en borekerne (8) af materialet i kernerøret (5),
- tilvejebringelse af et under højtryk stående strålemedium (3) ved borekronen (1), kendetegnet ved:
- generering af i det mindste to ind i borekronens (1) indvendige rum rettede stråler af strålemediet (3) ved hjælp af højtryks-stråledyser (2) og
- materialefjernelse på borekernen (8) ved hjælp af strålemediet (3), hvorved der ved hjælp af strålemediet (3) sker en materialefjernelse af borekernen (8) ved dens frie ende.

2. Fremgangsmåde ifølge krav 1, hvorved materialefjernelsen af borekernen (8) sker ved dens frie ende i kernerørets (5) indre.

3. Fremgangsmåde ifølge krav 2, hvorved aftaget materiale, der opstår i borekronen som følge af højtryksstrålernes materialefjernelse, fjernes fra borekronens indre ved hjælp af afløb, som borekronen har.

4. Fremgangsmåde ifølge et af de foregående krav, hvorved et afsnit af borekernen (8) fraskilles ved hjælp af højtryksstråler af strålemediet (3), hvilke højtryksstråler er rettet mod borekronens (1) akse (7).

5. Fremgangsmåde ifølge et af de foregående krav, hvorved i det mindste en yderligere højtryks-stråledyse (2), der er anbragt på kernerørets (5) frontside (9), stråler i boreretningen.

6. Fremgangsmåde ifølge et af de foregående krav, hvorved fremgangsmåden anvendes i forbindelse med en kanalrensningsanordning til fjernelse af vedhæftninger (51) på den indvendige flade af lukkede kanaler (50) ved hjælp af højtryksstråler.

7. Borekrone udformet til udførelse af fremgangsmåden ifølge et af de foregående krav, hvilken borekrone omfatter følgende bestanddele:
- et hult cylindrisk grundlegeme, i det følgende betegnet som kernerør (5), med en akse (7) og en forreste ende (16) og en modsat den forreste ende (16) liggende bageste ende (17),
- hvor kernerøret (5) har elementer til materialefjernelse (4), som ved den forreste ende (16) er fastgjort kransformet fordelt på kernerørets (5) overflade,
- forbindelsesmidler til etablering af en mekanisk forbindelse til en ekstern forsyningsenhed for et boreapparat (40) sådan, at borekronen (1) er drejelig,
kendetegnet ved:
- en slutplade (13) ved kernerørets (5) bageste ende (17),
- i det mindste to højtryks-stråledyser (2), som kan forbindes med en ekstern højtrykskilde (30) for et strålemedium (3),
- hvor højtryks-stråledyserne (2) er anbragt på den indvendige kappeflade (6) af kernerøret (5) og/eller den mod den forreste ende (16) vendte overflade af slutpladen (13) og er rettet ind i kernerørets (5) indre, og
- hvor borekronen (1) har i det mindste et afløb (14) til bortledning af aftaget materiale fra kernerørets (5) indvendige rum, og det i det mindste ene afløb (14) er en gennemgang, der er udformet i slutpladen (13).

8. Borekrone ifølge krav 7, hvor stråledyserne (2) er orienteret sådan ind i borekronens (1) indre, at strålen falder

på kernerørets (5) indvendige kappeflade (6) eller på slutpladen (13).

9. Borekrone ifølge et af kravene 7 eller 8, hvor højtryks-stråledysernes (2) stråleretning er varierbar.

10. Borekrone ifølge et af kravene 7 til 9, hvor i det mindste en højtryks-stråledyse (2) er anbragt på kernerørets (5) indvendige kappeflade (6) bag ved elementerne til materialefjernelse (4), hvor højtryks-stråledysens (2) stråleretning har en vinkel β i forhold til normalen til den indvendige kappeflade (6) ved dyseudløbet i området fra - 45° til + 45°, relateret til normalen.

11. Borekrone ifølge et af kravene 7 til 10, hvor kernerørets (5) udvendige kappeflade har kanalagtige fordybninger, som forløber hen til den bageste ende (17).

12. Borekrone ifølge et af kravene 7 til 11, hvor tilføringerne (11) til højtryks-stråledyserne (2) er udformet i kernerørets (5) væg og/eller i slutpladen (13).

13. Borekrone ifølge et af kravene 7 til 12, hvor kernerøret (5) har holdemidler (18) til fastholdelse af en borekerne (8) i kernerøret (5).

14. Borekrone ifølge et af kravene 7 til 13, hvor den i det mindste ene højtryks-stråledyse (2) er anbragt på kernerørets (5) frontside (9) og orienteret i boreretningen.

15. Anordning til fjernelse af vedhæftninger på den indvendige flade af kanaler (50) ved hjælp af højtryksstråler, omfattende følgende komponenter:
- en borekrone (1) ifølge et af kravene 7 til 14, der er anbragt på anordningens forreste ende (16),
- bevægelsesmidler til bevægelse og positionering af borekronen (1) i kanalen (50),
- en medietilførsel til forsyning af højtryks-stråledyserne (2)

med det under højtryk stående strålemedium (3),
- hvor bevægelsesmidlerne samt borekronen (1) er udformet sådan, at begge kan positioneres og bevæges i det mindste langs en side med en afstand til en kanalvæg (50).

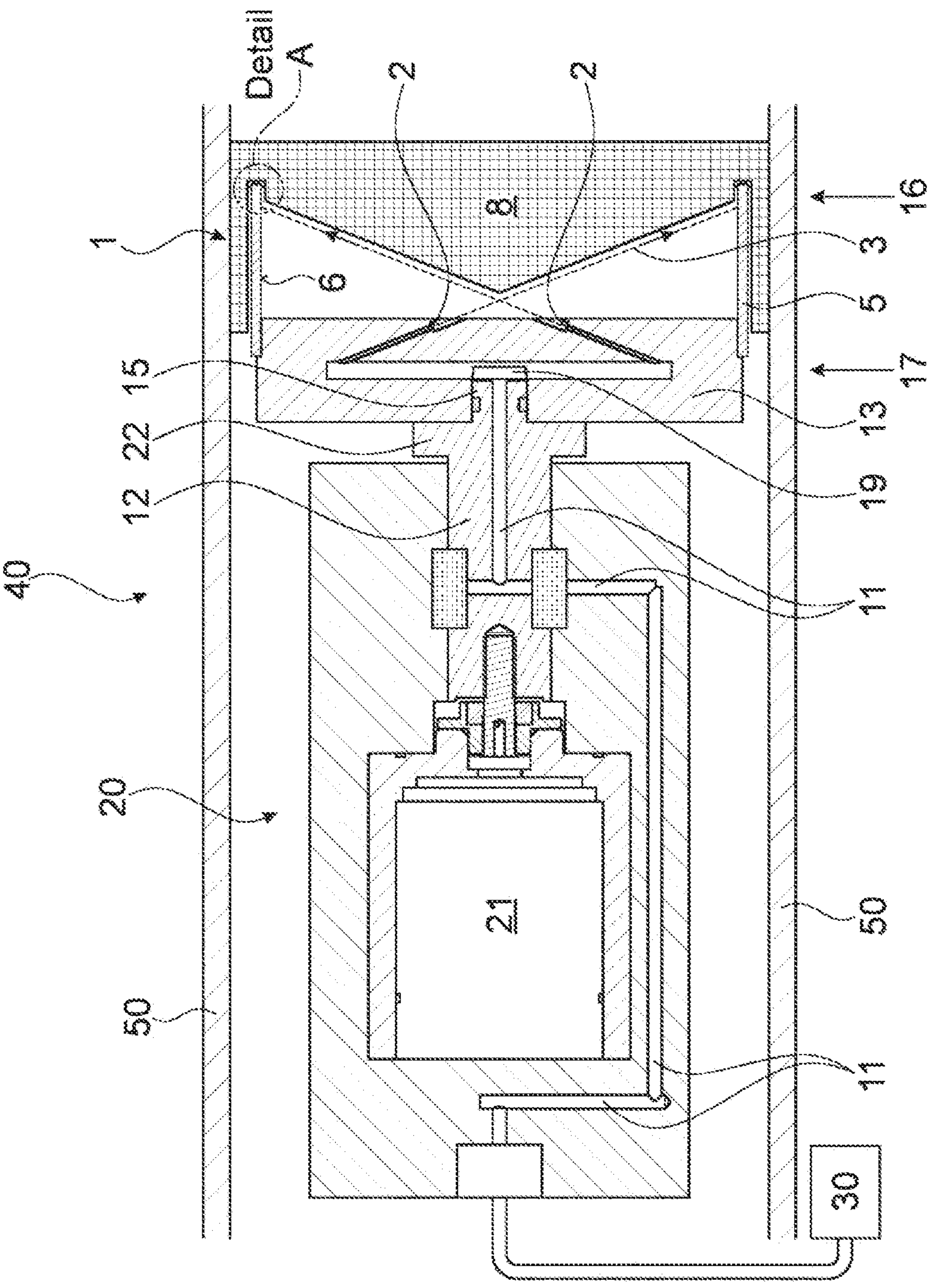

Fig. 1

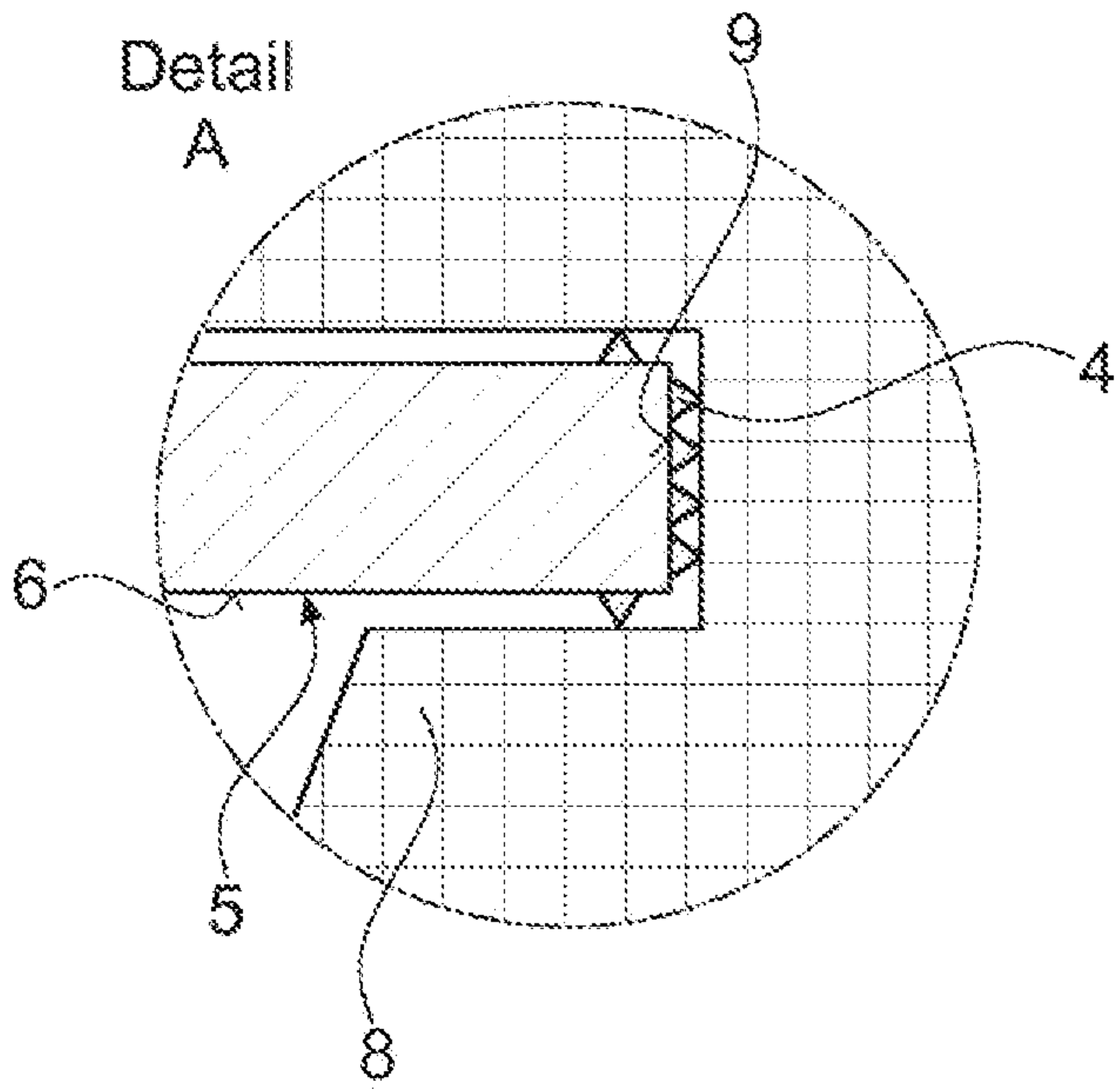

Fig. 2

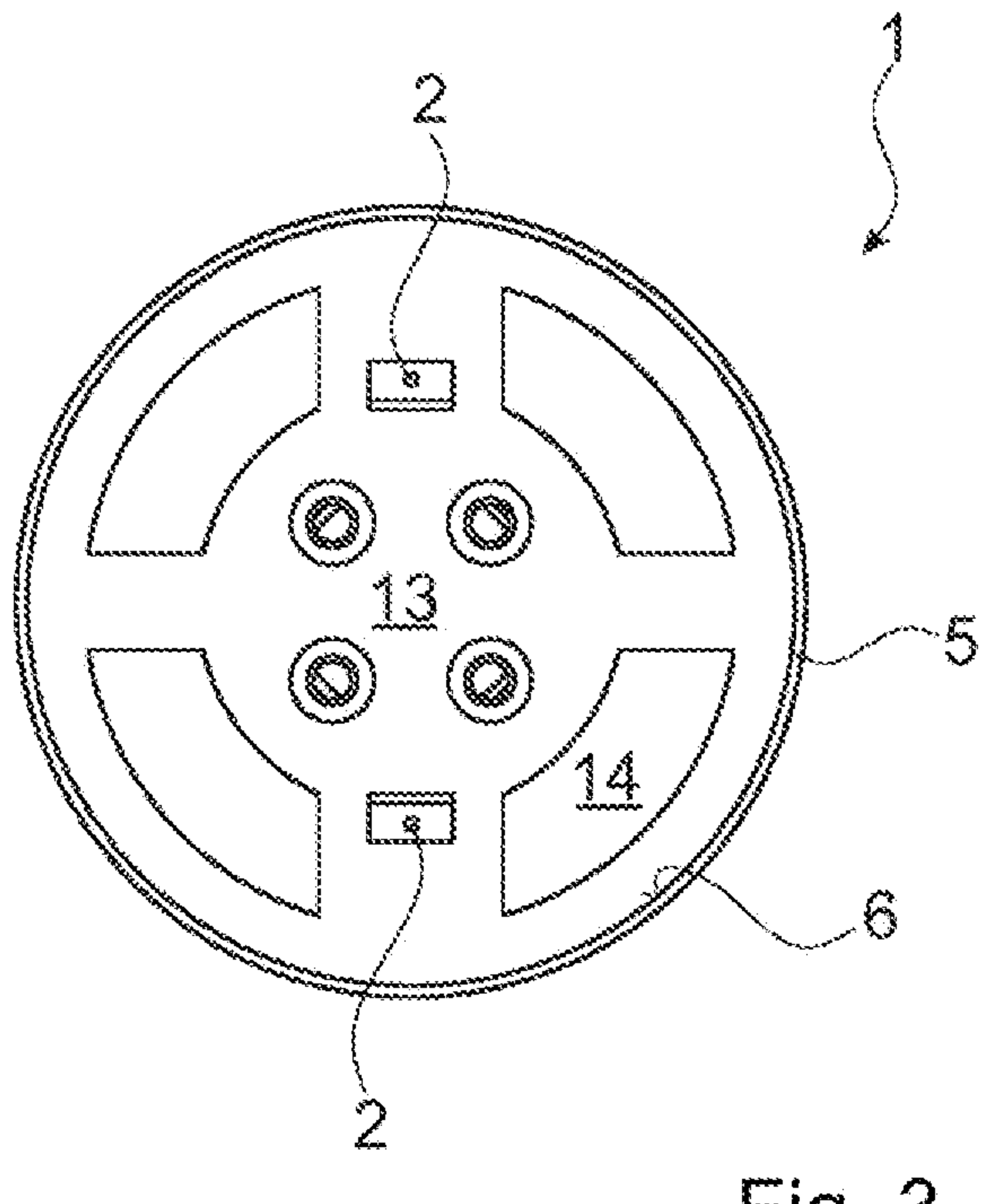

Fig. 3

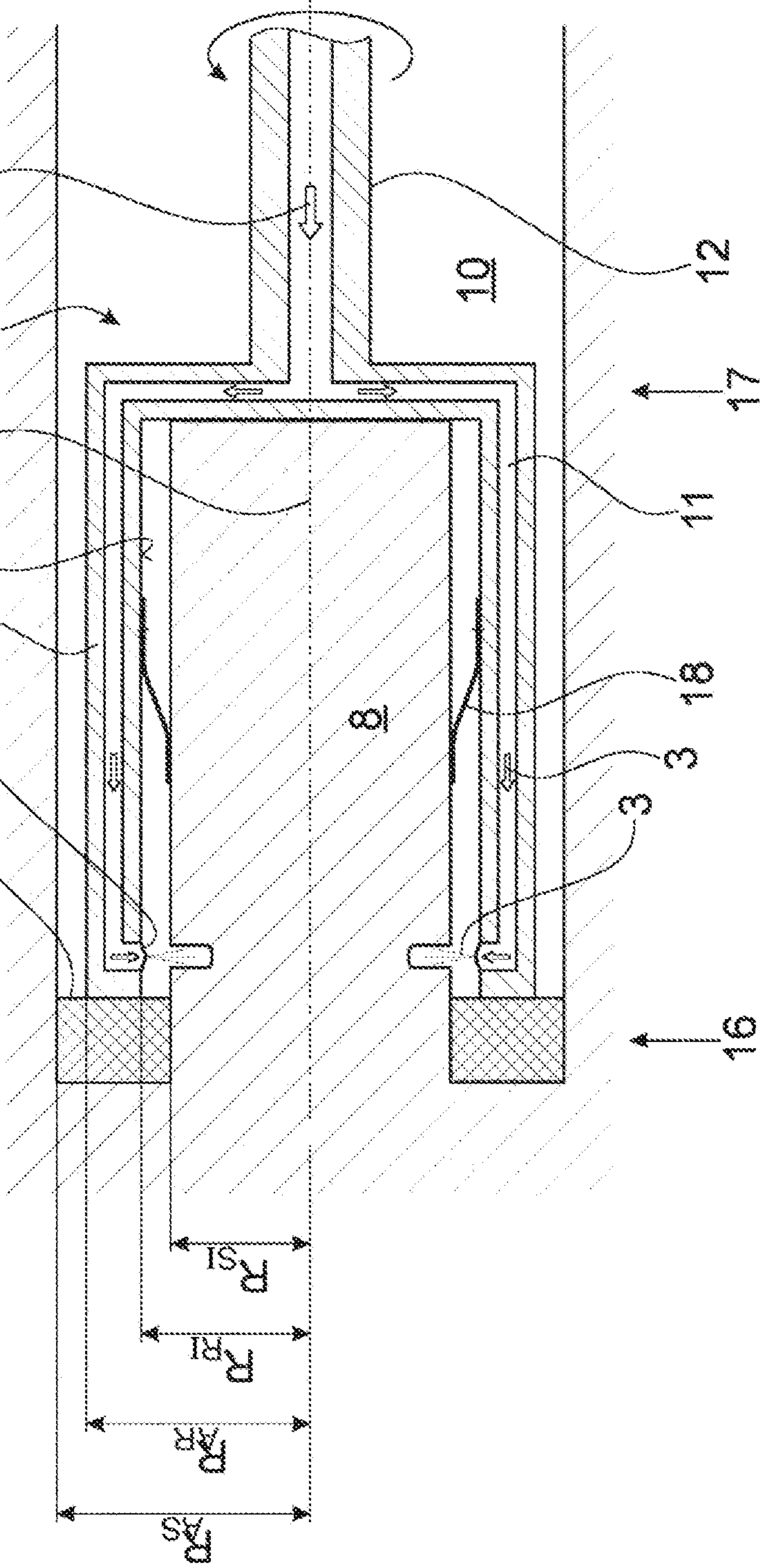

Fig. 4