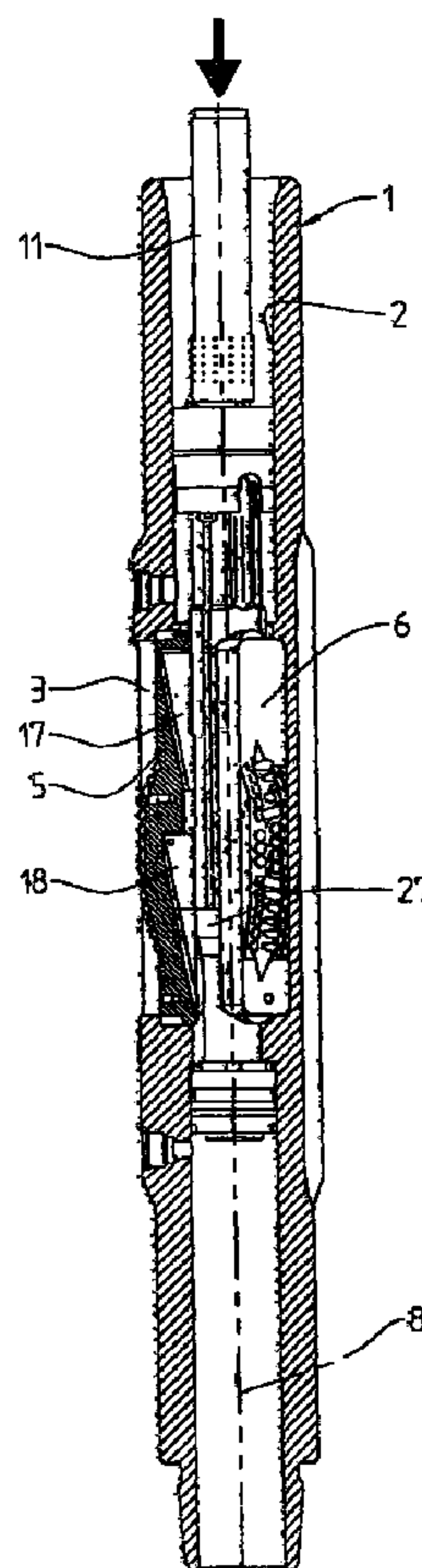




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(54) Titre : OUTIL D'ELARGISSEMENT ET DE STABILISATION A EMPLOYER DANS UN TROU DE FORAGE ET
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IT



(57) Abrégé/Abstract:

The invention concerns an under-reaming and stabilizing tool comprising a tubular body (1) having an axial cavity (2) open outwards by at least one radial guide channel (3), a blade element (5, 6) arranged radially mobile in each radial guide channel, and



(57) Abrégé(suite)/Abstract(continued):

wedge means (17, 18) which through an axial displacement inside the tubular body, induce a radial movement of each blade element (5, 6) as well as a drive tube (11) which is mounted inside said axial cavity so as to produce therein axial movements, the wedge means being supported at the periphery of the drive tube so as to perform between them a relative sliding movement, stop means being capable of releasably locking the wedge element on the drive tube in a locking position wherein the drive tube can produce its axial movements driving with it the wedge element.

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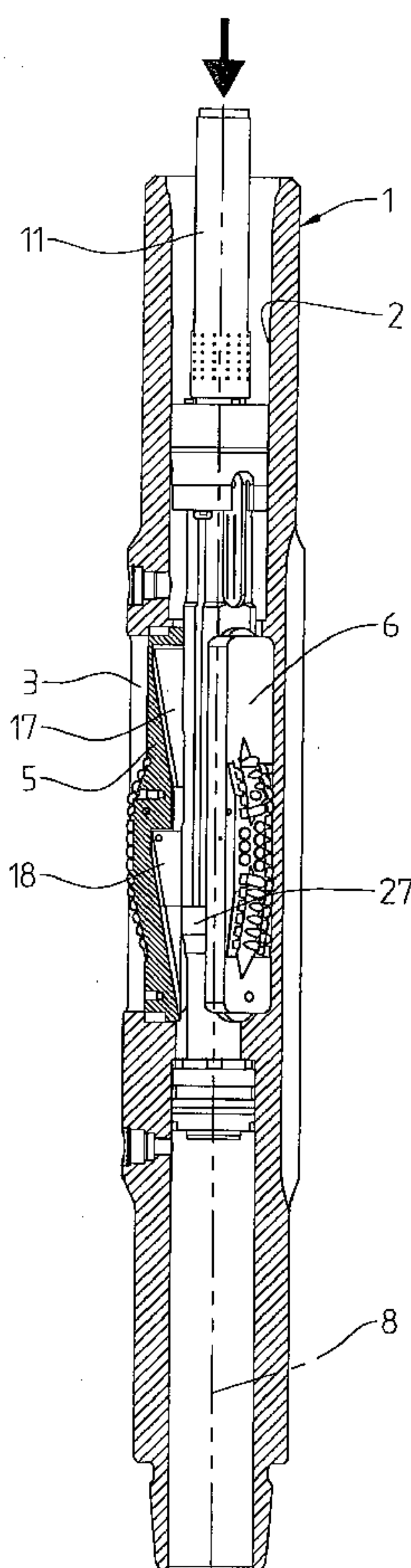
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(54) Titre : OUTIL D'ÉLARGISSEMENT ET DE STABILISATION À METTRE EN SERVICE DANS UN TROU DE FORAGE ET PROCÉDE POUR SA MISE EN ŒUVRE



(57) Abstract: The invention concerns an under-reaming and stabilizing tool comprising a tubular body (1) having an axial cavity (2) open outwards by at least one radial guide channel (3), a blade element (5, 6) arranged radially mobile in each radial guide channel, and wedge means (17, 18) which through an axial displacement inside the tubular body, induce a radial movement of each blade element (5, 6) as well as a drive tube (11) which is mounted inside said axial cavity so as to produce therein axial movements, the wedge means being supported at the periphery of the drive tube so as to perform between them a relative sliding movement, stop means being capable of releasably locking the wedge element on the drive tube in a locking position wherein the drive tube can produce its axial movements driving with it the wedge element.

(57) Abrégé : Outil d'élargissement et de stabilisation comprenant un corps tubulaire (1) présentant une cavité axiale (2) ouverte vers l'extérieur par au moins un canal de guidage radial (3), un élément de couteau (5, 6) agencé de manière radialement déplaçable dans chaque canal de guidage radial (3), et des moyens de coin (17, 18) qui, par un déplacement axial à l'intérieur du corps tubulaire, induisent un mouvement radial de chaque élément de couteau (5, 6) ainsi qu'un tube d'entraînement (11) qui est monté à l'intérieur de ladite cavité axiale de manière à pouvoir y effectuer des déplacements axiaux, les moyens de coin étant supportés à la périphérie du tube d'entraînement de manière à pouvoir effectuer entre eux un mouvement de coulissement relatif, des moyens d'arrêt étant capables de bloquer de manière détachable l'élément de coin sur le tube d'entraînement dans une position de blocage où le tube d'entraînement peut effectuer ses déplacements axiaux en entraînant avec lui l'élément de coin.

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Underreaming and stabilisation tool to be used in a borehole and a method for using it

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The present invention relates to an underreaming and stabilisation tool to be used in a borehole, comprising

10 a tubular body to be mounted between a first section of a string and a second section thereof, this tubular body having an axial cavity that is open towards the outside through at least one radial guide channel,

a blade element arranged so as to be radially movable in each aforementioned radial guide channel, and

15

wedge means that, through an axial movement inside the tubular body, cause a radial movement of each blade element in its guide channel.

20 Such tools have been known for a long time (see for example US-A-5.368.114, US-B-6.189.631, US-B-6.615.933 and US-A-2003/0155155).

25 It has become more and more necessary, during drilling in hard and abrasive geological formations, to have available underreaming tools provided with many blade elements, in the form of voluminous arms. The underreaming arms are therefore more and more elongate and comprise a large number of cutting tips. Finally, advantageously, the blade elements in the form of underreaming arms, which normally widen the drilling hole during a downward descent of the tool, are now provided with parts reinforced with diamond domes for stabilising the tool during the broadening and parts capable of broadening the hole by raising the
30 underreaming tool towards the surface.

The tools known in the prior art unfortunately have the drawback of being adequate only for use in one type of geological formation. When there is a change of geological formation, the underreaming tool must be completely
5 replaced, that is to say the tool must be extracted from the string and replaced with another tool, the configuration of which is better suited to the widening of the borehole in the new geological formation. The same applies in the event of wear or fault in the blade elements. The result is a high operating cost.

10

The purpose of the present invention is therefore to develop an underreaming and stabilisation tool as indicated at the start that affords great flexibility of use of the tool according to the geological formations in which it must widen a borehole and great ease of replacement of the blade
15 elements after they are worn.

This problem has been resolved according to the invention by an underreaming and stabilisation tool as indicated at the start that also comprises

20

a drive tube that is mounted inside the said axial cavity so as to be able to make axial movements therein and that has a longitudinal axis,

as wedge means, at least one wedge element per blade element that is
25 supported at the periphery of the drive tube, the said at least one wedge element and the drive tube being capable of effecting between them a relative axial sliding movement along the longitudinal axis, and

stop means that are capable of detachably locking the said at least one
30 wedge element on the drive tube in a locking position in which the drive

tube can make its aforementioned axial movements, and the said at least one wedge element is driven by the drive tube in these axial movements.

5 This tool therefore makes it possible easily to replace the wedge elements by detaching them from the drive tube on which they are supported. Because of this it is possible without difficulty to replace them with other wedge elements having a different configuration. Faced with a hard geological formation, it will be possible to provide blade elements that react more flexibly during the widening because they rest on wedge elements
10 with a steep slope. Faced with a friable geological formation, it will be possible to provide, in the same tool, blade elements reacting in a harder manner, since the wedge elements will then be provided with a more gentle slope. Such a transformation of the tool therefore requires only the replacement of the wedge elements and the replacement of the blade
15 elements with others adapted to these wedge elements. It is thus possible also to provide in the same radial guide channels blade elements having different active lengths without having to change tool.

In addition, when a phenomenon of wear on the blade elements appears,
20 these can be replaced rapidly, as will be described in more detail below.

According to one embodiment of the invention, the drive tube has at its periphery longitudinal grooves in each of which at least one wedge element can make the said relative axial sliding movement while being retained
25 radially inside this longitudinal groove.

According to another embodiment of the invention, the said stop means comprise

30 a stop closing off each longitudinal groove at a first axial end, and

a removable locking element that closes off each longitudinal groove at a second axial end, opposite to the first, when the said at least one wedge element and the said drive tube are in the said locking position, and that is driven by the drive tube during its axial movements. In this way there is
5 obtained, rapidly and easily, a holding of the drive tube in the tool so that it makes only a sliding movement inside the central tube without rotation about its axis.

Advantageously, provision has been made according to the invention for
10 the said locking element and the drive tube to have threads capable of cooperating for their mutual fixing in a position of closing of the second end of the longitudinal groove. In this position, at least part of the wedge element is enclosed so as to be completely stationary in its corresponding longitudinal groove closed at its two ends.

15

According to an improved embodiment of the invention, the inclined internal surface of each blade element and the inclined external surface of each wedge element on which the blade element is in abutment are provided with means of mutual retaining in the radial direction that are
20 arranged so that the blade element in the high position in its guide channel makes a radial descent towards a low position by a retraction on the part of the retaining means of the said at least one wedge element during the axial movement thereof. The thrust of the blade elements radially towards the outside and the retraction of these inside the tubular body therefore result
25 only from a cooperation between wedge elements and a corresponding blade element, trapped in a channel that serves solely for radial guiding. The result is that, whatever the slope of the cooperating surfaces of the wedge elements and of the blade element, the length of the latter or the extension sought for this out of the tool body, the tubular body remains the
30 same and the drive tube also.

According to an advantageous embodiment of the invention, the drive tube comprises a piston that separates, in the tubular body, a first portion in which a hydraulic fluid is under an internal pressure and a second portion that is in communication with the outside through the said at least one radial guide channel where the said at least one wedge element and their corresponding blade element are housed. By a simple difference in pressure applied between two portions of the tubular body, it is possible to drive the wedge elements longitudinally and to use the blade elements for a widening of the hole and/or a stabilisation of the tool in this hole.

10

Other embodiments of the tool according to the invention are indicated in the accompanying claims.

The present invention also concerns a method for using an underreaming and stabilisation tool to be used in a borehole.

15

The method according to the invention comprises

Introduction of each blade element provided with at least one wedge element so as to be engaged in a corresponding radial guide channel in the axial cavity of the tubular body,

20

introduction of the drive tube into the axial cavity of the tubular body, with relative sliding between this drive tube and the said at least one radially engaged wedge element, and

25

detachable locking of each wedge element on the drive tube in a locking position in which the drive tube can effect axial movements and the said at least one wedge element is driven by the drive tube in these axial movements.

30

Such a method allows particularly easy and rapid mounting and removal of the tool. A simple locking of the wedge elements on the drive tube in an appropriate position enables the tool to be brought into service immediately. The drive tube can make only an axial sliding movement,
5 without rotation about its axis.

According to an advantageous embodiment of the method according to the invention, it also comprises, before the step of introducing each blade element, an arrangement on at least one inclined internal surface of each
10 blade element of at least one wedge element having an external surface inclined in the same way, so that these elements remain secured to each other, during this introduction step, and, after the aforementioned locking step, blade elements and wedge elements are disconnected so that each blade element can slide over the inclined surface of the said at least one
15 corresponding wedge element. The disconnection between the wedge elements and the blade elements can take place for example by the shearing, using a threshold hydraulic pressure, of pins that hold the blade elements on the wedge elements, that is to say while the underreaming tool has already descended into the borehole.

20

Other embodiments of the method according to the invention are indicated in the accompanying claims.

Other details and particularities of the invention will emerge from the
25 description given below non-limitatively and with reference to the accompanying drawings.

Figure 1 depicts a partially cut-away perspective view of a tool drive tube according to the invention that is provided with wedge elements and blade
30 elements.

Figure 2 depicts a perspective view of the drive tube.

Figures 3 to 6 depict steps of mounting the tool according to the invention.

5 Figure 7 depicts the same tool when the blade elements are in service.

Figures 8 to 10 depict a view in axial section of an embodiment of a tool according to the invention provided on each side with joining elements for fixing the tool in the string.

10

Figures 11 and 12 are views in transverse section along the line XI-XI in figure 9 and respectively along the line XII-XII in this figure.

15 Figures 13 to 15 each depict a partially cut-away perspective view of a device activating the tool according to the invention in three different positions.

Figures 16 and 17 each depict a partially cut-away perspective view of a drive tube capture device in two different positions.

20

Figure 18 depicts a view in axial section of a variant of a device for activating the tool according to the invention.

25 Figure 19 depicts an enlarged perspective view of an embodiment of a wedge element.

As illustrated in particular in figure 3, the tool according to the invention comprises a tubular body 1 that is mounted between two sections of a string, not shown. This tubular body 1 has an axial cavity 2 that is open
30 towards the outside through three radial guide channels 3, only one of

which is visible in this figure. It would of course be possible to provide a different number of guide channels, according to requirements.

In each guide channel a blade element 5 and respectively 6 is arranged so
5 as to be radially movable. Each blade element comprises, as illustrated in
detail in figure 1, an external surface provided with cutting tips that have a
front part 7 inclined towards the front (that is to say towards the bottom in
figure 1) with respect to the longitudinal axis 8, a central part 9 substantially
parallel to the axis 8 and a rear part 10 inclined towards the rear with
10 respect to the axis 8. The front part 7 is intended to produce a widening of
the borehole during its descent, the central part 9 to stabilise the tool with
respect to the widened hole and the rear part 10 to produce a widening of
the borehole when the string is raised again.

15 The tool according to the invention also comprises a drive tube 11 that is
mounted inside the axial cavity 2 so as to be able to make axial
movements therein according to a hydraulic pressure.

As is clear in particular from figure 2, the drive tube 11 also has an axial
20 cavity 12 through which the drilling mud can flow. The drive tube 11 has a
piston 13 that separates, in the tubular body, a first portion 14 (see figure
8) and a second portion 15 (see figure 9). In the first portion 14 a fluid can
enter hydraulically under pressure, for example from the axial cavity 12 of
the drive tube passing through filtration means formed by the drillings 16.
25 The second portion 15 of the tubular body 1 is in communication with the
outside through the guide channels 3 where the blade elements 5 and 6
are housed.

The tool according to the invention also comprises, in the example
30 illustrated, two wedge elements 17 and 18 per blade element, these wedge
elements being supported by the drive tube 11. It can be understood that it

it would be possible to provide only one wedge element per blade element or more than two, according to requirements. Figure 19 depicts a variant embodiment in which two wedge elements are connected to each other rigidly.

5

Each blade element has at least one internal surface inclined with respect to the longitudinal axis 8. In the example embodiment illustrated it has two 19 and 20. Each wedge element has an external surface 21 inclined in the same way that is in abutment on the internal surfaces 19 and 20 of the
10 corresponding blade element.

In the example illustrated in figure 12, each blade element 5 has a U-shaped transverse section and therefore straddles the corresponding wedge element 17 or 18. The surfaces 19 or 20 and 21 of these elements,
15 which are in abutment on each other, have mutual holing means in the radial direction that, in the example illustrated, are in the form of a dovetail groove and a flute 38, of corresponding shape.

In addition, for mounting, the wedge elements are fixed to the blade
20 elements by shear pins 22 that hold the wedge elements with respect to the blade elements in the position illustrated in figures 3 to 6. To do this, these pins are introduced into a perforation 37 provided for this purpose in the blade element and a corresponding perforation in the wedge element (see figure 11).

25

If reference is made to figure 2, it can be seen that the drive tube 11 is provided at its periphery with longitudinal grooves 23 in which the wedge elements 17 and 18 can effect a relative axial sliding movement with respect to the drive tube 11, as shown in figures 5 and 6.

30

In this example embodiment, the grooves are delimited laterally by lips 24 directed towards each other, which narrow the opening of the grooves towards the outside. In a central position of the grooves, these lips are omitted, forming a splay 25 that allows at least part of the corresponding
5 wedge element to enter in the radial direction.

The wedge elements have in this example embodiment a conformation with lateral projections that can be slid underneath the aforementioned lips
24.

10

The tool according to the invention also comprises stop means that are capable of detachably locking the wedge elements 17, 18 on the drive tube 11, allowing the axial movements thereof.

15 The stop means comprise a stop 26 that longitudinally delimits each longitudinal groove 23. In the example illustrated, it is a case of a wall that terminates the groove on the piston side. The stop means also comprise a threaded sleeve 27 that can be screwed onto the threaded end 28 of the drive tube. After screwing, the threaded sleeve 27 closes the longitudinal
20 groove 23 on the opposite side to the piston.

After screwing, during the axial sliding of the drive tube 11, the latter can be brought from the position shown in figure 6 to the position shown in figure 7. It then draws with it the wedge elements that are trapped in the
25 longitudinal groove between the stop 26 and the threaded sleeve 27 as well as by the lips 24. During their movement, the wedge elements then cause a radially movement of each blade element 5, 6 in its guide channel 3. This is because the blade elements are locked against any axial movement by front 34 and rear 35 walls of their guide channel and they
30 therefore make a rising or descent movement therein between the low

position (retracted) illustrated in figure 6 and the high position (expansion) illustrated in figure 7.

Advantageously the piston 13 has a passage in the form of at least one
5 small-diameter conduit 36 (see figure 9) that affords communication
between the pressurised portion 14 (see figure 8) of the tubular body and
the portion 15 (see figure 9) that is in communication with the outside. The
throttling produced by this conduit 36 has the effect of a high-pressure
10 injection of jets of hydraulic fluid into the portion 15. This prevents
penetration into the tool of the drilling mud that flows outside the string and
cleans the wedge elements, the blade elements and the radial guide
channels.

The method for using the tool according to the invention will now be
15 described in more detail below.

As is clear from figure 1, each blade element 5 is provided, in the example
illustrated, with two wedge elements 17 and 18. For this purpose, the
dovetail flutes 38 of the wedge elements (see figure 12) are slid inside
20 corresponding dovetail grooves in the blade element, as far as the position
illustrated in figure 1. Then each wedge element is fixed to its blade
element by a shear pin 22 that passes through each wedge element and at
least one orifice 37 provided in the blade element (see figure 11). In this
way, the wedge elements and the blade element remain secured to each
25 other during the mounting operations.

The blade element 5 provided with its two wedge elements is then
introduced axially or, as illustrated in figure 3, radially aslant inside the
cavity 2 of the tubular body 1 in the direction of the arrow F1. When the
30 blade element 5 is facing the radial guide channel 3 that corresponds to it,

it is drawn radially outwards in the direction of the arrow F2 (see figure 4), manually or by means of a machine, and is kept in this engaged position.

Advantageously, the threaded sleeve 27, provided with a seal 29 in which it
5 is capable of sliding, is introduced from the bottom into the axial cavity 2. The seal is kept in position between the threaded end of the sleeve 27 and a return spring, not shown.

The following step is also illustrated in figure 4. The drive tube 11 is
10 introduced in the direction of the arrow F3 into the axial cavity 2 of the tubular body 1.

When the splay 25 of the longitudinal grooves 23 of the drive tube 11 comes opposite the wedge elements 17 (see figure 4), the wedge
15 elements 18 are situated facing the threaded end 28 of the drive tube.

The blade elements are then, as illustrated in figure 5, pressed in the direction of the arrow F4 into their guide channel. The wedge elements 17 enter radially into the longitudinal grooves, through the splays 25, and the
20 wedge elements 18 have their lateral projections in position in order to be able to pass below the lips 24 of the longitudinal groove 23.

Figure 6 illustrates a relative sliding between the drive tube 11 and the wedge elements 17 and 18. The drive tube is partially pressed into the
25 threaded sleeve 27. The wedge elements 17 enter the top part of the longitudinal grooves, which have no splay, and the wedge elements 18 enter the bottom part of these grooves.

The threaded sleeve 27 is then screwed from the bottom. In the screwing
30 position, the wedge elements 17, 18 are trapped in the longitudinal grooves 23 between the stops 26 and the threaded sleeve 27 and are immobilised

immobilised radially by the lips 24.

In this position, there is no longer any relative axial sliding between the wedge elements and the drive tube. The latter drives the wedge elements
5 in its axial movements.

Figure 7 illustrates a downward axial movement of the drive tube 11. The blade elements 5, 6 have slid on the slope of the wedge elements 17, 18 as far as the expanded position, illustrated. As can be seen the assembly
10 and of course the dismantling also of the two are very simple and rapid. The blade elements can easily be replaced by new ones and other blade models can be introduced into the tool without having to replace the tool itself.

15 The tool according to the invention also comprises an activation device that is capable of holding the drive tube 11 axially in its initial position shown in figures 8, 9 and 10. It is in this retracted position of the blade elements that the tool is lowered into the borehole.

20 In the example illustrated in figures 8 to 10, this activation device comprises a shear pin 39 that passes through an orifice 40 provided in the tubular body, entering a blind hole provided on an extension tube 41 applied against the sleeve 27 screwed on the drive tube 11. When the hydraulic pressure applied on the piston 13 is below a given threshold, the
25 pin prevents any axial movement of the extension tube 41. When this threshold is passed, the pin 39 is sheared, and the drive tube can slide in the tubular body 1.

As can be seen in particular in figures 9 and 10, the tool according to the
30 invention is also provided, in the example illustrated, with a return spring 42 that bears firstly on the extension tube 41 and secondly on a junction

element 43, fixed to the tubular body 41 and making it possible to insert the latter in the string. When, under the action of pressure, the drive tube 11 is moved, the return spring is compressed. When the pressure decreases, the drive tube 11 is returned to its initial position illustrated in figures 8 to 10.

According to another example embodiment illustrated in figures 13 to 15, the activation device comprises, at the end of the extension tube 41 a socket 44 that envelops this end. The extension tube is provided at its bottom end with several lateral holes 45. The socket 44 is designed so as to be able to slide inside a sleeve 46 that is incorporated fixedly in the adjoining element 43. A shear pin 47 holds the socket 44 in place over the end of the extension tube 41, in the initial position of the drive tube, and the socket 44 prevents any axial movement of the extension tube 41 and therefore of the drive tube 11. The drilling mud passes through the drive tube 11, the threaded sleeve 27, the extension tube 41 and the sleeve 46 and then rejoins the string.

It is then possible to launch from the surface an activation ball 48 that comes to be housed against an end narrowing 49 of the extension tube 41. The application of this ball as shown in figure 14 has the effect firstly of a mechanical impact on the shear pin 47 and secondly a closure of the axial mud passage and therefore an enormous increase in the pressure exerted on the piston 13 of the drive tube 11. The result is immediately a shearing of the pin 47, as shown in figure 14, and a downward sliding of the drive tube. Through the pressure created inside the space situated upstream of the socket 44, the latter is projected downwards as far as the position illustrated in figure 14, where it is immobilised by a stop 50. The sliding of the drive tube 11 and therefore of the threaded sleeve 27 and extension tube 41 is stopped before the drive tube 41 reaches the sleeve 44 in its immobilised position. Consequently the circulation of the mud is then re-

established by means of the lateral holes 45. In this position, illustrated in figure 14, the drive tube 11 is released and can develop its axial sliding movement. When the hydraulic pressure decreases, the return spring 42 returns the drive tube to its initial position, as shown for example in figure 5 15.

According to yet another embodiment of the invention it would be possible to imagine a bolt element, usual in itself, that holds the drive tube 11 axially in the tubular body 1 in the initial position.

10

An electrical control, known per se, is for example situated on the surface and, as illustrated in figure 18, connected to the bolt 70 by means of an electronic device 71, which can be controlled by fluid pulses. The electronic device can then in its turn control a movement of the bolt by a 15 bolt activator 72, and this in an open position in which it releases the drive tube.

The tool according to the invention can also advantageously be provided with a capture device for the drive tube. In the example embodiment 20 illustrated in figures 16 and 17, the drive tube 11 is provided with a tubular extension 51 fixed to it. This extension 51 is surrounded by a sleeve 52 capable of sliding over the said extension 51 and inside two successive sockets 53 and 54 connected together fixedly. These sockets 53 and 54 are themselves embedded in a stationary manner inside a joining element 25 57 connected fixedly to the tubular body 1 to allow its insertion in a string.

A first elastic clamping collar 55 is housed in an internal groove 58 of the sleeve 52 and can therefore slide with it on the extension 51. A second elastic clamping collar 59 is housed in an internal groove 60 formed 30 between the two sockets 53 and 54, so as to be able to slide on the sleeve 52.

In the initial position of the drive tube 11 and during the bringing of the tool into service the sleeve 52 is held axially inside the fixed socket 53 by a shear pin 61. The mud passes inside the sleeve 52 and then the extension 51 and finally the drive tube 11.

When the functioning of the tool is to be stopped, for example in order to be brought to the surface again, a second ball 62 with a diameter greater than that of the sleeve 52 is sent into the string. It comes to be applied at the entrance to the sleeve 52, blocking the passage. Through the mechanical impact of the ball and the immediate strong increase in pressure, the pin 61 is sheared and the sleeve 52 can effect a sliding downstream.

During this sliding, a peripheral groove 64 of the sleeve 52 comes to be placed facing the second elastic clamping collar 59 and the latter comes to be housed therein, thus fixing together the sleeve 52 and the fixed sockets 53 and 54, and therefore the joining element 57 of the tubular body 1. Next, when the pressure is reduced, the first elastic clamping collar 55 comes to be housed in a peripheral groove 63 provided between the extension 51 and the drive tube 11, which is returned to its initial position, which secures these to the sleeve 52. In this position, the drive tube is trapped by the tubular body 1 and can no longer move. As the upstream end of the sleeve 52 is provided with lateral holes 66, the mud can, in this capture position, continue to flow by passing laterally around the ball 62 in a space 67 provided between the socket 53 and the sleeve 52, then in the lateral holes 66 and finally in the sleeve 52.

It must be understood that the present invention is in no way limited to the embodiments described above and that many modifications can be made thereto without departing from the scope of the accompanying claims.

It can also be envisaged that the drive piston may be driven in its axial movements by totally or partially mechanical means situated for example above the tool.

5

Finally, provision can be made for the tool to comprise a bolt which, in a closed position, holds the capture device axially in a non-activated position and an electrical control member, connected to the bolt and capable of controlling movement of the bolt in an open position in which the capture
10 device is moved in its captured position.

It can also be envisaged, as depicted in figure 19, that, for each blade element 5, there are several wedge elements, for example two wedge elements 80 and 81 that are connected to each other rigidly by a strut 82.

15

This embodiment offers the advantage of excellent resistance to tilting of the wedge elements in the grooves and therefore avoiding any unwanted jamming of the wedge elements.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE
PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. Underreaming and stabilisation tool to be used in a borehole,
5 comprising

a tubular body to be mounted between a first section of a string and a
second section thereof, this tubular body having an axial cavity that is open
towards the outside through at least one radial guide channel,

10

a blade element arranged so as to be radially movable in each
aforementioned radial guide channel,

wedge means that, through an axial movement inside the tubular body,
15 cause a radial movement of each blade element in its guide channel,

a drive tube that is mounted inside the said axial cavity so as to be able to
make axial movements therein and that has a longitudinal axis,

20 as wedge means, at least one wedge element per blade element that is
supported at the periphery of the drive tube, the said at least one wedge
element and the drive tube being capable of effecting between them a
relative axial sliding movement along the longitudinal axis, and

25 stop means that are capable of detachably locking the said at least one
wedge element on the drive tube in a locking position in which the drive
tube can make its aforementioned axial movements, and the said at least
one wedge element is driven by the drive tube in these axial movements.

30 2. Tool according to claim 1, wherein the drive tube has at its periphery
longitudinal grooves in each of which at least one wedge element can

make the said relative axial sliding movement, while being held radially inside this longitudinal groove.

3. Tool according to claim 2, wherein the said stop means comprise a stop
5 closing each longitudinal groove at a first axial end, and

a removable locking element that closes each longitudinal groove at a second axial end, opposite to the first, when the said at least one wedge element and the drive tube are in the said locking position, and which is
10 driven by the drive tube during its axial movements.

4. Tool according to claim 3, wherein the said locking element is the drive tube having threads capable of cooperating for their mutual fixing in a position of closure of the said second end of the longitudinal grooves.
15

5. Tool according to any one of claims 1 to 4, wherein each blade element has at least one internal surface inclined with respect to the longitudinal axis of the drive tube, each wedge element has an external surface that is inclined in the same way with respect to the said longitudinal axis and on
20 which one of the said at least one inclined surface of a blade element is in abutment, each blade element is locked against any axial movement by front and rear walls of its guide channel and, when the said at least one wedge element is driven axially by the drive tube, the corresponding blade element makes a rising or descending movement in its radial guide
25 channel, sliding over the inclined surface of the said at least one wedge element, the blade element projecting out of the tubular body in the high position.

6. Tool according to claim 5, wherein the said at least one inclined internal
30 surface of each blade element and the said inclined external surface of each wedge element on which the main element is in abutment are

provided with means of mutual holding in the radial direction that are arranged so that the blade element in the high position in its guide channel makes a radial descent towards a low position by retraction on the part of the means of holding the said at least one wedge element during the axial
5 movement thereof.

7. Tool according to any one of claims 1 to 6, wherein the drive tube comprises a piston that separates, in the tubular body, a first portion in which a hydraulic fluid is situated at an internal pressure and a second
10 portion that is in communication with the outside through the said at least one radial guide channel where the said at least one wedge element and their corresponding blade element are housed.

8. Tool according to claim 7, which also comprises, at each blade element,
15 at least one pin that temporarily connects the latter to at least one wedge element by preventing any movement of one with respect to the other, when the internal hydraulic pressure is below a given threshold, and that is sheared when this hydraulic pressure is above this threshold.

20 9. Tool according to any one of claims 1 to 8, wherein each blade element is supported by at least two wedge elements.

10. Tool according to claim 9, wherein the wedge elements supporting one and the same blade element are connected to each other rigidly.

25

11. Tool according to any one of claims 1 to 10, wherein each blade element comprises an external surface provided with cutting tips that has a front part inclined towards the front with respect to the said longitudinal axis and intended to produce a widening of the drilling hole, a central part
30 substantially parallel to the longitudinal axis and intended to stabilise the tool with respect to the widened hole, and a rear part inclined towards the

rear with respect to the longitudinal axis and intended to produce a widening of the drilling hole when the string rises again.

12. Tool according to any one of claims 7 to 11, which comprises a
5 communication between the drive tube through which a hydraulic fluid passes under pressure and the said first portion and at least one throttled passage through the said piston allowing an injection into the said second portion of jets of hydraulic fluid preventing entry, into the said second portion, of a drilling fluid situated outside the tubular body.

10

13. Tool according to claim 12, wherein the said communication between the drive tube and the said first portion comprises means of filtering the fluid.

15 14. Tool according to any one of claims 1 to 13, which comprises

an activation device that holds the drive tube axially inside the tubular body in an initial position, in which the said at least one wedge element and each blade element are situated in a low position of the blade element in
20 its guide channel, and that is capable of releasing the drive tube at an appropriate moment, thus enabling it to make the said axial movements according to a hydraulic fluid pressure, and

at least one return spring that opposes these axial movements and returns
25 the drive tube to its initial position when the hydraulic pressure decreases.

15. Tool according to claim 14, wherein the activation device comprises at least one shear pin which, when the hydraulic pressure is less than a given threshold, holds the drive tube axially inside the tubular body in the said
30 initial position, and which, when the hydraulic pressure is above this threshold, is sheared, thus allowing an axial movement of the drive tube in

the tubular body, and simultaneously a radial rising of each blade element in this guide channel.

16. Tool according to claim 14 wherein the activation device also
5 comprises a bolt which, in a closure position, holds the drive tube axially inside the tubular body in the said initial position, and an electronic control device, connected to the bolt and capable of controlling a movement of the bolt in an opening position in which it releases the drive tube.

10 17. Tool according to any one of claims 14 to 16, which also comprises, inside the tubular body, a capture device that can be activated in a capture position in which the drive tube is captured by this device when, under the action of the return spring it regains its initial position.

15 18. Method for using a tool according to any one of claims 1 to 17, which comprises an introduction of each blade element provided with at least one wedge element so as to be engaged in a corresponding radial guide channel in the axial cavity of the tubular body,

20 introduction of the drive tube into the axial cavity of the tubular body with a relative sliding between this drive tube and the said at least one radially engaged wedge element, and

detachable locking of each wedge element on the drive tube in a locking
25 position in which the drive tube can make axial movements and the said at least one wedge element is driven by the drive tube in these axial movements.

19. Method according to claim 18, which also comprises, before the step
30 of introducing each blade element, an arrangement on at least one inclined internal surface of each blade element of at least one wedge element

having an external surface inclined in the same way, so that these elements remain secured to each other during this step of introducing each blade element, and in that, after the aforementioned locking step, blade elements and wedge elements are disconnected so that each blade
5 element can slide over the inclined surface of the said at least one corresponding wedge element.

20. Method according to claim 18 or 19, which also comprises, after descent of the tool according to the invention in a borehole,

10

an increase in pressure of a hydraulic fluid inside a portion of the tubular body that has the effect of an axial sliding of the drive tube with respect to an initial position where each blade element is in a low position in its guide channel, with driving of the said at least one wedge element in this sliding
15 movement, and

a sliding of each blade element on its at least one driven wedge element, with a radial rising in its radial guide channel so as to project out of the tubular body.

20

21. Method according to claim 20, which comprises, from a first portion of the tubular body in which the hydraulic fluid is situated at an internal pressure, a partial injection of this fluid in a second portion, which is in communication with the outside through the said at least one radial guide
25 channel, where the said at least one wedge element and their corresponding blade element are housed, to prevent penetration into the said second portion of a drilling fluid situated outside the tubular body.

22. Method according to claim 20 or 21 which comprises, when the
30 pressure of the hydraulic fluid increases,

first of all a temporary maintenance of the drive tube in its initial position by at least one shear pin, and

when the internal pressure has exceeded a given threshold, a shearing of
5 the said at least one shear pin.

23. Method according to any one of claims 20 to 22, which also comprises

a subsequent reduction in the pressure of the hydraulic fluid,

10

a return of the drive tube to its initial position, with radial descent of each blade element in its radial guide channel, and

capture of the drive tube in its initial position.

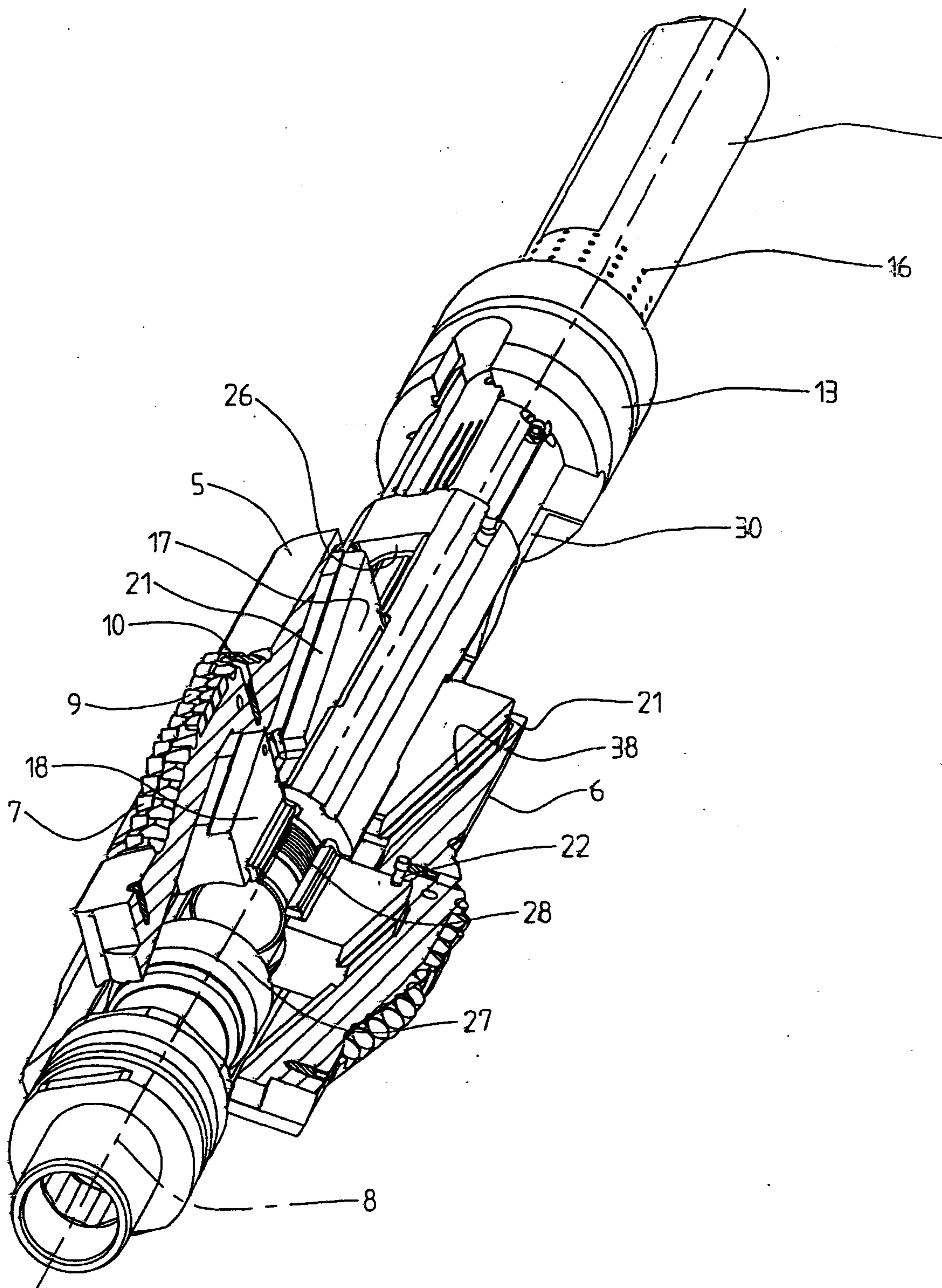


FIG 1

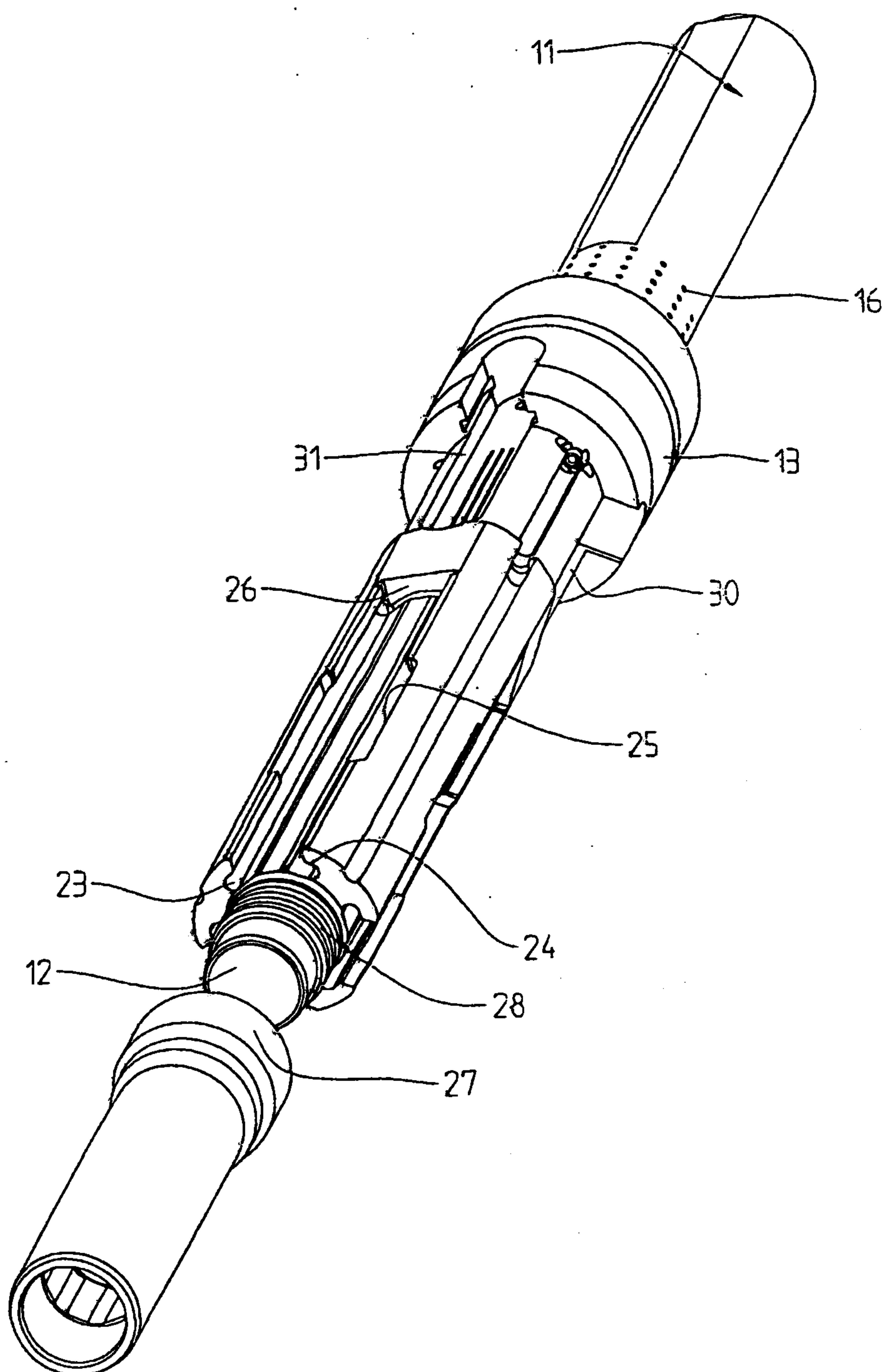


FIG 2

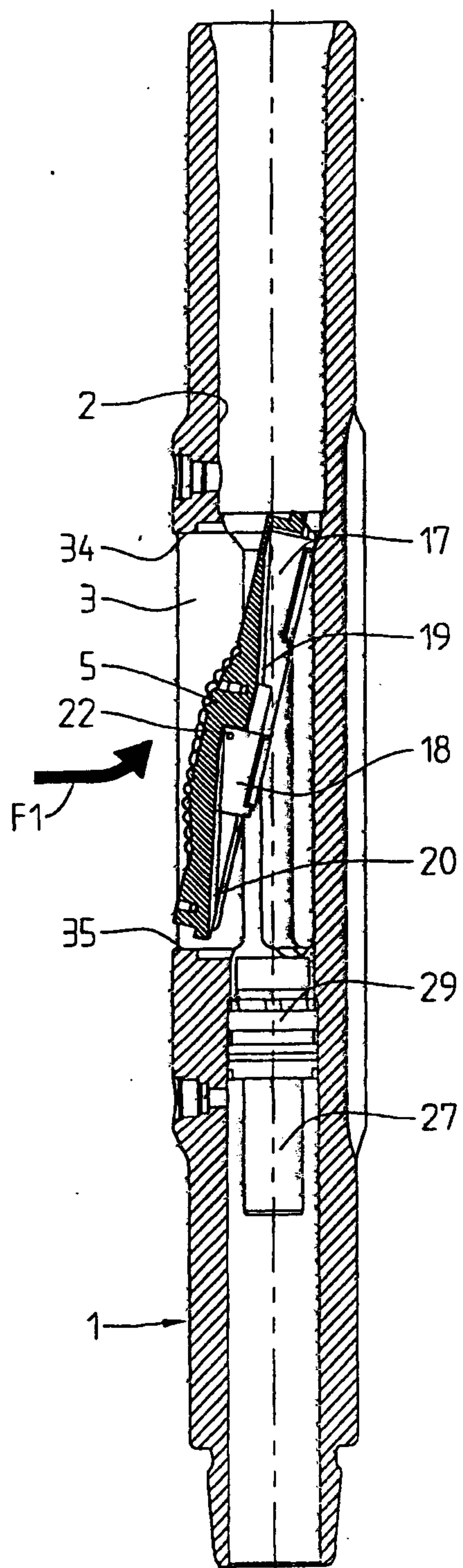


FIG 3

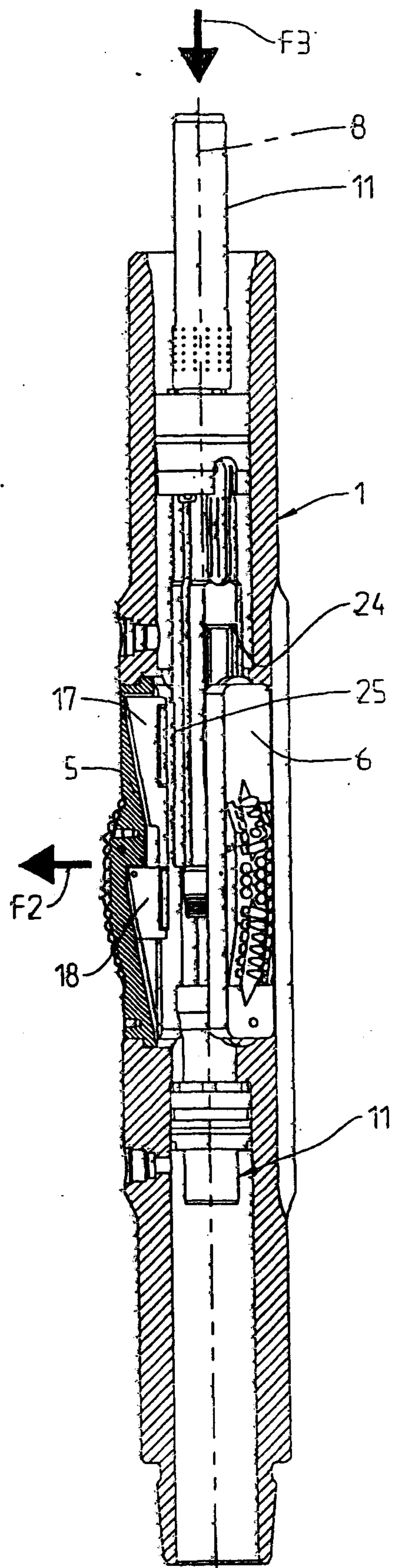


FIG 4

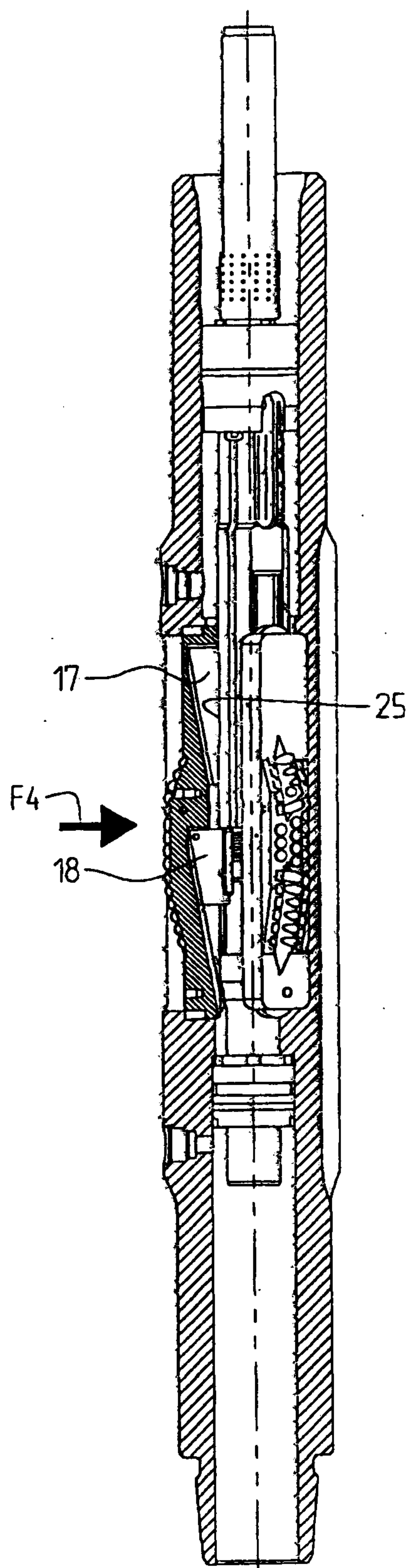


FIG 5

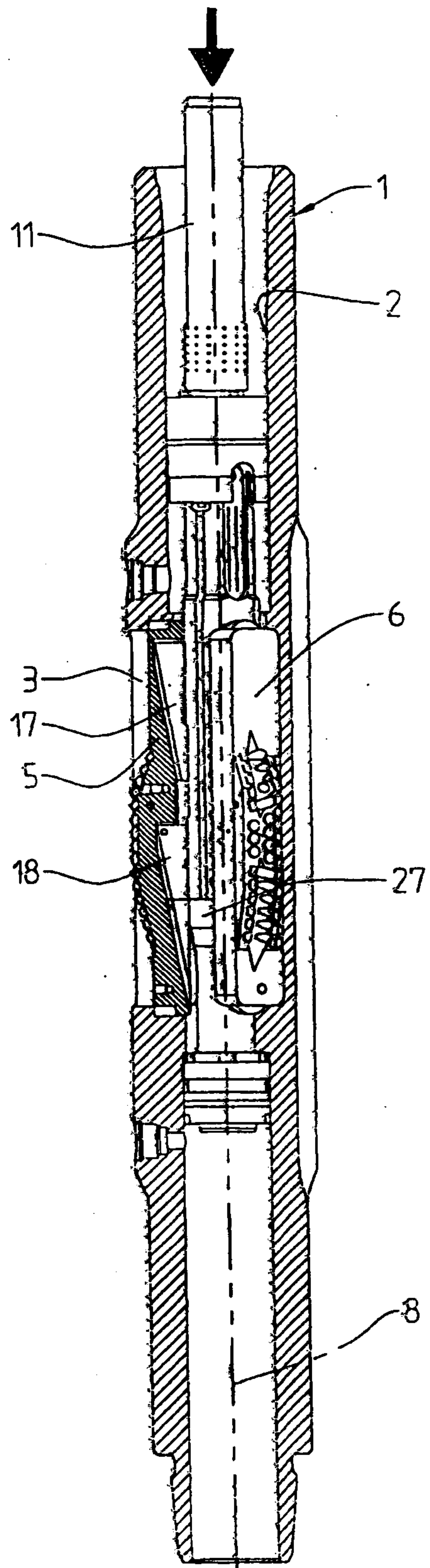


FIG 6

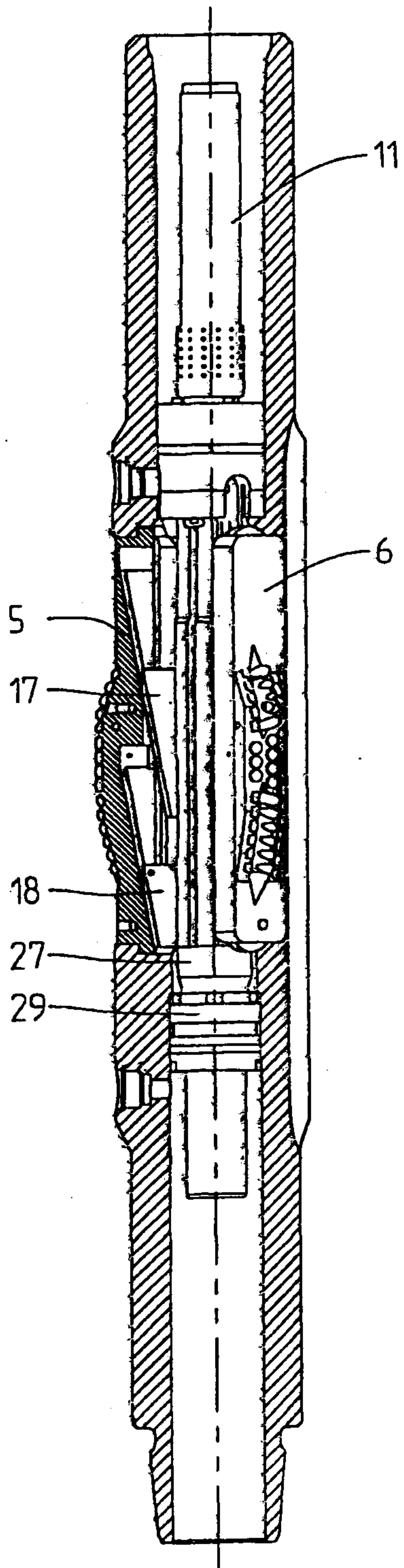


FIG 7

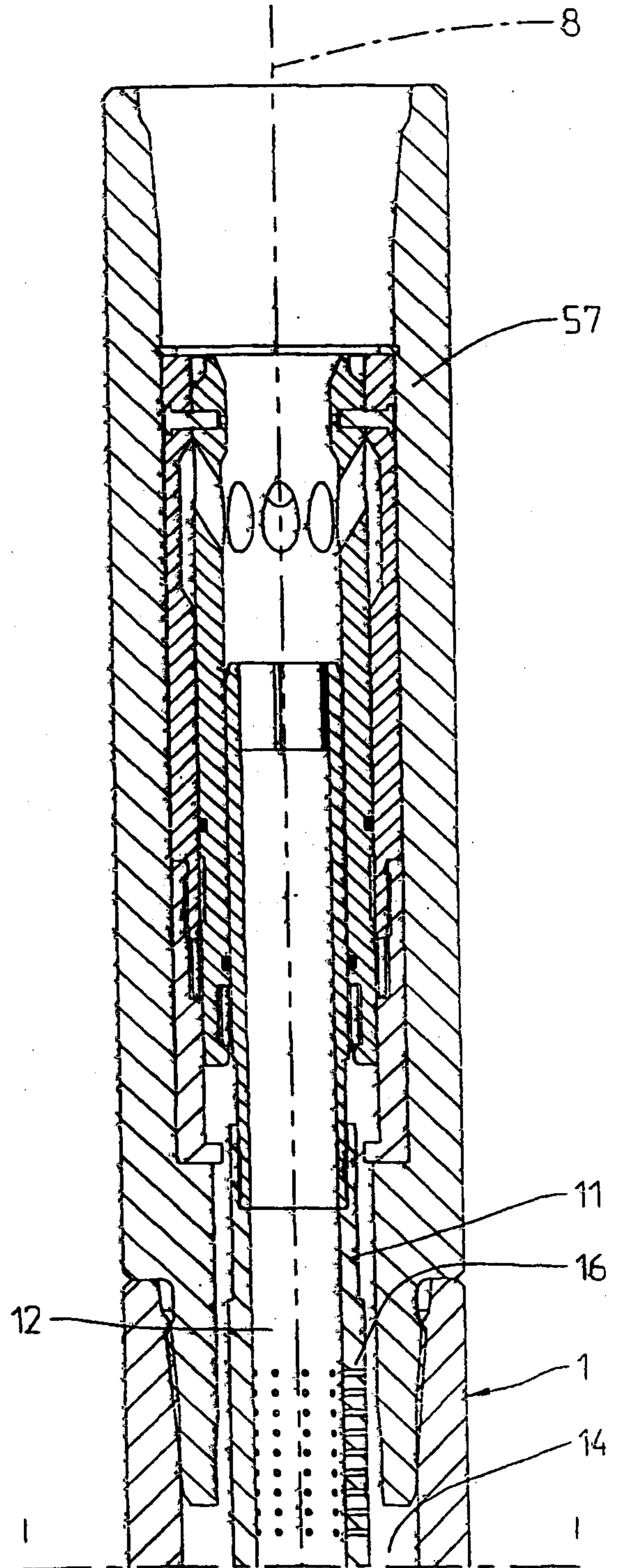


FIG 8

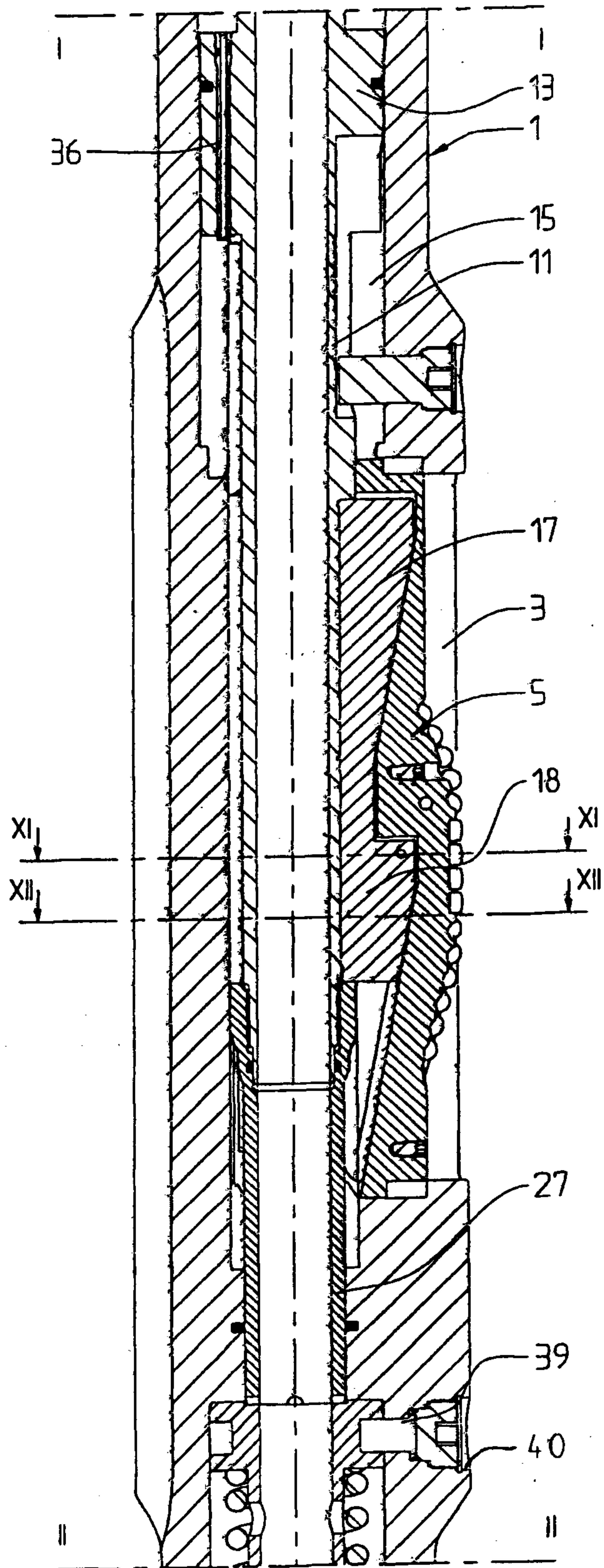


FIG 9

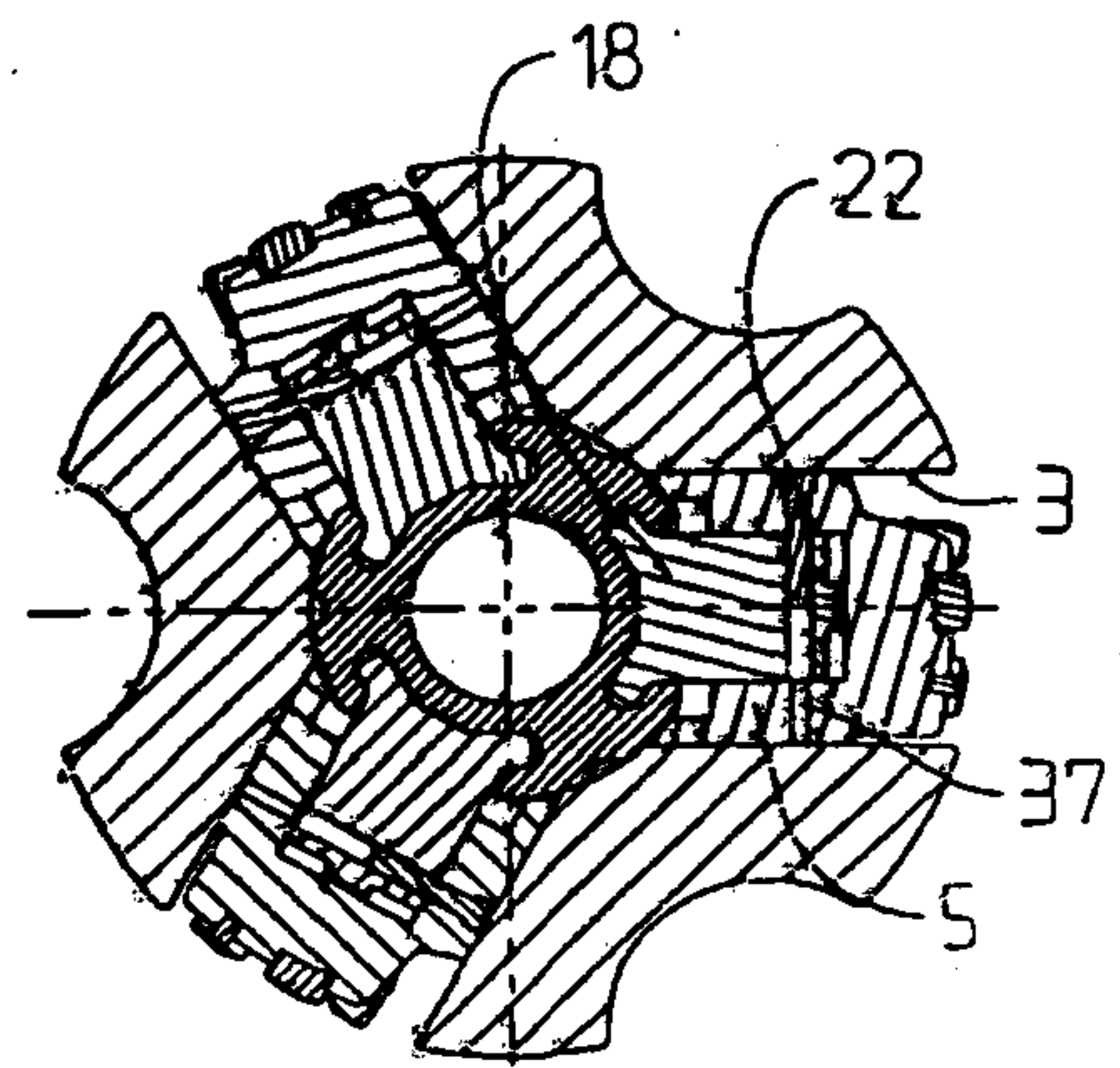


FIG 11

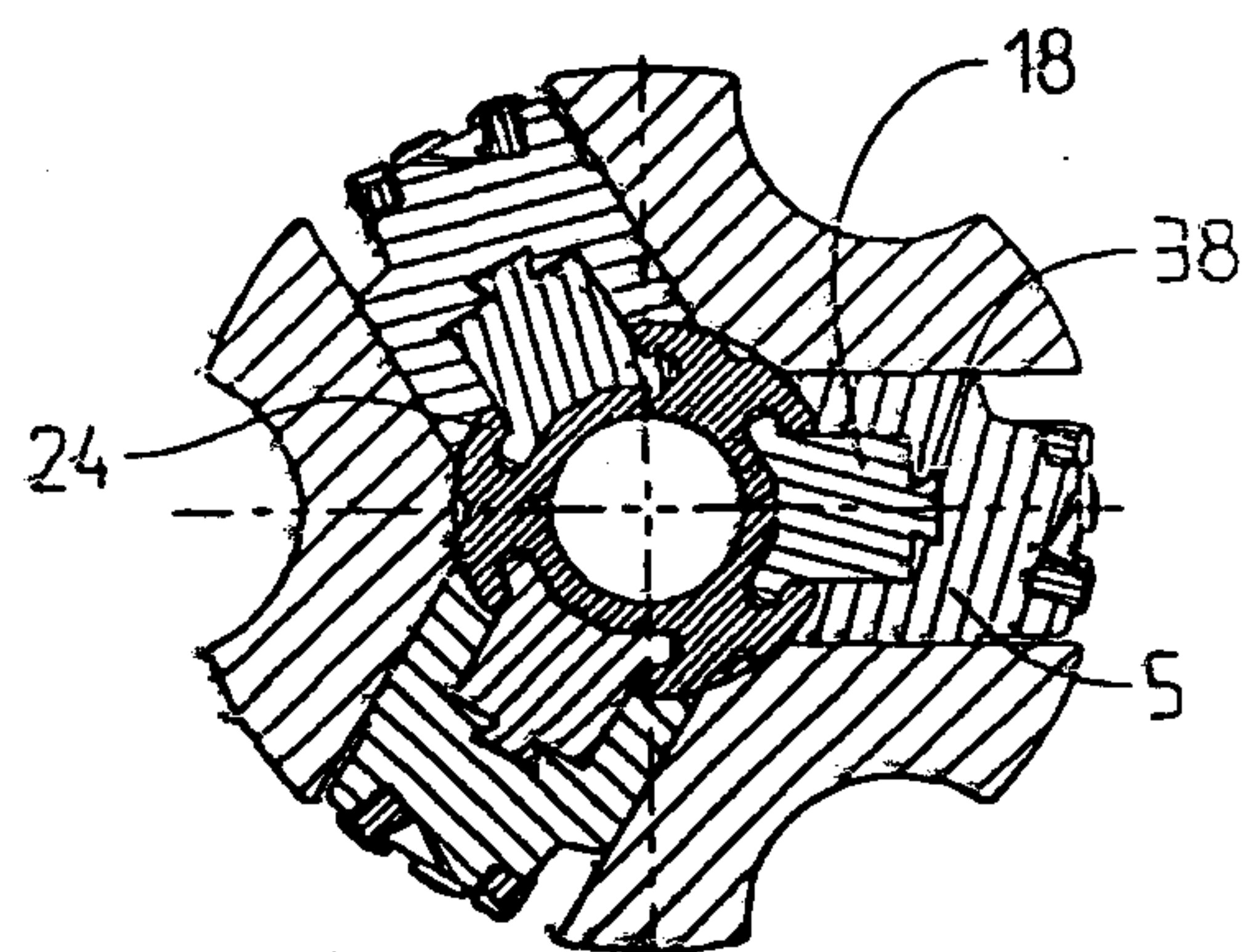


FIG 12

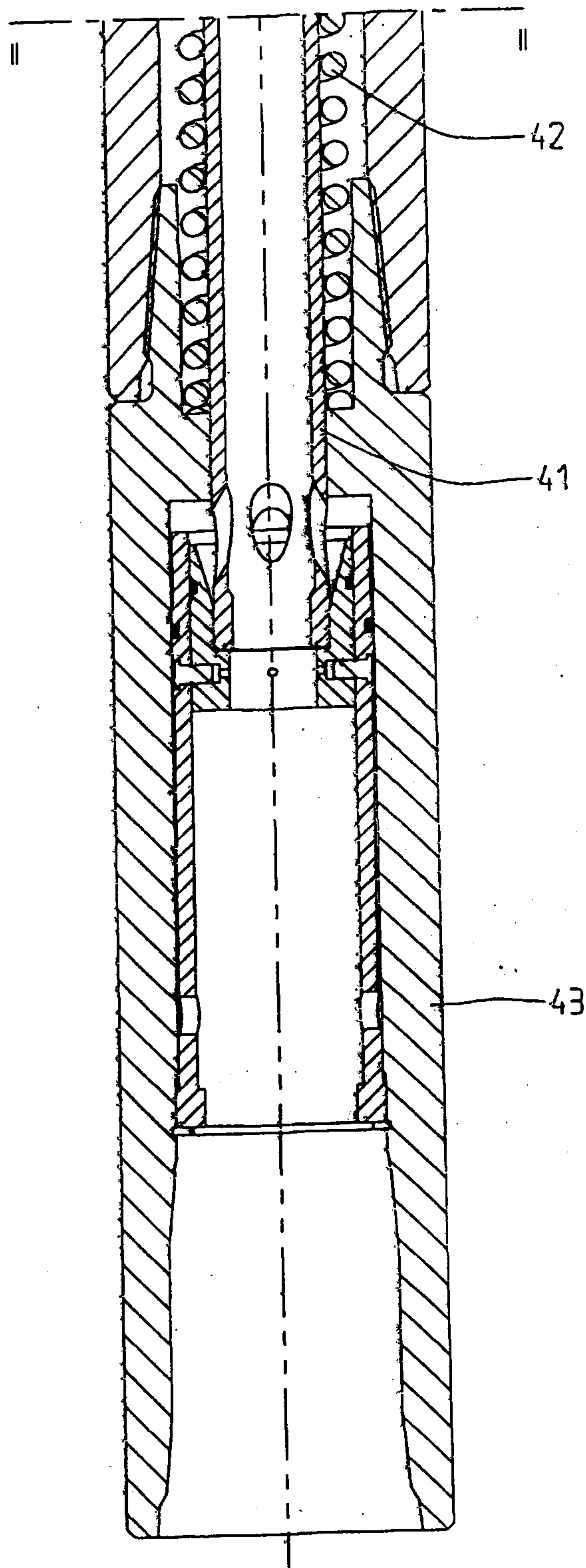


FIG 10

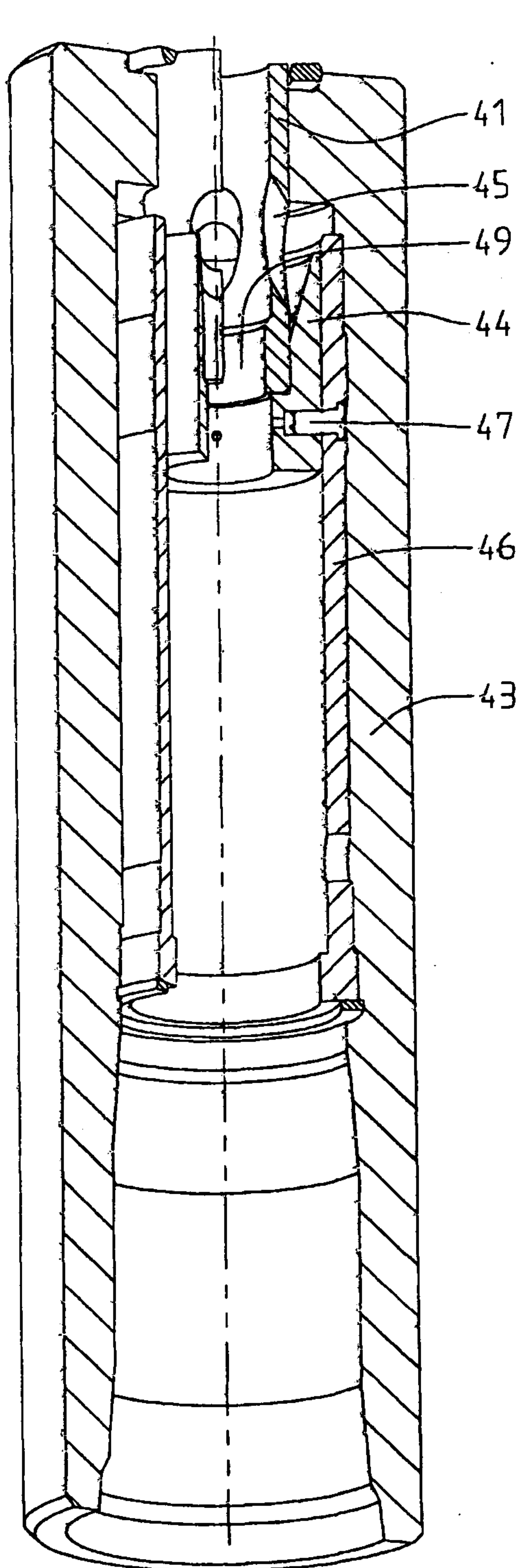


FIG 13

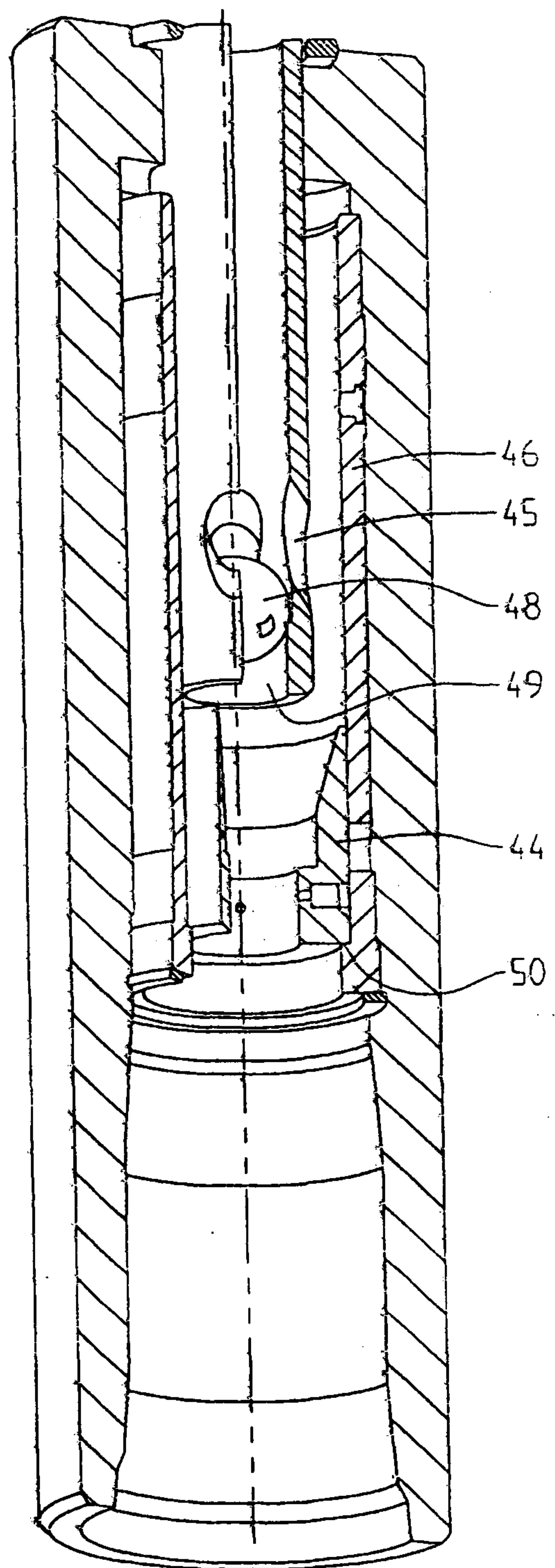


FIG 14

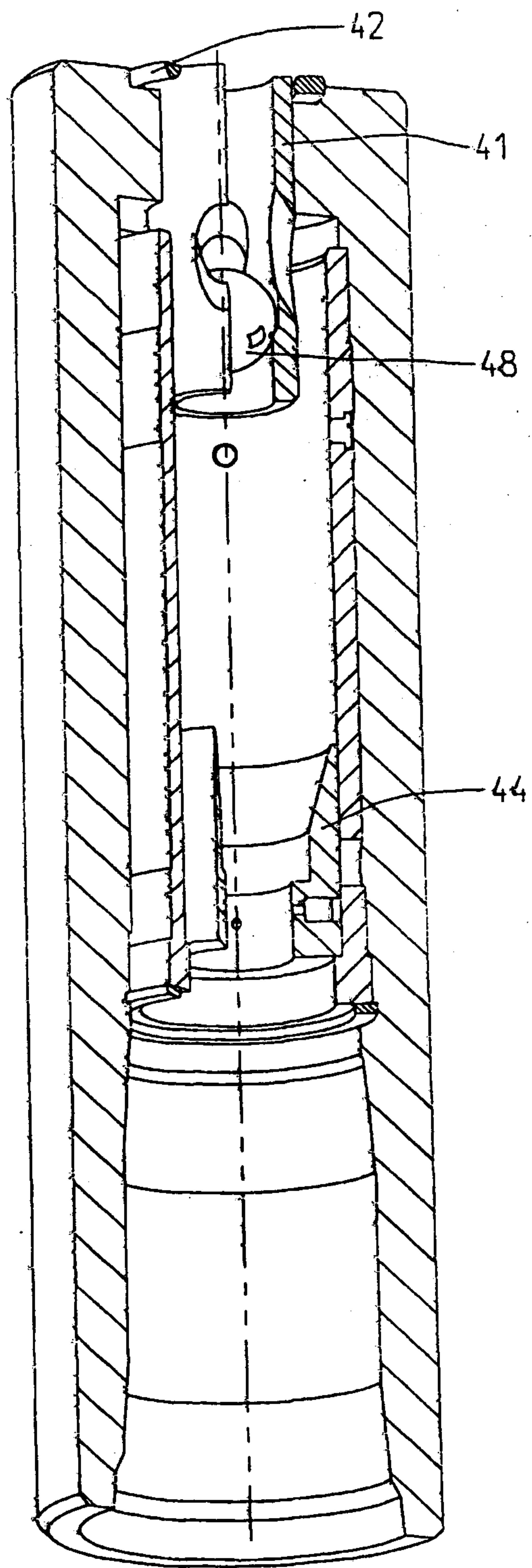


FIG 15

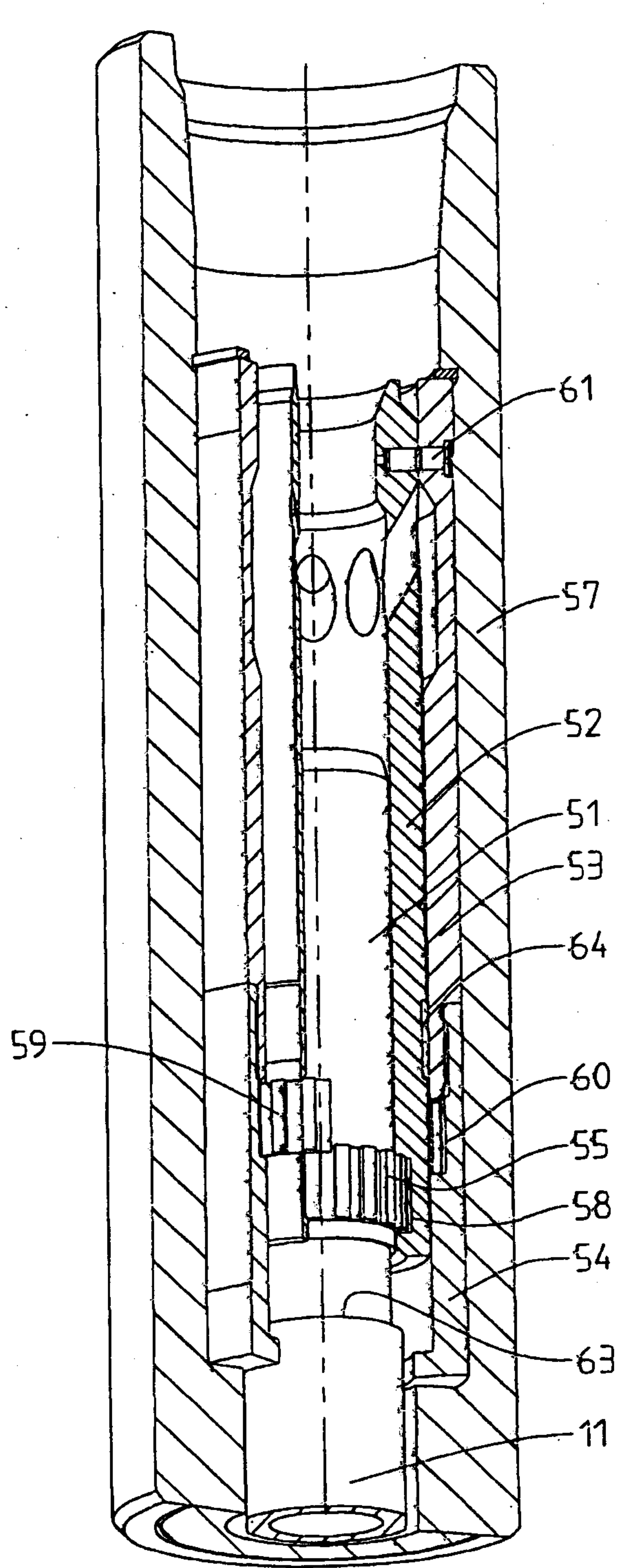


FIG 16

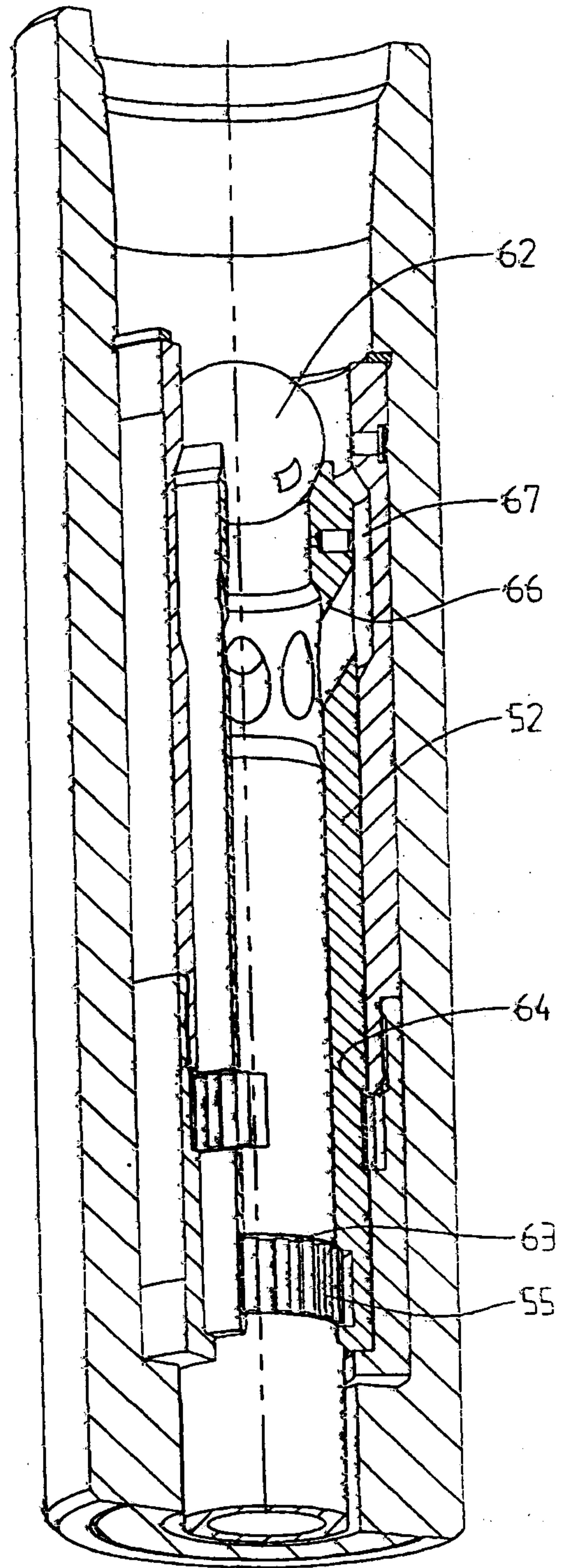


FIG 17

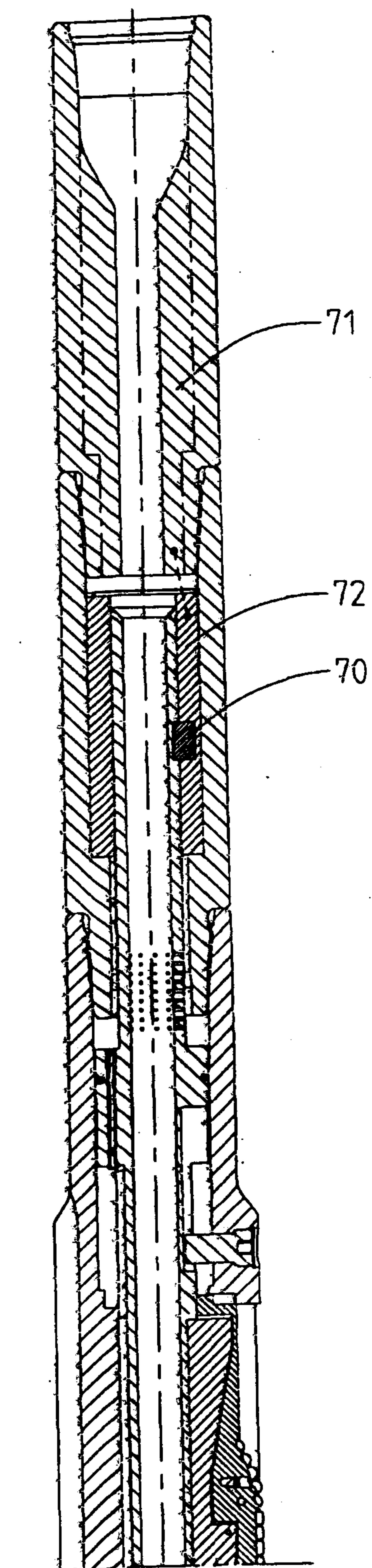


FIG 18

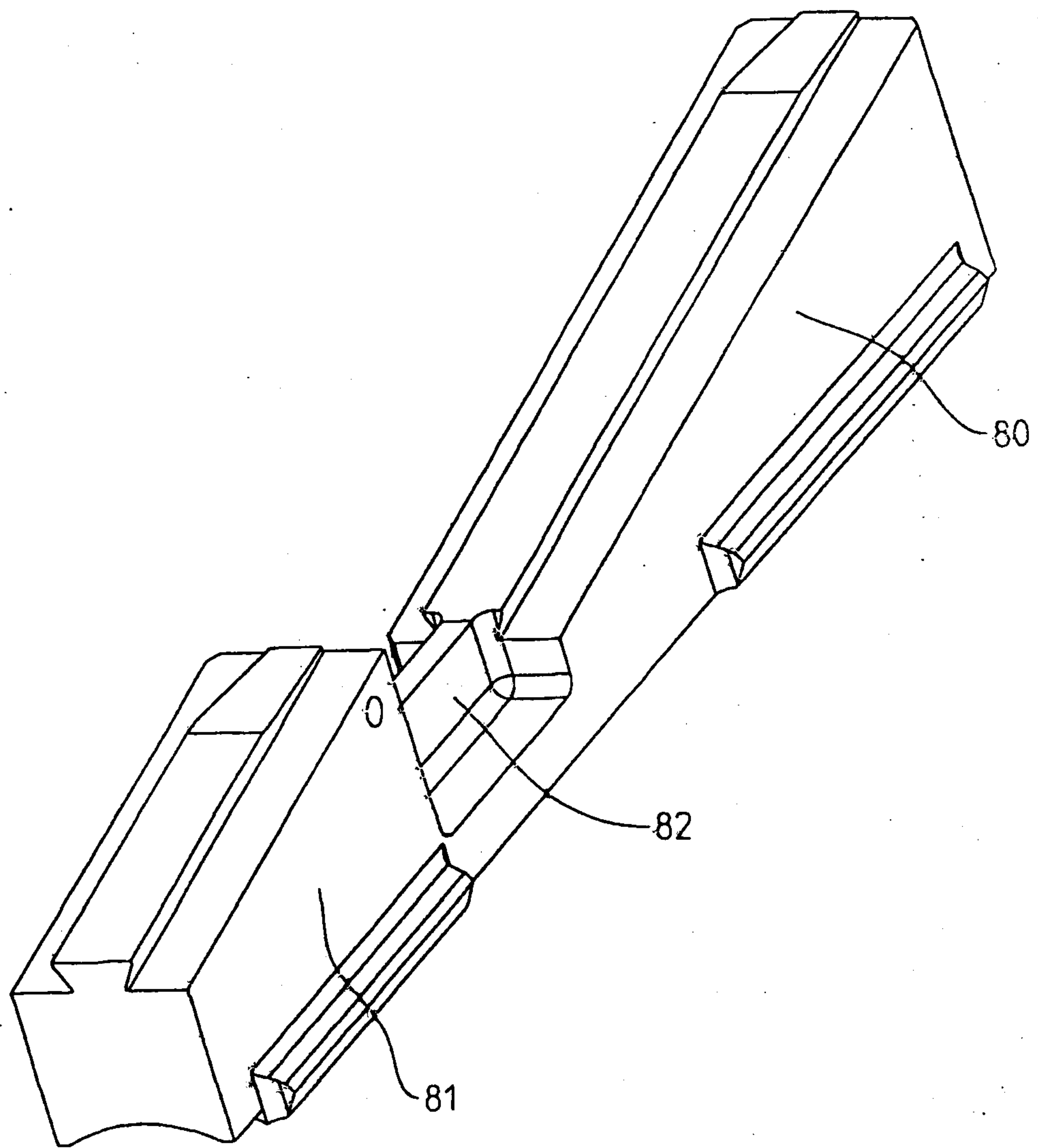


FIG 19

