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- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
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[Continued on next page]

(54) Title: A PNEUMATIC DRILL HAMMER

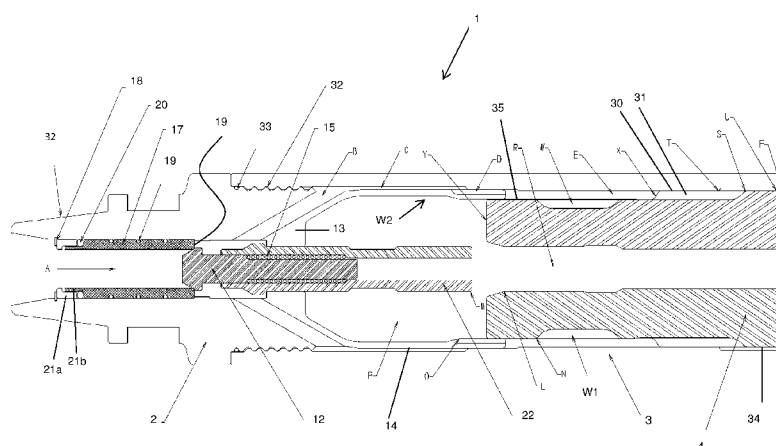


FIGURE 1

(57) Abstract: The invention relates to a pneumatic down-the-hole drill hammer (1) comprising a back-head (2) supporting a check valve (12) and having an integral chamber divider (13) and skirt (14) with a control rod (22) fixedly supported centrally inside the skirt (14). The check valve (12) is removably securable inside the back-head (2) with a sleeve providing a seat for the valve (12) and a dampener located behind the valve seat (16). The skirt (14) extends into a wear sleeve (3) to define a supply passage that feeds a distribution chamber (E) between a piston (4) and the wear sleeve (3). A drive chamber (P) for a working area on a back end of the piston (4) formed within the skirt (14). The piston (4) has a piston stem (23) at a front end which cooperates with a piston stern bush (5) to vent a return chamber (G) when the drill hammer (1) is lifted for flushing. A piston stern bush (5) is secured by a chuck (6) against a split locating ring (24), which fits into a radial groove (25) with a tapered wall provided in the wear sleeve (3).

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A PNEUMATIC DRILL HAMMER

FIELD OF THE INVENTION

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The invention relates to a drill hammer of the “down-the-hole” type, which is operated with pressurised air as its working fluid. More specifically, the invention relates to a drill hammer with a construction that does not include a foot valve tube protruding from a striking face of a drill bit.

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BACKGROUND TO THE INVENTION

Drill hammers of this general kind are well known. The components however vary from embodiment to embodiment.

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These components are designed to achieve the working mechanism of the drill hammer, which inter alia requires switching of supply air between a drive chamber and a return chamber to reciprocate a piston to impact a drill bit. The components are often unnecessarily complicated with the constructions that result from various designs often waste steel and suffer from losses in efficiency (or blow energy generated by a reciprocating piston). Drill hammers are made with mechanisms (involving working areas and fluid flow paths) that fail to optimize the space available within the diameter of a hole to be drilled (as determined by the bit diameter). This often also translates to unnecessary weight and/or length of drill hammers with less than optimal efficiency.

25

Some of these designs also forego important aspects of “in the field” servicing which often requires simple (instead of complicated) disassembly and assembly. Unnecessary downtime and loss of production are suffered as a result and (to begin with) the drill hammers are more difficult and expensive to manufacture.

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Presently it is also important to have less of a carbon footprint and a drill hammer construction that uses less steel, fewer components and involves simpler machining methods would present an advantage to the environment and the drilling industry.

OBJECT OF THE INVENTION

It is an object of the invention to provide a pneumatic down-the-hole drill hammer which at least partially achieves the advantage stated above in a manner that is accompanied by acceptable
5 (if not desirable) drilling efficiency and relatively simple assembly and disassembly.

SUMMARY OF THE INVENTION

10 In accordance with the invention there is provided a pneumatic down-the-hole drill hammer comprising a back-head supporting a check valve and having an integral chamber divider and skirt; with the skirt extending into a wear sleeve to define a supply passage between the skirt and the wear sleeve which feeds a distribution chamber between a piston and the wear sleeve; and a drive chamber for a working area on a back end of the piston formed within the skirt; the
15 back head including a control rod fixedly supported therefrom which cooperates with a first axial bore of the piston to exhaust the drive chamber through an aligned second axial bore of a drill bit; the piston having a piston stem at a front end which cooperates with a piston stem bush to vent a return chamber provided around the piston stem, between the piston, wear sleeve and piston stem bush, through a cut-out passage on the piston stem which overlaps a reduced diameter formation in a third bore of the piston stem bush when the drill hammer is
20 lifted from a hole bottom for flushing; and wherein the piston stem bush is secured by a chuck against a locating ring, which fits into a radial groove in the wear sleeve.

Further features of the invention provide for a drill hammer as defined in which: the check valve is removably securable inside the back-head; the check valve is insertable through an inlet in a
25 rear end of the back-head; a check valve seat is provided as a sleeve which is a close fit to a wall of the back-head inlet and removably secured inside the inlet of the back-head over the check valve; a resiliently deformable spacer is provided as a dampener located between the sleeve of the check valve seat and a removable stop that secures the seat within the back-head; and the removable stop is a circlip and the resiliently deformable spacer is an O-ring with
30 a locating cylindrical insert that overlaps with a lip on the sleeve of the check valve seat provided between the circlip and the O-ring.

Further features of the invention provide for a drill hammer as defined in which: the radial groove for the locating ring has an inclined surface adjacent an outer, leading edge; and the

locating ring is provided as a split ring of spring steel with ends of the split ring spaced.

Further features of the invention provide for a drill hammer as defined in which: the control rod is a separate component that is press-fitted into the back-head; the piston stem bush includes
5 at least one exterior groove for a friction rubber to frictionally engage the piston stem bush in the wear sleeve; the piston stem bush includes a pair of spaced apart exterior grooves, each with a friction rubber provided as an O-ring that protrudes from the piston stem bush sufficiently to provide an interference fit inside the wear sleeve; and the chuck is tightened against a split, bit retaining ring which biases the piston stem bush against the locating ring.

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Further features of the invention provide for a drill hammer as defined in which: the distribution chamber is continuously supplied with pressurized air through an inlet of the back-head via ports through the chamber divider of the back-head into a distribution chamber cut-out formed in the wear sleeve and via skirt end recess formed into and around the skirt of the back-head at
15 a free end thereof; and the distribution chamber includes a control area provided on the piston by a first switching shoulder at an upper end of a return chamber land formed inside longitudinal, flow passage grooves and by upper ends of ribs located between the longitudinal, flow passage grooves;.

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Further features of the invention provide for a drill hammer as defined in which: compressed air flows from the distribution chamber along the longitudinal, flow passage grooves which communicate with a first bypass cut-out in a wall of the wear sleeve and over the return chamber land to the return chamber and acts on a surface of a working area on an annular return chamber shoulder located around the piston stem at a lower edge of the return chamber
25 land to generate a return stroke; a second switching shoulder at an upper edge of an annular bypass recess on the piston passes a drive chamber shoulder at a lower edge of a second bypass cut-out inside the back-head skirt allowing compressed air from the distribution chamber to enter the drive chamber via the annular bypass recess and over a drive chamber land on the piston which is located inside the second bypass cut-out to generate a drive stroke.

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Further features of the invention provide for a drill hammer as defined in which: the return chamber exhausts via a drill bit bore when the piston stem is withdrawn from a piston stem bush; and the drive chamber exhausts via a drill bit bore when the control rod is withdrawn from a piston bore.

BRIEF DESCRIPTION OF THE DRAWINGS

5 These and other features of the invention will become more apparent from the following description of one embodiment, made by way of example, with reference to the accompanying drawings, in which:

- Figures 1 & 2 show a cross-sectional side view of a pneumatic drill hammer (divided across two sheets);
- 10 Figure 3 shows a cross-sectional side view of an alternative back-head; and
- Figure 4 shows a plan view of a piston stem bush locating ring.

DETAILED DESCRIPTION OF THE INVENTION

15 Referring to the Figures 1 and 2, a down-the-hole drill hammer 1 in accordance with the invention includes, as its main components, a back-head 2, wear sleeve 3, piston 4, piston stem bush 5 and chuck 6.

20 [The illustrated back-head 2 construction is distinguishable from alternatives that commonly have separate components providing a chamber divider (which usually supports a check valve that seats against a separate back-head component) and inner sleeve. The back-head, in that case, secures the separately fitted components within the assembly.]

25 The chuck 6 in this embodiment is tightened into a bottom end of the wear sleeve 3 through corresponding screw-threaded engagement to secure two halves of a split retaining ring 7 (or bit retaining rings) against the piston stem bush 5, which in turn engage within a recess 8 on a drill bit stem 9. Longitudinal or axial movement of the drill bit 10 is limited to the travel afforded by the bit stem recess 8 relative to the fixed bit retaining rings 7 and splines at 11 between the drill bit 10 (below the recess 8) and the inside of the chuck 6 prevent rotation of the drill bit 10

30 relative to the wear sleeve 3.

The back-head 2 of Figure 1 incorporates a check valve 12, chamber divider 13 and inner sleeve 14 (provided as an integral skirt) thereby using less steel and less manufacturing [and eliminates the necessity of locating a separate inner sleeve within the bore of the wear sleeve

and clamping a check valve assembly and chamber divider in between the back-head and inner sleeve]. The skirt 14 extends into the wear sleeve 3 to define a supply passage which feeds a fluid distribution chamber E.

- 5 The back-head 2 of the disclosed embodiment also allows the check valve 12 to be fitted from the rear end of the back-head 2 for easy installation and removal in case of cleaning, repair or replacement. The check valve 12 is biased by a spring 15 against a check valve seat 16, which is provided on an inner end of a sleeve 17 lining an axial back-head inlet A and secured in place by a removable retainer 18 (which may conveniently be provided as a circlip 18 that
10 locates in a groove). The sleeve 17 of the check valve seat 16 has three spaced apart grooves which each receive a seal 19 that locates against the wall of back-head inlet A.

In this particular embodiment, a resiliently deformable spacer 20 is provided between the check valve seat 16 and circlip 18. The spacer 20 is provided as a rubber O-ring 20 located in an
15 annular cavity between a shoulder on the outside of the sleeve 17 and a cylindrical Nylon insert 21a. The insert 21a is stepped providing an annular recess that receives a longitudinal lip 21b adjacent the shoulder of the sleeve 17 to provide overlapping components in a sliding relationship which accommodates compression of the spacer 20.

- 20 The deformable spacer 20 provides a dampener to absorb the thrust/shock of the check valve 12, when it shuts against the check valve seat 16, due to hydrostatic pressure when the supply air is shut off. Without the spacer 20, the check valve seat retainer (or circlip) 18 is eventually dislodged or broken, through transfer of the impact from the accelerating check valve 12 against the check valve seat 16. As an alternative to the compression ring (or spacer/O-ring)
25 20, a suitable spring may be used.

A control rod 22 has a free end that acts as a "finger valve", which enters and exits the bore R of the piston 4 as it cycles up and down (as described below). The control rod 22 is securely press-fitted into a central opening through the chamber divider 13 of the back-head 2 and is
30 never removed.

[Control rods provided as separate components to be inserted into the back-head are often designed to be held in place by continuous pressure caused by the compressed air pushing from the top end (with the other end is exposed to a lower exhaust pressure). However, such a

control rod that is held down by air pressure only tends with the ingress of dirt into the drill hammer (which becomes lodged between the piston bore and the free end of the control rod) to be engaged by the lifting piston and displaced from its position as required for the drill cycle. Such a change in position affects the timing of the exhaust from the drive chamber causing the hammer drill to "misfire". With the press-fitted arrangement of the disclosed embodiment, the control rod 22 cannot move out of position and the problem is avoided.]

It is easier to make the control rod 22 as a separate part and press-fit it into position, rather than to trepan it into the back-head component. The latter form of construction is an alternative of the invention and illustrated in the back-head 102 of Figure 3. The components and assembly of the check valve remain the same.

The mechanism of the drill hammer 1 employs an airflow path (also described in more detail below) that allows use of a piston 4 with a piston stem 23. The piston stem bush 5 for the piston 4 is secured in place against a locating ring 24, with these components fitted from a front end of the wear sleeve 3 and in a manner that enables easy disassembly when required.

The locating ring 24 is secured in a tapered groove 25, which has an inner shoulder 26 (perpendicular to an axis of the wear sleeve 3) and a sloping surface at an outer edge which tapers radially inwardly towards a chuck end of the drill hammer 1. The locating ring 24 locates on a flat portion of the tapered groove 25 against the shoulder 26 on the back-head side of the drill hammer 1 but can be twisted flat and pulled out by hand against sloping outer surface of the tapered groove 25 after the piston stem bush 5 has been removed. Figure 4 shows a separate view of the locating ring 24, which illustrates the space providing a gap between two ends of a split ring construction that is made from spring steel. This provides for the required resilient deformation that enables relatively easy removal (over the tapered surface) and adequately fast engagement against the shoulder 26 for location of the piston stem bush 5.

The piston stem bush 5 has friction O-rings 27 fitted into grooves around the outer diameter of the piston stem bush 5 in such a way that the O-rings 27 protrude slightly more than what is required for a normal sealing fit to provide an interference fit that is sufficient to cause the piston stem bush 5 to enter the bore of the wear sleeve 3 quite tightly. The friction fit of the O-rings 27 against the bore of the wear sleeve 3 will retain the piston stem bush 5 within the wear sleeve 3 (preventing it from falling out) but still afford relatively easy removal by gentle tapping

with a suitable tool.

[It is common practice for a piston stem bush 5 to be press-fitted into a reduced area in the bore of the wear sleeve and against an internal step that is machined onto the wear sleeve wall. Assembly or removal of such a piston stem bush 5 needs to be done using a hydraulic press at a machine shop. The internal step referred to also prevents removal of a piston 4 from the front end of the drill hammer. Removal from the back end, where such a hammer includes a separate back-head, chamber divider and inner sleeve (as referred to above) first requires removal of these separately assembled components.]

10

The piston 4 of the drill hammer 1 disclosed is easily removed from both sides of the wear sleeve 3. The presence of screw-thread formations is indicated by 32 and a seal 33 is provided between the back-head 2 and wear sleeve 3.

15 During operation, compressed air enters a bore or inlet A of the back-head 2, opens the check valve 12 and flows through ports B (through the chamber divider 13) into distribution chamber cut-out C (formed in the wear sleeve 3) and skirt end recess D (formed into and around the skirt 14 at a free end thereof) into the fluid distribution chamber E (located to the front of the back-head skirt 14 and between the piston 4 and wear sleeve 3) which is always charged with
20 compressed air.

To generate a return stroke, the compressed air flows from the distribution chamber E along longitudinal flow passage grooves 31 which are in communication with a first bypass cut-out F (in the wall of the wear sleeve 3) and over a return chamber land 34 which is located in the first
25 bypass cut-out F. From first bypass cut-out F the air flows into return chamber G (between the piston stem 23, piston stem bush 5 and wear sleeve 3) and acts on a return surface working area that is provided on an annular shoulder H (located around the piston stem 23) to cause the piston 4 to move towards the back-head side.

30 As the piston 4 moves rearwardly, a switching shoulder S on the piston 4 shuts off passage of compressed air as it passes internal return chamber shoulder T in the wear sleeve 3 (at an upper edge of the first bypass cut-out F) and stops the airflow to the return chamber G.

The trapped compressed air in the return chamber G continues expanding (and acting) against

surface area H of the rearward moving piston 4. When an external exhaust shoulder I on the end of the piston stem 23 passes an internal exhaust shoulder J in the piston stem bush 5 the return chamber G is placed in communication with an axial drill bit bore K and exhausts to atmosphere through openings 28 extending between the drill bit bore K and bit face 29.

5

With the rearward travel of the piston 4, a free end shoulder M on the control rod 22 enters the piston bore R and passes piston bore shoulder L sealing off a drive chamber P (behind the piston 4 and within the skirt 14 of the back-head 2). With further rearward travel, a second switching shoulder N at an upper edge of annular bypass recess W1 on the piston 4 passes drive chamber shoulder O at a lower edge of a second bypass cut-out W2 (inside the back-head skirt 5) allowing compressed air from charged distribution chamber E to enter the drive chamber P via annular bypass recess W1 and over a drive chamber land 35 on the piston 4 which is located inside a second bypass cut-out W2. The air in the drive chamber P acts on a main drive surface working area Y (on the back end of the piston 4).

10

15

A control area X is constantly exposed to working pressure in the fluid distribution chamber E. The control area X is provided by a surface area on the rear end of ribs 30 between the longitudinal flow passage grooves 31 on the piston 4 and a surface area (located between the ribs 30 at the bottom ends of the longitudinal grooves 31) to the inside of first switching shoulder S on the upper edge of the return chamber land 34.

20

Pressure acting on the working area Y inside the drive chamber P combined with continuous pressure in the distribution chamber E acting on control area X causes the piston 4 to decelerate, cease rearward travel, and then accelerate in the opposite direction on an impact or drive stroke towards an anvil (or striking) end of the drill bit 10.

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During the downward stroke, free end shoulder M on the control rod 22 is pulled away from piston bore shoulder L and out of the piston 4 bore R and the drive chamber P exhausts down the axial piston bore R and the bit bore K to atmosphere. (Pressure in the distribution chamber E continues to act on the control area X)

30

As the piston 4 moves towards the drill bit 10, first switching shoulder S passes return chamber shoulder T to once again allow compressed air from the distribution chamber E through first bypass cut-out F into the return chamber G. The piston 4 continues in its power stroke until it

strikes the drill bit 10 and the cycle repeats itself.

When lifting the drill hammer 1 off the bottom of a borehole the drill bit 10 drops forward and is followed by the piston 4. With this change in the drill bit 10 position, a lower stem shoulder Z in
5 a cut-out passage 36 on the piston stem 23 passes a lower bush shoulder Q in a reduced diameter formation 37 in a third bore of the piston stem bush of the piston stem bush 5 to allow the return chamber G to vent to the atmosphere. Also a peripheral edge U around the working area H on the piston 4 passes a stopping shoulder V (at the bottom of first bypass cut-out F) to ensure that no more compressed air enters the return chamber G. In this condition, the piston
10 cycle is deactivated and only flushing takes place (as required during drilling operations).

The applicant has manufactured and tested a prototype in accordance with the disclosed embodiment and drawings. In addition to the simplicity afforded for assembly and disassembly (as has been described and will be apparent from what is set out above) the drill in accordance
15 with the invention has drilled about 27% faster than a competing drill (designed for the same borehole size but) which is longer, heavier and of a more complicated and "difficult to service" design.

The hammer drill of the invention accordingly provides a construction and combination of
20 components that are cost effective, (relatively) lightweight (using less material) and compact, (relatively) easy to manufacture and maintain (including assembly and disassembly) and/or demonstrate competent performance at a level that is commercially desirable.

A person skilled in the art will appreciate that a number of variations may be made to the
25 combination of drill hammer features described without departing from the scope of the present invention.

CLAIMS

1. A pneumatic down-the-hole drill hammer comprising:
 - a back-head supporting a check valve and having an integral chamber divider and skirt;
 - with the skirt extending into a wear sleeve to define a supply passage between the skirt and the wear sleeve which feeds a distribution chamber between a piston and the wear sleeve;
 - a drive chamber for a working area on a back end of the piston formed within the skirt;
 - the back head including a control rod fixedly supported therefrom which cooperates with a first axial bore of the piston to exhaust the drive chamber through an aligned second axial bore of a drill bit;
 - the piston having a piston stem at a front end which cooperates with a piston stem bush to vent a return chamber provided around the piston stem, between the piston, wear sleeve and piston stem bush, through a cut-out passage on the piston stem which overlaps a reduced diameter formation in a third bore of the piston stem bush when the drill hammer is lifted from a hole bottom for flushing; and
 - wherein the piston stem bush is secured by a chuck against a locating ring, which fits into a radial groove in the wear sleeve.
2. A drill hammer as claimed in claim 1 in which the check valve is removably securable inside the back-head.
3. A drill hammer as claimed in claim 2 in which the check valve is insertable through an inlet in a rear end of the back-head.
4. A drill hammer as claimed in claim 3 in which a check valve seat is provided as a sleeve which is a close fit to a wall of the back-head inlet and removably secured inside the inlet of the back-head over the check valve.
5. A drill hammer as claimed in claim 4 in which a resiliently deformable spacer is provided as a dampener located between the sleeve of the check valve seat and a

removable stop that secures the seat within the back-head.

- 5 6. A drill hammer as claimed in claim 5 in which the removable stop is a circlip and the resiliently deformable spacer is an O-ring with a locating cylindrical insert that overlaps with a lip on the sleeve of the check valve seat provided between the circlip and the O-ring.
- 10 7. A drill hammer as claimed in claim 1 in which the radial groove for the locating ring has an inclined surface adjacent an outer, leading edge.
8. A drill hammer as claimed in claim 7 in which the locating ring is provided as a split ring of spring steel with ends of the split ring spaced.
- 15 9. A drill hammer as claimed in claim 1 in which the control rod is a separate component that is press-fitted into the back-head.
10. A drill hammer as claimed in claim 1 in which the piston stem bush includes at least one exterior groove for a friction rubber to frictionally engage the piston stem bush in the wear sleeve.
- 20 11. A drill hammer as claimed in claim 11 in which the piston stem bush includes a pair of spaced apart exterior grooves, each with a friction rubber provided as an O-ring that protrudes from the piston stem bush sufficiently to provide an interference fit inside the wear sleeve.
- 25 12. A drill hammer as claimed in claim 1 in which the chuck is tightened against a split, bit retaining ring which biases the piston stem bush against the locating ring.
- 30 13. A drill hammer as claimed in claim 1 in which the distribution chamber is continuously supplied with pressurized air through an inlet of the back-head via ports through the chamber divider of the back-head into a distribution chamber cut-out formed in the wear sleeve and via skirt end recess formed into and around the skirt of the back-head at a free end thereof.
- 35 14. A drill hammer as claimed in claim 13 in which the distribution chamber includes a control area provided on the piston by a first switching shoulder at an upper end of a

return chamber land formed inside longitudinal, flow passage grooves and by upper ends of ribs located between the longitudinal, flow passage grooves.

- 5 15. A drill hammer as claimed in claim 14 in which compressed air flows from the distribution chamber along the longitudinal, flow passage grooves which communicate with a first bypass cut-out in a wall of the wear sleeve and over the return chamber land to the return chamber and acts on a surface of a working area on an annular return chamber shoulder located around the piston stem at a lower edge of the return chamber land to generate a return stroke.

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16. A drill hammer as claimed in claim 14 in which a second switching shoulder at an upper edge of an annular bypass recess on the piston passes a drive chamber shoulder at a lower edge of a second bypass cut-out inside the back-head skirt allowing compressed air from the distribution chamber to enter the drive chamber via
15 the annular bypass recess and over a drive chamber land on the piston which is located inside the second bypass cut-out to generate a drive stroke.

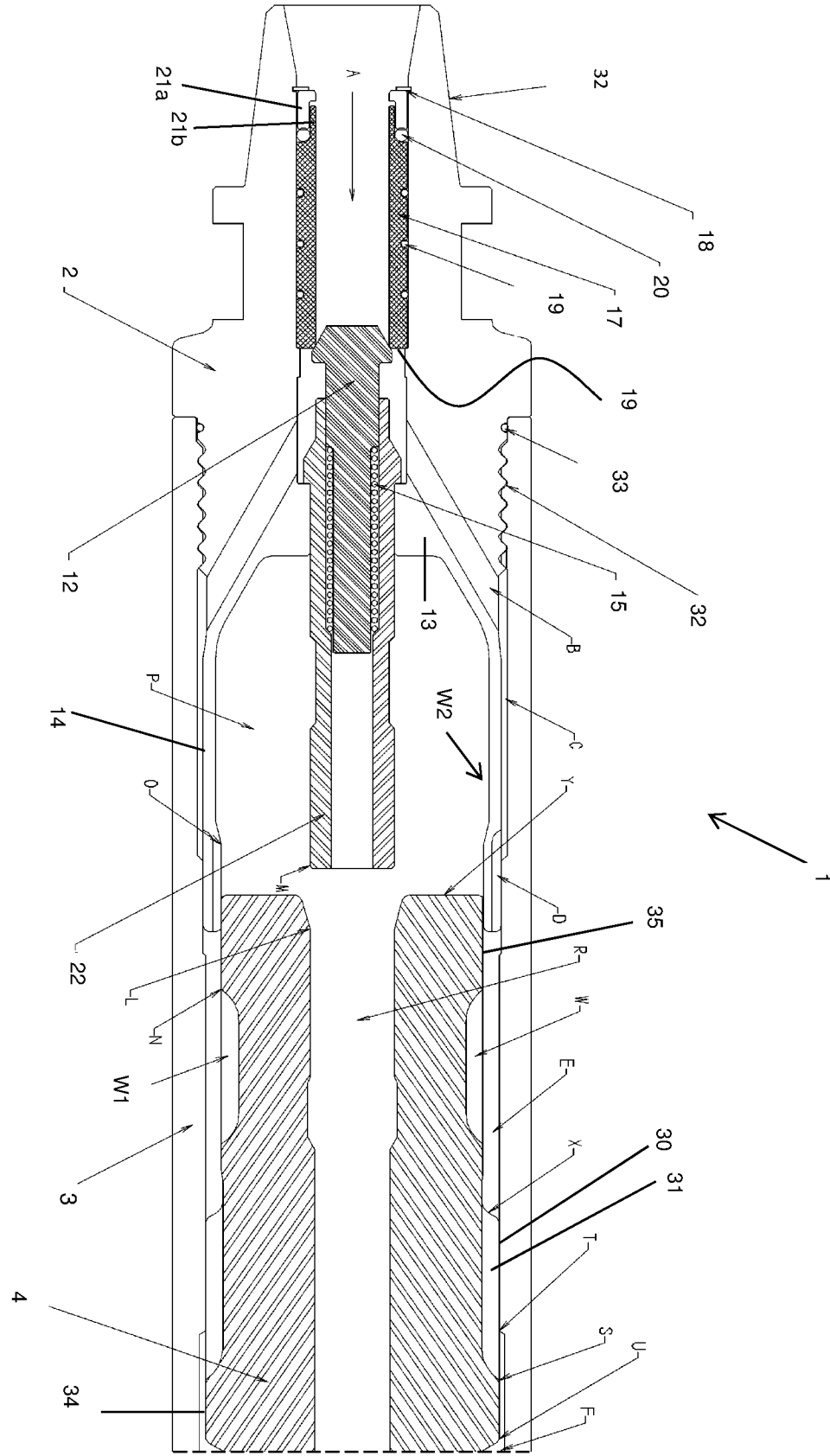


FIGURE 1

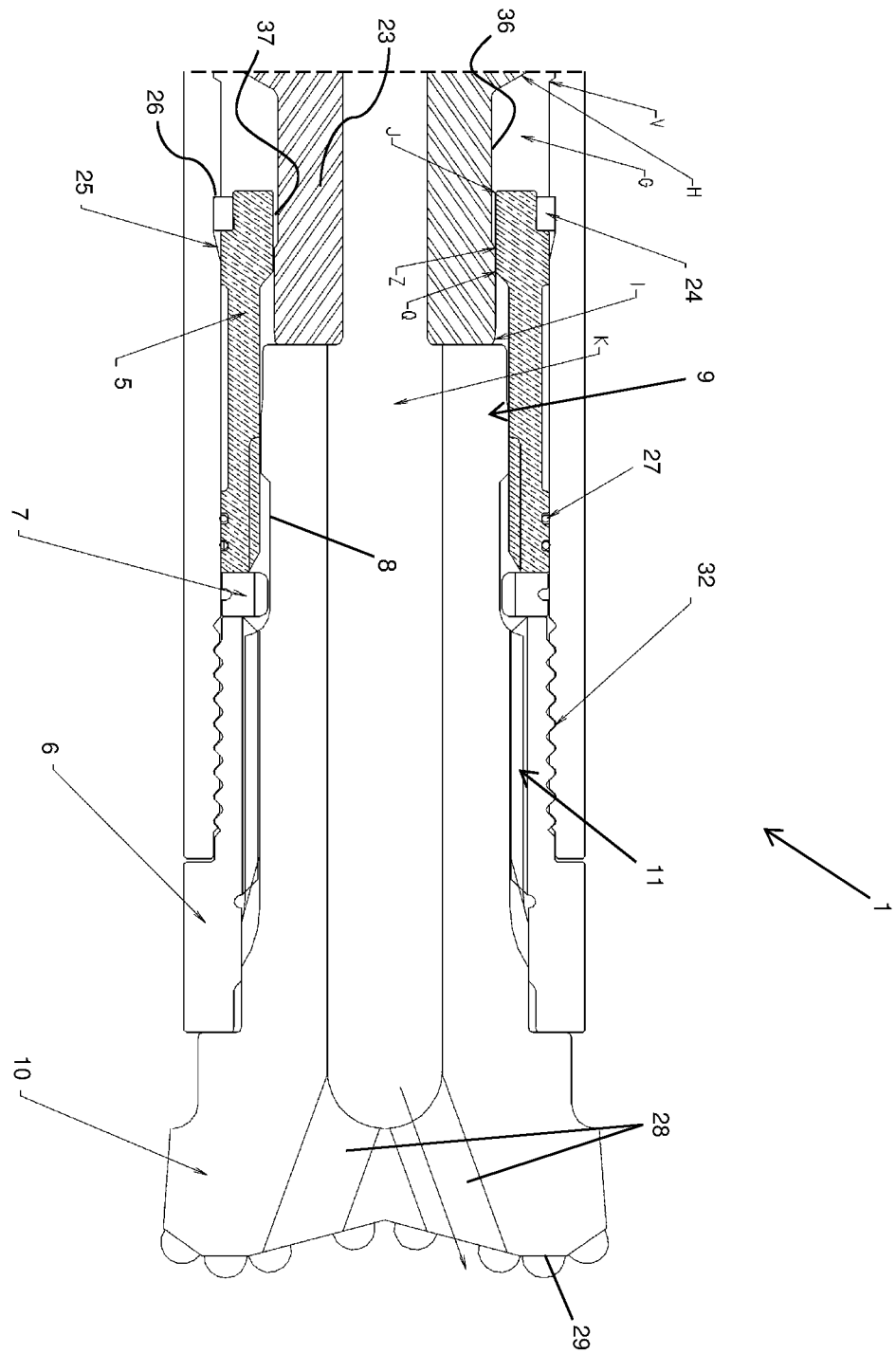


FIGURE 2

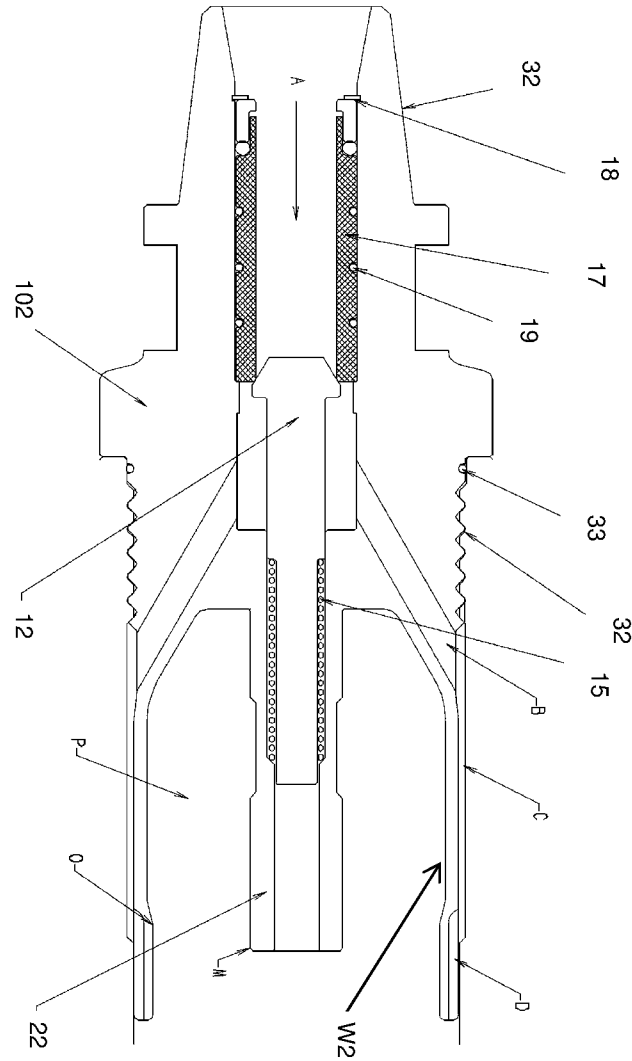


FIGURE 3

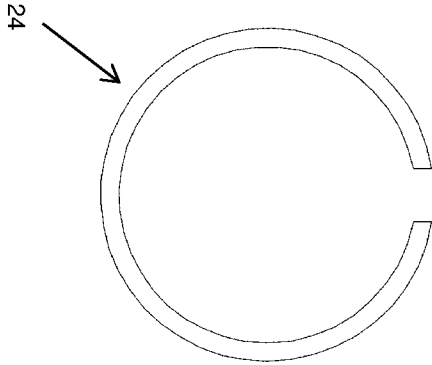


FIGURE 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT / IB 2016/054316

A. CLASSIFICATION OF SUBJECT MATTER IPC: B25D 9/00 (2006.01); E21B 1/38 (2006.01) According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B25D 1/00, 9/00, 17/00, 17/06; E21B 1/00, 1/12, 1/38, 4/14 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Epodoc		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CA 2670999 A1 (GIEN, BERNARD LIONEL) 10 January 2010 (10.01.2010) Fig. 2, 3; page 5, line 1 - page 11, line 5	1
A	US 6131672 A (BECCU, RAINER, SHOFNER, MATT, AHLHORN, KENNETH) 17 October 2000 (17.10.2000) Fig. 1 - 12; description of the drawings	1
A	WO 2006062309 A1 (LIM, BYUNG-DUK) 15 June 2006 (15.06.2006) Fig. 1 - 21; description of the drawings	1
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 06 October 2016 (06.10.2016)		Date of mailing of the international search report 19 October 2016 (19.10.2016)
Name and mailing address of the ISA/AT Austrian Patent Office Dresdner Straße 87, A-1200 Vienna Facsimile No. +43 / 1 / 534 24-535		Authorized officer BRÄUER C. Telephone No. +43 / 1 / 534 24-338

INTERNATIONAL SEARCH REPORT
Information on patent family members

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			MX	A	2007006684	2007-10-18
			WO	A1	2006062309	2006-06-15
			CA	A1	2589916	2006-06-15
			AU	A1	2005312495	2006-06-15