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(54) Title: A PNEUMATIC DRILL HAMMER

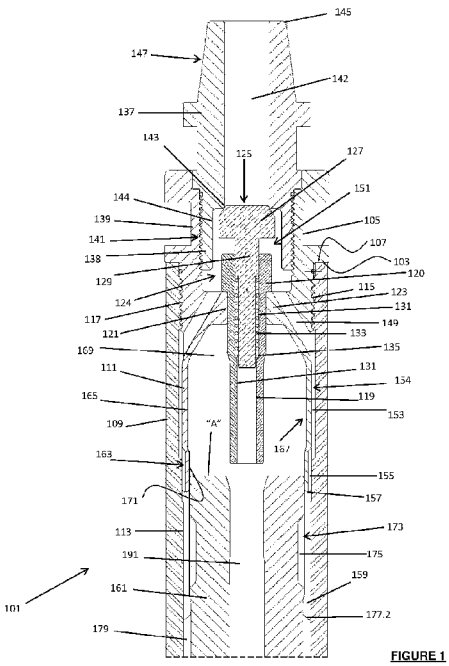

FIGURE 1

(57) Abstract: The invention relates to a pneumatic drill hammer (101) that includes a hollow control rod (119) supported from a dividing wall (123) of a back-head which withdraws from a piston bore (191) at the first end to exhaust a drive chamber (169). The dividing wall (123) is arranged between a rearwardly disposed, internally screw-threaded socket (115) and a forwardly disposed, integral air distribution skirt (111) that extends into a wear sleeve (109). A back- head connector (137) with an axial inlet (142) and a hollow, externally screw- threaded spigot (125) engages into the socket (139). A check valve closure (125) is provided at one end of a stem that is slidably supported inside the control rod (119) with a spring bias (133) against a valve seat (143) provided by the back-head connector (137). Inclined inlet ports (149) extend from the socket to an air supply passage (154) between the skirt (111) and the wear sleeve (109) to an air distribution chamber (159).

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A PNEUMATIC DRILL HAMMER

FIELD OF THE INVENTION

The invention relates to a pneumatic drill hammer of the down-the-hole type.

BACKGROUND TO THE INVENTION

There are a number of down-the-hole hammer constructions that are available. Convenient and cost effective manufacture of parts and assembly of the hammers is an obvious advantage. There is however a tendency to accept certain part constructions that seem to have been sufficient or acceptable in use and in manufacture.

The energy output of down the hole drilling hammers is increasing as compressor manufacturers increase the pressure output of their compressors. The higher energy output is accompanied by higher frequencies of a reciprocating, striking piston resulting in shockwaves in the internal parts of the hammer. This causes the parts to pick up a resonance, start bouncing and cause wear and tear to their mating parts. In the result, hammers can fail and broken parts require replacement. One of the hammer parts that is significant in relation to assembly at the time of manufacture and also to disassembly and reassembly for repairs is the back-head.

OBJECT OF THE INVENTION

It is an object of the invention to provide an arrangement of parts that simplifies the manufacturing and/or assembly process of a hammer.

SUMMARY OF THE INVENTION

In accordance with the invention there is provided a drill hammer comprising:

a reciprocating piston with a first end and a second end,

the piston having an axial piston bore extending from the first end to the second end, the first end of the piston providing a working area in a drive chamber and the second end providing a working area in a return chamber,

a control rod of hollow construction supported from a dividing wall of a back-head which withdraws from the piston bore at the first end to exhaust the drive chamber,

the dividing wall arranged between

a rearwardly disposed, internally screw-threaded socket and

a forwardly disposed, integral air distribution skirt that extends into a wear sleeve,

a back-head connector with an axial inlet and a hollow, externally screw-threaded spigot that engages into the socket of the back-head,

a check valve having a check valve closure provided on a head at one end of a stem slidably supported inside the control rod with a spring on the stem biasing the check valve closure against a valve seat provided by the back-head connector, and

at least one inlet port extending from within the back-head socket to an air supply passage extending between the skirt and the wear sleeve to an air distribution chamber.

The invention further provides for a drill hammer as defined:

in which the air supply passage is formed around the skirt on the inside of the wear sleeve through external slots at a front end of the skirt with ridges provided between the slots that locate against a bore of the wear sleeve;

in which the skirt has an internal under-cut portion spaced apart from a free end of the skirt with an annular internal shoulder located between the under-cut portion and the free end, the under-cut portion forming the drive chamber with the piston;

in which the first end of the piston is slidably engaged and guided inside the annular internal shoulder of the skirt throughout an entire piston stroke;

in which the back-head includes a locating shoulder with an externally screw-threaded portion provided between the locating shoulder and the skirt that tightens into the wear sleeve with the locating shoulder being pulled up against a face at a rear end of the wear sleeve;

in which the control rod is press-fitted through a central, axial opening formed through the dividing wall of the back-head;

in which an outer shoulder on the control rod abuts the dividing wall once this part has been pressed into place; and

in which the control rod to has an open inner end exposed to exhaust pressure of the drill hammer.

BRIEF DESCRIPTION OF THE DRAWINGS

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, which show in:

Figure 1 a cross-sectional view of a top half of a pneumatic drill hammer; and

Figure 2 a cross-sectional view of a bottom half of the drill hammer.

DETAILED DESCRIPTION OF THE INVENTION

In the drill hammer 101 of the invention, as shown in the drawings, an annular locating shoulder 103 is provided on a back-head 105 and locates against an outer face 107 at a rear end of a wear sleeve 109. A cylindrical forwardly disposed air distribution skirt 111 is formed integrally as part of the back-head 105 and extends into a bore 113 of the wear sleeve 109.

The back-head 105 has an externally screw-threaded portion 115. The screw-threaded portion 115 is extends in a region of the back-head 105 between the locating shoulder 103 and the skirt 111. The screw-threaded portion 115 is tightened with the locating shoulder 103 abutting against the outer face 107 of the wear sleeve 109. The back-head 105 is held in place by the continuous tightening of the screw-thread at 115 on the back-head 105 into an internally screw-threaded portion 117 adjacent the outer face 107 of the wear sleeve 109.

In accordance with the invention, a control rod 119 of hollow construction is press-fitted through a central, axial opening 121 formed through a dividing wall 123 of the back-head 105. An outward step 120 on the control rod 119 abuts the dividing wall 123 once this part has been pressed into place.

A spring activated check valve 124 is located inside the back-head 105. A check valve closure 125 is provided on a head 127 at one end of a stem 129. The stem 129 is slidably supported in a bore 131 of the control rod 119. A compression spring 133 is located against a shoulder 135 inside the bore 131 of the hollow control rod 119.

In accordance with the invention, a back-head connector 137 is securable into a socket 139 provided on a rear side of the back-head 105. The back-head connector 137 provides a hollow spigot 138 which together with the back-head

socket 139 provides corresponding screw-threads at 141 that provide secure engagement between these two components.

The back-head connector 137 provides an inlet 142 that leads to an annular concentric valve seat 143 for the check valve closure 125. Both the inlet 142 and valve seat 143 are located centrally or axially in the back-head connector 137. With the back-head connector 137 coupled to the back-head 105, the spring 133 biases the check valve closure 125 against the valve seat 143.

The inlet 142 opens through the valve seat 143 into a cavity 144 on the inside of the hollow spigot 138 that accommodates the valve closure 125. The head 127 providing the check valve closure 125 is larger than a diameter of the inlet 142 in the back-head connector 137. The arrangement allows for larger check valve closures 125 and, more importantly, an inlet in the back-head connector 137 that may be of relatively small diameter.

The larger the diameter of an inlet into a back-head of a drill hammer, the smaller the wall thickness. This provides a point of weakness. Where a break results, the drill hammer will be left in the hole.

The back-head connector 137 can be made with a choice of connecting threads adjacent an outer end 145 and could be of any suitable length. In the current embodiment, the back-head connector 137 is tapered to provide a conical formation 147 with a screw-thread for engagement to a drill string (not shown).

Inclined inlet ports 149 are provided through the dividing wall 123 of the back-head 105 to connect the air from an inlet chamber 151 (provided by the socket 139 and cavity 144) around the check valve closure 125, into a cut-out 153 in the bore 113 of the wear sleeve 109. This arrangement of parts provides an air

supply passage 154 to an air distribution chamber 159 between a piston 161 and the wear sleeve 109.

Slots 155 provided adjacent a free or front end 157 of the skirt 111 allow compressed air to pass into the air distribution chamber 159. Ridges 163 between the slots 155 are provided to abut the bore 113 of the wear sleeve 109 at this location. In the result, the front end 157 of the skirt 111 is supported against movement in the wear sleeve 109.

An inner wall 165 of the skirt 111 is outwardly stepped with an under-cut portion 167 that forms part of a drive chamber 169. The under-cut portion 167 provides an annular, internal shoulder 173 adjacent the free end of the skirt 111.

In the hammer of the invention, a bridging port 173 is provided for supply of air to past the shoulder 171 of the skirt 111 to the drive chamber 169. The bridging port 173 is formed by bridging grooves 175 cut into the outside of the piston 161. The bridging grooves 175 enable a first, rear end “A” of the piston 161 to be guided by the front end 157 of the skirt 111 throughout the entire working stroke of the piston 161, with ridges between the bridging grooves 175 slidably engaged by the internal shoulder 171, when air is being supplied to the drive chamber 169. An annular recess would not provide the same guiding and stability as the bridging grooves 175.

In the working cycle of the drill hammer 101, compressed air enters through the inlet 142 in the back-head connector 137 and pushes the check valve closure 125 down away from the valve seat 143. From the inlet chamber 151 inside the back-head 105, compressed air flows through inlet ports 149 along cut out 153 in the wear sleeve 109, through grooves 155 and into distribution chamber 159.

Pressurised air in the distribution chamber 159 acts on a rear shoulder 177.1 and 177.2 of the piston 161. The rear shoulder is provided by an area 177.1 at the bottom of first by-pass grooves 179 and by an area 177.2 on the top of ridges between the first by-pass grooves 179.

With the piston 161 in the position shown in the drawings, which it assumes when pressed against hole bottom and upon starting of the hammer 101, a return chamber lifting port 181 provided as a recess in the wear sleeve 109 is located to the outside of a lateral shoulder providing a switching land 183, represented by a full diameter of the piston 161. Second by-pass grooves 185 extend from below the switching land 183 to adjacent a second, front end "B" of the piston 161. The air from the distribution chamber 159 flows through first by-pass grooves 179 around the switching land 183 into the return chamber lifting port 181 which connects via second by-pass grooves 185 into a return chamber 187.

The return chamber 187 is charged with compressed air and the resulting pressure acts on a front shoulder 189.1 and 189.2 and the second end "B" of the piston 161, which together represent a greater working surface area than the rear shoulder 177.1 and 177.2. The piston 161 is propelled towards the back-head side of the hammer 101. In its rearward travel, the switching land 183 passes the lifting port 181 and cuts off the air supply to return chamber 187.

The piston 161 continues in its upward travel as the compressed air in return chamber 187 expands. The piston 161 includes an axial piston bore 191 that moves over the control rod 119 to isolate the drive chamber 169.

The piston bore 191 at its second front end "B" cooperates with a foot valve tube 193 secured into a rear end of a rock drill bit 195. The drill bit 195 is similarly provided with an axial bit bore 197 having two inclined vents that open through a

bit face. An exhaust passage from the return chamber 187 is accordingly provided when the piston 161 is pulled away from the foot valve tube 193.

As the bridging port 173 on the piston 161 moves over the internal shoulder 171 of the skirt, air from the distribution chamber 159 feeds the drive chamber 169. The piston 161 is decelerated and its direction of travel reversed to commence a drive or impact stroke. The relevant force is generated by pressure acting on the working area represented by the first end "A" of the piston 161 in the drive chamber 169 and that of the first shoulder 177.1 and 177.2 in the distribution chamber 159. The piston 161 strikes the bit and delivers its blow energy.

In the downward travel of the piston 161, the piston bore 191 disengages from the control rod 119 and the drive chamber 169 exhausts down the piston bore 191, bit bore 197 and vents through the bit face to atmosphere. The piston bore 191 has again closed over the foot valve tube 193 and charging of the return chamber commences 187. The cycle is repeated.

When the hammer 101 is lifted away from a drilling position against hole bottom, the piston 161 and drill bit 195 drop forward against bit retaining rings 199. In this condition the first, rear end "A" of the piston 161 pulls out of the skirt 111 and the air distribution chamber 159 is opened for flushing of air directly through the piston bore 191 and bit bore 197. Reciprocation of the piston 161 accordingly ceases when the hammer 101 is lifted and in this flushing mode.

The drill hammer of the invention accordingly provides a construction and combination of components providing the back-head that are (relatively) easy to manufacture and maintain (including assembly and disassembly) and/or demonstrate competent performance with reduced wear through continuous guiding of the piston during operation.

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

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CLAIMS

1. A pneumatic drill hammer comprising:

a reciprocating piston with a first end and a second end,

the piston having an axial piston bore extending from the first end to the second end,

the first end of the piston providing a working area in a drive chamber and the second end providing a working area in a return chamber,

a control rod of hollow construction supported from a dividing wall of a back-head which withdraws from the piston bore at the first end to exhaust the drive chamber,

the dividing wall arranged between

a rearwardly disposed, internally screw-threaded socket and

a forwardly disposed, integral air distribution skirt that extends into a wear sleeve

a back-head connector with an axial inlet and a hollow, externally screw-threaded spigot that engages into the socket of the back-head,

a check valve having a check valve closure provided on a head at one end of a stem slidably supported inside the control rod with a spring on the stem biasing the check valve closure against a valve seat provided by the back-head connector, and

at least one inlet port extending from within the back-head socket to an air supply passage extending between the skirt and the wear sleeve to an air distribution chamber.

2. A drill hammer as claimed in claim 1 in which the air supply passage is formed around the skirt on the inside of the wear sleeve through external slots at a front end of the skirt with ridges provided between the slots that locate against a bore of the wear sleeve.

3. A drill hammer as claimed in claim 1 in which the skirt has an internal under-cut portion spaced apart from a free end of the skirt with an annular internal shoulder located between the under-cut portion and the free end, the under-cut portion forming the drive chamber with the piston.

4. A drill hammer as claimed in claim 3 in which the first end of the piston is slidably engaged and guided inside the annular internal shoulder of the skirt throughout an entire piston stroke.

5. A drill hammer as claimed in claim 1 in which the back-head includes a locating shoulder with an externally screw-threaded portion provided between the locating shoulder and the skirt that tightens into the wear sleeve with the locating shoulder being pulled up against a face at a rear end of the wear sleeve.

6. A drill hammer as claimed in claim 1 in which the control rod is press-fitted through a central, axial opening formed through the dividing wall of the back-head.

7. A drill hammer as claimed in claim 6 in which an outer shoulder on the control rod abuts the dividing wall once this part has been pressed into place.

8. A drill hammer as claimed in claim 1 in which the control rod to has an open inner end exposed to exhaust pressure of the drill hammer.

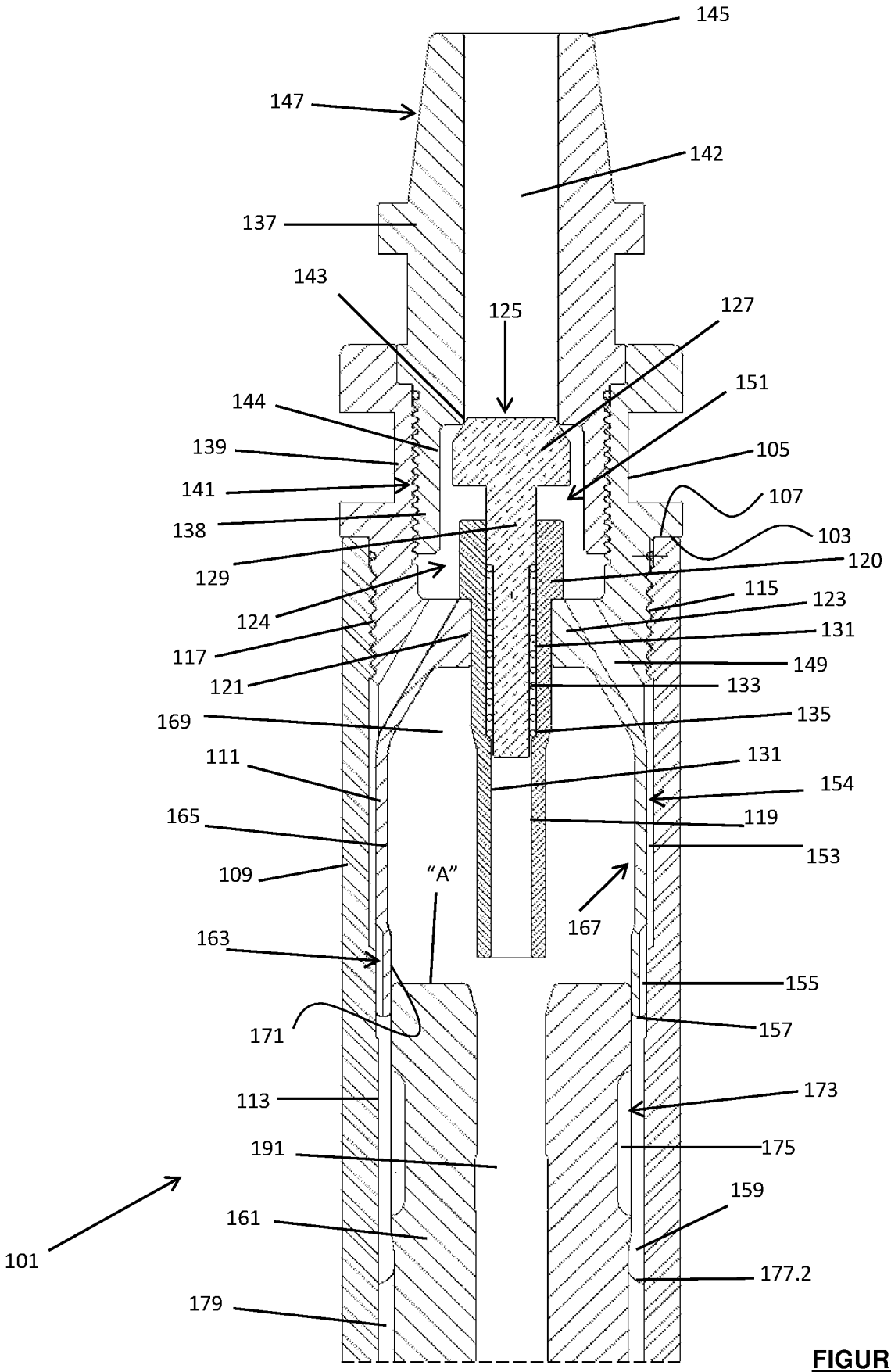
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FIGURE 1

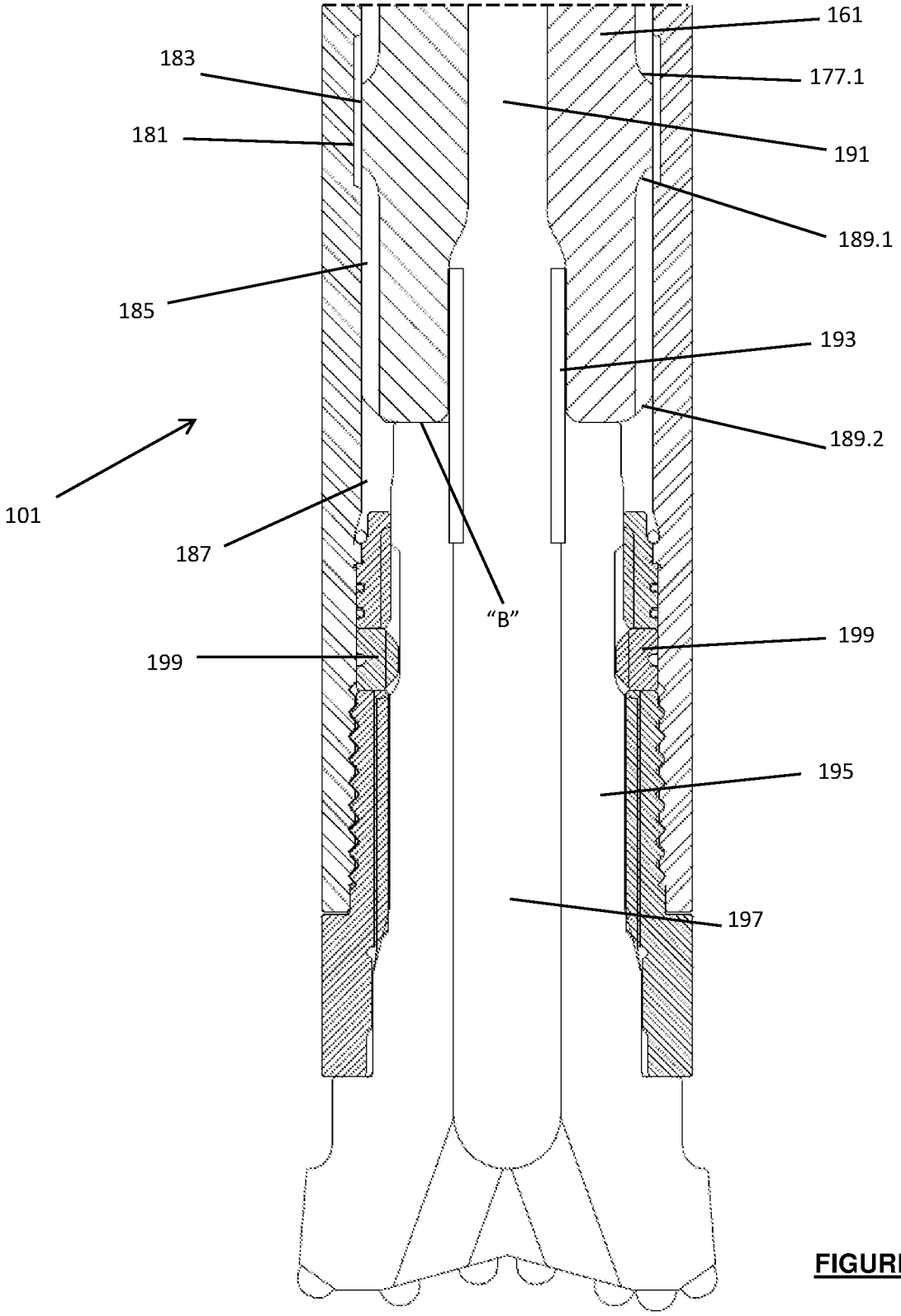

FIGURE 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT / IB 2018/058727

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***E21B 4/14***

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)

E21B

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, WPI, TXT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2017118963 A1 (GIEN, Bernard Lionel) 13 July 2017 (13.07.2017) figures, claims	1-8
A	WO 0183931 A1 (REAR, IAN, GRAEME) 08 November 2001 (08.11.2001) figures, claims	1-8

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT / IB 2018/058727

Patent document cited in search report			Patent family member(s)			Publication date
WO	A1	2017118963	WO	A1	2017118963	2017-07-13
WO	A1	0183931	WO	A1	0183931	2001-11-08