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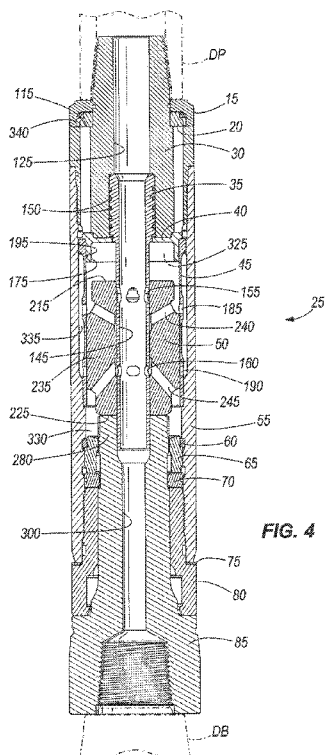
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[Continued on next page]

(54) Title: DOWN HOLE HAMMER HAVING ELEVATED EXHAUST



(57) Abstract: A percussive assisted rotary drill includes a top sub for connection with a drill pipe. The drill pipe imparts torque to the drill and also supplies motive fluid to the drill. The drill includes a shank adapter to facilitate affixing a rotary drill bit to the drill. The motive fluid is divided between a bit flow which flows through the bit to clear debris at the bottom of the drill, and an actuator flow. An actuator, which may be in the form of a reciprocating piston, moves within the drill under the influence of the actuator flow to impart cyclical blows to the shank adapter. The blows are transferred to the drill bit through the shank adapter to provide a relatively high frequency low amplitude percussive force on the rotating drill bit to assist in the drilling operation. At least a portion of the actuator flow portion of the motive fluid is exhausted through the top end of the drill. The relative flow rates and volumes of the bit and actuator flows can be adjusted with a check valve in the actuator flow exhaust path.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Published:

— *with international search report (Art. 21(3))*

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16 December 2010

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2010/023742

A. CLASSIFICATION OF SUBJECT MATTER

INV. E21B4/14

ADD.

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 181 473 A (TONE BORING CO) 23 April 1987 (1987-04-23) page 1, lines 6-18 page 1, lines 70-85 page 4, line 85 - page 5, line 117; figure 8	1-6
X	GB 800 725 A (BRAUNKOHLN U BRIKETWERKE RODD) 3 September 1958 (1958-09-03) page 2, line 96 - page 3, line 15; figures 1,4	1-6
X	US 2 942 578 A (HUFFMAN MERVIN C ET AL) 28 June 1960 (1960-06-28) column 3, line 14 - column 4, line 5; figure 1 column 4, lines 26-29	1,9-20



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 document 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.
- *Z* document member of the same patent family

Date of the actual completion of the international search

19 October 2010

Date of mailing of the international search report

29/10/2010

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/023742

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
1-6, 9-20
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-6

Downhole drilling tool with specific actuator flow path and actuator exhaust path.

2. claim: 7

Drilling tool comprising a drive exhaust port and a return exhaust port.

3. claim: 8

Drilling tool comprising a piston provided h a drive supply conduit and a return supply conduit.

4. claims: 9-20

Drilling tool comprising an actuator exhaust path and a bit exhaust path

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2010/023742

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