Title: VALVE FOR RECIPROCATING PUMP ASSEMBLY

Abstract: The valve member includes a valve body and a seal. The valve body defines a first frusto-conical surface and an outer annular cavity. The seal extends within the outer annular cavity and includes a first tapered and circumferentially-extending surface adapted to sealingly engage the tapered surface of the valve seat. In another aspect, the seal includes an annular bulbous protrusion from which the first tapered and circumferentially-extending surface angularly extends, the first tapered and circumferentially-extending surface engaging the annular bulbous protrusion and the first frusto-conical surface of the valve body. In another aspect, an offset distance is defined between the first frusto-conical surface of the valve body and at least a portion of the first tapered and circumferentially-extending surface of the seal, the offset distance extending in a direction that is perpendicular to at least the first frusto-conical surface of the valve body.
— 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))

(88) Date of publication of the international search report: 9 February 2017
## INTERNATIONAL SEARCH REPORT

### INTERNATIONAL application No.
PCT/US 16/40802

### A. CLASSIFICATION OF SUBJECT MATTER

<table>
<thead>
<tr>
<th>IPC(8)</th>
<th>CPC</th>
<th>According to International Patent Classification (IPC) or to both national classification and IPC</th>
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<td>F16K 1/00 (2016.01)</td>
<td>F16K 15/06</td>
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### B. MINIMUM DOCUMENTATION SEARCHED

#### Minimum documentation searched (classification system followed by classification symbols)

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<th>IPC(8)</th>
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<td>F16K 1/00 (2016.01)</td>
<td>F16K15/06</td>
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</tbody>
</table>

#### Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

- See Extra Sheet -

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X A</td>
<td>US 2013/0015385 A1 (MARICA) 17 January 2013 (17.01.2013) Figs. 1-5; paras [0009], [0028], [0041]-[3].</td>
<td>1, 3, 5-7</td>
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<td>A</td>
<td>US 2013/0020521 A1 (BYRNE) 24 January 2013 (24.01.2013) Fig. 1; paras [0040], [0042], [0044].</td>
<td>2, 4, 8-10</td>
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<td>A</td>
<td>US 2014/0070127 A1 (BLUME) 13 March 2014 (13.03.2014) Fig. 5; paras [0009-10].</td>
<td>4</td>
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<tr>
<td>A</td>
<td>US 2002/0079332 A1 (MCINTIRE et al.) 27 June 2002 (27.06.2002) Figs. 11-12; paras [0039], [0059-60].</td>
<td>1-10</td>
</tr>
<tr>
<td>A</td>
<td>US 5,226,445 A (SURJAATMADJA) 13 July 1993 (13.07.1993) Figs. 1-2; 7; col 3 In 7-27</td>
<td>1-10</td>
</tr>
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</table>

*Special documents are listed in the continuation of Box C.

## Further documents are listed in the continuation of Box C.

### Date of the actual completion of the international search
03 October 2016

### Date of mailing of the international search report
28 DEC 2016

### Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300

### Authorized officer:
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PCT OSP: 571-272-7774

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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:
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I Claims 1-10, directed to a valve member including an annular bulbous protrusion.

Group II Claims 11-20, directed to a valve member including an offset distance between a surface of a valve body and a surface of a seal, extending along a direction perpendicular to said valve body surface.

* - See Supplemental 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 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.:

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. 1-10

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.

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The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical feature(s) for the following reasons:

Group I requires the special technical feature of an annular bulbous protrusion from which a first tapered and circumferentially extending surface angularly extends, said tapered surface extending between the annular bulbous portion and a first frusto-conical surface of a valve body.

Group II requires the special technical feature of an offset distance defined between a first frusto-conical surface of a valve body and at least a portion of the first tapered and circumferentially-extending surface of the seal, the offset distance extending in a direction perpendicular to the first frusto-conical surface of the valve body.

The only shared technical feature(s) that would otherwise unify Groups I-II are a valve member for a reciprocating pump assembly, the valve member comprising:

- a valve body comprising a first frusto-conical surface, the valve body defining an outside annular cavity formed therein; and
- a seal extending within the circumferentially-extending surface adapted to sealingly engage a tapered surface of a valve seat of the reciprocating pump assembly

However, these technical feature(s) do not represent a contribution to the prior art, as they are anticipated by US 5,062,450 A to BAILEY et al. (hereinafter "BAILEY").

BAILEY teaches a valve member (valve assembly 16, Fig. 2; col 3 ln 18-21) for a reciprocating pump assembly (which includes pump housing 12 and valve assembly 10, Fig. 1; col 3 ln 1-5), the valve member comprising:

- a valve body (valve head 20, Fig. 3; col 3 ln 22-24) comprising a first frusto-conical surface (underside surface 24, Fig. 3; col 3 ln 22-24), the valve body defining an outside annular cavity formed therein (unnumbered; space in head 20 receiving seal ring 25 as illustrated in Fig. 3; col 3 ln 24-27); and
- a seal (seal ring 25, Fig. 3; col 3 ln 24-27) extending within the outside annular cavity (as illustrated in Fig. 3), the seal comprising:
  - a first tapered and circumferentially-extending surface (unnumbered; bottom face of 25 flush with surface 24, as illustrated in Fig. 3; col 3 ln 24-27) adapted to sealingly engage a tapered surface (unnumbered; conical face of valve seat 14 illustrated in Fig. 2; col 3 ln 18-21) of a valve seat (valve seat 14, Fig. 2; col 3 ln 18-21) of the reciprocating pump assembly (as illustrated in Fig. 2).

As the common technical feature(s) of Groups I-II were known in the art at the time of the invention, they cannot be considered to be common technical feature(s) that would otherwise unify Groups I-II.

Therefore, Groups I-II lack unity under PCT Rule 13.

Search Terms Used:

Abrasive, Angle, Basin, Boot, Borehole, Burst, Caught, Chamfer, Check, Check, Conformal, Conical, Control, Counterbore, Disc, Disk, Drain, Elastomeric, Face, Flap, Flow, Frustum, Gasket, Glass, Inlaid, Mechanical, Needle, One, Particle, Perimeter, Piston, Plump, Plunger, Popup, Profile, Pump, Reciprocating, Relief, Resistant, Ribbed, Ridge, Ring, Rubber, Rupture, Seal, Sink, Slurry, Stem, Stopper, Tapered, Toroidal, Two, Urethane, Valve, Valve, Way, Wellbore

Documentaiton Searched:

IPC (8): B21K1/24, F16K1/00, F16K1/32, F16K1/38, F16K1/42, F16K1/46, F16K15/00, F16K15/02, F16K15/06, F16K17/14, F16K17/16, F16K25/00, F16K38/00, F16K51/00, F17D5/00 (2016.01)
USPC: 137/14, 137/15.18, 137/15.19, 137/375, 137/516.29, 137/550, 137/68.23, 137/902, 251/262, 251/318, 251/321, 251/332, 251/333, 251/334, 251/385, 251/395, 251/367, 251/366, 277/316, 277/437, 29/890.122

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