



- (51) International Patent Classification:
F04C 14/28 (2006.01)
- (21) International Application Number:
PCT/US2013/035897
- (22) International Filing Date:
10 April 2013 (10.04.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/622,684 11 April 2012 (11.04.2012) US
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- (81) Designated States (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,
KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD,
ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,
NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU,
RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ,
TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA,
ZM, ZW.

- (84) Designated States (*unless otherwise indicated, for every
kind of regional protection available*): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- 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))

[Continued on next page]

- (54) Title: METHOD FOR ROTARY POSITIVE DISPLACEMENT PUMP PROTECTION

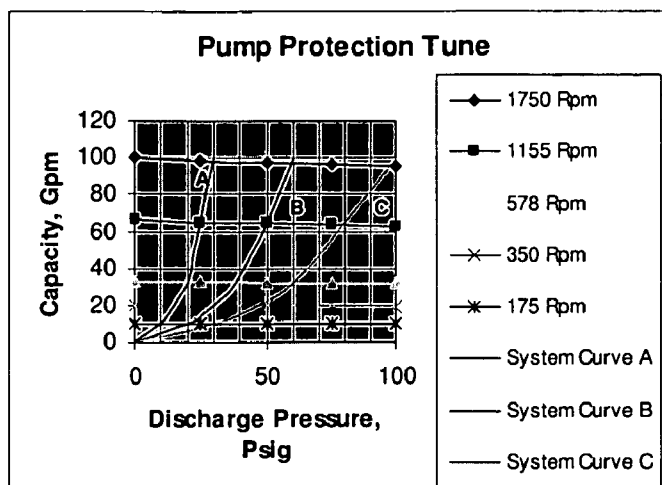


Figure 3

(57) Abstract: Techniques are provided for protecting a rotary positive displacement pump. The techniques include apparatus featuring a signal processor configured to receive signaling containing information about power, torque, speed, viscosity and specific gravity related to the operation of a pump; and determine whether to enter an enhanced pump protection mode for the rotary positive displacement pump based at least partly on a relationship between an actual corrected tune ratio and a tuned ratio set point (Tune Ratio SP). The signal processor may determine if the actual corrected tune ratio is less than or equal to the actual corrected tune ratio set point (Tune Ratio SP), and if so, then to enter the enhanced pump protection mode, else to continue to use a basic pump protection mode, and may also determine the actual corrected tune ratio based at least partly on a ratio of an actual corrected power (PACorr) divided by a tuned corrected power (PTcorr) at a specific operating speed.



(88) Date of publication of the international search report:

17 April 2014

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/035897

A. CLASSIFICATION OF SUBJECT MATTER
INV. F04C14/28
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)
F04C F01C

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/154321 A1 (STILES ROBERT W JR [US] ET AL STILES JR ROBERT W [US] ET AL) 5 July 2007 (2007-07-05) the whole document paragraph [0002] paragraph [0004] paragraph [0007] paragraph [0024] paragraph [0038] claims 1,15 ----- -/--	1,2, 8-10,12, 20-22, 28-30, 32,40, 42,43, 45,46



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

24 February 2014

Date of mailing of the international search report

28/02/2014

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2013/035897

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/252205 A1 (STAVALE ANTHONY E [US] ET AL) 17 November 2005 (2005-11-17) the whole document	1,2, 8-10,12, 20-22, 28-30, 32,40, 42,43, 45,46
A	----- WO 01/88379 A1 (NETZSCH MOHNOPUMPEN GMBH [DE]; RUDERT WOLFGANG [DE]; GUTMANN GUIDO [US] 22 November 2001 (2001-11-22) the whole document -----	1,21,42

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/035897

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.: 3-7, 11, 13-19, 23-27, 31, 33-39, 41, 44, 47
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:
see FURTHER INFORMATION sheet PCT/ISA/210
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:

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.:
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

Continuation of Box II.2

Claims Nos.: 3-7, 11, 13-19, 23-27, 31, 33-39, 41, 44, 47

The application lacks sufficient disclosure, contrary to the requirements of Article 5 PCT, and is extremely vague and unclear. The reasons are the following.

The claims and the description concern an "actual corrected power (PACorr)" and a "tuned corrected power (PTcorr)". These are not clearly defined or well established technical terms in the technical field of rotary positive displacement pumps. In the description (and also the respective dependent claims), a way of determining the "actual corrected power (PACorr)" and "tuned corrected power (PTcorr)" is described as "based at least partly" on (an equation comprising) "rated" values of specific gravity and viscosity, an "actual power (PACT)", and a "measured or interpolated tuned value power (PMEAS)". However, it is not disclosed in the application, what actually

- "rated" values of specific gravity and viscosity,
- "actual power (PACT)" and
- "measured or interpolated tuned value power (PMEAS)"

are.

With respect to the "rated" values, it is merely implied that these values have to be applied for "varying temperature systems". However, it is not disclosed in what way the Applicant intends to "correct to rated conditions". Additional lack of disclosure appears to result from the fact, that specific gravity and viscosity relate to the pumped fluid and the environmental conditions of the pump or any claimed "apparatus", and not to any features of the actually addressed apparatus.

With respect to the "actual power (PACT)" and "measured or interpolated tuned value power (PMEAS)", it appears to be simply not defined what power actually is addressed, respectively, and in what way any "actual power" differs from any "measured or interpolated tuned value power", notwithstanding their lacking definition as such.

Furthermore, it is not disclosed on which other features the determination of those values is based, which are determined "based at least partly" on the above listed undisclosed values.

As a result, also taking into account the dependencies of the claims, the subject-matter referred to by claims 3 - 7, 15 - 18, 23 - 27, 35 - 38 and 44 is not sufficiently disclosed in order to enable a skilled person to carry out the claimed invention (Article 5 PCT). Hence, the above-mentioned claims lack clarity and support in the description to such an extent that a meaningful search is not possible for these

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

claims.

In addition, also the following has to be noted:

- Claims 11

and 31 concern a "signal processor" with which to "compensate torque measurements continuously for specific gravity and viscosity changes in systems where a temperature is not constant". However, neither is it disclosed in the application in what way to "compensate", nor is it to be considered as well known in the technical field how to compensate torque measurements continuously for specific gravity and viscosity changes.

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Claims 13 and 33 concern a signal processor with which an evaluation is performed "in order to distinguish between increasing/decreasing discharge pressure and an upset condition". However, neither is it disclosed in the application how to "distinguish", i.e. on what criteria a distinction is based, nor is that to be considered as well known in the technical field.

- Claims 14 and 34 concern a signal processor "to detect a speed change and restart a protection mode algorithm". However, it is neither disclosed on which criteria of a speed change such a "restart" depends, nor what actually a "restart" of a "protection mode algorithm" is supposed to be and what technical effect such a "restart" of a "protection mode algorithm" is claimed to have, according to the applicant.

- Claims 41 and 47 concern a signal processor keeping "basic pump protection mode always active". However, this appears to contradict the respective definitions of independent claims 1 and 21, in which it is defined to enter an "enhanced pump protection mode", and it is also not disclosed in the application how to be in basic pump protection mode and in "enhanced pump protection mode" simultaneously.

As a result, also taking into account the dependencies of the claims, the subject-matter referred to by claims 11, 13, 14, 31, 33, 34, 41 and 47 is also not sufficiently disclosed in order to enable a skilled person to carry out the claimed invention (Article 5 PCT). Hence, also the above-mentioned claims lack clarity and support in the description to such an extent that a meaningful search is not possible for these claims.

The

non-compliance with the substantive provisions is to such an extent, that the search was performed taking into consideration the non-compliance in determining the extent of the search (PCT Guidelines 9.19).

Consequently, the search was based on the subject-matter that, as far as can be understood, could reasonably be expected to be claimed later in the procedure, and the corresponding claims, namely the subject-matter addressed with claims 1, 2, 8 - 10, 12, 20, 21, 22, 28 - 30, 32, 40, 42, 43, 45, 46.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/035897

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007154321 A1	05-07-2007	AU 2007332796 A1 EP 2102503 A2 US 2007154321 A1 US 2012020810 A1 WO 2008073329 A2 ZA 200904747 A	19-06-2008 23-09-2009 05-07-2007 26-01-2012 19-06-2008 28-07-2010
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WO 0188379 A1	22-11-2001	EP 1196693 A1 WO 0188379 A1	17-04-2002 22-11-2001