

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44bis)

Applicant's or agent's file reference 320838-5	FOR FURTHER ACTION	See item 4 below
International application No. PCT/US2018/055109	International filing date (<i>day/month/year</i>) 10 October 2018 (10.10.2018)	Priority date (<i>day/month/year</i>) 10 October 2017 (10.10.2017)
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant LUFKIN INDUSTRIES, LLC		

1.	This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 bis.1(a).																								
2.	This REPORT consists of a total of 11 sheets, including this cover sheet.																								
In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.																									
3.	This report contains indications relating to the following items: <table style="width: 100%;"> <tr> <td style="width: 5%; text-align: center;">☒</td> <td style="width: 25%;">Box No. I</td> <td>Basis of the report</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td style="text-align: center;">☒</td> <td>Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td style="text-align: center;">☒</td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table>	☒	Box No. I	Basis of the report	☐	Box No. II	Priority	☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	☐	Box No. IV	Lack of unity of invention	☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	☐	Box No. VI	Certain documents cited	☐	Box No. VII	Certain defects in the international application	☒	Box No. VIII	Certain observations on the international application
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4.	The International Bureau will communicate this report to designated Offices in accordance with Rules 44bis.3(c) and 93bis.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44bis .2).																								

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Date of issuance of this report 14 April 2020 (14.04.2020)
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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To:
POLLANDER, Laura L.

General Electric Company Global Patent Operation 901 Main
Avenue, 3rd Floor Norwalk, CT 06851 USA

Date of mailing
(day/month/year) **08 February 2019 (08.02.2019)**

Applicant's or agent's file reference 320838-5		FOR FURTHER ACTION See paragraph 2 below	
International application No. PCT/US2018/055109	International filing date (day/month/year) 10 October 2018 (10.10.2018)	Priority date(day/month/year) 10 October 2017 (10.10.2017)	
International Patent Classification (IPC) or both national classification and IPC F04B 47/02(2006.01)i, F04B 17/03(2006.01)i, E21B 43/12(2006.01)i			
Applicant LUFKIN INDUSTRIES, LLC			

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis. I(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.
For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/KR International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578	Date of completion of this opinion 08 February 2019 (08.02.2019)	Authorized officer KIM, Jin Ho Telephone No. +82-42-481-8699
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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2018/055109

Box No. 1 Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of :

- ☒ the international application in the language in which it was filed
- ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*. I(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

- a. ☐ forming part of the international application as filed:
☐ in the form of an Annex C/ST.25 text file.
☐ on paper or in the form of an image file.
- b. ☐ furnished together with the international application under PCT Rule 13*ter*. I(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
- c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*. I(a)).
☐ on paper or in the form of an image file (Rule 13*ter*. I(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2018/055109

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	NONE	NO

2. Citations and explanations :

Reference is made to the following documents:

D1: US 2016-0131128 A1 (LUFKIN INDUSTRIES, LLC) 12 May 2016

D2: CN 201401157 Y (WEIKANG, ZENG) 10 February 2010

1. Novelty and Inventive step

1.1 Independent Claim 1

D1, which is considered to be the closest prior art to the subject matter of claim 1, discloses a rod pumping unit configured to raise and lower a polished rod (24), comprising: a base (11); a Sampson post (14); a walking beam (18); a horse head (16) attached to a forward end of the walking head (18); and a liner motion vector (100) including a linear actuator assembly (170) and a counterbalance assembly (see paragraphs [0056], [0065], [0066], claim 4, and figures 1, 8).

Claim 1 differs from D1 in that a linear drive unit is connected between a base and a walking beam. However, D2 discloses that a balanced column of a hydraulic power unit (1) is connected between a base (5) and a walking beam (3) (see page 4, lines 6-26 and figures 1, 2). D1 and D2 are concerned with mutually related technical fields. It would not be particularly difficult for a person skilled in the art to combine D1 and D2, and it is regarded that the effect achieved from the combination of D1 and D2 can be easily foreseen by a person skilled in the art. Accordingly, claim 1 would have been obvious over D1 in view of D2. Therefore, claim 1 does not involve an inventive step under PCT Article 33(3).

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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2018/055109

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

In claim 7, "the shaft/screw" has not been previously defined (PCT Article 6).

In claim 17, "the motor" and "the threaded shaft" have not been previously defined (PCT Article 6).

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1.2 Dependent Claims 2-9

1.2.1 Claim 2

The additional feature of claim 2 is identical to the feature of D1 in that the linear actuator assembly (170) comprises a motor (134), a shaft rotated by the motor (132), a forcer ram (108), and a planetary roller nut (122) (see paragraph [0066] and figures 8, 9). Accordingly, claim 2 would have been obvious over D1 in view of D2. Therefore, claim 2 does not involve an inventive step under PCT Article 33(3).

1.2.2 Claim 3

The additional feature of claim 3 is identical to a guide tube (146) providing a rotary constraint for the forcer ram (108) in D1 (see paragraph [0069] and figures 8, 9). Accordingly, claim 3 would have been obvious over D1 in view of D2. Therefore, claim 3 does not involve an inventive step under PCT Article 33(3).

1.2.3 Claim 4

The additional feature of claim 4 is characterized in that the counterbalance system comprises a pressure jacket and a path of communication between the ram interior and the pressure jacket. This feature would be easily conceived from a pressure vessel (101) surrounding the forcer ram (108) in D1 (see figures 8, 9). Accordingly, claim 4 would have been obvious over D1 in view of D2. Therefore, claim 4 does not involve an inventive step under PCT Article 33(3).

1.2.4 Claim 5

The additional feature of claim 5 is characterized in that the counterbalance system further comprises a compressor connected to the pressure jacket that maintains the pressure of the fluid within the pressure jacket. This feature would be easily conceived from providing balancing pressure correction commands to a gas compressor in D1 (see paragraph [0126]). Accordingly, claim 5 would have been obvious over D1 in view of D2. Therefore, claim 5 does not involve an inventive step under PCT Article 33(3).

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1.2.5 Claim 6

The additional feature of claim 6 is characterized in that the motor is a permanent magnet electric motor. This feature is merely a variation of the electric motor (30) in D1 (see paragraph [0057]). Accordingly, claim 6 would have been obvious over D1 in view of D2. Therefore, claim 6 does not involve an inventive step under PCT Article 33(3).

1.2.6 Claim 7

The additional feature of claim 7 is characterized in that the motor further comprises an encoder that is configured to measure the rotational speed and position of the shaft/screw and output representative measurement signals and a variable speed drive that controls the operational parameters of the motor, wherein the variable speed drive includes a servo controller that adjusts the operation of the motor in response to measurements signals sent from the encoder to the servo controller. This feature would be easily conceived from the disclosure of D1 considering that the pumping unit motor may be controlled and monitored by a variable speed drive (VSD, 204) which in turn exchanges data with a rod pump controller (RPC, 206) (see paragraph [0091] and figure 12). Accordingly, claim 7 would have been obvious over D1 in view of D2. Therefore, claim 7 does not involve an inventive step under PCT Article 33(3).

1.2.7 Claim 8

The additional feature of claim 8 is identical to the feature of D2 in that the balanced column of a hydraulic power unit (1) is connected to the walking beam (3) between a support (4) and a horse head (2) (see figure 1). Accordingly, claim 8 would have been obvious over D1 in view of D2. Therefore, claim 8 does not involve an inventive step under PCT Article 33(3).

1.2.8 Claim 9

The additional feature of claim 9 is characterized in that the Sampson post is connected to the walking beam between the linear drive unit and the horsehead. This feature is merely a variation of the disclosure of D2 considering that the balanced column of a hydraulic power

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unit (1) is connected to the walking beam (3) between a support (4) and a horse head (2) (see figure 1). Accordingly, claim 9 would have been obvious over D1 in view of D2. Therefore, claim 9 does not involve an inventive step under PCT Article 33(3).

1.3 Independent Claim 10

D1, which is considered to be the closest prior art to the subject matter of claim 10, discloses a rod pumping unit configured to raise and lower a polished rod (24), comprising: a base (11); a Sampson post (14); a walking beam (18); a horse head (16) attached to a forward end of the walking head (18); and a liner motion vector (100) including a forcer ram (108) (see paragraphs [0056], [0065], [0066], claim 4, and figures 1, 8).

Claim 10 differs from D1 in that a linear drive unit is connected between a base and a walking beam, wherein the linear drive unit comprises an upper pivot bearing connected between the ram and the walking beam. However, D2 discloses that a balanced column of a hydraulic power unit (1) is connected between a base (5) and a walking beam (3), and comprises an upper pivot bearing (see page 4, lines 6-26 and figures 1, 2). D1 and D2 are concerned with mutually related technical fields. It would not be particularly difficult for a person skilled in the art to combine D1 and D2, and it is regarded that the effect achieved from the combination of D1 and D2 can be easily foreseen by a person skilled in the art. Accordingly, claim 10 would have been obvious over D1 in view of D2. Therefore, claim 10 does not involve an inventive step under PCT Article 33(3).

1.4 Dependent Claims 11-18

1.4.1 Claim 11

The additional feature of claim 11 is identical to a lower pivot bearing in D1 (see figure 1). Accordingly, claim 11 would have been obvious over D1 in view of D2. Therefore, claim 11 does not involve an inventive step under PCT Article 33(3).

1.4.2 Claim 12

The additional feature of claim 12 is identical to the feature of D1 in that the linear actuator assembly (170) comprises a motor (134), a shaft rotated by the motor (132), a forcer ram

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(108), and a planetary roller nut (122) (see paragraph [0066] and figures 8, 9). Accordingly, claim 12 would have been obvious over D1 in view of D2. Therefore, claim 12 does not involve an inventive step under PCT Article 33(3).

1.4.3 Claim 13

The additional feature of claim 13 is identical to a guide tube (146) providing a rotary constraint for the forcer ram (108) in D1 (see paragraph [0069] and figures 8, 9). Accordingly, claim 13 would have been obvious over D1 in view of D2. Therefore, claim 13 does not involve an inventive step under PCT Article 33(3).

1.4.4 Claim 14

The additional feature of claim 14 is identical to the feature of D1 in that the liner motion vector (100) comprises a counterbalance assembly (see claim 4). Accordingly, claim 14 would have been obvious over D1 in view of D2. Therefore, claim 14 does not involve an inventive step under PCT Article 33(3).

1.4.5 Claim 15

The additional feature of claim 15 is characterized in that the pneumatic counterbalance system comprises a pressure jacket and a path of communication between the interior of the ram and the pressure jacket. This feature would be easily conceived from a pressure vessel (101) surrounding the forcer ram (108) in D1 (see figures 8, 9). Accordingly, claim 15 would have been obvious over D1 in view of D2. Therefore, claim 15 does not involve an inventive step under PCT Article 33(3).

1.4.6 Claim 16

The additional feature of claim 16 is characterized in that the counterbalance system further comprises a compressor connected to the pressure jacket that maintains the pressure of the fluid within the pressure jacket. This feature would be easily conceived from providing balancing pressure correction commands to a gas compressor in D1 (see paragraph [0126]). Accordingly, claim 16 would have been obvious over D1 in view of D2. Therefore, claim 16 does not

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involve an inventive step under PCT Article 33(3).

1.4.7 Claim 17

The additional feature of claim 17 is characterized in that the motor of the linear drive system further comprises an encoder that is configured to measure the rotational speed and position of the threaded shaft and output representative measurement signals and a variable speed drive that controls the operational parameters of the motor, wherein the variable speed drive includes a servo controller that adjusts the operation of the motor in response to measurements signals sent from the encoder to the servo controller. This feature would be easily conceived from the disclosure of D1 considering that the pumping unit motor may be controlled and monitored by a variable speed drive (VSD, 204) which in turn exchanges data with a rod pump controller (RPC, 206) (see paragraph [0091] and figure 12). Accordingly, claim 17 would have been obvious over D1 in view of D2. Therefore, claim 17 does not involve an inventive step under PCT Article 33(3).

1.4.8 Claim 18

The additional feature of claim 18 is characterized in that the Sampson post is connected to the walking beam between the linear drive unit and the horsehead. This feature is merely a variation of the disclosure of D2 considering that the balanced column of a hydraulic power unit (1) is connected to the walking beam (3) between a support (4) and a horse head (2) (see figure 1). Accordingly, claim 18 would have been obvious over D1 in view of D2. Therefore, claim 18 does not involve an inventive step under PCT Article 33(3).

1.5 Independent Claim 19

D1, which is considered to be the closest prior art to the subject matter of claim 19, discloses a rod pumping unit configured to raise and lower a polished rod (24), comprising: a base (11); a Sampson post (14) comprising a center bearing or a pivot connection (20); a walking beam (18); a horse head (16) attached to a forward end of the walking head (18); and a liner motion vector (100), wherein the liner motion vector (100) comprises: a linear actuator assembly (170) including a motor (134), a shaft rotated by the motor (132), a forcer ram (108), and a planetary roller nut (122); and a counterbalance assembly (see paragraphs [0056],

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[0065], [0066], claim 4, and figures 1, 8, 9).

Claim 19 differs from D1 in that a linear drive unit is supported by a base and connected to a point on a walking beam between the horsehead and a rear bearing assembly. However, D2 discloses that a balanced column of a hydraulic power unit (1) is connected between a base (5) and a walking beam (3) (see page 4, lines 6-26 and figures 1, 2). D1 and D2 are concerned with mutually related technical fields. It would not be particularly difficult for a person skilled in the art to combine D1 and D2, and it is regarded that the effect achieved from the combination of D1 and D2 can be easily foreseen by a person skilled in the art. Accordingly, claim 19 would have been obvious over D1 in view of D2. Therefore, claim 19 does not involve an inventive step under PCT Article 33(3).

1.6 Dependent Claim 20

The additional feature of claim 20 is characterized in that the pneumatic counterbalance system comprises a pressure jacket a path of communication between the pressure jacket and the ram, and a compressor connected to the pressure jacket that adjusts the pressure within the pressure jacket. This feature would be easily conceived from a pressure vessel (101) surrounding the forcer ram (108) and a gas compressor providing balancing pressure in D1 (see paragraph [0126] and figures 8, 9). Accordingly, claim 20 would have been obvious over D1 in view of D2. Therefore, claim 20 does not involve an inventive step under PCT Article 33(3).

2. Industrial Applicability

Claims 1-20 are industrially applicable under PCT Article 33(4).