

## PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

|                                                                                                            |
|------------------------------------------------------------------------------------------------------------|
| To:<br>CHANDLER, Kimberly<br><br>Baker Hughes, a GE company, LLC 11211 FM 2920 Tomball,<br>Texas 77375 USA |
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|                                     |                                     |
|-------------------------------------|-------------------------------------|
| Date of mailing<br>(day/month/year) | <b>08 October 2019 (08.10.2019)</b> |
|-------------------------------------|-------------------------------------|

|                                                                                                                                       |                                                                                |                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------|
| Applicant's or agent's file reference<br>CM4-63704WO                                                                                  | <b>FOR FURTHER ACTION</b><br>See paragraph 2 below                             |                                                            |
| International application No.<br><b>PCT/US2019/038372</b>                                                                             | International filing date (day/month/year)<br><b>21 June 2019 (21.06.2019)</b> | Priority date(day/month/year)<br>29 June 2018 (29.06.2018) |
| International Patent Classification (IPC) or both national classification and IPC<br><b>C09K 8/42(2006.01)i, E21B 33/13(2006.01)i</b> |                                                                                |                                                            |
| Applicant<br><b>BAKER HUGHES, A GE COMPANY, LLC</b>                                                                                   |                                                                                |                                                            |

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

- |                                     |              |                                                                                                                                                                        |
|-------------------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | Box No. I    | Basis of the opinion                                                                                                                                                   |
| <input type="checkbox"/>            | Box No. II   | Priority                                                                                                                                                               |
| <input type="checkbox"/>            | Box No. III  | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability                                                                       |
| <input type="checkbox"/>            | Box No. IV   | Lack of unity of invention                                                                                                                                             |
| <input checked="" type="checkbox"/> | 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 |
| <input type="checkbox"/>            | Box No. VI   | Certain documents cited                                                                                                                                                |
| <input type="checkbox"/>            | Box No. VII  | Certain defects in the international application                                                                                                                       |
| <input checked="" type="checkbox"/> | 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<br>International Application Division<br>Korean Intellectual Property Office<br>189 Cheongsa-ro, Seo-gu, Daejeon,<br>35208, Republic of Korea<br>Facsimile No. +82-42-481-8578 | Date of completion of this opinion<br><br>08 October 2019 (08.10.2019) | Authorized officer<br><br>HAN, Inho<br><br>Telephone No. +82-42-481-3362 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------|



**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

**PCT/US2019/038372**

**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/US2019/038372**

**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 | 1-15 | YES |
|                               | Claims | NONE | NO  |
| Inventive step (IS)           | Claims | NONE | YES |
|                               | Claims | 1-15 | NO  |
| Industrial applicability (IA) | Claims | 1-15 | YES |
|                               | Claims | NONE | NO  |

2. Citations and explanations :

Reference is made to the following documents:

D1: US 2011-0278004 A1 (ALI, SYED A. et al.) 17 November 2011

D2: US 2016-0003022 A1 (RESEARCH TRIANGLE INSTITUTE) 07 January 2016

D3: US 5979555 A (GADBERRY, JAMES F. et al.) 09 November 1999

I. Novelty and Inventive Step (PCT Article 33(2) and 33(3))

1. Claims 1-11

1.1. Claim 1

D1, which is considered to be the closest prior art to the subject matter of claim 1, discloses a method of cementing a subterranean well having a wellbore comprising the steps of: providing and pumping a single-phase microemulsion spacer into a region between a casing and the wellbore, the spacer comprising a carrier fluid, viscoelastic surfactant (VES), and viscosifying agents, wherein the VES has the formula:  $RCONH-(CH_2)_a(CH_2CH_2O)_m(CH_2)_b-N+(CH_3)_2-(CH_2)_{a'}(CH_2CH_2O)_{m'}(CH_2)_{b'}COO^-$ , in which: R is an alkyl group that contains from about 14 to about 23 carbon atoms, the alkyl group may be branched or straight chained, and may be saturated or unsaturated; the suffixes a, b, a', and b' are each from 0 to 10, and m and m' are each from 0 to 13; in addition, a and b are each 1 or 2 if m is not 0, and (a+b) is from 2 to about 10 if m is 0; furthermore, a' and b' are each 1 or 2 when m' is not 0, and (a'+b') is from 1 to about 5 if m is 0; (m+m') is from 0 to about 14, and the 0 in either or both CH<sub>2</sub>CH<sub>2</sub>O groups or chains, if present, may be located on the end towards or away from the quaternary nitrogen; and preferred surfactants are betaines (see abstract; claims 1, 14; and paragraphs [0032], [0036]); providing and pumping a cement slurry into the region

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**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

**PCT/US2019/038372**

**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:

The total sum of the all the components exceeds 100% when the component (a carrier fluid) is set at its maximum value (100 wt%), though the rest components (a quaternary surfactant, a viscosifier, and a proppant) are set at their minimum values. Thus, claims 5 and 12 do not meet the requirement of PCT Article 6.

**Supplemental Box**

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Continuation of : Box No. V

between the casing and the well bore (see claim 14); and setting the cement (see paragraph [0004]).

The subject matter of claim 1 differs from that of D1 in that a cement spacer fluid comprises a proppant. However, regarding the different feature, D2 discloses that a spacer fluid can include a proppant (see paragraphs [0041], [0042]). Therefore, claim 1 is novel, but lacks an inventive step as being obvious over D1 in view of D2.

**1.2. Claims 2-5 and 9-11**

Regarding the additional feature of claim 2, D1 discloses pumping the spacer in the region between the casing and the wellbore and pumping the cement slurry into the region between the casing and the wellbore (see claim 14).

The additional feature of claim 3 can be easily derived from the disclosure of D1 that a gelling agent, alkyl quaternary ammonium bentonite, is used to increase the viscosity of a base fluid (spacer) (see paragraph [0047]; and Tables 3-5).

The additional feature of claim 4 can be easily derived from the disclosure of D1 that the density of the microemulsion spacer is equal to or greater than the density of the drilling fluid and the density of the microemulsion spacer is equal to or less than the density of the cement slurry (see claims 19, 20).

The additional feature of claim 5 can be easily modified or optimized by a person skilled in the art through repeated experimentation which does not require a technical burden considering that: the space comprises 5%-30% aqueous fluid, 1-5% surfactant, and the viscosifying agent in D1 (see claim 15; and paragraph [0032]); and the spacer fluid can include the proppant in D2 (see paragraphs [0041], [0042]).

Regarding the additional feature of claim 9, D1 discloses that the viscosifying agents suitable include xanthan gum, carboxymethylcellulose, and hydroxyethylcellulose (see paragraph [0032]).

Regarding the additional feature of claim 10, D1 discloses that the wellbore has been treated with an oil-based or synthetic-based drilling fluid (see paragraph [0040]).

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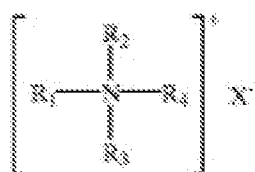
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The additional feature of claim 11 can be easily derived from the disclosure of D1 that the wellbore has been treated with the oil- or synthetic-based drilling fluid prior to a cementing operation (see claim 1).

Therefore, claims 2-5 and 9-11 are novel, but lack an inventive step as being obvious over D1 in view of D2.

**1.3. Claims 6-8**

The additional features of claims 6-8 are merely variations of the disclosure of D3 in a surfactant composition comprising one or more quaternary ammonium compounds of the general



formula: , wherein R1 is a C10 to C30 aliphatic group which

may be branched or straight chained and which may be saturated or unsaturated, provided that about 3% or less of the R1 groups in the surfactant composition have 18 or less carbon atoms; R2, R3 and R4 can be the same or different and are each independently selected from the group consisting of C2 to C6 hydroxyalkyl groups, poly(oxyalkylene) groups and C1 to C6 aliphatic groups which can be branched or straight chained, saturated or unsaturated and which is optionally substituted with one or more groups that renders the R2, R3 or R4 group more hydrophilic, the R2, R3 and R4 groups can be formed into a heterocyclic 5- or 6-member ring structure which includes the nitrogen atom of the amine, and X<sup>-</sup> is an anion such as a nitrate, acetate, oxalate, perchlorate or halide (Cl, Br or I) (see claim 1; and column 4, lines 2-33). Therefore, claims 6-8 are novel but lack an inventive step as being obvious over D1 in view of D2 and D3.

**2. Claims 12-15**

(NOTE: This written opinion and international search report have been made on the presumption that claim 15 refers to claim 12.)

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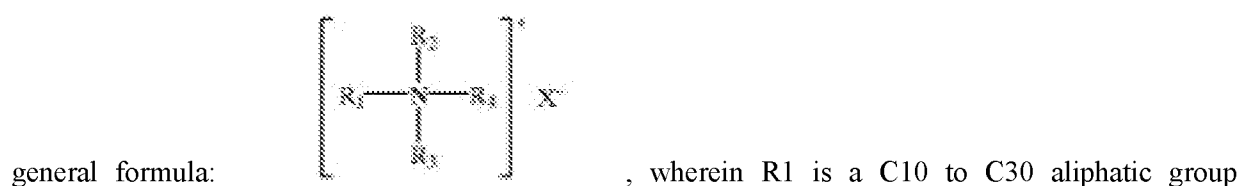
**2.1. Claim 12**

D1, which is considered to be the closest prior art to the subject matter of claim 12, discloses a single-phase microemulsion spacer comprising: 5%-30% aqueous fluid (water) (see claim 15; and paragraph [0023]); a viscoelastic surfactant (VES) having the formula:  $RCONH-(CH_2)_a(CH_2CH_2O)_m(CH_2)_b-N+(CH_3)_2-(CH_2)_{a'}(CH_2CH_2O)_{m'}(CH_2)_{b'}COO^-$ , in which R is an alkyl group that contains from about 14 to about 23 carbon atoms. The alkyl group may be branched or straight chained, and may be saturated or unsaturated. The suffixes a, b, a', and b' are each from 0 to 10, and m and m' are each from 0 to 13; in addition, a and b are each 1 or 2 if m is not 0, and (a+b) is from 2 to about 10 if m is 0. Furthermore, a' and b' are each 1 or 2 when m' is not 0, and (a'+b') is from 1 to about 5 if m is 0; (m+m') is from 0 to about 14, and the 0 in either or both CH<sub>2</sub>CH<sub>2</sub>O groups or chains, if present, may be located on the end towards or away from the quaternary nitrogen; and preferred surfactants are betaines (see abstract; claims 1, 14; and paragraph [0036]); and viscosifying agents (see paragraph [0032]).

The subject matter of claim 12 differs from that of D1 in: a cement spacer fluid comprising about 1 to about 65 wt% of a proppant, each based on the weight of water in the cement spacer fluid (different feature 1); and the numerical ranges of components in the cement spacer (different feature 2). However, regarding the different feature 1, D2 discloses that a spacer fluid can include a proppant (see paragraphs [0041], [0042]). And the different feature 2 can be easily modified or optimized by a person skilled in the art through repeated experimentation which does not require a technical burden. Therefore, claim 12 is novel, but lacks an inventive step as being obvious over D1 in view of D2.

**2.2. Claims 13 and 14**

The additional features of claims 13 and 14 are merely variations of the disclosure of D3 in a surfactant composition comprising one or more quaternary ammonium compounds of the



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which may be branched or straight chained and which may be saturated or unsaturated, provided that about 3% or less of the R1 groups in the surfactant composition have 18 or less carbon atoms; R2, R3 and R4 can be the same or different and are each independently selected from the group consisting of C2 to C6 hydroxyalkyl groups, poly(oxyalkylene) groups and C1 to C6 aliphatic groups which can be branched or straight chained, saturated or unsaturated and which is optionally substituted with one or more groups that renders the R2, R3 or R4 group more hydrophilic, the R2, R3 and R4 groups can be formed into a heterocyclic 5- or 6-member ring structure which includes the nitrogen atom of the amine, and X<sup>-</sup> is an anion such as a nitrate, acetate, oxalate, perchlorate or halide (Cl, Br or I) (see claim 1; and column 4, lines 2-33). Therefore, claims 13 and 14 are novel, but lack an inventive step as being obvious over D1 in view of D2 and D3.

**2.3. Claim 15**

Regarding the additional feature of claim 15, D1 discloses that the viscosifying agents include xanthan gum, carboxymethylcellulose, and hydroxyethylcellulose (see paragraph [0032]). Therefore, claim 15 is novel, but lacks an inventive step as being obvious over D1 in view of D2.

**II. Industrial Applicability (PCT Article 33(4))**

Claims 1-15 are industrially applicable.