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PCT

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**
(PCT Rule 43*bis*.1)

To:

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Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
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FOR FURTHER ACTION
See paragraph 2 below

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International Patent Classification (IPC) or both national classification and IPC
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Applicant
FARADAY&FUTURE INC.

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 43*bis*.1(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 usually 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 66.1*bis*(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:



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Box No. I Basis of the 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 43bis.1(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 13ter.1(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 13ter.1(a)).
 - on paper or in the form of an image file (Rule 13ter.1(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:

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)	Yes: Claims	<u>1-20</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	<u>1-20</u>
Industrial applicability (IA)	Yes: Claims	<u>1-20</u>
	No: Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

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:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 2011/135975 A1 (FUHR JASON D [US] ET AL) 9 June 2011
(2011-06-09)

D2 US 2013/344362 A1 (RAISCH SVEN ROBERT [DE] ET AL) 26
December 2013 (2013-12-26)

D3 US 2013/306353 A1 (ZHAO WEIPING [US]) 21 November 2013
(2013-11-21)

D4 US 2009/297892 A1 (IJAZ MUJEEB [US] ET AL) 3 December
2009 (2009-12-03)

2 Inventive Step

2.1 The present application does not meet the criteria of Article 33(3) PCT, because the subject-matter of claims 1-20 does not involve an inventive step.

2.2 D1 may be regarded as being the prior art closest to the subject-matter of claim 1 as it relates to an energy storage system where the cells are partially immersed in a cooling fluid.

2.3 D1 discloses an energy-storage system in the form of a battery module (abstract, figure 32) comprising a plurality of battery cells (224). The cells are disposed (paragraph [0085]) in a retainer (246) which includes a sealing element (paragraph [0086]). The sealing element separates the top and bottom parts of the cells, where the top part is exposed to a coolant (paragraph [0088]), and the bottom part is enclosed in a chamber (250) (paragraph [0085]), constituting the non-coolant section. As the seal prevents the gases in the chamber (250) to escape (paragraph [0085]), then it is obvious that the coolant does not enter the chamber.

- 2.3.1 The subject-matter of claim 1 therefore differs from this known energy-storage system in that the cells have a coated portion and a non-coated portion, the coated portion disposed in the coolant section and the non-coated portion disposed in the non-coolant section.
- 2.3.2 According to the present application (paragraph [0044]), the coating has two effects, (i) to avoid shorting of the cells, and (ii) to transfer heat to the coolant.
- 2.3.3 The problem to be solved by the present invention may therefore be regarded as how to insulate electrically the cells while providing enhanced temperature control.
- 2.3.4 The solution proposed in claim 1 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons. D2 discloses (abstract) a temperature-controlling plastic housing for lithium-ion cells, including at least an additive to increase thermal conductivity. D2 explicitly discloses (paragraphs [0045]-[0046]) that the additive must have high electrical resistance and high thermal conductivity, and it is obvious to the skilled person that a plastic housing is electrically insulating. The skilled person looking to solve the problem above would therefore select the cell coating of D2 and optimize the amount of coating necessary to solve the problem above without performing an inventive step.
- 2.3.5 Therefore, the subject-matter of independent claim 1 can be readily derived from D1 in combination with D2 and thus it does not meet the requirements of the PCT concerning inventive step.
- 2.4 Furthermore, the skilled person would use his general knowledge to select water and ethylene glycol as coolant liquids, as these liquids are obvious choices. As discussed above, D2 explicitly discloses (paragraphs [0045]-[0046]) that the coating material has high electrical resistance and high thermal conductivity, and explicitly discloses boron nitride and aluminum oxide as possible choices. D1 explicitly discloses (paragraph [0089]) that the seal can be made with silicone, and therefore the retainer is potted. D1 also explicitly discloses (paragraph [0044]) that the cells can be of the cylindrical lithium-ion type, and that (paragraph [0045]) the cells are all connected by welding to busbars contained in a busbar holder, which can be therefore seen as a current carrier. The negative and positive connections are an obvious feature that the skilled person would optimize without exercising any inventive skills.

- 2.4.1 Therefore, the subject-matter of dependent claims 2-8 can be readily derived from D1 in combination with D2 and thus it does not meet the requirements of the PCT concerning inventive step.
- 2.5 The subject-matter of claim 9 introduces another feature over the non-inventive energy-storage system subject-matter of claim 6, in particular that the current carrier and the terminals of the cells are laser welded. As this difference has no synergetic effect with the features differing between the energy-storage system known from D1 and those subject-matter of claim 6 (i.e. the coating on the battery cells and the potting of the retainer), then the subject-matter of claim 6 is treated as a mere aggregation of features.
- 2.5.1 According to the present application (paragraph [0037]), the effect of laser welding terminals and current carrier is that (i) a lower resistance and consequently a higher power efficiency is obtained; and (ii) faster welding is achieved.
- 2.5.2 The problem to be solved by the present invention may therefore be regarded as how to achieve an energy-storage system with greater performance and high manufacturing efficiency (paragraph [0037]).
- 2.5.3 The solution proposed in claim 9 of the present application cannot be considered to involve an inventive step (Article 33(3) PCT). D3 discloses (paragraph [0055]) that laser welding busbar and terminals allows to obtain low interfacial resistances and that this process is quicker than other welding methods. The skilled person looking to solve the problem above would therefore select this technique without performing an inventive step.
- 2.5.4 Therefore, the subject-matter of dependent claim 9 can be readily derived from D1 in combination with D3 and thus it does not meet the requirements of the PCT concerning inventive step.
- 2.6 The subject-matter of claim 10 introduces another feature over the non-inventive energy-storage system subject-matter of claim 7, in particular that fuses are present on the current carrier. As this difference has no synergetic effect with the features differing between the energy-storage system known from D1 and those subject-matter of claim 7 (i.e. the coating on the battery cells), then the subject-matter of claim 10 is treated as a mere aggregation of features.

- 2.6.1 According to the present application (paragraph [0038]), the effect of the fuse is to blow in case of an internal short circuit, thereby cutting the current flow.
- 2.6.2 The problem to be solved by the present invention may therefore be regarded as how to provide an energy-storage system with increased safety.
- 2.6.3 The solution proposed in claim 10 of the present application cannot be considered to involve an inventive step (Article 33(3) PCT). D4 discloses (paragraphs [0100]) that a fuse can be placed on each cell in order to interrupt the current flow during a short circuit. Furthermore, D4 also discloses (paragraph [0101], figure 27) that the fuses can be integrated on the busbars. The skilled person looking to solve the problem above would therefore select the fuses of D4 without performing an inventive step.
- 2.6.4 Therefore, the subject-matter of dependent claim 10 can be readily derived from D1 in combination with D4 and thus it does not meet the requirements of the PCT concerning inventive step.
- 2.7 D1 may be regarded as being the prior art closest to the subject-matter of claim 11 as it relates to an energy storage system where the cells are partially immersed in a cooling fluid.
- 2.7.1 D1 discloses an energy-storage system in the form of a battery module (abstract, figure 32) comprising a plurality of battery cells (224). The cells are disposed (paragraph [0085]) in a retainer (246) which includes a sealing element (paragraph [0086]). The sealing element separates the top and bottom parts of the cells, where the top part is exposed to a coolant (paragraph [0088]), and the bottom part is enclosed in a chamber (250) (paragraph [0085]), where the coolant does not enter: as the seal prevents the gases in the chamber (250) to escape (paragraph [0085]), then it is obvious that the coolant does not enter the chamber.
- 2.7.2 The subject-matter of claim 11 therefore differs from this known energy-storage system in that the cells have a coated portion and a non-coated portion, and that the retainer is disposed between the coated and non-coated portions.
- 2.7.3 According to the present application (paragraph [0044]), the coating has two effects, (i) to avoid shorting of the cells, and (ii) to transfer heat to the coolant; while no specific technical effect is given for the position of the retainer.

- 2.7.4 The problem to be solved by the present invention may therefore be regarded as how to insulate electrically the cells while providing enhanced temperature control.
- 2.7.5 The solution proposed in claim 11 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons. D2 discloses (abstract) a temperature-controlling plastic housing for lithium-ion cells, including at least an additive to increase thermal conductivity. D2 explicitly discloses (paragraphs [0045]-[0046]) that the additive must have high electrical resistance and high thermal conductivity, and it is obvious to the skilled person that a plastic housing is electrically insulating. The skilled person looking to solve the problem above would therefore select the cell coating of D2 and optimize the amount of coating and the position of the retainer in order to solve the problem above without performing an inventive step.
- 2.7.6 Therefore, the subject-matter of independent claim 11 can be readily derived from D1 in combination with D2 and thus it does not meet the requirements of the PCT concerning inventive step.
- 2.8 Furthermore, D1 also explicitly discloses (paragraph [0044]) that the cells can be of the cylindrical lithium-ion type. The skilled person would use his general knowledge to select water and ethylene glycol as coolant liquids, as these liquids are obvious choices. As discussed above, D2 explicitly discloses (paragraphs [0045]-[0046]) that the coating material has high electrical resistance and high thermal conductivity, and explicitly discloses boron nitride and aluminum oxide as possible choices. D1 explicitly discloses (paragraph [0089]) that the seal can be made with silicone, and therefore the retainer is potted. D1 also discloses (paragraph [0045]) that the cells are all connected by welding to busbars contained in a busbar holder, which can be therefore seen as a current carrier. The negative and positive connections are an obvious feature that the skilled person would optimize without exercising any inventive skills.
- 2.8.1 Therefore, the subject-matter of dependent claims 12-18 can be readily derived from D1 in combination with D2 and thus it does not meet the requirements of the PCT concerning inventive step.

- 2.9 The subject-matter of claim 19 introduces another feature over the non-inventive energy-storage system subject-matter of claim 18, in particular that the current carrier and the terminals of the cells are laser welded. As this difference has no synergetic effect with the features differing between the energy-storage system known from D1 and those subject-matter of claim 18 (i.e. the coating on the battery cells and the potting of the retainer), then the subject-matter of claim 19 is treated as a mere aggregation of features.
- 2.9.1 According to the present application (paragraph [0037]), the effect of laser welding terminals and current carrier is that (i) a lower resistance and consequently a higher power efficiency is obtained; and (ii) faster welding is achieved.
- 2.9.2 The problem to be solved by the present invention may therefore be regarded as how to achieve an energy-storage system with greater performance and high manufacturing efficiency (paragraph [0037]).
- 2.9.3 The solution proposed in claim 19 of the present application cannot be considered to involve an inventive step (Article 33(3) PCT). D3 discloses (paragraph [0055]) that laser welding busbar and terminals allows to obtain low interfacial resistances and that this process is quicker than other welding methods. The skilled person looking to solve the problem above would therefore select this technique without performing an inventive step.
- 2.9.4 Therefore, the subject-matter of dependent claim 19 can be readily derived from D1 in combination with D3 and thus it does not meet the requirements of the PCT concerning inventive step.
- 2.10 The subject-matter of claim 20 introduces another feature over the non-inventive energy-storage system subject-matter of claim 19, in particular that fuses are present on the current carrier. As this difference has no synergetic effect with the features differing between the energy-storage system known from D1 and those subject-matter of claim 19 (i.e. the coating on the battery cells, the potting of the retainer, and the laser welding of busbars and terminals), then the subject-matter of claim 20 is treated as a mere aggregation of features.
- 2.10.1 According to the present application (paragraph [0038]), the effect of the fuse is to blow in case of an internal short circuit, thereby cutting the current flow.
- 2.10.2 The problem to be solved by the present invention may therefore be regarded as how to provide an energy-storage system with increased safety.

- 2.10.3 The solution proposed in claim 20 of the present application cannot be considered to involve an inventive step (Article 33(3) PCT). D4 discloses (paragraphs [0100]) that a fuse can be placed on each cell in order to interrupt the current flow during a short circuit. Furthermore, D4 also discloses (paragraph [0101], figure 27) that the fuses can be integrated on the busbars. The skilled person looking to solve the problem above would therefore select the fuses of D4 without performing an inventive step.
- 2.10.4 Therefore, the subject-matter of dependent claim 20 can be readily derived from D1 in combination with D4 and thus it does not meet the requirements of the PCT concerning inventive step.

3 Industrial Applicability

- 3.1 Claims 1-20 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject-matter claimed can be made or used in industry.

Re Item VII

Certain defects in the international application

- 4 The application does not meet the requirements of the PCT because of the following formal defects.
- 4.1 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in D1-D4 is not mentioned in the description, nor are these documents identified therein.

Re Item VIII

Certain observations on the international application

- 5 The application does not meet the requirements of Article 6 PCT, because claims 3, 11, 13 are not clear.

- 5.1 The expressions "high electrical resistance" and "high thermal conductivity" used in claims 3 and 13 are vague and unclear and leave the reader in doubt as to the meaning of the technical feature to which they refer, thereby rendering the definition of the subject-matter of said claims unclear, Article 6 PCT. In particular, it is not clear what is the desired amount of electrical resistance and thermal conductivity, since the word "high" does not define a commonly recognized value.
- 5.2 Claim 11 uses the word "approximately". This term is unclear since the reader cannot quantify the tolerance in the position of the retainer.
- 5.3 Although claims 1 and 11 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard of minor details of the definition of the subject-matter for which protection is sought. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.
- 5.4 The present application (paragraph [0001]) refers to documents US62/186977 and US14/841617, and mentions that their content is "incorporated by reference" in the description. If the content of these documents is essential towards towards the disclosure of the present inventions (Article 5 PCT), then the relevant parts should be explicitly cited. Otherwise, these references should be deleted.