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Reply requested to:  
Bremen

Ihr Zeichen:  
Your reference:

Our sign: 41513  
Our reference: (1515)

Bremen, den  
23.04.2024

Cancellation plaintiff:  
Proprietor and  
defendant: Patent in  
suit: File number DE:  
BPatG-Az.:

No Canary GmbH, 38239 Salzgitter  
Duesenfeld GmbH, 38176 Wendeburg  
EP 3,312,922  
50.2017.000.109.2  
Not yet assigned

## ACTION FOR ANNULMENT

In the name and on behalf of

No Canary GmbH, represented by the managing directors Benjamin von  
Loeper and Christian Hanisch, Linke-Hoffmann-Busch Straße 1, 38239  
Salzgitter,

- Plaintiff for annulment -

Authorized representative:

Jabbusch Siekmann & Wasiljeff Patent  
Attorneys, Otto-Lilienthal-Str. 25, 28199 Bremen

Contributing lawyers:

Attorneys-at-Law Klaus Haft and Dr. Alexander  
Lukas and attorneys-at-law of PartGmbH HOYNG  
ROKH MONEGIER, Steinstraße 20, 40212  
Düsseldorf

against the

Duesenfeld GmbH, represented by the managing director Lydia Grote, Roth-  
bergstraße 8, 38176 Wendeburg,

- Defendant for annulment -

we bring an action for revocation on the grounds of invalidity of the German part of the European patent EP 3 312 922 and apply for

1. declare the European patent EP 3 312 922 invalid with effect for the territory of the Federal Republic of Germany to the extent of patent claims 1, 8, 9, 10, 12 and 14;
2. Order the defendant to pay the costs.

The amount in dispute is provisionally estimated at € 625,000.

The court fees in the amount of 20,227.50€ will be paid after notification of the court file number.

As the European patent EP 3 312 922 is being asserted in the above-mentioned parallel proceedings before the Düsseldorf Regional Court, we request that a date be set as soon as possible in this matter.

#### Reason

The European patent EP 3 312 922 (hereinafter also referred to as the "patent in dispute") is protected under Art. II § 6 (1) sentence 1 no. 1-3 IntPatÜG in conjunction with Art. Art. 138 para. 1 lit. a) to c) to be invalid to the extent requested.

It is at least to the extent requested in accordance with Art. 138 para. 1 lit. c) in conjunction with. Art. II § 6 para. 1 sentence 1 no. 3 IntPatÜG, since the subject matter of the patent in suit goes beyond the content of the application as originally filed.

Furthermore, the patent in suit is at least to the extent requested pursuant to Art. 138 (1) (b) in conjunction with Art. 138 (1) (c). Art. II § 6 para. 1 sentence 1 no. 2 IntPatÜG, since the patent in suit does not disclose the invention in question so clearly and completely that a person skilled in the art can carry it out.

Furthermore, the patent in suit is at least to the extent requested pursuant to Art. 138 para. 1 lit. a) in conjunction with Art. 138 para. 1 lit. b). Art. II § 6 (1) sentence 1 no. 1 IntPatÜG due to lack of patentability, in particular lack of novelty pursuant to Art. 54 EPC and lack of inventive step pursuant to Art. 56 EPC.

## **I. Background to the action for annulment**

The revocation defendant has an action for patent infringement based on the patent in dispute before the Düsseldorf Regional Court, which conducted by the Düsseldorf Regional Court under the case number 4b O 100/23. The patent infringement action relates to patent claims 1, 8, 9, 10, 12 and 14. We are submitting a copy of the statement of claim dated November 27, 2023 as a

Annex K1.

The above provisionally estimated value in dispute is based on the value in dispute stated by the defendant in the above-mentioned patent infringement action at € 500,000 and takes into account the case law according to which the value in dispute of the nullity proceedings is increased by one quarter compared to the value in dispute of the infringement proceedings (see *Keukenschryver*, Nichtigkeitsverfahren, 7th ed. 2021, para. 567, with numerous case law references in footnote 24).

## **II. Patent in dispute**

1. The defendant is the owner of European patent EP 3 312 922 relating to a method for treating used lithium batteries and a battery processing system for treating batteries. The underlying application with the European patent application number 17161150.2 was filed on March 15, 2017 and published on April 25, 2018. The patent grant was published and the patent specification issued on August 15, 2018.

Appendix K2

we enclose the patent specification EP 3 312 922 B1 of the patent in suit. Furthermore, the patent specification EP 3 312 922 A1 is attached as

Appendix K3

attached. In accordance with the

#### Appendix K4

According to the attached excerpt from the German patent register, the patent in suit is in with effect in Germany. It is listed in the German patent register under file number 50 2017 000 109.2. The revocation defendant is entered there as the proprietor.

### III. Evidence

As part of the

#### Plant group K5

the following documents were as evidence in the proceedings:

- D1: WO 2016/174156 A1 (republished on 3/11/2016, but Art. 54 (3) EPC) EP 3
- D2: 289 627 B1 (patent granted to D1, proves applicability of Art. 54 (3) EPC) of D1)
- D3: Priority document DE 10 2015 207 843.4 for D1
- D4: US 2016/0049699 A1 (published on 18.2.2016) DE
- D5: 10 2011 110 083 A1 (published on 14.2.2013)
- D6: EP 0 794 587 A2 (published on 10.9.1997)
- D7: CN 102496752 A (published on 13.6.2012)
- D7A: Translation of D7
- D8: Final report on the LithoRec II research project of the grant recipient Hosokawa Alpine Aktiengesellschaft (published on 29.8.2016)
- D8-B: Confirmation of the TIB (Technical Information Library), Hanover, dated 4.3.2024 on the publication of D8
- D9: Joe Aliasso "Choose the Right Vacuum Pump", Chemical Engineering, McGrawHill, (published in March 1999)
- D10: WO 2010/102377 A1 (published on 16.9.2010)
- D11: DE 10 2012 024 876 A1
- D12: "LithoRec - Recycling of lithium-ion batteries" Final report of the joint project from April 2, 2012, duration of the project: September 1, 2009 - September 30, 2011,
- D13: CN 1438729 A,
- D13a: Translation of D13,

D14: JP2005-197149A,  
D14a: Translation of D14, D15:  
CN 105 552 470 A,  
D15a: Translation of D15 and  
D16: WO 2010/149611 A1,

The documents D1, D5, D10 and D11 are known from the granting procedure. The other documents are introduced here for the first time.

The invalidity applicant refers to D10 to D16 as a precautionary measure in the event that individual claim features in the documents D1 to D9 discussed in detail should be regarded as undisclosed, since they also call into question the inventive step of the contested claims.

Further submissions on these documents are reserved, in particular in the event that the patent proprietor should amend the claims.

#### IV. Subject matter of the patent in suit

According to the generic term of claim 1, the patent in suit relates to a method for treating used lithium batteries (10) comprising the steps:

- (a) shredding the batteries (10) so that shredded material (24) is obtained, and
- (b) Dry at a maximum of 80 °C.

Furthermore, according to the generic term of claim 8, the patent in suit relates to a battery processing system for treating batteries, in particular used lithium batteries, with:

- (a) a shredding unit (18) for shredding the batteries (10), so that shredded material (24) is obtained,
- (b) an inactivating device in the form of a drying device (26) for inactivating the comminuted material (24) and
- (c) a vacuum unit to the drying device (26) for generating a vacuum in the drying device (26),

- (d) wherein the drying device (26) is designed for drying at a temperature of at most 80 °C.

In the introduction to the description, the patent in suit cites several prior art documents relating to the treatment of used batteries and their waste:

According to US 2005/0241943 A1, batteries are heated before being crushed so that plastic components of the batteries are destroyed. The disadvantage mentioned is that the remaining components of the batteries can be contaminated with degradation products of the plastic.

Furthermore, according to DE 10 2012 024 876 A1, electrolyte cells are first crushed under inert gas and then dusted with deactivation powder in order to spontaneous combustion of the electrochemically active material. The disadvantage mentioned is that the resulting material is nevertheless dangerous and the formation of a flammable/explosive atmosphere cannot ruled out.

Furthermore, according to DE 10 2011 110 083 A1, galvanic cells are first crushed, then pre-dried and subsequently sifted. Finally, a binder is decomposed in an oven. The disadvantage mentioned is that toxic fluorinated compounds and hydrogen fluoride can be produced.

Furthermore, according to WO 2010/102377 A1, lithium batteries are heated in a rotary kiln and the resulting gases are extracted. The disadvantage is that the electrolyte is difficult to recycle and large quantities of fluoroorganic compounds and hydrogen fluoride are produced.

Furthermore, according to WO 2016/174156 A1, batteries are first deactivated decentrally and filled into a transport container. After transportation of the crushed material to a central processing point, the deactivated cell fragments are further processed.

According to the patent in suit, the alleged invention is based on the task of reducing disadvantages in the prior art.

This task is to be solved by a method according to claim 1 and by a battery processing system according to claim 8.

Claims 1 and 8, which are structured according to generic term and characteristic, are subdivided into features as follows:

- 1 Process for treating used lithium batteries (10) with the steps:
  - (a) shredding the batteries (10) so that shredded material (24) is obtained, and
  - (b) Drying at a maximum of 80 °C, characterized in that
  - (c) the drying takes place at a pressure of at most 300 hPa and the comminution material (24) is inactivated by the drying, so that an electrochemical reaction is impossible, and
  - (d) the inactivated comminuted material (42) not filled into a transport container after drying.
  
8. Battery processing system for treating batteries, in particular used lithium batteries, with:
  - (a) a shredding unit (18) for shredding the batteries (10), so that shredded material (24) is obtained,
  - (b) an inactivating device in the form of a drying device (26) for inactivating the comminuted material (24) and
  - (c) a vacuum unit to the drying device (26) for generating a vacuum in the drying device (26),
  - (d) wherein the drying device (26) is designed for drying at a temperature of at most 80 °C, characterized in that
  - (e) the drying device (26) is designed to generate a vacuum of at least 300 hPa and that

- (f) a particle separator arranged between the drying device and the condenser in the direction of material flow.

This classification of features is taken from the patent specification, so that a separate classification of features is not provided.

## V. Specialist

The skilled person responsible for the subject matter of the patent in suit is a graduate engineer in mechanical engineering or process engineering who has several years of development experience in the fields of recycling technology and battery chemistry as well as the recycling of batteries.

## VI. Interpretation

### 1. Claim 1

- a) according to feature (a) of claim 1, *the batteries are "reduced in size so that shredded material is obtained"*.

The patent in suit, paragraph [0022] provides in this regard:

"[0022] It is favorable if the drying takes place after the batteries have been crushed. It is possible and represents an embodiment of the invention that the batteries are exposed to a vacuum in the uncomminuted state, so that at least parts of the electrolyte evaporate, whereby the resulting gas either escapes through a safety valve in the accumulator or the battery destroyed by the pressure difference between the external environment and the internal pressure, so that evaporating electrolyte can escape. However, as the electrolyte is usually present between tightly wound or stacked and pressed layers of electrodes and separator and in their pores and connected to other components of the batteries, this procedure can time-consuming. It is therefore often more favorable, and represents a preferred embodiment of the invention, that the batteries are mechanically comminuted, for example by cutting, shearing, pral- ing, or crushing.

action, separation and/or crushing. This provides a larger interface for the material transfer into the gas phase."

Accordingly, *mechanically reducing the size* of the batteries is merely a preferred embodiment of the alleged invention. However, the alleged invention does not intend to limit itself to this. Rather, the destruction of a battery by a pressure difference between the external environment and the internal pressure and the resulting evaporation of the electrolyte as well as the evaporation of parts of the electrolyte and the escape of the resulting gas through a safety valve should be understood as a reduction in size according to the invention.

b) Feature (b) of claim 1 is self-explanatory.

c) According to feature (c) of claim 1, the comminution material (24) is inactivated by drying, so that an electrochemical reaction becomes impossible. Paragraph [0041] of the patent in suit explains this:

"Preferably, the comminuted material is dried until the electrolyte content in the comminuted material is so low that electrochemical reaction is impossible. In other words, the electrolyte content is less than a threshold value, whereby the threshold value is selected such that the cell voltage has fallen to a maximum of a quarter when this threshold value is not reached. This threshold value determined, for example, by determining the cell voltage of a battery as a function of the electrolyte content. Shortly before the threshold value is reached, the cell voltage collapses i.e. it drops by at least 75%. If the threshold value is , the battery contains so little electrolyte that an electrochemical reaction is no longer possible in the immediate vicinity." [Underlining added on this side.]

Feature (c) does state *"that an electrochemical reaction should be impossible"*. However, the above passage in the description qualifies this characteristic. The characteristic is therefore not to be understood absolutely, but in the sense of *"that an electrochemical reaction is impossible"*.

*electrochemical reaction is no longer possible to a good approximation'*. This means that an electrochemical reaction should apparently still be possible within certain limits.

Feature (c), according to which *"the comminuted material is inactivated drying so that an electrochemical reaction is impossible"*, must therefore be interpreted as meaning that an electrochemical reaction is merely reduced.

d) According to feature (d), *"the inactivated comminuted material is not filled into a transport container after drying"*.

According to paragraphs [0090], [0091] and [0100] of the patent in suit, Fig. 1 shows a flow diagram of a method according to the invention and Fig. 2 shows a cross-section of a battery processing plant according to the invention.

Fig. 1 shows a comminution unit 18, via which comminuted material 24 fed into a drying device 26. An arrow below the drying device points to a filling device 44. The arrow is provided with the reference numeral 42, which designates inactivated comminuted material according to the list of reference signs in accordance with paragraph (0114) of the patent in suit. Below the filling device 44, a further arrow points to a packaging or a (transport) container 46. The words "Dried battery fragments" on both arrows.

Fig. 2 also shows a comminution unit 18, a first conveyor 56 to a drying device 26 and a second conveyor 58 to a filling device 44 with a packaging or (transport) container 46 containing inactive comminuted material 42.

In order to interpret feature (d) without contradiction to Figures 1 and 2 according to the invention, the skilled person assumes that the presence of a filling device and a (transport) container does not exclude that *"the inactivated comminuted material is not filled into a transport container drying"*, but rather includes that *"the inactivated comminuted material is not filled into a transport container after drying"*.

This interpretation is supported by paragraph [0039] of the patent in suit. There it is described as a *preferred embodiment* of the invention that the comminuted material further processed directly after drying and is not filled into a transport container. The reference to a *preferred embodiment* of the invention means that the subject matter of the alleged invention also includes the case in which the comminuted material is not further processed directly after drying, but is filled into a transport container.

## 2. Claim 8

a) Feature (a) of claim 8 is self-explanatory.

b) Feature (b) of claim 8 recites an inactivation device in the form of a drying device for inactivating the comminuted material.

From the wording "*inactivating device in the form of a drying device for inactivating the comminuted material*", the skilled person understands that the comminuted material is inactivated by drying the comminuted material in the drying device - unless the comminuted material enters the drying device already inactivated, because then inactivation can no longer take place in the drying device. Each drying device therefore an inactivation device, unless inactivated comminuted material is the drying device.

c) Features (c) and (d) of claim 8 are self-explanatory.

d) Feature (e) of claim 8 states that "*the drying device is designed to generate a vacuum of at least 300 hPa*".

It is recalled from feature (c) of claim 1 that "*drying at a pressure of at most 300 hPa* e/Yo/g".

The pressure value (300 hPa) is the same in both of these features. However, the pressure value is linked to "at least" on the one hand and "at most" on the other.

Furthermore, the pressure value is linked to the term "vacuum" on the one hand and the term "pressure" on the other.

The description indicates that drying should take place at a pressure below the ambient pressure.

The person skilled in the art concludes from this that at an ambient pressure of, for example, 1013 hPa according to feature (d) of claim 8, there should be a negative pressure of at least 300 hPa in the drying device compared to the ambient pressure, so that in this example there is an absolute pressure of 713 hPa or lower in the drying device.

In contrast, the person skilled in the art concludes from feature (c) of claim 1 that an absolute pressure of 300 hPa or lower is present in the drying device, so that in this example with an ambient pressure of 1013 hPa a pressure difference of 713 hPa or more is present.

Accordingly, claim B permits a higher absolute pressure in the drying device than claim 1.

e) Features (f) of claim 8 state that *"a particle separator is arranged between the drying device and the condenser in the direction of material flow"*.

If the definite article ("the") before "capacitor" is replaced by the indefinite article ("one"), this feature is so far understandable.

However, the term "particle separator" used in feature (f) is only used in this feature and in claim 10, but not in the description.

The term "particle" is introduced in paragraph [0020] of the patent in suit in connection with the crushing unit. Accordingly, a shredding unit is a device that shreds the batteries during operation. For example, the shredding unit is thus a pressure shredding unit, an impact shredding unit, a shear shredding unit, a cutting shredding unit

and/or impact crushing, in which the batteries are thrown against a wall, bounce against a moving tool or two particles collide with each other.

Accordingly, particles within the meaning of the patent in suit are (at least also) battery fragments which are produced during shredding and are consequently contained in the shredded material.

The person skilled in the art therefore understands the term "particle separator", which is only used in claims 8 and 10, (at least also) to mean a device which is used to separate battery fragments produced during the crushing process.

**VII. Inadmissible extension '(Art. II § 6 para. 1 sentence 1 no. 3 IntPatÜG)**

1. Claim 1

The subject matter of claim 1 goes beyond the content of the application as originally filed and is therefore inadmissibly broadened (Art. II Sec. 6 (1) sentence 1 no. 3 IntPatÜG).

Feature (c) of claim 1 was supplemented in the course of the grant procedure by the subfeature *"the comminuted material is inactivated by drying SO that an electrochemical reaction is impossible"*.

The consequence of the inactivation of the comminution material is therefore that an electrochemical reaction is impossible. In other words, the impossibility of an electrochemical reaction is a consequence of the inactivation of the comminution material.

This feature was not included in the claims of the originally submitted version.

Paragraphs [0009], [0041] and [0048] of the disclosure document (EP 3 312 922 A1) relating to the patent in suit contain references to how an electrochemical reaction is made impossible.

Paragraph [0009] of the disclosure states that drying can remove so much electrolyte from the comminuted material that an electrochemical reaction is no longer possible or only to a negligibly small extent.

Paragraph [0041] of the disclosure that the comminuted material is dried until the electrolyte content in the comminuted material is so low that an electrochemical reaction is impossible.

Finally, paragraph [0068] states that the drying device is arranged to dry the comminuted material for such a long time until an electrolyte content is so small that an electrochemical reaction is impossible.

From all these passages in the description, it is clear that the impossibility of an electrochemical reaction is a consequence of the reduction of the electrolyte content.

However, the impossibility of an electrochemical reaction as a result of the inactivation of the comminution of the crushing agent is not disclosed in the original application documents (neither in their claims nor in their description).

There is no support for the addition of the above subfeature in the original application documents, nor is there a clear teaching that the impossibility of an electrochemical reaction as a result of the reduction of the electrolyte content would be the same as an impossibility of an electrochemical reaction as a result of the inactivation of the comminution material.

By adding the above-mentioned partial feature to claim 1, the subject matter of the patent in suit goes beyond the content of the patent application as originally filed and is therefore inadmissibly amended within the meaning of Art. II § 6 para. 1 sentence 1 no. 3 IntPatÜG.

## 2. Claim 8

The subject matter of claim 8 goes beyond the content of the application originally filed and is therefore inadmissibly extended (Art. II Sec. 6 (1) No. 3 sentence 1 IntPatÜG).

Feature (c) of claim 8 as originally filed provides that *"a vacuum unit is connected to the drying device for generating a vacuum in the drying device of at least 300 hPa"*.

Accordingly, according to the application as originally filed, it was envisaged that the vacuum system is connected to the drying device and that the vacuum system and the generation of a vacuum are therefore not to be attributed to the drying device.

This is also shown in Figures 1 and 4 with the drying devices 26 or 26.1 and 26.2 and the vacuum system 29 shown in each of these figures. The vacuum system 29 comprises a vacuum pump 30 to generate the vacuum.

The description in the originally submitted version also assumes that the vacuum system is not part of the drying device.

However, feature (e) of claim 8 of the (granted) patent in suit provides, after amendment, that *"the drying device is designed to generate a vacuum of at least 300 hPa"*.

Accordingly, whereas originally the vacuum was generated outside the drying device 26 or 26.1 and 26.2, namely inside the vacuum system 29 by means of a vacuum pump 30, claim 8 as granted now provides that the vacuum is generated by the drying device itself.

There is no support for this amendment in the original notification documents.

By adding the above-mentioned feature (e) to claim 8, the subject matter of the patent in suit goes beyond the content of the patent avoidance in its originally filed version and is therefore inadmissibly amended within the meaning of Art. II § 6 para. 1 sentence 1 no. 3 IntPatÜG.

3. Claims 9, 10, 12 and 14 dependent on claim 8

Claims 9, 10, 12 and 14, which are dependent on claim 8, therefore also contain feature (e) of claim 8 by referring back to claim 8, according to which *"the drying device is designed to generate a vacuum of at least 300 hPa"*.

Claims 9, 10, 12 and 14 therefore go beyond the content of the application as originally filed for the same reason as claim 8 and are therefore inadmissibly extended (Art. II Sec. 6 (1) sentence 1 no. 3 IntPatÜG).

VIII. Insufficient disclosure (Art. II § 6 para. 1 sentence 1 no. 2 **IntPatÜG**)

1. Creating a vacuum with **a drying device**

The patent in suit is to be declared invalid in the scope of claims 8, 9, 10, 12 and 14 because the patent in suit does not disclose the alleged invention so clearly and completely that a person skilled in the art can carry it out (Art. II § 6 para. 1 sentence 1 no. 2 Int- PatÜG).

As shown in the previous section, feature (e) of claim 8 of the patent in suit provides that *"the drying device is adapted to generate a vacuum of at least 300 hPa"*.

As also shown in the previous section, according to the application as originally filed, it is only provided that the drying device 26 or 26.1, 26.2 is connected to a vacuum system 29 which a vacuum in the drying device. Only a vacuum pump 30 is provided in the vacuum system 29 for this purpose. Any vacuum generating devices as

Components of the drying device 26 or 26.1, 26.2 are not disclosed. In other words, a drying device for generating a vacuum is not disclosed.

This also applies to the version granted on the basis of this application in accordance with the patent in suit.

Neither the application as originally filed nor the patent in suit disclose a vacuum pump or any other vacuum generating device as part of the drying apparatus would enable the drying apparatus to generate a vacuum.

Rather, there is no disclosure of a drying device for generating a vacuum.

The alleged invention according to claim 8 is therefore not so clearly and fully disclosed that a person skilled in the art can carry it out.

For *the same* reason, this also applies to claims 9, 10, 12 and 14, which refer back to claim 8, since they also contain the feature *that "the drying device is designed to generate a vacuum of at least 300 hPa"*.

## 2. Sufficient disclosure not in the entire claimed area

The prerequisite for sufficient disclosure within the meaning of Art. II § 6 (1) sentence 1 no. 2 IntPatÜG is (inter alia) that the invention can be realized in the entire claimed area (see Schulte, PatG, 11th ed. 2022, § 34 para. 343 d).

The patent in suit does not fulfill this necessary disclosure requirement in several respects:

### a) Missing disclosure for solid-state electrolytes

Claim 1, as well as claim 8 and the claims 9, 10, 12 and 14 referring back to it, claim a range which on the one hand comprises batteries which

The range includes batteries that use liquid electrolytes and batteries that use solid electrolytes.

However, the disclosure of the alleged invention is limited to batteries with liquid electrolytes. There is no disclosure for batteries with solid electrolytes.

The alleged invention is directed to inactivating the comminuted material of the batteries. According to the patent in suit, the comminuted material is to be dried until an electrolyte content is so low that an electrochemical reaction is impossible (see above and in particular paragraphs [0010], [0041] and [0068] of the patent in suit).

However, the patent in suit does not tell the skilled person how the electrolyte content can be reduced by drying in the case of a battery with solid-state electrolytes.

A solid-state electrolyte would probably have to be liquefied and vaporized or even sublimated (immediate transition from the solid to the gaseous state without prior liquefaction). The patent in suit leaves unanswered how this could be done in detail.

According to the temperature range claimed in claims 1 and 8, such a solid-state electrolyte would also have to liquefy and vaporize or sublime at temperatures of at most 80 °C.

However, a corresponding solid-state electrolyte with these properties is not disclosed in the patent in suit, nor is it known to a person skilled in the art.

The alleged invention - both according to claim 1, as well as according to claim 8 and the claims 9, 10, 12 and 14 referring back to it - is therefore not sufficiently disclosed so that the person skilled in the art could carry it out in the entire claimed area. Therefore, the ground for invalidity according to Art. II § 6 para. 1 sentence 1 no. 2 IntPatÜG exists.

b) Temperature and pressure range

According to claim 1, inactivation of the comminuted material is provided by drying at not more than 80 °C the pressure not more than 300 hPa.

According to claim 8, inactivation of the comminuted material by drying at a maximum of 80 °C is similarly provided, a vacuum of at least 300 hPa being provided. As explained above, this corresponds to an absolute pressure in the case of an ambient pressure in the range of the normal pressure (1,013 hPa) of 713 hPa.

A pressure of 300 hPa corresponds to around 30% of the normal pressure (1,013 hPa). A pressure of 713 hPa corresponds to about 70 % of the normal pressure. The specialist usually refers to such pressures as "negative pressure". The pressure range limit of 300 hPa or 713 hPa is chosen very generously, i.e. high, and is far above the pressure of 100 hPa mentioned solely in the first embodiment example according to Fig. 1, in some cases below 50 hPa (see para. [0094] of the patent in suit). The pressure range limit according to the claim is thus at least 3-fold (claim 1) or at least 7-fold (claim 8 and claims 9, 10, 12 and 14 referring back to it) above the preferred pressure.

For the second embodiment example according to Fig. 4, no specific pressure is specified for the drying device.

Neither embodiment contains any temperature specifications for drying. Only for the condenser a temperature of -10 °G is given (see para. [0096] of the patent in suit).

Neither embodiment contains any information regarding any heating device in the drying device (26).

Paragraph [0027] of the patent in suit deals with pressure and temperature and states that drying takes place under a pressure of at most 300 hPa, in particular at most 100 hPa. The patent in suit there that at such

low pressures, essential components of most electrolytes already vaporize at temperatures of less than 80 °C. Low temperatures are described as advantageous because they hinder the formation of hydrogen fluoride and organofluorine compounds, both of which pose a potential hazard to the battery processing equipment and the environment. Therefore, the formation of hydrogen fluoride and organofluorine compounds must be prevented.

The evaporation of the electrolytes is therefore dependent on the pressure *and* temperature. 1st the pressure is higher, a higher temperature is also required for vaporization. Conversely, a lower pressure allows a lower temperature.

Only the first embodiment example (see para. [0094] of the patent in suit)) only mentions a pressure of 100 hPa, in some cases 50 hPa, and does not specify the temperature required for electrolytes to vaporize.

However, from the respective upper limit values for pressure and temperature according to claim 1, namely at most 300 hPa and at most 80 °C, and according to claim 8, which (as explained above) assumes at most 713 hPa ("*vacuum of at least 300 hPa*") and at most 80 °C, the person skilled in the art does not know, for example, how the temperature is to be selected at a lower pressure than 300 hPa or 713 hPa so that the electrolytes can evaporate and drying can take place.

The alleged invention is therefore not sufficiently disclosed for the person skilled in the art carry it out in entire claimed field. Therefore, the ground for invalidity pursuant to Art. II § 6 (1) sentence 1 no. 2 IntPatÜG is present for claim 1 as well as for claim 8 and the claims 9, 10, 12 and 14 referring back to claim 8.

**IX. Invalidity of claims 1, 8, 9, 10, 12 and 14 due to lack of novelty in relation to post-published prior art under Art. 54 (3) EPC**

The print

D1 (WO 2016/174156 A1)

was published on November 3, 2016, but claims the priority of April 28, 2015, which is prior to the priority of the patent in suit of October 20, 2016, so that D1 constitutes relevant prior art for novelty according to Art. 54 (3) in conjunction with Art. 89 EPC. Art. 89 EPC.

The application under D1 was forwarded to the European Patent Office in one of its official languages (German) in accordance with Art. 153(3) and (4) EPC and the applicant paid the filing fee under Rule 159(1)(c) EPC, as is evident from the subsequent grant of the European patent specification.

D2 (EP 3 289 627 B1)

(whose corresponding disclosure document is D1).

With regard to Art. 89 EPC we add as

D3 (priority document DE 10 2015 207 843.4)

the priority document for D1, which is a reproduction of the German priority application DE 10 2015 207 843.4. All relevant text passages and drawings subsequently referred to in D1 are contained in D3, so that according to Art. 89 EPC the priority date of April 28, 2015 is deemed to be the filing date of D1 for the application of Art. 54(3) EPC.

The requirements of Rule 165 EPC are thus fulfilled. D1 thus qualifies as art under Art. 54(3) in conjunction with Art. 89 EPC. Art. 89 EPC.

D1 shows identical figures 1 to 3 as the patent in suit. As explained above, the patent in suit states that Fig. 1 shows a method according to the invention and Figs. 2 and 3 show battery processing systems according to the invention.

#### 1. Claim 1

D1 shows all the features of claim 1. In detail, D1 shows a

*"Process for the treatment of used lithium batteries (10)"*

as can be seen from D1, p. 1, lines

4-6. D1 also shows

*"(a) Shredding the batteries (10) so that shredded material {£4} is obtained,"*

as can be seen from D1, p. 1, lines 6/7.

D1 also shows

*"(b) drying at not more than 80 °C",*

as can be seen from D1, p. 4, lines 23-33, and p. 8, line 12.

D1 also shows

*"(c) the drying takes place at a pressure of at most 300 hPa and the comminution material (24) is inactivated by the drying, so that an electrochemical reaction is impossible,"*

as is apparent from D1, p. 4, lines 23-33, and p. 2, lines 13-21, claim 1, in particular feature (d), and claim 7, in particular feature (d).

D1 also shows

*"(d) the inactivated comminuted material (42) is not filled into a transport container after drying".*

a) D1, p. 15, lines 21/22, comprises an alternative to waste in a transport container, so that feature (d) is not suitable for delimitation. There, D1 discloses the possibility *"that a vacuum-sealed film, for example an aluminum composite film, is selected as an alternative to the transport container"*. Even in this alternative, D1 therefore also shows feature (d), according to which *the inactive comminuted material is not filled into a transport container after drying*.

b) Fig. 1 of D1 labels the component provided with the reference number 46 as "Packaging / container".

In other words, the component 46 can therefore generally be a package or a container. A package or a container is not necessarily a transport container. For example, a package or a container also refers to a simple storage package or a simple storage container that is not intended for transportation.

The person skilled in the art knows that filling into a package/container 46 does not necessarily constitute filling into a transport container.

Even if it were to be assumed that Fig. 1 necessarily presupposes that the comminuted material is filled into a packaging/container 46 (which, however, as explained below, is not to be assumed), the person skilled in the art understands from Fig. 1 that the packaging or container 46 does not have to be a transport container.

Thus D1 (also) shows the filling into a simple packaging or a simple container, i.e. that the shredded material is *not* filled into a 7ransoo container after drying.

Claim 1 is therefore not new in relation to D1.

c) Moreover, the above interpretation of feature (d) of claim 8 results in the following: According to paragraphs [0090], [0091] and [0100] of the patent in suit, Fig. 1 shows a *flow chart of a method according to the invention* and Fig. 2 shows a *cross-sectional view of a battery processing plant according to the invention*.

Like Fig. 1 of the patent in suit, Fig. 1 of D1 shows a comminution unit 18, via which comminuted material 24 a drying device 26. An arrow below the drying device points to a filling device 44. The arrow is provided with the reference numeral 42, which designates inactivated comminuted material according to the list of reference signs of both D1 and the patent in suit. Below the filling device 44, a further arrow points to a packaging or a (transport) container 46. Both arrows bear the reference "Dried batch fragments".

Fig. 2 of D1 also shows - just like Fig. 2 of the patent in suit - a comminution unit 18, a first conveyor 56 to a drying device 26 and a second conveyor 58 to a filling device 44 with a packaging or (transport) container 46 containing active comminution material 42.

As explained above in the section on design, the person skilled in the art uses (d) of claim 1 of the patent in suit to be interpreted without contradiction to Figures 1 and 2 thereof (according to the invention), indicates that the presence of a filling device and a (transport) container does not exclude that *"the inactivated comminuted material is not filled into a transport container after drying"*, but includes that *"the inactivated comminuted material is not filled into a transport container after drying"*.

With this understanding, the skilled person also takes feature (d) of claim 1 of the patent in suit from figures 1 and 2 of D1 - which are contained identically in D1 and the specification of the patent in suit.

Claim 1 is therefore not new in relation to D1.

## 2. Claim 8

D1 also shows all the features of claim 8. In detail, D1 shows a

*"Ba//er/e processing plant for the treatment of batteries, in particular used lithium batteries"*

as can be seen from D1, p. 1, lines 11-13.

D1 also shows

*"(a) a shredding unit (18) for shredding the batteries (10) so that shredded material (24) is obtained,"*

as can be seen from D1, p. 1, lines 13/14, p. 13, lines 27-33, figures 1 and 2, comminution unit 18.

D1 also shows

*"(b) an inactivating device in the form of a drying device (26) for inactivating the comminuted material (24)"*

as can be seen from D1, p. 14, lines 7/8, Figures 1 and 2, drying device 26.

D1 also shows

*"(c) a vacuum unit to the drying device (26) for generating a vacuum in the drying device (26),"*

as can be seen from D1, p. 11, lines 30-32, p. 14, lines 13-15, p. 20, lines 31-33, Fig. 1, Vacuum an-position 29, results.

D1 also shows that

*"(d) the drying device (26) is designed for drying at a temperature of at most 80 °C,"*

as can be seen from D1, p. 4, lines 23-33, and p. 8, line 12.

D1 also shows that

*"(e) the drying device (26) is designed to generate a vacuum of at least 300 hPa"*

as can be seen from D1, p. 4, lines 26/27.

D1 also shows that

*"(f) a particle separator is arranged between the drying device and the condenser in the direction of material flow,*

as can be seen from D1, Fig. 1, in the form of the filling device 44, which fills or separates the dried battery fragments (particles) into the package/container 46.

As explained above in connection with the interpretation of claim 8, feature (f), it follows from the lack of use of the term "particle separator" in the description of the patent in suit and the use of the term "particles" in paragraph [0020] of the specification of the patent in suit that particles within the meaning of the patent in suit are (at least also) battery fragments which are produced during shredding and are contained in the shredded material. These particles (dried battery fragments) are, as be seen from DI, Fig. 1, bottom left, filled into the packaging by means of a filling device 44.

/ the container 46.

The filling device 44 therefore a particle separator.

It is also arranged in the direction of material flow between the drying device 26 and the condenser 34.

Thus, D1 also shows feature (f) of claim 8 of the patent in suit. Claim 8 is therefore not new compared to D1.

### 3. **Claim 9**

D1 also shows the feature of claim 9, according to which

*"the shredding unit (18) is arranged in the drying device".*

a) On the one hand, the skilled person understands from D1, p. 13, lines 27-31 that the comminution unit 18 comprises, for example, a rotor shear or a granulator with one or more rotors.

The person skilled in the art is familiar with the fact that such a shredding unit with rotating cutting elements introduces thermal energy into the material to be shredded, which heats the material to be shredded. The heating helps to dry the contained liquid components.

The shredding unit can therefore also be regarded as a drying device. Thus, D1 shows two drying devices, namely in the form of the comminution unit 18 and the drying device 26, which can be understood as a common drying device. The comminution unit 18 is arranged in this common drying device, as provided for in claim 9.

D1 also shows that the opening of the pressure relief valve of the battery cell by negative pressure and the subsequent drying of the mechanically uncrushed cell is also an embodiment of the invention. D1, p. 3, line 28, to p. 4, Z. 9, explains:

"It is advantageous if the drying takes place after the batteries have been crushed. It is possible and represents an embodiment of the invention that the batteries are exposed to a vacuum in the unshredded state,

so that at least parts of the electrolyte vaporize, whereby the resulting gas either escapes through a safety valve in the accumulator or the battery is destroyed by the pressure difference between the external environment and the internal pressure, so that vaporizing electrolyte can escape. However, as the electrolyte is usually present between tightly wound or stacked and compressed layers of electrodes and separator and in their pores and is connected to other components of the batteries, this procedure can be time-consuming. It is therefore often more favorable and represents a preferred embodiment of the invention that the batteries are mechanically comminuted, for example by cutting, shearing, impacting, separating and/or crushing. This provides a larger interface for the mass transfer into the gas phase."

Opening the pressure relief valve is a form of crushing, as the battery cell opened in such a way that electrolyte vapor can be removed. opening by vacuum (crushing), the battery cell is already in a vacuum, so it is also in the drying device. The reduction place in the drying device. The feature is thus disclosed.

D1 are therefore also preceded by claim 9, which is therefore not neU.

b) On the other hand, D1, claim 9, provides that the shredding unit and the drying device are arranged in a common standard container 54. D1, p. 10, lines 31-33, as well as p. 15, line 32, to p. 16, line 32, describe correspondingly.

2. i.e. D1 proposes an integration of the comminution unit 18 and the drying device 26 in a container which can be understood as a common drying device. The comminution unit 18 is arranged in this common drying device, as provided for in claim 9 of the patent in suit.

For this reason, too, D1 anticipates claim 9, which is therefore not new.

#### 4. Claim 10

D1 also shows the feature of claim 10. In detail, D1 shows

*"a condenser for condensing gaseous electrolyte extracted from the dryer",*  
as can be seen from D1, p. 8, lines 16-27, p. 14, line 31, to p. 15, line 5, Fig. 1, capacitor 34.

D1 also shows that

*"a particle separator is arranged in the material flow direction between the drying device and the at least one pump /s/",*  
as can be seen from D1, Fig. 1, drying device 26, vacuum pump 30, filling device 44.

- a) Fig. 1 shows that a particle separator in the form of the filling device 44 (see the above comments on claim 8, feature (f) opposite D1) is arranged in the direction of material flow between the drying device 26 and the vacuum pump 30.
- b) If the indefinite article "a" is used before the term "particle separator" as  
If the term "further particle separator" is to be understood, the gas purification device 32 with condenser 34 and filter 36 such a further particle separator. This is because in the gas purification device 32, particle separation takes place in the filter 36 and in the condensate container 38. Corresponding explanations 1 can be found in D1, p. 8, fig. 29, to p. 9, fig. 6, and p. 14, line 31, to p. 15, line 5.

Claim 10 is therefore not new compared to D1.

#### 5. Claim 12

D1 also shows the feature of claim 10. In detail, D1 shows a

*"a sluice arranged upstream of the shredding unit (18) for feeding the batters (10)",*

as can be seen from D1, p. 13, line 1/2, p. 14, lines 8-11, line 5, Fig. 1, lock 28.

D1 shows a sluice 28 between the shredding unit 18 and the trough device 26.

The airlock 28 is arranged in front of the shredding unit 18 in the opposite direction to the material flow direction. However, claim 1 2 - in contrast to claims 8 (feature (f)) and 10, in which an observation "in the direction of material flow" is made - says nothing about the direction. In other words, the claimed airlock can in particular be arranged in the material flow direction or against the material flow direction.

Therefore, the airlock 28 shown in D1, Fig. 1, is an airlock within the meaning of claim 12.

Claim 12 is therefore not new compared to D1.

#### 6. Claim 14

D1 also shows the feature of claim 14, according to which

*"Drying device at least has at least one dry-running vacuum pump".*

D1, Fig. 1, shows the vacuum pump 30 without liquid. The skilled person therefore assumes a dry-running vacuum pump.

Thus, D1 anticipates claim 14, which is therefore not new.

X. Invalidity of claims 1, 8, 9, 10, 12 and 14 due to lack of patentability with respect to pre-published prior art

#### 1. Claim 1

a) Lack of novelty compared to D4 (US 2016/0049699 A1)

Claim 1 is not new vis-à-vis

D4 (US 2016/0049699 A1).

D4 shows all the features of claim 1. In detail, D4 shows a

*"Process for the treatment of used lithium batteries (10)"*

as be seen from D4, paragraphs [0031] and [0071], where, among other things, it is stated:

"[0031] In this processing method, in order to take the electrolyte solution out of the lithium ion battery safely, after the used lithium ion battery is discharged,

"[0071] The large-sized battery cell for an automobile (the lithium ion battery, 1.66 kg) was discharged, the packaging sheet was peeled off, the safety valve was opened,..."

D4 also shows

*"(a) reducing the size of the batteries (10) so that shredded material (24) is obtained becomes,"*

as be seen from D4, para. [0025], where it is stated:

"[0025] [11] The method for processing a fluorine-containing electrolyte solution according to [10] described above, in which a safety valve of the used lithium ion battery is opened, the pipe passage is connected to the opening, and the volatile component of the electrolyte solution is gasified by heating the battery under reduced pressure."

As explained in the above section on the interpretation of claim 1, feature (a), with reference to para. [0022] of the patent in suit, the patent in suit is intended to cover not only the mechanical crushing of the batteries, but also the destruction of a battery by a pressure difference between the external environment and the internal pressure and the resulting escape of evaporating electrolyte as well as the evaporation of parts of the electrolyte and the escape of the resulting gas through a safety valve are to be understood as crushing according to the invention.

This corresponds to the above procedure of D4, para [0025]. Therefore, D4 shows feature (a) of claim 1.

D4 also shows

*"(b) Drying at not more than 60 °C",*

as be seen from D4, paragraphs [0034], [0035] and TABLE 1, where it is stated:

"[0034] Specifically, each electrolyte solution at 0°C., 10° C., 20° C., 80°C., and 150° C. under atmospheric pressure (101.3 kPa) is in a state of an atmospheric pressure conversion temperature shown in Table 1 under reduced pressure conditions of 15 kPa, 10 kPa, 5 kPa, 1 kPa, and 0.1 kPa. Accordingly, under the reduced pressure conditions which are selected, the electrolyte solution is heated such that the atmospheric pressure conversion temperature of the electrolyte solution, for example, is higher than or equal to 244°C., and thus it is possible to volatilize DMC, EMC, DEC, PC, EC, or the like."

"[0035] For example, when the inside of the battery is depressurized to be 5 kPa and is heated at 80° C. to 150° C., the electrolyte solution is in a state of 170° G. to 251° C. at the atmospheric pressure conversion temperature, and thus DMC, EMC, DEC, PC, and EC included in the electrolyte solution, and the thermally decomposed fluorine compound are able to be volatilized. Furthermore, the inside of the battery may be depressurized to be less than 5 kPa, for example, 1 kPa to 0.1 kPa and may be heated at 80°C. to 120° C."

TABLE 1

| [Atmospheric Pressure Conversion Temperature] |                         |           |        |        |        |        |
|-----------------------------------------------|-------------------------|-----------|--------|--------|--------|--------|
| Actual<br>Temperature                         | Atmospheric<br>Pressure | Pressure  |        |        |        |        |
|                                               |                         | 101.3 kPa | 15 kPa | 10 kPa | 5 kPa  | 1 kPa  |
| 0°C.                                          | 0°C.                    | 49°C.     | 58°C.  | 74°C.  | 113°C. | 152°C. |
| 10°C.                                         | 10°C.                   | 60°C.     | 70°C.  | 86°C.  | 121°C. | 166°C. |
| 20°C.                                         | 20°C.                   | 71°C.     | 81°C.  | 98°C.  | 134°C. | 180°C. |
| 30°C.                                         | 30°C.                   | 83°C.     | 93°C.  | 110°C. | 148°C. | 192°C. |
| 50°C.                                         | 50°C.                   | 109°C.    | 121°C. | 138°C. | 176°C. | 228°C. |
| 100°C.                                        | 100°C.                  | 179°C.    | 193°C. | 210°C. | 248°C. | 304°C. |

D4 would also like to vaporize EC (ethylene carbonate) at 244 °C. However, according to TABLE 1 (or according to VDI-Wärmeatlas), D4 requires well below 80 °C at 0.1 kPa (- 1hPa = 1 mbar).

In particular, if only 1-3 components of the electrolyte (e.g. DMC (dimethyl carbonate) with a boiling point of 90°C, EMC (ethyl methyl carbonate) with a boiling point of 109°C, DEC (diethyl carbonate) with a boiling point of 127°C) are used with the aim of inactivating by electrolyte decomposition. DMC (dimethyl carbonate) with a boiling point of 90°C, EMC (ethyl methyl carbonate) with a boiling point of 109°C, DEC (diethyl carbonate) with a boiling point of 127°C are to be vaporized (see D4, paragraphs [0030] and [0033]), an "Atmospheric Pressure Conversion Temperature" of 127°C is already sufficient. In TABLE 1 (or according to the VDI heat atlas) it can be read that temperatures < 0°C are already sufficient for this at a suggested pressure of 0.1 kPa (- 1hPa = 1 mbar).

Accordingly, the drying according to D4 takes place at at most 80 °C. Therefore, D4 shows feature (b) of claim 1.

D4 also shows

*"(c) the drying takes place at a pressure of at most 300 hPa and the comminution material (24) is inactivated by the drying, so that an electrochemical reaction is impossible,"*

as can be seen from D4, para. [0022], [0056], [0057], [0066]-[0068], [0071] and the annexes to the

sayings 7, 14, 15 and 16, where, among other things, it is stated:

"[0022] [8] The method 1or processing a fluorine-containing electrolyte solution according to [1] described above, in which the electrolyte solution is heated at 80° C. to 150° C. under reduced pressure of less than or equal to 1 kPa, the volatile component is gasified, and the gasified gas is introduced to a dry pro- cessing step."

[Note: 1 kPa - 10 hPa= 10 mbar].

[0056] The gasification gas is cooled by the cooler 16 up to reduced pressure of approximately 5 kPa. When the gasification gas is generated by heating the electrolyte solution in a depressurized state stronger than the reduced pres- sure, for example, in a depressurized state of 1 kPa and 0.1 kPa, the water cooling trap is not suitable because the pressure of the gasification gas is lower than the vapor pressure of water even when it is cooled to 10°C. by the cooler 16. In this case, the gasification gas is introduced to the dry processing step and is processed.

Drying takes place at a pressure from 0.1 kPa= 1 hPa - 1 mbar.

"[0057] In contrast, when the electrolyte solution is heated and the volatile component is gasified in a depressurized state of 5 kPa to ordinary pressure, the pressure is higher than the vapor pressure of water when the gasification gas is cooled to be lower than or equal to 10° C. by the cooler 16. Therefore, the gasification gas is able to be introduced to the wet processing step and is able to be processed. Furthermore, the gasification gas may be introduced to a dry step."

Drying takes place at a pressure of 5 kPa= 50 hPa= 50 mbar.

In addition, however, the above paragraphs (0034] and [0035] and TABLE 1 reveal further possible pressure-temperature combinations in the text and in the table on "Atmospheric Pressure Conversion Temperature" down to 0.1 kPa= 1 hPa= 1 mbar.

Therefore, D4 shows the first part of feature (c) of claim 1, according to which *"the drying takes place at a pressure of at most 300 hPa"*.

D4 also shows the further part of feature (c) of claim 1, according to which *"the fragmentation material (24) is inactivated by drying, so that an electrochemical reaction is impossible"*, as can be seen from D4, paragraphs [0060], [0015], [0004], [0012], [0059], where it is stated, inter alia:

"[0060]. In addition, according to the processing method of the present invention, since the electrolyte solution is gasified and obtained from the battery, it is possible to detoxify the battery without freezing or combustion at a high temperature. Therefore, it is possible to safely and efficiently perform material recycling in the subsequent stage."

It is disclosed here that the process control of D4 is used for inactivation.

"[0015] [1] A method for processing a fluorine-containing electrolyte solution including a volatile fluorine compound and an organic solvent, the method including a gasification step of gasifying a volatile component by heating the electrolyte solution under reduced pressure; a fluorine immobilization step of immobilizing the fluorine component included in the gasified gas as calcium fluoride by allowing the fluorine component to react with calcium; and an organic solvent component collection step of collecting an organic solvent component in the gasification gas."

It is disclosed here that the inactivation takes place by gasification (evaporation, drying) under negative pressure.

The electrolyte is inactivated without effect, i.e. within the meaning of the patent in suit, by the process of D4 through drying. The fact that further fluorine is subsequently removed from the dried material by further heating is not relevant for inactivation. It is already fulfilled by drying the "organic solvents".

"[0004] An electrolyte solution used in the lithium ion battery or the like includes a fluorine compound which is an electrolyte (LiPF<sub>6</sub>, LiBF<sub>4</sub>, or the like) and a volatile organic solvent, and the organic solvent is a flammable substance which is mainly ester carbonates. In addition, when LiPF<sub>6</sub> reacts with water, LiPF<sub>6</sub> is hydrolyzed and generates toxic hydrogen fluoride. For this reason, a safe processing method is required."

"[0012] In the processing method of the related art, the processing method in which the lithium battery is demolished and crushed while being frozen requires refrigeration equipment, and thus it is difficult to perform this method. In addition, in the processing method in which the lithium battery is roasted, fluorine is processed as combustion gas. Therefore, fluorine cannot be recycled since it cannot be collected as a fluorine component having high purity. In the processing method of collecting the electrolyte solution by using the organic solvent, it is difficult to process the collected electrolyte solution. As indicated above, the flammable organic solvent is included in the electrolyte solution, and the fluoride compound in the electrolyte solution reacts with water and generates toxic hydrogen fluoride, and thus safe processing is required."

This passage clearly states: The aim is not to release hydrogen fluoride (HF) (undefined); the aim here is also precisely not to release HF together with other components with which it could react, as it then contaminate the other components (the electrolyte solvents) as well as the fluorine components. The solvents must therefore be recovered without releasing the fluorine so that the pure fluorine can then be recovered. To do this, the battery must also be inactivated, which is achieved here by a combination of discharge and solvent evaporation (drying).

From D4, para. [0015] (see above) and [0059]

"[0059] Further, according to the processing method of the present invention, the organic solvent of the electrolyte solution is able to be collected and used as fuel or alternative fuel. Because fluorine is separated from the organic sol-

vent component collected by the processing method of the present invention, a harmful Substance Such as hydrogen fluoride is not generated at the time of using the collected organic solvent component as fuel. Therefore, it is possible to safely use the organic solvent component."

This means that the reaction of the solvent with hydrogen fluoride is prohibited. Instead, a sequential procedure is required.

After all this, D4 also shows the further part of feature (c) of claim 1 according to which *"the comminuted material (24) is inactivated by drying, so that an electrochemical reaction is impossible"*.

D4 also shows

*'(d) the inactivated comminuted material (42) is not filled into a transport container after drying',*

since D4 does not disclose a transport container and therefore no filling into a transport container.

b) Lack of novelty compared to D5 (DE 10 2011 110 083 A1)

Claim 1 is not new vis-à-vis

D5 (EN 10 2011 110 083 A1).

D5 shows all the features of claim 1. In detail, D5 shows a

*"Process for the treatment of used lithium batteries (10)"*

as shown in D5, Summary and paragraphs [0021], [0022] and [0034] to [0039].

DS also shows

*"(a) reducing the size of the batteries (10) so that shredded material (24) is obtained,"*

as can be seen from D5, claim 1, feature (a), in particular paragraphs [0001] and [0034], and Fig. 1, in particular fig. 12 "Cell crushing device".

D5 also shows

*"(b) Drying at not more than 80 °C",*  
as in D5, paragraph [0021].

D5 also implicitly discloses that

*"(c) the drying takes place at a pressure of not more than 300 hPa and the comminution material (24) is inactivated by the drying, so that an electrochemical reaction is impossible".*

i) For a maximum pressure of 300 hPa:

A vacuum for drying highly volatile electrolyte solvents, such as DMC (dimethyl carbonate) and EMC (ethyl methyl carbonate), is necessarily below 300 hPa. The specialist can see this from the course of the vapor pressure curves. For evaporation, the specialist will select a point at which the vapor pressure of the component to be evaporated is above the ambient pressure or, conversely, the ambient pressure is below the vapor pressure. If the specialist calculates the vapor pressure using the Antoine equation, at 80 °C the result is the low boiling point DEC (diethyl carbonate) to a vapor pressure of 206 hPa, with EMC to 399 hPa. At 70 °C, the vapor pressure of DEC is already 139 hPa, that of EMC 273 hPa. At 60 °C, the vapor pressure of DEC is 90 hPa, the vapor pressure of EMC is 182 hPa and the vapor pressure of DMC is 349 hPa.

At 50 °C (the preferred temperature according to the statement of claim according to Annex K1 due to the formation of hydrogen fluoride (HF) to be prevented), the vapor pressure of DEC is 57 hPa, of EMC 118 hPa and of DMC 233 hPa (the patent in suit, paragraphs [0012], [0027], [0034], [0054] and [0055], also states that hydrogen fluoride is to be prevented, so that low temperatures are to be aimed for).

In other words, from the fact that D5, para. [0021], specifies a drying temperature of below 80 °C, the skilled person implicitly assumes that drying takes place under vacuum at a pressure of at most 300 hPa.

Accordingly feature (c) as a whole is implicitly disclosed with regard to the pressure of at most 300 hPa in DS.

- ii) On the partial feature that *"the comminution (24) is indrying, so that an electrochemical reaction is impossible"*.

D5, para [0037],

"[0037] In the material flow direction downstream of the pre-dryer 28, a separator 38, which comprises a magnetic separator and possibly also an eddy current separator. The magnetic material is removed via a discharge line 40. The non-magnetic material enters a separator 42, for example a zigzag separator. Like the separator 38, the classifier 42 is optional and is particularly advantageous if, as in the present case, only the cathode of the galvanic cells is to be reused. The anodes are removed, as are any pouch foils."

and D5, Fig. 1, disclose that a magnetic separator 38, and possibly an eddy current separator, and a zigzag separator 42 are arranged downstream of the pre-dryer 28. In contrast to the process steps of comminution and pre-drying, no inertization or evacuation is disclosed here. Evacuation or inerting of continuous magnetic separators, eddy current separators or zig-zag classifiers would be very unusual. A zig-zag separator needs larger gas flows to perform its separation task. Practice shows that zig-zag separators almost always work with air as the flow medium. The specialist would not tolerate an explosive atmosphere here. Therefore, the material to be crushed must be very dry and therefore electrochemically inactive.

In addition, we refer to the above comments on the interpretation of claim 1, feature (c), according to which paragraph [0041] of the patent in suit qualifies the subfeature according to which an electrochemical reaction is to be impossible and is therefore to be understood in the sense *"that an electrochemical reaction is no longer possible to a good approximation"*. This means that an electrochemical reaction within the meaning of the patent in suit may still be possible within certain limits. Feature (c), according to which *"the decomposition*

*The material is inactivated drying, so that an electrochemical reaction is impossible, must therefore be designed in such a way that an electrochemical reaction is only reduced.*

After all this, D5 implicitly reveals feature (c).

D5 also shows that

*"(d) the inactivated comminuted material (42) is not filled into a transport container after drying".*

D5, para. [0037] and Fig. 1 show that the comminuted material is further processed in the process after drying in the pre-dryer 28 and therefore not filled into a transport container after drying.

D5 therefore also shows feature (d). Claim 1

is therefore not new compared to D5.

c) Lack of novelty compared to D6 (EP 0 794 587 A2)

Claim 1 is not new vis-à-vis

D6 (EP 0 794 587 A2).

D6 shows all the features of claim 1. In detail, D6 shows a

*"Process for the treatment of used lithium batteries (10)"*

as can be seen from D6, sp. 1, lines 7-12, and sp. 5, lines 14-31.

D6 also shows

*"(a) reducing the size of the batteries (10) so that shredded material (24) is obtained,"*

as can be seen from D6, sp. 6, lines 26-38, sp. 17, line 49, to sp. 18, line 45, and claim 17 in conjunction with claim 1.

D6 further discloses

*"(b) Drying at not more than 80 °G",*

as D6 works without heating elements, only describes cooling processes and the highest process-relevant temperature is specified as 16 °C (D6, col. 6, lines 26-38, and col. 17, lines 3-11).

D6 further discloses that

*"(c) the drying takes place at a pressure of at most 300 hPa and the comminution material (24) is inactivated by the drying, so that an electrochemical reaction is impossible,"*

as be seen from D6, sp. 6, lines 20-38, and sp. 28, lines 20-24, from which the skilled person concludes that the pressure can be at most 300 hPa to reach the vapor pressure. D6 further describes in sp. 6, lines 20-38, sp. 13, line 24, to sp. 14, line 22 that during an inactivation process (DE 6, claim 1: "decreasing the ionic conductivity") the battery 100 is placed in a container 111, which is then evacuated, whereby the battery 100 electrolyte solution is removed through the overpressure valves 102 commonly used in sealed batteries 100. This Inactivation process is carried out by drying in the above-mentioned sense. This drying is carried out until an electrolyte content is sufficiently small that an electrochemical reaction is impossible (see also the above explanations on the interpretation of feature (c) of claim 1 for relativization of this feature).

As also be seen from D6, sp. 3, lines 6-23, D6 to make batteries recyclable by reducing the electrochemical activity so that short circuits and thus reactions activated by increased local temperatures do not occur during recycling.

D6 also shows that

*'(d) the inactive comminuted material (42) is not filled into a transport container after drying'.*

D6, e.g. Figs. 1 and 2, show that the shredded material is further processed in the process after drying and is therefore not filled into a transport container after drying.

D6 therefore also shows feature (d).

Claim 1 is therefore not new compared to D6.

d) Lack of novelty over D7 (CN 102496752 A) Claim 1 is

not novel over

D7 (CN 102496752 A).

A translation of D7 is available as

D7A (translation of D7)

enclosed.

D7 shows all the features of claim 1. In detail, D7 shows a

*"Process for the treatment of used lithium batteries (10)"*

as in D7A, claim 1.

D6 also shows

*"(a) reducing the size of the batteries (10) so that shredded material (24) is obtained,"*

as is from D7A, , claim 1, step 2, according to which the electrolyte is removed from the battery in a preparatory step under a protective atmosphere. Since feature (a) does not contain any information regarding the type of comminution and the degree of comminution, the opening of the battery cell to remove the electrolyte also a "reduction" of the battery within the meaning of feature (a).

In addition, we refer to the above explanations on the interpretation of claim 1, feature (a).

D7 further reveals

*"(b) drying at not more than 80 °C",*

since an inactivation and drying at a temperature between 20 °C and 120 °C is provided, as be seen from D7A, claim 1, step 3. The value of 20 °C is below 80 °C and is therefore within the claimed temperature range of "at most 80 °C".

D7 further discloses that

*"(c) the drying takes place at a pressure of at most 300 hPa and the comminution material (24) is inactivated by the drying, so that an electrochemical reaction is impossible,"*

since inactivation and drying under vacuum at not more than 20 kPa - 200 hPa is provided, as is also apparent from D7A, claim 1, step 3.

D7 further discloses drying until the electrolyte content is so small that an electrochemical reaction is impossible, since this process step is carried out to prevent decomposition and side reactions as described in D7A, claim 1, step 3.

D7 also shows that

*'(d) the inactivated comminuted material (42) is not filled into a transport container after drying'.*

D7, Fig. 1, shows the process sequence in which the end product is present at reference number 12. In the preceding process steps, the shredded material is not filled into a transport container.

D7 therefore also shows feature (d).

Claim 7 is therefore not new compared to D7.

- e) Lack of inventive step in relation to D8 (LithoRec II Hosokawa Alpine) in conjunction with Specialized knowledge

The final report on the LithoRec II research project of the grant recipient Hosokawa Alpine Aktiengesellschaft (project name: LithoRec II - Recycling of lithium-ion batteries)

D8 (LithoRec II Hosokawa Alpine)

was accredited by the German National Library of Science and Technology (TIB), Hanover, in electronic form on 29.8.2016 and in printed form on 13.5.2016. With the

The public will have access to this literature from the date of accession. This is stated in the attached confirmation from the German National Library of Science and Technology (TIB), Hanover, dated 4.3.2024 in accordance with

D8-B (confirmation from TIB Hannover dated 4.3.2024).

Claim 1 is not inventive over D8 in conjunction with common general knowledge.

D8 shows a

*"Process for the treatment of used lithium batteries (10)"*

as can be seen from D8, p. 1, project name: "LithoRec II - Recycling of lithium-ion batteries".

D8 also shows

*"(a) reducing the size of the batteries (10) so that shredded material (24) is obtained,"*

as be seen from D8, p. 1, where it is stated:

". "Safe shredding of battery cells and battery systems" to design, construct and build a pre-shredding and disintegration shredding machine and to it into operation in the pilot plant."

D8 shows with regard to the characteristic

*"(b) Drying at not more than 80 °G",*

according to p. 3, Figure 1, a dryer for vacuum drying battery trays at a maximum of 140°C.

The skilled person will recognize from this that the temperature during drying should be limited. It is normal professional practice to keep the drying temperature as low as possible in order to save energy on the one hand and to avoid or reduce the formation of toxic compounds on the other.

Limiting the temperature for drying to a maximum of 80 °C is therefore obvious on the basis of D8.

D8 shows with regard to the first sub-characteristic of characteristic (c), according to which

*"(c) drying takes place at a pressure not exceeding 300 hPa ...",*

according to p. 3, Figure 1, a dryer for vacuum drying and a vacuum pump for vacuum generation as well as a vacuum slide. The skilled person assumes that vacuum slides are designed to achieve a vacuum of at least 300 mbar.

In addition, the pressure range limit of 300 hPa is very generous, i.e. high, it is at the discretion of the specialist operating a system with a vacuum pump to select a pressure of 300 hPa or less.

Limiting the pressure to a maximum of 300 hPa is therefore obvious.

D8 leads with regard to the further sub-characteristic of characteristic (c), according to which

*"(c) ... the comminuted material (24) is inactivated by drying, so that an electrochemical reaction is impossible,"*

on p. 2:

"The particulate components are still bound by liquid bridges in agglomerates and therefore only represent a very low hazard potential. Once the electrolyte has been removed from the fragments by drying, the particulate coating components represent the risks against which measures are taken when designing the processes due to their potential risk of dust explosion and their carcinogenicity."

A safety concept against the dangers arising from the components of the electrolyte is in the following Figure 1 on page 3, above, in particular by the above-mentioned dryer for vacuum drying of battery fragments at a maximum of 140°C.

D8, p. 4, continues:

"After pre-shredding and drying, the battery fragments are freed from the solvents in the electrolyte. By removing the flammable

The inert components no longer have to be under inert conditions in the subsequent process steps."

Achieving the goal of explosion protection through drying automatically achieves the goal of electrochemical inactivity of the low boilers.

This results in characteristic (c) from D8.

D8 shows with regard to characteristic (d)

*'(d) the inactivated comminuted material (42) is not filled into a transport container after drying'*

in Figure 1 on p. 3 a "container for intermediate storage of the dry cell fragments". This means that the shredded material is not filled into a transport container after drying.

In view of all the above, claim 1 is obvious from D8 using skill in the art.

f) Lack of inventive step with respect to D8 (LithoRec II Hosokawa Alpine) in conjunction with D4 (US 2016/0049699 A1)

Claim 1 is also not inventive over D8 (LithoRec II Hosokawa Alpine) i.V.m. D4 (US 2016/0049699 A1).

Unless the Senate agrees with the above view the setting of an upper temperature limit of at most 80 °C and an upper pressure limit of at most 300 hPa at the discretion of the skilled person and is purely a matter of skill in the art, claim 1 is not based on an inventive step starting from D8 in combination with D4.

In the event that the Senate should consider this feature as a distinguishing feature with regard to D8, we submit that the advantage of this feature is that the drying of the electrolyte is optimized.

The objective *task* is then to *optimize the drying process*.

However, this task is already solved by D4:

D4 discloses vacuum drying at a pressure of at most 50 hPa (see D4, paragraphs [0021], [0034J and [0035] where "5 kPa" is mentioned, which is identical to 50 hPa). This vacuum drying serves to lower the boiling point. The temperature range is specified as 80 °C to 150 °C. These parameters are intended safely remove the electrolyte from a lithium battery.

The skilled person also had cause to apply this teaching of D4 to D8: According to D8, p. 3, the solvent vapors generated during drying should be removed by condensing in the condenser. (D8, p. 3: *"The solvent mixture released when the battery modules are opened is continuously conveyed through the condenser by a fan (Z1) and then through a gas scrubber in order to remove the solvents."*)

When optimizing the drying process, the specialist will start from the specification of this low temperature and come across D4, as the removal of the electrolyte solvent is also tracked there.

The vacuum drying described in D4 fits well with the teachings of D8, as the heating to the decomposition temperature in the subsequent process steps takes place under vacuum.

D4 describes in detail the boiling point depression as a function of pressure with values below 300 hPa (= 30 kPa) and an upper temperature limit of 80 °C to 150 °C or 80 °C to 120 °C (see D4, paragraphs [0021], [0034] and [0035]).

The skilled person therefore arrives at the subject matter of claim 1 in an obvious manner starting from D8 in combination with D4.

- g) Lack of **inventive** step over D8 (LithoRec II Hosokawa Alpine) i.V.m. DS (DE 10 2011 110 083 A1)

Claim 1 is also not inventive over D8 (LithoRec II Hosokawa Alpine) i.V.m. D5 (DE 10 2011 110 083 A1).

Unless the Senate agrees with the above view that the setting of an upper temperature limit of at most 80 °C and an upper pressure limit of at most 300 hPa is at the discretion of the skilled person and is purely a matter of skill in the art, claim 1 does not involve an inventive step based on D8 in combination with D5.

In the event that the Senate should consider this feature as a distinguishing feature with regard to D8, we submit that the advantage of this feature is that the drying of the electrolyte is optimized.

The objective *task* is then to *optimize the drying process*.

The skilled person can obtain a solution to this problem from D5.

D5, para [0021] discloses a drying temperature of below 80 °C.

Furthermore, D5 shows that the pressure during drying is at most 300 hPa.

As already explained above for D5, a vacuum for drying light electrolyte solvents such as DMC (dimethyl carbonate) and EMC (ethyl methyl carbonate) is necessarily below 300 hPa. The specialist can see this from the course of the vapor pressure curves. The specialist will select a point for evaporation at the vapor pressure of the component to be evaporated is above the ambient pressure or, conversely, the ambient pressure is below the vapor pressure. If the specialist calculates the vapor pressure using the Antoine equation, the vapor pressure 80 °C is 206 hPa for the low boiling point DEC (diethyl carbonate) and 399 hPa for EMC. At 70 , the vapor pressure of

DEC is already at 139 hPa, EMC at 273 hPa. At 60 °C, the vapor pressure of DEC is 90 hPa, the vapor pressure of EMC is 182 hPa and the vapor pressure of DMC is 349 hPa.

At 50 °C (the preferred temperature according to the statement of claim according to Annex K1 due to the formation of hydrogen fluoride (HF) to be prevented), the vapor pressure of DEC is 57 hPa, of EMC 118 hPa and of DMC 233 hPa (the patent in suit, paragraphs [0012], [0027], [0034], [0054] and [0055], also states that hydrogen fluoride is to be prevented, so that low temperatures are to be aimed for):

I.e. from the fact that D5, para. [0021], specifies a drying temperature of below 80 °C, the skilled person implicitly assumes that drying takes place under vacuum at a pressure of at most 300 hPa.

Accordingly, the upper temperature limit of no more than 80 °C (characteristic (b)) and the upper pressure limit of no more than 300 hPa (first sub-characteristic of characteristic (c)) result from D5.

Overall, therefore, the subject-matter of claim 1 is obvious from D8 in combination with D5.

## 2. Claim 8

### a) Lack of novelty compared to D4 (US 2016/0049699 A1)

Claim 8 is not new compared to D4 (US 2016/0049699 A1). D4 shows all the features of claim 8.

In detail, D4 shows a

*"Battery processing plant for the treatment of batteries, especially used lithium batteries"* as be seen from D4, Figures 1-4, paragraphs [0061] to [0064], [0066] and [0031]. D4

also shows

*"(a) a shredding unit (18) for shredding the batteries (10) so that shredded material (24) is obtained,"*

as is apparent from D4, paragraph [0025]. As already explained above, it follows from paragraph [0022] of the patent in suit, according to the patent in suit, not only a mechanical crushing of the batteries is to be covered, but also the destruction of a battery by a pressure difference between the external environment and the internal pressure and the resulting evaporating electrolyte as well as the evaporation of parts of the electrolyte and escape of the resulting gas through a safety valve are to be understood as crushing according to the invention. However, this corresponds to the above-mentioned procedure from D4, paragraph [0025].

Therefore, D4, in particular fig. 10 (battery), 11 (opening), 15 (heating equipment), shows feature (a) of claim 8.

D4 also shows

*"(b) an inactivation device in the form of a drying device (26) for inactivating the comminuted material (24)"*

as be seen from D4, para. [0060], where it is explained that battery processing is for inactivation. In paragraph [0015] it is stated that inactivation takes place by gasification (evaporation, drying) under atmospheric pressure. By the procedure described in D4, the electrolyte is rendered ineffective by drying, i.e. inactivated within the meaning of the patent in suit. The fact that further fluorine is subsequently removed from the dried material by further heating is not relevant for inactivation. Inactivation is already achieved by drying the "organic solvents".

It from D4, paragraphs [0004] and [0012]: The aim is not to release hydrogen fluoride (HF) (undefined); here too, the aim is precisely not to release HF together with other components with which it could react, as this contaminate the other components (the electrolyte solvents) as well as the fluorine components. The solvents must therefore be recovered without releasing the fluorine so that the fluorine can be recovered afterwards.

It follows from D4, paragraphs [0015] and [0059] that the reaction of the solvent with hydrogen fluoride is prohibited. A sequential procedure is required.

According to all of the above, the figures in particular show an inactivation device 10, 11, 15 in the form of a drying device (battery 10, opening 11, heating equipment 15) for inactivating the comminuted material within the meaning of feature (b) of claim 8.

D4 also shows

*"(c) a vacuum unit to the drying device (26) for generating a vacuum in the drying device (26),"*

as can be seen from D4, para. (0077] and Fig. 1-4, "vacuum pump 13", [0041], [0047] and [0066] to [0071] results.

D4 also shows that

*"(d) the drying device (26) is designed for drying at a temperature of at most 80 °C,"*

as be seen from D4, paragraphs [0074], [0079] and Figures 1-4, "battery 10", "heating equip- ment 14", paragraphs [0034], [0035] and TABLE 1. As explained above in the section "Claim 1 - Lack of novelty over D4" to feature (b), EC (ethylene carbonate) also wants to be vaporized at 244 °C. However, according to TABLE 1 (or according to the VDI heat atlas), D4 requires a vaporization temperature of 0.1 kPa (= 1hPa= 1 mbar) well below 80 C.

In particular, if only 1-3 components of the electrolyte (e.g. DMC (dimethyl carbonate) with a boiling point of 90°C, EMC (ethyl methyl carbonate) with a boiling point of 109°C, DEC (diethyl carbonate) with a boiling point of 109°C) are used with the aim of inactivating by electrolyte decomposition. DMC (dimethyl carbonate) with a boiling point of 90°C, EMC (ethyl methyl carbonate) with a boiling point of 109°C, DEC (diethyl carbonate) with a boiling point of 127°C are to be vaporized (see D4, paragraphs [0030] and [0033]), an "Atmospheric Pressure Con- version Temperature" of 127°C is already sufficient. In TABLE 1 (or according to the VDI heat atlas) it can be read that temperatures < 0°C are already sufficient for this at a suggested pressure of 0.1 kPa (= 1hPa= 1 mbar).

Accordingly, the drying according to D4 takes place at a maximum of 80 °C, so that the drying device 10, 11, 15 is designed accordingly. Therefore, D4 shows feature (d) of claim 8.

D4 also shows that

*"(e) the drying device (26) is designed to generate a vacuum of at least 300 hPa"*

as shown in D4, paragraphs [0022], [0056], [0057], [0066] to [0068], [0071] and the notes to the consolidated financial statements.

claims 7, 14, 15 and 16, as explained above in the section "Claim 1 - Lack of novelty with respect to D4" for feature (c). Accordingly, drying took place at a pressure of 5 kPa= 50 hPa or 0.1 kPa - 1 hPa. Accordingly, a vacuum (negative pressure in the sense of differential pressure compared to normal pressure) of at least 300 hPa is generated in the drying device 10, 11, 15.

D4 also shows that

*"(f) a particle separator arranged between the drying device and the condenser in the direction of material flow",*

as can be seen from D4, paragraphs [0020] and [0053] and Fig. 4 "Ca FILLING LAYER", where it is stated:

"[0020] The method for processing a fluorine-containing electrolyte solution according to 1 or 2 described above, in which the gas in which the volatile component of the electrolyte solution is gasified is introduced to a dry processing step, and in the dry processing step, the gasification gas passes through a filling layer of the calcium compound, fluorine in the gas reacts with calcium, calcium fluoride is generated, the gas passing through the filling layer is condensed, and the organic solvent component is collected."

"[0053] A dry processing step is illustrated in FIG. 4. As illustrated, the gasification gas passes through a filling layer of the calcium compound, fluorine in the gas reacts with calcium, and thus calcium fluoride is generated. This calcium fluoride is extracted from the filling layer, and the filling layer is filled with a new calcium compound and is used. Meanwhile, the gas passing through the filling layers is introduced to a condensation trap, and the organic solvent com-

ponent is collected. A plurality of filling layers of the calcium compound may be disposed in series or in parallel, or may be disposed by combining both dispositions in series and in parallel."

It follows from these explanations that particles are separated in "Ca FILLING LAYER" according to Fig. 4. Incidentally, the patent in suit understands "particles" to mean not only battery fragments contained in the comminuted material (see above section on the interpretation of claim 8, feature (f)), but also, according to the patent in suit, para. [0079], particles with a diameter of at least 0.1 micrometers, i.e. very small particles.

Finally, it is industry standard to install particle separators upstream of vacuum pumps. The person skilled in the art therefore also reads a particle separator if a vacuum pump is shown, as in D4.

In view of the above, D4 discloses all the features of claim 8, which is therefore not new compared to D4.

b) Lack of inventive step compared to D5 (DE 10 2011 110 083 A1)

Claim 8 is not inventive over D5 (DE 10 2011 110 083 A1).

D5 shows a

*"Battery processing plant for the treatment of batteries, especially used lithium batteries"* as can be seen from D5, Fig. 1, active material separation plant 10, para. (0002), [0034] and claim 10, results.

DS also shows

*"(a) a shredding unit (18) for shredding the batteries (10) so that shredded material (24) is obtained,"*

as is apparent from D5, Fig. 1, cell crushing device 12, paragraphs [0002], [0034] and claim 10, in particular feature (a).

D5 also shows

*"(b) an inactivation device in the form of a drying device (26) for inactivating the comminuted material (24)".*

As explained above in the section "Claim 1 - Lack of novelty over D5" with respect to the second sub-characteristic of feature (c) of claim 1 *"that the comminuted material (24) is inactivated by the drying so that an electrochemical reaction is impossible /sf"* with reference to para. [0037] and Fig. 1 of D5, D5 discloses that a magnetic separator 38 (and optionally an eddy current separator) and a zigzag separator 42 are arranged downstream of the pre-dryer 28.

In contrast to the process steps of comminution and pre-drying, however, no inertization or evacuation is disclosed here. Evacuation or inertization of continuous magnetic separators, eddy current separators or zig-zag separators would be very unusual. A zig-zag classifier needs larger gas flows to perform its separation task. Practice shows that zig-zag separators almost always work with air as the flow medium. The specialist would not tolerate an explosive atmosphere.

This means that the shredding material must be very dry and therefore electrochemically inactive.

Drying takes place in the pre-dryer 28, which therefore not only a drying device, but also an inactivation device.

D5 therefore also shows feature (b).

With regard to feature (c)

*"(c) a vacuum unit to the drying device (26) for generating a vacuum in the drying device (26),"*

disclosed D5, para [0012], claim 1, feature (a), and the summary that the drying takes place (under inert gas or) in a vacuum.

This disclosure of D5 suggests to the person skilled in the art to connect the pre-dryer 28 according to D5 to a vacuum system in order to generate a vacuum in the pre-dryer 28.

D5 also shows that

*"(d) the drying device (26) is designed for drying at a temperature of at most 80 °C,"*

as in D5, paragraph [0021].

With regard to feature (e)

*"(e) the drying device (26) is designed to generate a vacuum of at least 300 hPa"*

results from D5, as explained above in the section "Claim 1 - Lack of novelty over D5" with respect to the first sub-characteristic of feature (c) of claim 1 *"that the drying takes place at a pressure of at most 300 hPa"*:

A vacuum for drying highly volatile electrolyte solvents, such as DMC (dimethyl carbonate) and EMG (ethyl methyl carbonate), necessarily lies below 300 hPa. The specialist can see this from the course of the vapor pressure curves. For evaporation, the specialist will select a point at which the vapor pressure of the component to be evaporated is above the ambient pressure or, conversely, the ambient pressure is below the vapor pressure. If the specialist calculates the vapor pressure using the Antoine equation, the vapor pressure at 80 °C is 206 hPa for the low boiling point DEC (diethyl carbonate) and 399 hPa for EMC. At 70 °C, the vapor pressure of DEC is already 139 hPa, that of EMC 273 hPa. At 60 °C, the vapor pressure of DEC is 90 hPa, the vapor pressure of EMC is 182 hPa and the vapor pressure of DMC is 349 hPa.

At 50 °C (the preferred temperature according to the statement of claim according to Annex KI due to the formation of hydrogen fluoride (HF) to be prevented), the vapor pressure of DEC is 57 hPa, of EMC 118 hPa and of DMC 233 hPa (the patent in suit, paragraphs [0012], [0027], [0034], [0054] and [0055], also states that hydrogen fluoride is to be prevented, so that low temperatures are to be aimed for).

I.e. from the fact that DS, para. [0021], specifies a drying temperature of below 80 °C, the skilled person implicitly assumes that drying takes place under vacuum at a pressure of at most 300 hPa.

The disclosure of D5 therefore suggests to the person skilled in the art that the above-mentioned pre-dryer 28 according to D5 - i.e. the drying device within the meaning of this claim feature of the patent in suit - should not only be connected to a vacuum system in order to generate a vacuum in the pre-dryer 28, but should also be designed to generate a vacuum of at least 300 hPa.

With regard to feature (f)

*"(f) a particle separator is arranged between the drying device and the condenser in the direction of material flow,*

it follows from D5, paragraphs [0021], [0025] and claim 5 that the electrolyte solvents are to be recovered. From this, the person skilled in the art concludes that he must arrange a dust filter - i.e. a particle separator - upstream of the condenser 34, since the solvents would otherwise be contaminated. This leads the skilled person directly to arrange a particle separator between the drying device (pre-dryer 28) and the condenser (34) in the direction of material flow.

In view of all the above, claim 8 is obvious from D5.

c) Lack of **inventive step** in relation to **D8 (LithoRec II Hosokawa Alpine)**

Claim 8 is not inventive over D8 (LithoRec II Hosokawa Alpine).

D8 shows a

*"Battery processing plant for treating batteries, in particular used lithium batteries"*

as can be seen from D8, p. 1, project name: "LithoRec II - Recycling of lithium-ion batteries", and p. 3, Figure 1.

D8 also shows

*"(a) a shredding unit (1B) for shredding the batteries (10) so that shredded material (24) is obtained,"*

as can be seen from D8, p. 1, 2nd para, ("*... Hosokawa Alpine took on the task of designing, constructing and building a pre-shredding machine and a disintegration shredding machine as part of the work package "P3 - Safe reduction battery cells and battery systems" and putting them into operation in the pilot plant.*")

D8, p. 3, Figure 1, shows such a pre-shredding unit for shredding batteries so that shredded material is obtained.

D8 also shows

*"(b) an inactivation device in the form of a drying device (26) for inactivating the comminuted material (24)".*

Page 2 of D8 explains:

"The particulate components are still bound by liquid bridges in agglomerates and therefore only represent a very low hazard potential. Once the electrolyte has been removed from the fragments by drying, the particulate coating components represent the risks against which measures are taken when designing the processes due to their potential risk of dust explosion and their carcinogenicity."

Figure 1 on page 3 shows a dryer for vacuum drying battery fragments at a maximum of 140°C.

Page 4 of D8 explains:

"After pre-shredding and drying, the battery fragments are freed from the solvents in the electrolyte. By removing the flammable components, it is no longer necessary work under inert conditions in the subsequent process steps."

Achieving the goal of explosion protection through drying automatically achieves the goal of electrochemical inactivity.

This results in characteristic (b) from D8.

With regard to feature (c)

*"(c) a vacuum unit connected to the drying device (26) for generating a vacuum in the drying device (26),"*

D8, p. 3, Figure 1, a dryer for vacuum drying of battery fragments and a vacuum pump. This results in feature (c) from D8.

With regard to feature (d)

*"(d) the drying device (26) is designed for drying at a temperature at most 80 °C,"*

D8, p. 3, Figure 1, shows the dryer for vacuum drying battery trays at a maximum of 140°C.

The skilled person will recognize from this that the temperature during drying should be limited. It is normal professional practice to keep the drying temperature as low as possible in order to save energy on the one hand and to avoid or reduce the formation of toxic compounds on the other.

Limiting the temperature for drying to a maximum of 80 °C is therefore obvious on the basis of D8.

With regard to feature (e)

*"(e) the drying device (26) is designed to generate a vacuum of at least 300 hPa"*

D8, p. 3, Figure 1, shows not only a dryer for vacuum drying and a vacuum pump for vacuum generation, but also a vacuum slide. The skilled person that vacuum slides are designed to achieve a vacuum of at least 300 mbar.

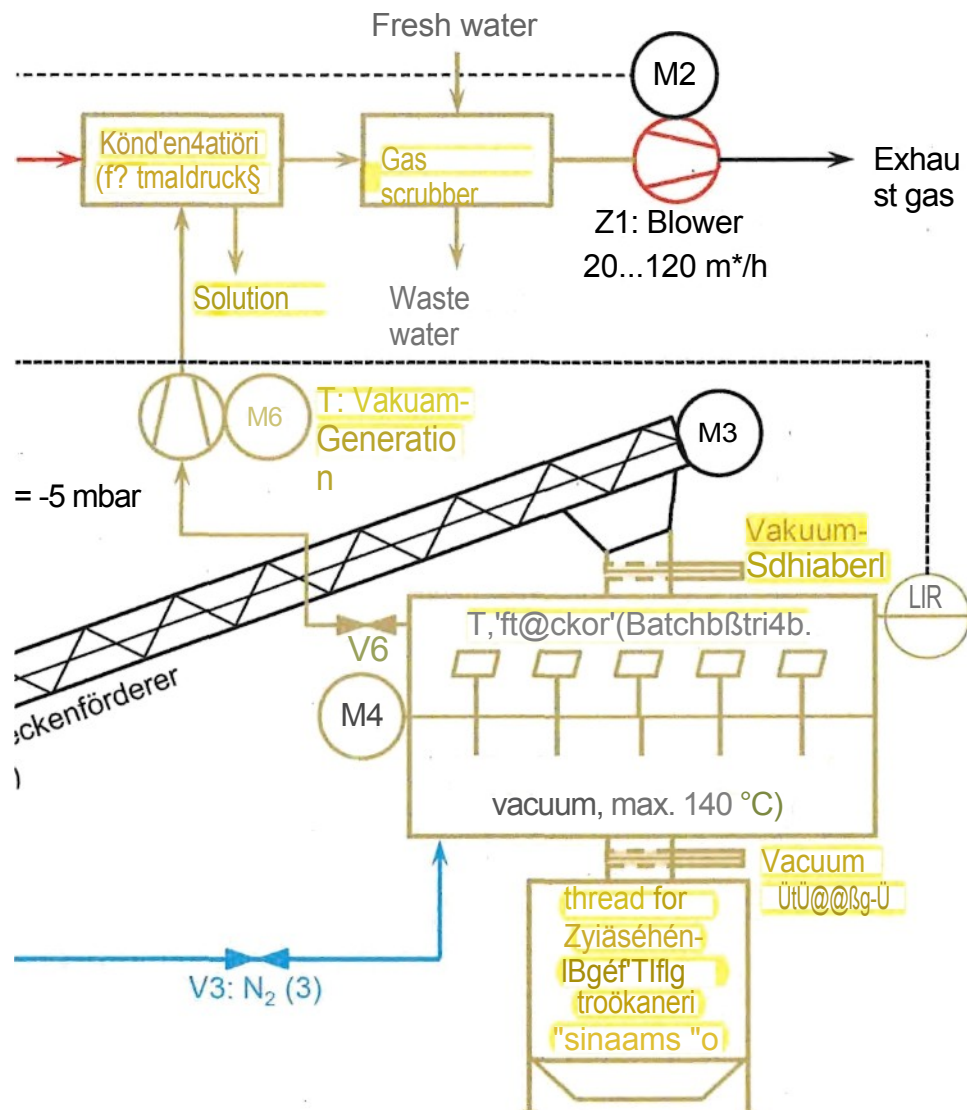
In addition, the pressure range limit of 300 hPa is very generous,  
d)h., it is at the discretion of specialist operating a system with a vacuum pump to select a pressure of 300 hPa or less.

Limiting the pressure to a maximum of 300 hPa is therefore obvious. With

regard to feature (f)

"(f) a particle separator is arranged between the drying device and the condenser in the direction of material flow",

it follows from D8, Figure 1, that the electrolyte solvents should be recovered:



From this, the skilled person concludes that he must arrange a dust filter - i.e. a particle separator - upstream of the condenser, as the solvents would otherwise be contaminated. This leads the person skilled in the art directly to install a dust filter in the material flow direction between

A particle separator must be arranged between the drying device (dryer) and the condenser.

In view of all the above, claim 8 is obvious from DS.

3. Claim 9

a) Lack of novelty compared to D4 (US 2016/0049699 A1)

Claim 9 is not new compared to D4 (US 2016/0049699 A1). D4 also shows the feature of claim 9.

In detail, D4 shows that

*"the shredding unit (18) is arranged in the drying device".*

As already explained above, it follows from paragraph [0022] of the patent in suit that, according to the patent in suit, not only a mechanical crushing of the batteries is to be covered, but also the destruction of a battery by a pressure difference between the external environment and the internal pressure and the resulting evaporating electrolyte as well as the evaporation of parts of the electrolyte and the escape of the resulting gas through a safety valve are to be understood as crushing essential to the invention. However, this corresponds to the above-mentioned procedure from D4, paragraph [0025]. Therefore, D4 with FIGS. 10 (battery), 11 (opening), 15 (heating equipment) shows a comminution unit which also heats and thus dries and consequently includes a drying device (heating equipment 15).

Therefore, claim 9 is not new compared to D4.

b) Lack of **inventive step** compared to D5 (DE 10 2011 110 083 A1)

Claim 9 is not inventive over D5 (DE 10 2011 110 083 A1). D5 also shows the feature of claim 9, according to which

*"the shredding unit (18) is arranged in the drying device".*

D5, claim 1, contains the feature "(a) comminution of the cells, in particular under inert gas or in a vacuum, so that at least solid cell fragments are also produced".

vacuum crushing of battery cells, vacuum drying occurs automatically. Claim 9 is thus disclosed.

According to D5, paragraph [0011], the skilled person also understands that the cell crushing device 12 crushes the cells, in particular by cutting, shredding, chopping or crushing.

Those skilled in the art are familiar with the fact that this type of shredding introduces thermal energy into the shredded material, which heats it up. The heating helps to dry the liquid components contained.

The cell crushing device can therefore also be regarded as a drying device. Thus, D5 shows two drying devices, namely in the form of the cell comminution device 12 and the pre-dryer 28, which can be understood as a common drying device. In this common drying device, the comminution unit is arranged in the form of the cell comminution device 12, as provided for in claim 9.

Therefore, claim 9 is obvious from D5.

c) Lack of **inventive step** in relation to D8 (LithoRec II Hosokawa Alpine)

Claim 9 is not inventive over D8 (LithoRec II Hosokawa Alpine). D8 also shows the feature of claim 9, according to which

*"the shredding unit (18) is arranged in the drying device".*

The skilled person can see from D8, p. 3, Figure 1 that the pre-shredding unit mechanically shreds the battery cells/battery modules.

The skilled person is familiar with the fact that mechanical comminution introduces thermal energy into the material to be comminuted, which heats the material to be comminuted. The heating helps to dry the liquid components contained.

The pre-shredding unit can therefore also be regarded as a drying device. Thus, D8 shows two drying devices, namely in the form of the pre-shredding unit and the dryer, which can be regarded as a common drying device. In this common drying device, the comminution unit is arranged in the form of the pre-comminution unit, as provided for in claim 9.

Therefore, claim 9 is obvious from D5.

#### 4. Claim 10

##### a) Lack of novelty compared to D4 (US 2016/0049699 A1)

D4 also shows from claim 10 the feature

*"a condenser for condensing gaseous electrolyte extracted from the dryer",*  
as be seen from D4, Fig. 4, according to which a "CONDENSATION TRAP" is arranged in the line between the opening 11 of the battery 10 and the vacuum pump 13.

D4 also shows that

*"a particle separator arranged in the material flow direction between the drying device and the at least one pump",*  
as can be seen from D1, Fig. 4, according to which a particle separator (Ca FILLING LAYER) is arranged between the heating equipment (15) and the vacuum pump (13).

Therefore, claim 10 is not new compared to D4.

##### b) Lack of inventive step compared to D5 (DE 10 2011 110 083 A1)

D5 also shows from claim 10 the feature

*"a condenser for condensing gaseous electrolyte extracted from the dryer",*  
as be seen from D5, Fig. 1, according to which a condenser 34 is arranged to the right of the pre-dryer 28, which is suitable for condensing gaseous electrolytes drawn off from the pre-dryer 28.

D5 also shows that

*"a particle separator arranged between the drying device and the at least one pump in the direction of material flow",*  
as can be seen from D5, Fig. 1, according to which a particle separator (separator 38 for separating particles, in particular a magnetic separator or eddy current separator, - see also D5, paragraphs [0023], [0028], [0037]) is arranged in the material flow direction between the drying device (pre-dryer 28) and the pump E-28 and/or the pump E-29.

Therefore, claim 10 is obvious from D5.

c) Lack of **inventive** step in relation to D8 (LithoRec II Hosokawa Alpine)

D8 also shows from claim 10 the feature

*"a condenser for condensing gaseous electrolyte extracted from the dryer",*  
as be seen from D8, p. 3, Figure 1, according to which a condenser (top) is arranged which is suitable for condensing gaseous electrolytes extracted from the dryer.

D8 also shows that

*"a particle separator arranged in the material flow direction between the drying device and the at least one pump",*

as can be seen from D8, p. 3, Figure 1, according to which a particle separator (gas scrubber) is arranged between the drying device (dryer) and the pump Z1 (top right) in the direction of material flow.

Therefore, claim 10 is obvious from D8.

5. Claim 12

a) Lack of inventive step compared to D5 (DE 10 2011 110 083 A1)

D5 leads with regard to claim 12, according to which

*"a sluice arranged upstream of the shredding unit (18) for feeding the batteries (10)",*

in paragraphs [0015] and [0016] and claim 1:

"[0015] The comminution of the cells and/or the heating of the solid cell fragments preferably takes place under inert gas, for example under nitrogen. It is favorable if the comminution of the cells takes place at ambient temperature, in particular at a maximum of 30°, whereby it can be advantageous if the comminution device with which the cells are comminuted is cooled so that the heat effect on the cells remains low."

"[0016] The method according to the invention is preferably carried out as a continuous process, i.e. not in batches."

Claim 1 :

". An active material of a galvanic cell comprising an active material, a carrier for the active material and a binder for bonding the active material and the carrier, comprising the steps of:

(a) comminution of the cells, in particular under inert gas or in a vacuum, so that at least solid cell fragments are also produced, ..."

According to D5, comminution should therefore take place under inert gas or in a vacuum and preferably continuously and not in batches. The skilled person can use a continuous process under vacuum or an inert gas protective atmosphere.

only with a sluice. Otherwise it would have to switch to batch operation, which should be avoided.

The person skilled in the art therefore advised from D5 to provide an airlock which is arranged upstream of the shredding unit (cell shredding device 12).

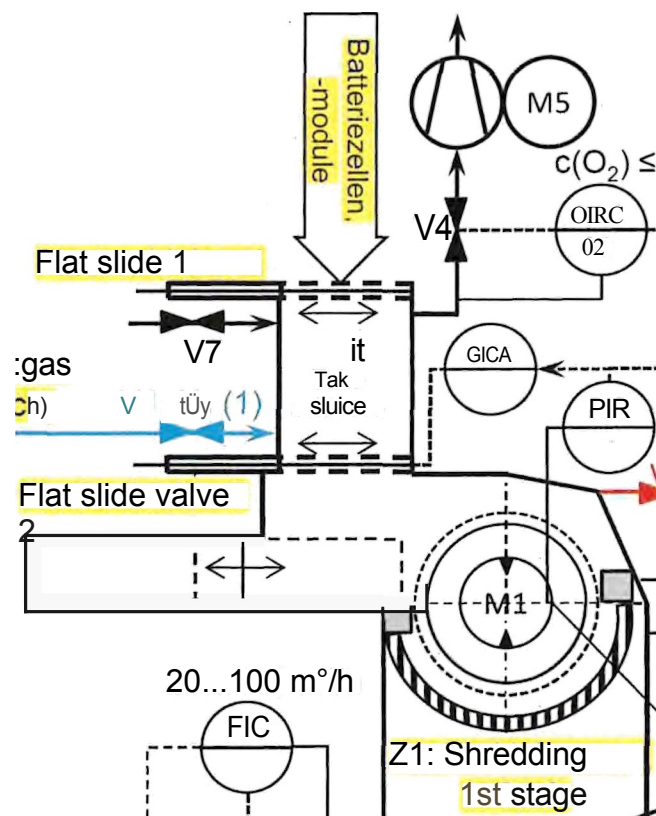
Therefore, claim 12 is obvious from DS.

b) Lack of inventive step in relation to D8 (LithoRec II Hosokawa Alpine)

D8 also shows claim 12, according to which

*"a sluice arranged in front of the shredding unit (18) for feeding the batteries (10)",*

as can be seen from D8, p. 3, Figure 1 (clock lock, top left), and the paragraph below:



Therefore, claim 12 is obvious from D8.

6. Claim 14

- a) Lack of novelty or inventive step compared to D4 (US 2016/0049699 A1) possibly in conjunction with general knowledge according to D9 ("Choose the Right Vacuum Pump")

Claim 14 provides for

*"that the drying device comprises at least one dry-running vacuum pump".*

- (i) D4, Figs. 1-4, show the vacuum pump 13 without liquid supply. The skilled person therefore a dry-running vacuum pump.

Thus, D4 anticipates claim 14, which is therefore not new.

- (ii) In addition, it is simple professional practice to design vacuum pumps as dry-running vacuum pumps, as can be seen from

D9 ("Choose the Right Vacuum Pump")

results.

The publication D9 by Joe Aliasso "Choose the Right Vacuum Pump" was published in March 1999 in Chemical Engineering, McGrawHill Publishing, and reflects general technical knowledge regarding the availability of dry-running vacuum pumps, see D9, 2nd paragraph, as well as the section "Dry Pumps run cleanly" on p. 2 and 3.

When vacuum pumps are used in the recovery of solvents, it is professional practice to ensure that the recovered solvents are not contaminated by a vacuum pump.

D9 proves that dry-running vacuum pumps are advantageous precisely when contamination of the evacuated gas is to be prevented.

At the very least, claim 14 thus arises in an obvious manner from D4 in conjunction with common general knowledge according to D9.

- b) Lack of inventive step as compared to D5 (DE 10 2011 110 083 A1), possibly in conjunction with general knowledge according to D9 ("Choose the Right **Vacuum Pump**")

Claim 14 provides for

*"that the drying device has at least one dry-running vacuum pump has".*

- (i) D5, Fig. 1, shows the vacuum pump E-28, E-29 without liquid supply. The skilled person therefore dry-running vacuum pumps.

Therefore, claim 14 is obvious from D5.

- (ii) Incidentally, as explained above, it is simple professional practice to design vacuum pumps as dry-running vacuum pumps, as can be seen from D9 ("Choose the Right Vacuum Pump").

When vacuum pumps are used in the recovery of solvents, as in D5 (see D5, paragraphs [0021], [0025] and claim 5), it is good to that the recovered solvents are not contaminated by a vacuum pump. D9 shows that dry-running vacuum pumps are advantageous precisely when contamination of the evacuated gas is to be prevented.

At the very least, claim 14 thus arises in an obvious manner from D5 in conjunction with common general knowledge according to D9.

- c) Lack of inventive step as compared to D8 (LithoRec II Hosokawa Alpine), possibly in conjunction with general knowledge according to D9 ("Choose the Right Vacuum Pump")

Claim 14 provides for

*"that the drying device has at least one dry-running vacuum pump".*

(i) D8, p. 3, Figure 1, shows the vacuum pump T: Vacuum generation without liquid supply. The person skilled in the art therefore assumes a dry-running vacuum pump.

Therefore, claim 14 is obvious from D8.

(ii) Incidentally, as explained above, it is simple professional practice to design vacuum pumps as dry-running vacuum pumps, as can be seen from D9 ("Choose the Right Vacuum Pump").

When vacuum pumps are used in the recovery of solvents, as in D8, it is good practice to ensure that the recovered solvents are not contaminated by a vacuum pump. D9 shows that dry-running vacuum pumps are advantageous precisely when contamination of the evacuated gas is to be prevented.

At the very least, claim 14 thus arises in an obvious manner from D5 in conjunction with common general knowledge according to D9.

According to all of the above, the contested claims are inadmissibly broadened, not disclosed in detail and not patentable, so that the patent in suit is invalid to the extent requested.

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#### Attachments

K1: Patent infringement action of  
27.11.2023 K2: EP 3 312 922 B1  
K3: EP 3 312 922 A1  
K4: Register extract for 50 2017 000 109.2  
K5: Plant bundle - state of the art documents D1: WO  
2016/174156 A1

D2: EP 3 289 627 B1  
D3: Priority document DE 10 2015 207 843.4 to  
D4: D1 US 2016/0049699 A1  
D5: EN 10 2011 110 083 A1  
D6: EP 0 794 587 A2  
D7: CN 102496752 A  
D7a: Translation from D7  
D8: Final report on the LithoRec II Hosokawa Alpine research project  
D8-B: Confirmation of TIB Hannover dated 4.3.2024 about publication of D8  
D9: Joe Aliasso "Choose the Right Vacuum Pump", McGrawHill, March 1999  
WO 2010/102377 A1  
D10: EN 10 2012 024 876  
D11: A1  
D12: "LithoRec - Recycling of lithium-ion batteries" - Final report of the joint  
project from April 2, 2012, duration of the project: September 1, 2009 -  
September 30, 2011,  
D13: CN 1438729 A,  
D13a: Translation of D13,  
D14: JP2005-197149A,  
D14a: Translation of D14,  
D15: CN 105 552 470 A,  
D15a: Translation of D15 and  
D16: WO 2010/149611 A1.