

Internal distribution code:

- (A) [-] Publication in OJ
- (B) [-] To Chairmen and Members
- (C) [-] To Chairmen
- (D) [X] No distribution

**Datasheet for the decision
of 7 October 2016**

Case Number: T 1124/14 - 3.3.05

Application Number: 04819548.1

Publication Number: 1685612

IPC: H01M2/02, H01M2/14, H01M2/16,
H01M2/18, H01M4/02, H01M4/38,
H01M4/40, H01M4/58, H01M6/10,
H01M6/14, H01M6/16

Language of the proceedings: EN

Title of invention:

High discharge capacity lithium battery

Patent Proprietor:

Energizer Brands, LLC

Opponents:

Spectrum Brands, Inc.
The Gillette Company

Headword:

Lithium battery/ENERGIZER

Relevant legal provisions:

EPC Art. 123(2), 83, 56

Keyword:

Main request - amendments - allowable (no)
Sufficiency of disclosure - reproducibility (yes)
First auxiliary request - inventive step - non-obvious
solution

Decisions cited:

Catchword:



Beschwerdekammern
Boards of Appeal
Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 1124/14 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 7 October 2016

Appellant I: Spectrum Brands, Inc.
(Opponent 1) PO Box 44960
Madison, Wisconsin 53744-4 (US)

Representative: Davies, Christopher Robert
Dehns
St Bride's House
10 Salisbury Square
London EC4Y 8JD (GB)

Appellant II: The Gillette Company
(Opponent 2) One Gillette Park
Boston, MA 02127 (US)

Representative: Hoyng Rokh Monegier LLP
Rembrandt Tower, 31st Floor
Amstelplein 1
1096 HA Amsterdam (NL)

Respondent: Energizer Brands, LLC
(Patent Proprietor) 533 Maryville University Drive
St. Louis, Missouri 63141 (US)

Representative: Dompatent von Kreisler Selting Werner -
Partnerschaft von Patent- und Rechtsanwälten mbB
Deichmannhaus am Dom
Bahnhofsvorplatz 1
50667 Köln (DE)

Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted on
9 April 2014 maintaining European patent
No. 1685612 in amended form.

Composition of the Board:

Chairman E. Bendl
Members: J.-M. Schwaller
 R. Winkelhofer

Summary of Facts and Submissions

- I. The present appeals were filed by both opponents and lie from the interlocutory decision of the opposition division to maintain European patent No. 1 685 612 in amended form.
- II. In their grounds of appeal, appellants I and II (opponents 1 and 2) held that claim 1 as maintained infringed the requirements of Articles 123(2), 83 and 56 EPC.
- III. With its response dated 2 March 2015 the respondent (proprietor) submitted *inter alia* new experimental data and four amended sets of claims (main request and auxiliary requests 1 to 3).

Claim 1 of the main request reads as follows (amendment compared to claim 1 as granted shown in **bold**):

"1. A lithium electrochemical battery cell comprising a housing; a negative electrode strip comprising metallic lithium, a positive electrode strip comprising an active material mixture wherein the electrode active material comprises greater than 50 weight percent iron disulfide; and an electrolyte comprising at least one salt dissolved in a nonaqueous electrolyte disposed within the housing wherein the electrolyte salt is dissolved in an organic solvent; and a separator disposed between the negative and positive electrodes, characterized in that the separator is a microporous membrane and has a thickness less than 25 μm and a tensile stress of at least 9.81 N/cm (1.0 kgf/cm) in both a machine direction and a transverse direction; the cell having a ratio of a cathode interfacial capacity to an electrode assembly interfacial volume of

at least 710 mAh/cm^3 , wherein the cathode interfacial capacity is the total contribution of an electrode to the cell theoretical discharge capacity, based on the overall cell discharge reaction mechanism(s) and the total amount of active material contained within the portion of the active material mixture adjacent to active material in the opposite electrode, and wherein the electrode assembly interfacial volume is the volume within the cell housing defined by the cross-sectional area, perpendicular to the longitudinal axis of the cell, at the inner surface of the container side wall(s) and the electrode assembly interfacial height, and wherein the BET specific surface area of the separator is from **$25\text{m}^2/\text{g}$** to $40\text{m}^2/\text{g}$."

Claim 1 of the first auxiliary request reads as follows (amendments compared to claim 1 as granted shown in **bold**):

"1. A lithium electrochemical battery cell comprising a housing; a negative electrode strip comprising metallic lithium, a positive electrode strip comprising an active material mixture wherein the electrode active material comprises greater than 50 weight percent iron disulfide; and an electrolyte comprising at least one salt dissolved in a nonaqueous electrolyte disposed within the housing wherein the electrolyte salt is dissolved in an organic solvent; and a separator disposed between the negative and positive electrodes, characterized in that the separator is a microporous membrane and has a thickness less than $25 \mu\text{m}$ and a tensile stress of at least 9.81 N/cm (1.0 kgf/cm) in both a machine direction and a transverse direction; the cell having a ratio of a cathode interfacial capacity to an electrode assembly interfacial volume of at least 710 mAh/cm^3 , wherein the cathode interfacial

*capacity is the total contribution of an electrode to the cell theoretical discharge capacity, based on the overall cell discharge reaction mechanism(s) and the total amount of active material contained within the portion of the active material mixture adjacent to active material in the opposite electrode, **assuming complete reaction of all of the active material, generally expressed in Ah or mAh and wherein when only one of the two major surfaces of an electrode strip is adjacent active material in the opposite electrode, only the active material on that side of the electrode - either the material on that side of a solid current collector sheet or that material in half the thickness of an electrode without a solid current collector sheet - is included in the determination of interfacial capacity,** and wherein the electrode assembly interfacial volume is the volume within the cell housing defined by the cross-sectional area, perpendicular to the longitudinal axis of the cell, at the inner surface of the container side wall(s) and the electrode assembly interfacial height, and wherein the BET specific surface area of the separator is from **25m²/g to 40m²/g.**"*

- IV. The board summoned the parties to oral proceedings and issued a communication setting out its preliminary, non-binding opinion.

- V. In their letters of reply the appellants argued that the amended sets of claims did not meet the requirements of Articles 123(2), 83 and 56 EPC, and they referred to the following documents:

D4: US 5 219 683

D9: Mobil Chemical Company, Films Division, Product Characteristics of Setela ® (1999)

D14: US 4 298 666.

VI. Oral proceedings took place in the absence of both appellants.

VII. The parties' requests were as follows:

Appellants I and II requested in writing that the decision under appeal be set aside and that the patent be revoked in its entirety.

The respondent requested that the patent be maintained in amended form on the basis of one of the sets of claims (main request and auxiliary requests 1-3) filed with letter of 2 March 2015.

VIII. The arguments of the **appellants**, as far as relevant to the present decision, can be summarised as follows:

Main request - Article 123(2) EPC

- The combination of parameters according to claim 1 was not originally disclosed.
- In particular the insertion deriving from original page 6 was incomplete and therefore contravened Article 123(2) EPC.

Auxiliary request 1 - Article 123(2) EPC

- The amended BET specific surface area range of claim 1 was not directly and unambiguously disclosed in combination with the remaining features in the application as filed.

Auxiliary request 1 - Article 83 EPC

- The invention could not be reproduced.
- In particular, there was no general disclosure of how to manufacture separators with BET specific surface area values as claimed.

Auxiliary request 1 - Article 56 EPC

- Either D4 or Lot E (prior-art battery cell described in the patent in suit) was considered to be the closest state of the art.
- No effect achieved by the claimed invention had been convincingly shown by the respondent.
- Therefore, the closest prior art in combination with D9 or D14 rendered the claimed subject-matter obvious.

The arguments of the **respondent**, as far as relevant to the present decision, can be summarised as follows:

Main request - Article 123(2) EPC

- The requirements of Article 123(2) EPC were met.

Auxiliary request 1 - Article 83 EPC

- Lot D (battery cell according to the invention) could be reworked without problems.
- Therefore, the requirements of Article 83 EPC were met.

Auxiliary request 1 - Article 56 EPC

- Lot E cited in the patent in suit represented the closest prior art.
- Comparative test data provided with letter of 2 March 2015 demonstrated that discharge capacity and BET specific surface area were interrelated.
- As it was not derivable from the prior-art documents at issue that a precisely defined BET

specific surface area positively influenced discharge capacity, the claimed subject-matter was not obvious.

Reasons for the Decision

1. Amendments - main request
 - 1.1 Claim 1 of this request infringes Article 123(2) EPC, because the definition of the feature "cathode interfacial capacity" is incomplete in comparison to the passage of the description from which it originates.
 - 1.2 In fact, the omitted passage corresponds to the definition on page 6, lines 10 to 15 of the application as filed and gives further details about the conditions for determining the "cathode interfacial capacity", namely: *"assuming complete reaction of all of the active material, generally expressed in Ah or mAh (where only one of the two major surfaces of an electrode strip is adjacent active material in the opposite electrode, only the active material on that side of the electrode - either the material on that side of a solid current collector sheet or that material in half the thickness of an electrode without a solid current collector sheet - is included in the determination of interfacial capacity"*.

The feature "cathode interfacial capacity" defined in claim 1 as originally filed had been narrowed down during the examination proceedings by inserting the features on page 6, lines 6 to 9. The board considers this passage to be inextricably linked to the remaining part (page 6, lines 10 to 15) of said definition, with

the consequence that omitting only the first part leads to an undisclosed generalisation.

- 1.3 It follows that the main request does not meet the requirements of Article 123(2) EPC and is not allowable.
2. First auxiliary request - amendments
- 2.1 Claim 1 of this request includes the missing passage identified in point 1.2 above, and so Article 123(2) EPC is no longer infringed.
- 2.2 For the board, the remaining parts of claim 1 at issue have a basis in claims 1 and 2 and in the passages on page 6, lines 6 to 16 and 30 to 32; page 13, lines 10 and 11; page 13, line 16 to page 14, line 2; page 14, lines 18 to 22 and page 16, lines 3 to 7 of the application as filed.
- 2.3 In this respect, the board cannot accept appellant I's argument that there was no basis in the application as filed for the combination of the now claimed BET range, thickness and tensile strengths of the membrane. For the board, the basis for these three parameters is found in the passages on page 13, lines 10 and 11; page 13, line 16 to page 14, line 2; page 14, lines 18 to 22, which respectively read (emphasis added by the board):
- *"To minimize the total separator volume in the cell, the **separator should be as thin as possible, preferably less than 25 μ m, ...**";*
 - *"A number of characteristics **besides thickness** can affect separator strength. **One of these is tensile***

stress. A high tensile stress is desirable, preferably 800, more preferably at least 1000 kilograms of force per square centimeter". [...]. Tensile stress can also be expressed in kgf/cm, [...]. **Tensile stress in kgf/cm is also useful for identifying desirable properties related to separator strength. Therefore, it is desirable that the separator have a tensile stress of at least 1.0 kgf/cm, preferably at least [...], in both the machine and transverse directions";**

- "In general, cell discharge performance tends to be better when the separator has a higher specific surface area, but the separator strength tends to be lower. **It is desirable for the BET specific surface area to be no greater than 40 m²/g, but it is also desirable that it be at least 15 m²/g, more preferably at least 25 m²/g."**

The combination of values for these three parameters is furthermore directly and unambiguously derivable from the first two passages - which are general disclosures of the **lowest preferred values** for thickness and tensile stresses of the membrane - and from the general disclosure on page 14, lines 18 to 22 of the specific surface area claimed, which derives directly and unambiguously from the expressions "no greater than 40 m²/g" and "more preferably at least 25 m²/g" in said passage.

- 2.4 The other amendments to claim 1 at issue having not been contested, in view of the above considerations claim 1 at issue satisfies the requirements of Article 123(2) EPC.
- 2.5 The same conclusion applies to dependent claims 2 to 18 of this request, the subject-matter of which has a basis as follows in the application as filed:

- claim 2: in claims 3 and 4;
- claims 3 to 7: in claims 5 to 9 respectively;
- claim 8: in claim 11;
- claim 9: in claims 12 and 13;
- claim 10: in claims 14 to 16;
- claims 11 to 13: in claims 17 to 19;
- claim 14: in claim 21;
- claim 15: in claims 22 and 23;
- claims 16 to 18: in claims 24 to 26 respectively.

3. Sufficiency of disclosure

For the board, in the absence of evidence to the contrary, the skilled person would be able to reproduce the invention on the basis of the information disclosed in the patent, in particular the technical data given in the examples, specifically those of Lot D, which is a specific embodiment falling within the terms of claim 1 at issue.

3.1 In the absence of any attempt to reproduce this specific embodiment, the board does not accept the appellants' assertions that the invention is not reproducible, let alone that the value of "*at least 710 mAh/cm³*" defined in claim 1 at issue is not achievable.

3.2 The board also does not accept appellant I's argument that the invention was insufficiently disclosed because there was no information in the patent as to how separators having specific BET values over the whole claimed range could be manufactured, because apart from the fact that this assertion is not supported by any kind of evidence either, document D14 - published 22 years before the priority date of the patent - discloses the use in batteries of microporous separator membranes having a surface area of 15 to 50 m²/g (D14;

column 15, lines 13 to 20), i.e. a range of BET surface areas covering the entire range claimed. It follows that D14 discloses that separators having the claimed surface area were commonly known at the priority date of the invention.

3.3 Therefore, the board is not convinced that the invention is insufficiently disclosed for it to be carried out by a person skilled in the art, and so it meets the requirements of Article 83 EPC.

4. First auxiliary request - inventive step

By applying the problem-solution approach, the board comes to the conclusion that the claimed subject-matter involves an inventive step for the following reasons:

4.1 Closest prior art

The board takes the view that D4 is a suitable starting point for the problem-and-solution approach. Both appellants shared this view.

D4 (see examples) discloses Li/FeS₂ cells made with a lithium anode and a FeS₂ cathode, with the cathode mix comprising 91 wt.% FeS₂ and the separator being composed of two layers (each 0.001 inch thick) of microporous polypropylene containing surfactants.

4.2 The problem

The problem underlying the invention as defined in the patent in suit is described in paragraph [0012] of the patent as consisting in the provision of a lithium battery cell with increased discharge capacity.

4.3 The solution

As a solution to this problem, the contested patent proposes the lithium battery cell according to claim 1 at issue, which is in particular characterised in that the microporous membrane has:

- a thickness of less than 25 μm ,
- a BET specific surface area of from 25 to 40 m^2/g ,
- a tensile stress of at least 9.81 N/cm (1.0 kgf/cm) in both a machine and a transverse direction, and in that the cell has
- a ratio of a cathode interfacial capacity to an electrode assembly interfacial volume of at least 710 mAh/cm^3 .

In contrast, D4 discloses a separator having a thickness of 25.4 μm . D4 is furthermore silent as to the values of the other parameters.

4.4 Success of the solution proposed

In the absence of a direct comparison with the cell disclosed in D4, an improvement in terms of discharge capacity cannot be acknowledged. It follows that the problem is to be reformulated as the provision of an alternative lithium battery cell with high discharge capacity. The board has no doubt, in particular in view of the examples in the patent, that the alternative problem has been solved.

The cell according to the claimed invention ("Lot D"), which contains a separator made of a porous polyethylene membrane having a thickness of 20 μm and a surface area of 36.4 m^2/g , shows a higher discharge capacity than the cells according to the prior art (Lots E and F), which were both made of a porous

polypropylene membrane with a thickness of 25 μm and a surface area of 44 m^2/g .

Furthermore, the additional experimental data filed with letter of 2 March 2015 (reproduced below)

Separator	Material	Thickness (μm)	BET Surface Area (m^2/g)	DSC Test Result (minutes)
Lot 1	Biaxial PE	20	20.75	308
Lot 2	Biaxial PE	20	27.81	337
Lot 3	Biaxial PE	20	30.93	330
Lot 4	Biaxial PE	20	38	325

clearly show better DSC values for cells made with a microporous separator having a specific surface area falling within the claimed range.

The board does not see any reason to disregard these results, because the DSC test measuring the battery cell discharge capacity, the above data show - in the absence of evidence to the contrary - that the problem underlying the claimed invention is credibly solved over the whole scope of protection.

4.5 Obviousness

As regards the obviousness of the claimed subject-matter over the closest prior art D4, it has to be determined whether the proposed solution was obvious in the light of the state of the art, in particular documents D9 and D14 that the appellants held to be particularly relevant.

4.5.1 D4 focuses on non-aqueous batteries, in particular lithium batteries, with a particular electrolyte system. The question arises whether it was obvious for the skilled person to modify these batteries in such a way as to reflect all the features claimed.

- 4.5.2 D9 discloses a microporous film of polyethylene having high strength in both machine and transverse directions (1270 kg/cm² and 1110 kg/cm² respectively) and being thinner (at 16 μm) than the porous polyethylene film known from D4. The use of this film as battery separator is disclosed.

For the board, even if the skilled person faced with the problem as reformulated in point 4.4 above had an incentive to replace the separator of D4 with the film disclosed in D9, he would not arrive at the subject-matter of claim 1 at issue because D9 is silent *inter alia* as regards the BET specific surface area and its impact on discharge capacity.

- 4.5.3 D14 discloses (column 5, line 66 to column 4, line 20) a rechargeable zinc electrode battery having a separator made of a microporous membrane coated on at least one surface with a low hydrogen over-potential material, said microporous membrane having *inter alia* a surface area of at least 10 m²/g prior to deposit of said coating. The membrane is described as having a thickness of from 0.7 mil (17.8 μm) to about 8 mils, most preferably from about 0.7 to about 2 mils (50.8 μm) (D14: column 15, lines 56 to 61). For membranes made of polyethylene, the surface area is described as ranging from 10 to preferably 20 m²/g, and for those made of polypropylene from 20 to 50 m²/g.

For the board, the skilled person faced with the problem as redefined in point 4.4 above had no incentive to replace the separator of D4 with the one disclosed in D14, as the latter is concerned neither with lithium batteries nor with the problem underlying the invention. D14 rather seeks to solve a different problem, namely the resistance of the battery to

penetration by zinc dendrites and the increase of uniformity of current density upon recharging the battery, and so the skilled person would not take this document into consideration.

D14 is furthermore silent as to the strength values of the polymer and the ratio of the cathode interfacial capacity to the electrode assembly interfacial volume, which means that even if the skilled person considered the teaching of D14, he would not arrive at the subject-matter of claim 1 at issue.

- 4.5.4 For the board, starting from document D4, the other documents in the proceedings neither disclose nor suggest the solution as defined in claim 1 at issue to solve the problem defined in point 4.4 above.
- 4.6 Eventually, even if Lot E was regarded as the closest prior art, the claimed invention would not be obvious either, as there was at least no incentive or teaching to modify the BET specific surface area in order to optimise the discharge capacity.
- 4.7 It follows from the above considerations that the subject-matter of claim 1 at issue, and by the same token that of claims 2 to 18, which depend on claim 1, involves an inventive step (Article 56 EPC).
5. Since the claims of the first auxiliary request meet the requirements of the EPC, there is no need to consider the lower-ranking requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to maintain the patent on the basis of the claims according to auxiliary request 1 filed with letter of 2 March 2015 and a description to be adapted.

The Registrar:

The Chairman:



C. Vodz

E. Bendl

Decision electronically authenticated