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D E C I S I O N
of 1 February 1994

Case Number: T 0622/91 - 3.4.2

Application Number: 81304731.3

Publication Number: 0055888

IPC: H01M 10/34

Language of the proceedings: EN

Title of invention:
Multicell recombining lead-acid battery

Patentee:
Gates Energy Products Inc.

Opponent:
VARTA Batterie AG

Headword:
-

Relevant legal norms:
EPC Art. 54(3),(4), 56, 158(1),(2)

Keyword:
"Novelty - prior international applications"
"Inventive step - prejudice in the art"

Decisions cited:
T 0606/89

Catchword:
-

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Case Number: T 0622/91 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 1 February 1994

Appellant: (Opponent)
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office dated 21 June 1991 rejecting the opposition filed against European patent No. 0 055 888 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: W.W.G. Hofmann
L.C. Mancini

Summary of Facts and Submissions

I. The Appellant (Opponent) lodged an appeal against the decision of the Opposition Division to reject the opposition against the patent No. 0 055 888 granted on the basis of the application No. 81 304 731.3, filed on 12 October 1981, claiming the priority of the previous application of 29 December 1980 (US 221 226) and designating the following Contracting States: BE, CH, DE, FR, GB, IT, LI, NL and SE.

The Opposition Division had *inter alia* considered the following documents:

(D1) US-A-3 846 175 and
(D2) US-A-3 862 861.

The following further documents, cited in the European search report, were considered by the Board:

(D3) WO-A-80/02472,
(D4) WO-A-81/01078 and
(D5) WO-A-81/01075.

II. The patent as granted contained a set of Claims 1 to 17 for the Contracting States other than FR and another set of Claims 1 to 14 for FR (Rule 87 EPC).

III. Oral proceedings were held on 1 February 1994.

During the oral proceedings the Appellant requested that the decision under appeal be set aside and the patent revoked.

The Respondent (Proprietor of the patent) requested that the decision under appeal be set aside and the patent

maintained on the basis of the following documents submitted for **all** designated Contracting States:

main request:

- Claims 1, 15, 16 and 17 received during the oral proceedings,

- Claims 2 to 14 of the patent specification according to the set of claims for the Contracting States other than FR,

- description and drawings of the patent specification,

first auxiliary request:

- Claims 1, 15, 16 and 17 received during the oral proceedings (the Board notes that Claims 15, 16 and 17 should be renumbered 14, 15 and 16),

- Claims 2 to 12 and 14 of the patent specification according to the set of claims for the Contracting States other than FR (the Board notes that Claim 14 should be renumbered 13),

- description and drawings of the patent specification,

second auxiliary request:

- Claims 1, 15, 16 and 17 received during the oral proceedings (the Board notes that Claims 15, 16 and 17 should be renumbered 14, 15 and 16),

- Claims 2 to 12 and 14 of the patent specification according to the set of claims for the Contracting

States other than FR (the Board notes that Claim 14 should be renumbered 13),

- description and drawings of the patent specification,

third auxiliary request:

- as main request but with the omission of Claims 15, 16 and 17,

fourth auxiliary request:

- as first auxiliary request but with the omission of Claims 15, 16 and 17,

fifth auxiliary request:

- as second auxiliary request but with the omission of Claims 15, 16 and 17,

IV. The wording of **Claim 1** according to the **Respondent's main request** reads as follows:

"A multicell lead-acid battery operating on the oxygen cycle, wherein oxygen liberated at the positive electrodes upon overcharge is fully consumed at the negative electrodes, each cell (28-1 to 28-6; 68-1 to 68-4; 120-1 to 120-3) comprising:

spaced-apart positive and negative electrodes (11, 13; 88, 90; 112, 114; 134, 136) which are in intimate face-to-face compressive contact with interleaved, porous, compressible separator(s) (15, 86, 110, 138), the assembly of electrodes and separator(s) being compressed together and housed within a container so that the separator(s) is/are sandwiched under firm mutual stacking pressure;

a liquid acid electrolyte which is present in an amount substantially less than the maximum capable of being absorbed by the electrodes and separator(s), and which is fully absorbed by said electrodes and separator(s);

said separator(s) having a relatively greater electrolyte absorptive power than the adjoining electrodes with the bulk of the electrolyte being retained in the pores of the separator(s), a substantial proportion of the separator's and electrodes' pore volumes remaining void thereby facilitating gas transport during the gas recombination reaction upon charging;

characterised in that:

the cells are housed in a sealed monobloc container (12; 70; 126) wherein partition members (82; 116; 122, 124) segregate the cells from direct physical contact with one another yet provide a gas space (60; 78; 130) which is common to all the cells enabling gas from any one cell to migrate to any other cell."

Claims 2 to 17 according to the **Respondent's main request** are dependent on Claim 1 in the sense of Rule 29(4) EPC.

The wording of **Claim 1** according to the **Respondent's first auxiliary request** reads as follows:

"A multicell lead-acid battery operating on the oxygen cycle, wherein oxygen liberated at the positive electrodes upon overcharge is fully consumed at the negative electrodes, each cell (28-1 to 28-6; 68-1 to 68-4; 120-1 to 120-3) comprising:

spaced-apart positive and negative electrodes (11, 13; 88, 90; 112, 114; 134, 136) which are in intimate face-to-face compressive contact with interleaved, porous, compressible separator(s) (15, 86, 110, 138),

the separator(s) being sandwiched under firm mutual stacking pressure;

a liquid acid electrolyte which is present in an amount substantially less than the maximum capable of being absorbed by the electrodes and separator(s), and which is fully absorbed by said electrodes and separator(s);

said separator(s) having a relatively greater electrolyte absorptive power than the adjoining electrodes with the bulk of the electrolyte being retained in the pores of the separator(s), a substantial proportion of the separator's and electrodes' pore volumes remaining void thereby facilitating gas transport during the gas recombination reaction upon charging;

characterised in that:

the cells are housed in a sealed monobloc container (12; 70; 126) wherein partition members (82; 116; 122, 124) segregate the cells from direct physical contact with one another yet provide a gas space (60; 78; 130) which is common to all the cells enabling gas from any one cell to migrate to any other cell,

the electrodes are substantially flat and are stacked in parallel to form a prismatic block, said partition members being parallel to said substantially flat electrodes."

Claims 2 to 12 and 14 to 17 according to the **Respondent's first auxiliary request** are dependent on Claim 1 in the sense of Rule 29(4) EPC.

The wording of **Claim 1** according to the **Respondent's second auxiliary request** reads as follows:

"A multicell lead-acid battery operating on the oxygen cycle, wherein oxygen liberated at the positive electrodes upon overcharge is fully consumed at the

negative electrodes, each cell (28-1 to 28-6; 68-1 to 68-4; 120-1 to 120-3) comprising:

spaced-apart positive and negative electrodes (11, 13; 88, 90; 112, 114; 134, 136) which are in intimate face-to-face compressive contact with interleaved, porous, compressible separator(s) (15, 86, 110, 138), the assembly of electrodes and separator(s) being compressed together and housed within a container so that the separator(s) is/are sandwiched under firm mutual stacking pressure;

a liquid acid electrolyte which is present in an amount substantially less than the maximum capable of being absorbed by the electrodes and separator(s), and which is fully absorbed by said electrodes and separator(s);

said separator(s) having a relatively greater electrolyte absorptive power than the adjoining electrodes with the bulk of the electrolyte being retained in the pores of the separator(s), a substantial proportion of the separator's and electrodes' pore volumes remaining void thereby facilitating gas transport during the gas recombination reaction upon charging;

characterised in that:

the cells are housed in a sealed monobloc container (12; 70; 126) wherein partition members (82; 116; 122, 124) segregate the cells from direct physical contact with one another yet provide a gas space (60; 78; 130) which is common to all the cells enabling gas from any one cell to migrate to any other cell,

the electrodes are substantially flat and are stacked in parallel to form a prismatic block, said partition members being parallel to said substantially flat electrodes."

Claims 2 to 12 and 14 to 17 according to the **Respondent's second auxiliary request** are dependent on Claim 1 in the sense of Rule 29(4) EPC.

V. The Appellant essentially argued as follows:

D1 and D2 are relevant documents in the same technical field as the present subject-matter. D1, in particular, shows a multicell lead-acid battery operating on the oxygen cycle and comprising, *inter alia*, a starved amount of electrolyte and a common gas space. Although there is no explicit statement concerning the presence of a stacking pressure in the cells, the skilled person, while reading D1, understands that such a stacking pressure is present, otherwise the cells could not work. Anyhow, the feature of the stacking pressure in a lead-acid cell is already known from D2 and can be transferred to the battery of D1. The combination of D1 and D2 renders obvious the subject-matter of Claim 1 according to the various requests.

VI. The Respondent essentially argued as follows:

The closest prior art is not D1 but that acknowledged in column 1, lines 17 to 22, of the patent in suit. Starting from this prior art, the solution to the problem mentioned in column 1, lines 22 to 29, consists in the provision of a common gas space enabling gas from any one cell to migrate to any other cell. Such a solution is not rendered obvious by any cited document. On the contrary, in the art of lead-acid batteries there was a technical prejudice against linking the cells by a common gas space because of problems arising from unequal states of charge and intercell electrolyte creepage.

Reasons for the Decision

1. *Main request*

1.1 Novelty of Claim 1

1.1.1 The patent in suit correctly claims the priority date of 29 December 1980.

The earlier PCT application D4, published on 16 April 1981, has the priority date of 8 October 1979 and the filing date of 8 October 1980. It has been submitted to the European Patent Office in one of its official languages and the national fee provided for in Article 22(1) or 39(1) PCT has been paid. The requirements of Article 158(2) EPC are thus fulfilled. The content of the earlier application as filed is, therefore, considered as comprised in the state of the art relevant to the present patent in accordance with Articles 54(3) and 158(1) EPC. Since the earlier application concerns the Contracting State FR (European patent), which is designated both in the present patent and the earlier application, the following is to be noted (using the same terminology as Claim 1 of the main request):

D4 discloses a multicell lead-acid battery operating on the oxygen cycle, wherein oxygen liberated at the positive electrodes upon overcharge is fully consumed at the negative electrodes (see page 6, line 12 to page 7, line 1), and wherein

- each cell comprises spaced-apart positive and negative electrodes in intimate face-to-face compressive contact with interleaved, porous, compressible separators, the assembly of electrodes

and separators being compressed together and housed within a container so that the separators are sandwiched under firm mutual stacking pressure (see Claim 1; page 2, line 17 to page 3, line 6; page 4, lines 4 to 8);

- each cell comprises a liquid acid electrolyte which is present in an amount substantially less than the maximum capable of being absorbed by the electrodes and separators, and which is fully absorbed by said electrodes and separators (see page 4, lines 12 to 18; page 6, lines 3 to 8), said separators having a relatively greater electrolyte absorptive power than the adjoining electrodes with the bulk of the electrolyte being retained in the pores of the separators (this feature is implicitly disclosed and can be derived from the structure of the separators as compared to that of the electrodes - see page 7, lines 18 to 22 and page 11, lines 23 to 30), a substantial proportion of the separators' and electrodes' pore volumes remaining void thereby facilitating gas transport during the gas recombination reaction upon charging (see page 4, lines 12 to 18; page 5, line 30 to page 6, line 26);

- the cells are housed in a sealed monobloc container wherein partition members segregate the cells from direct physical contact with one another (see page 3, lines 7 to 30; page 9, lines 3 to 9) yet provide a gas space which is common to all the cells enabling gas from any one cell to migrate to any other cell (see page 10, lines 3 to 5; page 11, lines 3 to 11).

Thus, D4 destroys the novelty of the subject-matter of Claim 1 insofar as the same Contracting State FR is designated.

1.1.2 The same is true for the earlier PCT application D5 which also fulfils the requirements of Article 158(2) EPC and also comprises FR (European patent) among the designated Contracting States.

Attention is drawn, in particular, to page 5, line 23 to page 6, line 11 (multicell lead-acid battery with oxygen cycle); page 7, line 32 to page 8, line 1 (stacking pressure); page 4, lines 6 to 11 and page 5, line 23 to page 6, line 7 (starved amount of electrolyte and consequent gas transport); page 8, lines 1 to 7 and Figure 1 (partition members and common gas space).

1.1.3 As shown above, the subject-matter of Claim 1 lacks novelty in the sense of Article 54(1),(3),(4) EPC. This fact alone is sufficient to render the Respondent's main request non-allowable (Article 52(1) EPC).

1.2 Inventive step of Claim 1

1.2.1 Since the Respondent, at the oral proceedings, while being aware of this situation, nevertheless expressly renounced establishing novelty by filing an amended Claim 1 for FR in view of the likewise negative opinion of the Board on the issue of inventive step (necessarily relating to all designated States), which issue had been thoroughly discussed during all of the opposition and appeal procedure, the Board feels bound to also give its reasons regarding inventive step.

1.2.2 D1, which is considered as the closest prepublished prior art, relates to a multicell lead-acid battery operating on the oxygen cycle (see, in particular,

column 1, lines 38 to 72). The known battery comprises the following constructional features:

- Each cell comprises spaced-apart positive and negative electrodes in face-to-face contact with an interleaved, porous, compressible separator. The existence of a contact between electrode and separator can be clearly derived from Figures 1, 5 and 9. Moreover, according to column 3, lines 47 to 50, the separator provides "some support for the positive active material", which means that a contact must take place, otherwise such a support would not be possible. A further hint at the presence of a contact derives from the fact that the surface of the positive active material is "in active engagement" with the separator (see column 3, lines 53 to 55), whereby it may be assumed that the same also applies to the inner surface of the negative active material. As to the properties of the separator, examples of suitable materials are mentioned in column 4, lines 21 to 32, the mentioned materials being clearly porous and compressible.

- In each cell a liquid acid electrolyte is present in a starved amount, the bulk of the electrolyte being retained in the pores of the separator and a substantial proportion of the pore volume of the separator and electrodes remaining void (see column 5, lines 10 to 14 in conjunction with column 4, lines 21 to 32). Although "saturation or a small amount of excess free electrolyte" are also mentioned as possible alternatives, the document clearly discloses the fact that the cell, as a rule, works with a starved amount of electrolyte which is then fully absorbed by the separator and electrodes. The mention in Claim 1 of the fact

that, by this feature, gas transport is facilitated during the gas recombination reaction upon charging, relates to the result necessarily achieved by the said feature, rather than specifying an additional constructional feature.

- The cells are housed in a sealed monobloc container comprising partition members and providing a gas space common to all the cells enabling gas migration from cell to cell (see Figure 7, column 6, lines 3 to 24).

Thus, the only distinguishing feature of the battery according to Claim 1 over that known from D1 consists in that a firm stacking pressure is applied to the separator between the electrodes of each cell. This feature is neither explicitly described in D1, nor does it form part of the implicit disclosure which the skilled person would at once recognise.

1.2.3 Of the objects mentioned in the patent in suit in column 1, line 60 to column 2, line 16, none is connected to the above-mentioned single distinguishing feature. Full absorption of the electrolyte and intercommunication of the cells by gas redistribution with the consequence of compensation of imbalance in electrolyte fill levels (see column 1, lines 60 to column 2, line 2) is already achieved by the battery known from D1 since it has the same features regarding non-saturation and a common gas space as the battery according to Claim 1. The same applies to the further object mentioned in column 2, lines 2 to 7 (in particular, the possibility to overcharge and to store in any indiscriminate attitude), having regard to D1, column 6, lines 3 to 17 and column 2, lines 60 to 63. The further object mentioned in column 2, lines 7 to 14 (common stacking pressure), does not relate to the

subject-matter of Claim 1, but only to a special embodiment.

What remains as the problem to be solved by the said distinguishing feature, is to achieve a more efficient oxygen cycle in the battery (see column 2, lines 50 to 52; column 5, lines 39 to 41; Claim 1), i.e. recombination of oxygen at higher rates than that typical of the cells of the battery known from D1. Indeed, although not expressly stated in the patent itself, the provision of a stacking pressure applied on the separator and electrodes of each cell may promote the internal transport of oxygen in the cell, as underlined by Dr Mrha in his declaration received with the letter of 21 October 1991 (see last paragraph of section 2.1).

1.2.4 Starting from the battery known from D1, it must be assessed whether the solution of holding the electrodes and separators of each cell under firm mutual stacking pressure would be obvious for the skilled person having to solve the stated problem.

According to D1, perforations are provided in the negative support plate (see Figures 1, 4 and 5) in order to facilitate removal of oxygen by oxidation via the outer side of the negative electrode (see column 4, lines 41 to 43). For this type of oxygen transport, applying a stacking pressure on the electrodes and separator would not appear to be of assistance.

However, this kind of gas transport is not the only one which can occur in the cell of D1 since this cell operates in the starved condition (see column 5, lines 10 to 12).

It is known from D2 which describes a maintenance-free lead-acid cell, i.e. a cell of the same type as that used in the battery of D1, that the recombination of oxygen with the negative plate by diffusion thereto is maximised by choosing a starved electrolyte condition (see column 3, lines 5 to 8; column 7, lines 57 to 62 and column 8, line 66 to column 9, line 19). It is evident that the less electrolyte is contained in the interstices of the separator and electrode materials, the more likely the electrolytic conductive contact between the electrodes and the separator would be interrupted unless the separator and electrodes were made to conform to each other by a stacking pressure (see D2, column 6, lines 6 to 21), so that the stacking pressure is a necessity if - for maximising oxygen recombination - the amount of absorbed electrolyte is very much reduced. This is in agreement with the declaration of Dr Mrha filed with the letter of 21 October 1991, where he states (uncontradicted by the other expert declarations on file) that a stacking pressure will have a positive influence on the oxygen transport (see last paragraph of page 5).

Furthermore, D3 deals with the fact that a starved amount of electrolyte and a stacking pressure are conditions providing rapid gas transmission through the separator, which means an improved oxygen cycle (see page 7, lines 3 to 16, page 8, line 18 to page 9, line 1 and page 13, lines 3 to 9).

In view of these effects to be expected from applying a stacking pressure, the combination of this feature from D2 with the features according to D1 must be considered obvious.

1.2.5 According to the Respondent, D1 should not be regarded as the closest prior art. Rather, the monobloc multicell

parallel plate batteries referred to in column 1, lines 8 to 22 of the patent specification - which are further developments of the subject-matter of D2 - represent the closest prior art, in respect of which the problem to be solved, mentioned in lines 22 to 29, is defined. This approach is, in the Respondent's opinion, supported by the unpublished Decision T 0606/89, according to which "the claimed invention should be compared with the art concerned with a similar use which requires the minimum of structural and functional modifications" (see point 2 of the Reasons).

In the Board's judgment, the requirement that a "similar use" and a "minimum of structural and functional modifications" for going from the closest prior art to the claimed invention are necessary, is met when starting the assessment of inventive step from D1. This document also relates to a gas-tight maintenance-free multicell lead-acid battery (the patent in suit does not mention a more specific use) comprising all the features of the claimed battery with the only exception of the stacking pressure. Therefore, the Board considers D1 as representing the closest prior art.

1.2.6 In his argumentation regarding inventive step according to the approach mentioned in section 1.2.5 above, the Respondent puts forward that a technical prejudice was present in the art against the provision of a common gas space enabling gas transport between cells in a multicell lead-acid battery of the starved type, and draws attention to

- Mr R.F. Nelson's declaration of 14 September 1987, received with letter of 25 September 1991, section 5,

- Dr P. Ruetschi's letter to Mr J.A. Mitchell, dated 26 January 1984 (read 1985), received with letter of 25 November 1985, last paragraph of section 2,

- Dr J. Mrha's declaration of 3 October 1991, received with letter of 21 October 1991, page 10 and first paragraph of page 11,

- Prof A.J. Salkind's declaration of 8 April 1992, received with letter of 22 April 1992, section 10.

However, the Board is not convinced of the existence of such a general technical prejudice, firstly having regard to Dr E. Voss's declaration of 20 September 1991, received with letter of 21 October 1991 (see page 9, point IV.4), which denies such a prejudice, and secondly in view of the fact that a prior art document, namely D1, clearly describes such a battery which has nearly all the features of the battery claimed in the patent in suit and, in particular, in refutation of the alleged prejudice, a common gas space for all the cells.

1.2.7 In view of the foregoing, the Board comes to the conclusion that it was obvious for the skilled person starting from the battery according to D1 and having to solve the problem of improving the oxygen cycle, to apply the measure of holding the electrodes and separator of each cell under a given pressure, as already known from D2, thereby arriving at the claimed battery.

Accordingly, the subject-matter of Claim 1 lacks inventive step.

1.3 Since the subject-matter of Claim 1 is not novel with respect to each one of the earlier applications D4 and D5 (and does not involve an inventive step with regard

to the combination of the prepublished patents D1 and D2), it is not necessary to examine the remaining claims.

Accordingly, the main request is not allowable.

2. *First auxiliary request*

2.1 Claim 1 according to the first auxiliary request corresponds to Claim 1 of the main request with the following differences:

(i) the feature that the assembly of electrodes and separator(s) is compressed together and housed within a container, has been deleted,

(ii) the feature that the electrodes are substantially flat and stacked in parallel to form a prismatic block, the partition members being parallel to the substantially flat electrodes, has been added.

2.1.1 The feature (ii) is also known from D4 (see Figure 1) as well as D5 (see Figure 1 - plastic bags, in which the cell packs are inserted, serve the function of the intercell partitions).

Thus, D4 and D5 destroy the novelty of the subject-matter of Claim 1 since both the present patent and the earlier applications concern the designated Contracting State FR (European patent).

Claim 1 is therefore not allowable.

2.1.2 Moreover, the feature (ii) is usual in the prepublished prior art as well. In D2, the parallel plate construction, represented in Figure 3, is considered as "conventional" (see column 6, lines 6 to 11).

In the light of the foregoing, the subject-matter of Claim 1 does not involve an inventive step with regard to the combination of the prepublished documents D1 and D2.

2.2 Since Claim 1 is not allowable, it is not necessary to examine the remaining claims.

Accordingly, the first auxiliary request is not allowable.

3. *Second auxiliary request*

3.1 Claim 1 according to the second auxiliary request corresponds to Claim 1 of the main request supplemented with the further feature (ii).

It follows from the foregoing that the subject-matter of Claim 1 according to the second auxiliary request, on the one hand, is not novel with respect to the earlier applications D4 and D5, and, on the other hand, does not involve an inventive step with regard to the combination of the prepublished documents D1 and D2.

Since Claim 1 is not allowable, it is not necessary to examine the remaining claims.

Accordingly, the second auxiliary request is not allowable.

4. *Third, fourth and fifth auxiliary requests*

4.1 Claims 1 according to the third, fourth and fifth auxiliary requests correspond to Claims 1 of the main, first and second auxiliary requests, respectively.

Accordingly, the third, fourth and fifth auxiliary requests are not allowable.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

P. Martorana E. Turrini