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D E C I S I O N
of 27 October 2000

Case Number: T 0281/98 - 3.4.2

Application Number: 91105059.9

Publication Number: 0477461

IPC: H01M 10/34, H01M 4/24, H01M 4/32,
H01M 2/16

Language of the proceedings: EN

Title of invention:
Nickel/hydrogen storage battery and method of manufacturing the
same

Patentee:
MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.

Opponent:
ALCATEL ALSTHOM CIE. GEN. D'ELECTRICITE

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 56

Keyword:
"Novelty and inventive step (after amendments - yes)"

Decisions cited:
T 0135/86, T 0629/90, T 0078/95

Catchword:
-



Case Number: T 0281/98 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 27 October 2000

Appellant: MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.
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Osaka-fu, 571 (JP)

Representative: Patentanwälte
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Respondent: ALCATEL ALSTHOM CIE. GEN. D'ELECTRICITE
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 23 February 1998
revoking European patent No. 0 477 461 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: E. Turrini
Members: R. Zottmann
B. J. Schachenmann

Summary of Facts and Submissions

- I. The appellant (patentee) lodged an appeal against the decision of the Opposition Division to revoke the European patent No. 0 477 461 with the application No. 91 105 059.9.

The respondent (opponent) withdrew his opposition.

Later, in a communication and a consultation by telephone, the Board of Appeal expressed its preliminary opinion that and why amended patent documents filed in the course of the appeal proceedings did not comply with the provisions of the EPC.

Thereafter, the appellant filed new amended patent documents to meet the objections of the Board of Appeal.

- II. The appellant requested that the decision under appeal be set aside and the patent be maintained on the basis of the following documents:

Description: pages 2 and 4 to 7 filed with the letter dated 14 September 2000;
pages 3 and 8 filed with the letter dated 16 October 2000;

Claims: 1 to 9 filed with the letter dated 16 October 2000;

Drawings: Figures 1 and 2 as granted.

III. The following prior art documents were cited during the appeal proceedings:

D1: EP-A-0 353 837;

D2: English translation of JP-A-059 083 347 (pages 1 to 13) submitted by the (former) respondent with his letter dated 13 March 1996 and the drawings of JP-A-059 083 347 (Figures 1 to 3);

D3: Proceedings of the 16th International Power Sources Symposium, Bournemouth, September 1988, Power Sources 12, pages 393 to 410; and

D4: Proceedings of the 34th International Power Sources Symposium, June 25 to 28, 1990, pages 299 to 304.

IV. The independent claim reads as follows:

"1. A nickel-hydrogen storage battery which comprises a nickel positive electrode having a nickel oxide as a main active material, a negative electrode mainly composed of a hydrogen absorbing alloy capable of carrying out the electrochemical hydrogen absorbing and desorbing reaction, an alkaline electrolyte, and a separator, wherein the nickel positive electrode, the negative electrode and the separator contain a zinc compound, the content of the zinc compound in the nickel positive electrode being 30-500 mg/Ah of battery capacity and the contents of the zinc compound in the negative electrode and the separator being 0.3-15 mg/Ah of battery capacity respectively, in terms of zinc oxide ZnO, said battery resulting from the following manufacturing steps:

adding a zinc compound to the negative electrode, the positive electrode and the separator of the above constructive elements, and constructing the battery with the negative electrode, the separator, the electrolyte and the positive electrode."

The remaining claims 2 to 9 are dependent on claim 1.

V. The arguments of the appellant are summarized as follows:

Batteries containing zinc oxide in the positive electrode before assembling the battery, but lacking initially added zinc oxide in the negative electrode or the separator, respectively, have only short cycle lives, whereas long cycle lives are achieved in case that zinc oxide is initially added to the negative electrode and the separator; this can be taken from Tables 2 and 3 of the patent specification. Adding of zinc oxide to the negative electrode and the separator only by migration thereof from the positive electrode during initial charging and discharging is not sufficient. Zinc oxide initially added to the negative electrode and the separator bonds to or coordinates with hydroxide ion and water present in the electrolyte in form of a complex-like hydratized zinc hydroxide. The zinc oxide is thus stabilized on the separator/negative electrode and retains the water or the electrolyte in them. Though zinc oxide initially added to the positive electrode may be dissolved in the electrolyte in the form of $ZnOOH^-$, this compound is not immobilized on the separator/negative electrode due to the absence of a complexing agent. Therefore, in use of the battery, it repeatedly moves so that water will not

reliably be held in the separator/negative electrode. Rather, the electrolyte will move into the positive electrode, resulting in an increase of the internal resistance and thus in a deterioration of the cycle life of the battery.

References D1 and D4 only refer to zinc comprised in the positive electrode in the form of a solid solution. It is hereby strongly bonded to the crystal making up said electrode and therefore any dissolution in the electrolyte and migration to the separator or negative electrode are inhibited.

None of the prior art references cited during the opposition proceedings shows to initially add a zinc compound not only to the positive electrode but also to the negative electrode and the separator. This is true even for a combination of D2 and D3 which can only teach to initially add a zinc compound only to the positive electrode.

- VI. The respondent did not submit arguments being significant with respect to the present patent documents.

Reasons for the Decision

1. *Appeal proceedings*

The opponent (respondent) withdrew his opposition during the present appeal proceedings. It is established case law that in such a case the board of appeal has to examine the substance of the Opposition Division's decision of its own motion: it can only set said decision revoking the patent aside and maintain the patent if the latter meets the requirements of the

EPC (see e. g. decisions T 135/86, T 629/90 OJ EPO 1992, 654, and T 78/95). The board can also take account of evidence submitted by the opponent prior to withdrawal of the opposition.

2. *Amendments*

Present claim 1 differs from claim 1 as granted only in that the manufacturing steps have been added. Said steps are essential for the structure of the electrodes and the separator of the battery according to Examples 1 to 3. This modification restricts the scope of claim 1. Claims 2 to 9 are - except for the removal of a clerical error in claim 7 - identical with claims 2 to 9 as granted.

Though in all examples only ZnO is used for the starting material of the electrodes and the separator, it is mentioned at several places of the application documents as originally filed that a zinc *compound* is used for the starting material for constructive elements of the battery (see e. g. page 7 lines 13 to 16, page 8 second paragraph, the paragraph bridging pages 21 and 22 and claim 11).

The amendments of the description and the drawings take account of the new claim set and the most relevant prior art (requirements of Rule 27(1) EPC).

Therefore, the amendments of the patent documents do not infringe Article 123(2) and (3) EPC.

3. *Novelty*

Document D1 describes an alkaline battery having a nickel positive electrode with nickel hydroxide as a main active material to which zinc or magnesium has been added, and a separator. Since zinc is present in

state of a solid solution (see e. g. the abstract, the paragraph bridging pages 2 and 3 and claims 1 and 3) it cannot migrate within the battery. The negative electrode consists for example of cadmium hydroxide; a hydrogen absorbing alloy is not mentioned as material for said electrode.

D2 discloses a nickel-cadmium battery having a nickel positive electrode having nickel hydroxide as a main active material to which cobalt and zinc or a zinc compound have been added, and a separator. The negative electrode consists of cadmium hydroxide; a hydrogen absorbing alloy is not mentioned as material for said electrode.

From D3 a high capacity nickel/hydrogen storage battery is known comprising a nickel positive electrode having nickel hydroxide as a main active material, a negative electrode mainly composed of a hydrogen absorbing alloy capable of carrying out the electrochemical hydrogen absorbing and desorbing reaction, an alkaline electrolyte and a separator. Zinc or a zinc compound as a component of a constructive element of the battery is not mentioned there.

The high energy density nickel-cadmium battery of D4 has a positive electrode with nickel hydroxide as a main active material to which zinc or cadmium or cobalt, zinc and cadmium have been added, and a separator. Since the zinc is present in state of a solid solution (see e. g. the paragraph bridging the columns of page 300 and page 301 paragraphs 2 and 5), it cannot migrate within the battery. The negative electrode consists of cadmium. It is mentioned that

pasted nickel electrodes using nickel hydroxyde powder added with zinc are more useful for Ni-Zn and Ni-H₂ or Ni-metal hydride batteries without a cadmium pollution problem. Initial addition of zinc to the negative electrode or the separator is not mentioned in D4.

Though according to D2 the starting materials for the negative electrode and the separator do not comprise zinc or a zinc compound, the latter can migrate from the positive electrodes of the battery of D2 to the separator and the negative electrode during the usual formation process step (normally one charge/discharge cycle). The appellant argues that there is a significant difference in cycle lives between batteries lacking initially added zinc compound in the negative electrode and the separator (receiving zinc, if at all, only by migration during the formation process) and batteries having an initially added zinc compound in the negative electrode and the separator and tries to explain this effect, see section V. above. The Board has no reason to doubt the above submissions of the appellant that initial adding of the zinc compound according to claim 1 of the attacked patent leads to different materials of the separator/negative electrode in comparison with those of D2 where the zinc or zinc compound reaches the separator and negative electrode - if at all - only by migration.

Therefore, the subject-matter of claim 1 is novel in the sense of Article 52(1) EPC.

4. *Inventive step*

4.1 From the preceding section 3. it follows that the nearest prior art is disclosed in document D2.

The battery according to claim 1 differs from said prior art mainly in that - instead of a cadmium (hydroxide) negative electrode - a negative electrode mainly composed of a hydrogen absorbing alloy is used and in that the zinc compound is initially added not only to the positive electrode but also to the negative electrode and the separator.

This results in an improved cycle life of the storage battery and an enhanced capacity.

The problem underlying the invention as defined in the present claim is therefore to further develop the storage battery of the nearest prior art in such a manner that the above-mentioned effects are obtained.

- 4.2 Replacement of the cadmium negative electrode of the battery of D2 by an electrode consisting essentially of a hydrogen absorbing alloy in order to enhance the capacity of the battery seems to be a routine option for the skilled person and is for example suggested by the teachings of document D3. However, initial addition of a zinc compound not only to the positive electrode but also to the negative electrode and the separator is not obvious for the skilled person when taking into account the teachings of D2 alone, since there is no suggestion to proceed in this direction and the reactions of the zinc compound in the battery are - according to the appellant's submissions, see e. g. the arguments of the appellant in section V. above - relatively complicated and therefore hard to predict. Moreover, none of the remaining documents D1, D3 or D4 disclose or suggest said initial addition of a zinc compound.

4.3 Therefore, the Board concludes that the subject-matter of claim 1 involves an inventive step as defined in Article 56 EPC.

5. In the result, the Board takes the view that claim 1 complies with the provisions of the EPC. This applies also the other documents of the patent.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent in amended form with the following documents:

Description: pages 2 and 4 to 7 filed with the letter dated 14 September 2000;
pages 3 and 8 filed with the letter dated 16 October 2000;

Claims: 1 to 9 filed with the letter dated 16 October 2000;

Drawings: Figures 1 and 2 as granted.

The Registrar:

The Chairman:

P. Martorana

E. Turrini