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Datasheet for the decision of 26 November 2013

Case Number: T 1788/08 - 3.4.03

Application Number: 01105782.5

Publication Number: 1132989

IPC: H01M10/44

Language of the proceedings: EN

Title of invention:
Device and method for controlled charging of a secondary battery

Applicants:
Panasonic Corporation
TOYOTA JIDOSHA KABUSHIKI KAISHA

Headword:

Relevant legal provisions:
EPC Art. 123(2)
EPC 1973 Art. 54(1), 56, 83, 84

Keyword:
Amendments - added subject-matter (no)
Claims - clarity (yes)
Novelty - (yes)
Inventive step - (yes)

Decisions cited:

Catchword:

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Case Number: T 1788/08 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 26 November 2013

Appellants: (Applicants)
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Decision under appeal:
Decision of the Examining Division of the European Patent Office posted on 8 April 2008 refusing European patent application No. 01105782.5 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: G. Eliasson
Members: S. Ward
T. Karamanli

Summary of Facts and Submissions

I. The appeal is against the decision of the Examining Division refusing European patent application No. 01 105 782 on the grounds that the main request (filed in oral proceedings before the Examining Division) did not fulfill the requirements of Article 123(2) EPC and that the first and second auxiliary requests filed with the letter of 21 January 2008 lacked novelty. In addition, it was mentioned in the Reasons for the decision that all three requests failed to overcome further objections "with regard to Art. 84 and 123(2) EPC", which had been "raised during the written procedure".

II. The following documents cited by the Examining Division are referred to in this decision:

D1: EP 0 966 089 A
D2: EP 0 949 740 A.

III. Together with a letter stating the grounds of appeal the appellants filed a main request and 1st, 2nd and 3rd auxiliary requests. In the letter the appellants requested that the decision under appeal be set aside and that a patent be granted on the basis of one of the above requests. A conditional request for oral proceedings was made for the case that the Board was disinclined to grant a patent based on the main request.

IV. With a summons to oral proceedings, the Board sent the appellants a communication under Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA)

setting out the provisional view of the Board. In this communication, the Board expressed a doubt whether claim 11 of the main request met the requirements of Article 123(2) EPC. In addition, the Board expressed the preliminary view that claims 1 and 7 of the main request did not meet the requirements of Article 84 EPC 1973. It was further noted that the claims of the main request appeared to satisfy the requirements of the EPC in relation to novelty and inventive step.

V. The appellants filed a further letter dated 3 September 2013 together with a new main request and new 1st, 2nd and 3rd auxiliary requests. The main request was that a patent be granted, or that the case be remitted to the department of first instance, on the basis of:

- claims 1 to 12 of the main request filed with the letter dated 3 September 2013
- description pages 1 to 6 and 8 of the main request filed with the letter dated 3 September 2013
- description pages 7 and 9 to 12, as originally filed
- drawing sheets 1/6 to 6/6, as originally filed.

Alternatively, it was requested that a patent be granted or that the case be remitted to the department of first instance on the basis of one of the 1st, 2nd or 3rd auxiliary requests. In the letter the appellant argued that the claims of the new requests were clear within the meaning of Article 84 EPC 1973.

VI. On 2 October 2013 the Board informed the appellants by fax that it was minded to grant the main request, and that the oral proceedings scheduled for 10 October 2013 were therefore cancelled.

VII. Claims 1 and 7 of the main request read as follows (reference numbers omitted):

A charging control device for detecting a fully charged state of a secondary battery used for applications in which the secondary battery is charged and discharged repeatedly in a charged but not fully charged state, comprising
a battery temperature detecting section for detecting a temperature of the secondary battery every first predetermined time,
a temperature gradient operation section for calculating a temperature gradient, indicating a temperature increase per unit time, during a second predetermined time that is longer than the first predetermined time, based on the temperature detected by the battery temperature detecting section, and
a temperature gradient determination section for determining whether the temperature gradient calculated by the temperature gradient operation section is larger than a predetermined temperature gradient threshold preset according to a charged state of the secondary battery,
wherein when the temperature gradient determination section determines that the temperature gradient calculated by the temperature gradient operation section is larger than the predetermined temperature gradient threshold N times in a row, where N is a natural number, the temperature gradient determination section outputs a signal for notifying a fully charged state of the secondary battery.

A charging control method for detecting a fully charged state of a secondary battery used for applications in which the secondary battery is charged and discharged

repeatedly in a charged but not fully charged state, comprising
detecting a temperature of the secondary battery every first predetermined time,
calculating a temperature gradient indicating a temperature increase per unit time during a second predetermined time that is longer than the first predetermined time, based on the temperature detected,
determining whether the temperature gradient thus calculated is larger than a predetermined temperature gradient threshold preset according to a charged state of the secondary battery, and
outputting a signal for notifying a fully charged state of the secondary battery when it is determined that the temperature gradient calculated is larger than the predetermined temperature gradient threshold N times in a row, where N is a natural number.

VIII. The appellant argued essentially as follows:

All objections under Article 123(2) EPC and Article 84 EPC 1973 have been overcome by appropriate amendments.

In relation to novelty, document D1 does not anticipate the subject-matter of claim 1 of the main request, as it fails to disclose at least the final feature of the claim, which reads:

- wherein when the temperature gradient determination section determines that the temperature gradient calculated by the temperature gradient operation section is larger than the predetermined temperature gradient threshold N times in a row, where N is a natural number, the temperature gradient determination section outputs

a signal for notifying a fully charged state of the secondary battery.

The present application is concerned with the problem of "reliably attaining a fully charged state without over-charging of the battery", and the subject-matter of independent claims 1 and 7 of the main request represents a solution which would not be obvious in the light of any combination of the documents cited in the European search report, and hence involves an inventive step within the meaning of Article 56 EPC.

Reasons for the Decision

1. Article 123(2) EPC: Main Request

1.1 In the contested decision the main request was rejected for the principal reason that the phrase "the charging of the secondary battery is terminated" in independent claims 1 and 7 was found by the Examining Division to have no basis in the application as filed. This phrase no longer appears in the claims of the current main request, and hence this objection has been rendered moot.

1.2 The phrase "time period" has been deleted from claim 11, and consequently no longer appears in any of the the claims of the current main request. The objection raised against this feature under Article 123(2) EPC by the Examining Division has therefore also been rendered moot.

1.3 Regarding the differences between the present main request and the application as filed, in particular as a result of the amendments made during the appeal procedure to claims 1, 5, 7, and 11, and to the description, the Board sees no reason to raise any objection under Article 123(2) EPC.

1.4 The requirements of Article 123(2) EPC are therefore fulfilled.

2. Article 83 EPC 1973: Main Request

2.1 The appellants devote a number of pages in the statement of grounds of appeal to rebutting objections under Article 83 EPC which are said to be in the impugned decision. However, in paragraph 1.1 of the Reasons, the Examining Division stated that "the Art. 83 objection was considered to be overcome". The Board also sees no reason for raising or pursuing such an objection.

3. Article 84 EPC 1973: Main Request

3.1 During the procedure before the first instance, the Examining Division took the view that references in the claims to "a first predetermined time" and "a second predetermined time" introduced a lack of clarity, as the concept of a point in time was confused with a period or interval of time.

The respective formulations used in claim 1 of the present main request are "every first predetermined time (t1)" and "during a second predetermined time (t2)". The Board does not believe that these expressions would lead to any confusion in the mind of

a skilled reader, it being implicit that predetermined time intervals or periods are intended.

3.2 The term "temperature gradient" in the present context was also considered by the Examining Division to pose a clarity problem.

It is true that the term "temperature gradient" is normally applied to the concept of a spatial (rather than a temporal) variation in temperature, however it is clear from the explicit wording of claim 1 that a "temperature gradient" is being used to denote "a temperature increase per unit time". Hence no lack of clarity arises in this regard.

3.3 The subject-matter of the claims is therefore considered to be defined in a manner which complies with the requirements of Article 84 EPC 1973.

4. Novelty: Main Request

4.1 In the Reasons of the contested decision, the Examining Division argued that the subject-matter of the independent claims of the main, first auxiliary and second auxiliary requests filed with the letter of 21 January 2008 lacked novelty in the light of the document D1. It is therefore appropriate to consider whether this objection may validly be raised in relation to the present main request.

4.2 As mentioned above, the principal point at issue is whether the document D1 discloses the following feature:

- wherein when the temperature gradient determination section determines that the

temperature gradient calculated by the temperature gradient operation section is larger than the predetermined temperature gradient threshold N times in a row, where N is a natural number, the temperature gradient determination section outputs a signal for notifying a fully charged state of the secondary battery.

4.3 It is clear from the reference to "pars. 33-34" in the contested decision that it is the second embodiment of document D1 (described in paragraphs [0027]-[0035] in combination with the flow chart of figure 3) which was considered to anticipate claim 1. This embodiment includes steps involving the comparison of a temperature gradient (dT/dt) with a predetermined threshold at ST21 and ST29 (figure 3). In addition, the point at which the charging process is terminated (END step ST25) may be determined by a temperature gradient based method (paragraph [0025]).

4.4 At step ST21 the value of the temperature gradient (dT/dt) is compared with a threshold value X, and at step ST29, the value of the temperature gradient is compared with a threshold value y. The threshold value y is disclosed as being preferably equal to X. In the case that dT/dt is determined to exceed X at both ST21 and at ST29, a determination would have been made two times in a row that the temperature gradient exceeds a threshold value, as required in the claimed feature referred to above (with N=2).

However, claim 1 of the main request also defines the *consequence* of this, namely that "the temperature gradient determination section outputs a signal for notifying a fully charged state of the secondary battery".

It is therefore defined in claim 1 of the main request that the "charging control device for detecting a fully charged state of a secondary battery" has the feature that a determination that the temperature gradient is larger than the predetermined threshold N times in a row is indicative of a fully charged state of the secondary battery, and that a signal notifying such a fully charged state is then generated.

It must therefore be asked whether this feature of claim 1 of the main request is anticipated by the temperature gradient comparisons made at steps ST21 and ST29 in document D1, and the consequences of the temperature gradient exceeding the threshold at both of these steps.

The comparison made at step ST21 enables the disclosed device to determine whether to temporarily suspend charging (ST26) or to continue charging (ST24), possibly after an increase of the counter (ST23). The comparison made at step ST29 enables the device to determine whether to restart charging (ST30) after a suspension. There is no disclosure that these steps, either separately or taken together, serve to detect, or would be capable of detecting, a fully charged state of the secondary battery, nor is there any disclosure of an output signal notifying such a fully charged state.

In document D1, the consequence of a determination that the temperature gradient is larger than the threshold at both step ST21 and step ST29 would be to return the system to ST27. Even if this implies the outputting of some form of control signal, it would be a signal directing the system to sense the temperature as part

of a loop (ST27/ST28/ST29) to determine a suitable point to restart charging (ST30). Such a signal could not be equated with a signal notifying a fully charged state of the secondary battery.

The Board therefore does not believe that a consideration of steps ST21 and ST29 could legitimately lead to the conclusion that the final feature of claim 1 of the main request is disclosed in document D1.

4.5 An alternative argument might focus on END step ST25, at which the charging procedure is terminated. A first objection to such an argument would be that it is not explicitly disclosed that termination occurs at a point at which a fully charged state is determined.

Even if this were considered to be implicit, the only explanation of the termination procedure is that it may be based on a "temperature change rate" scheme (see paragraph [0025]) said to be "explained above". This must be presumed to be a reference to paragraph [0007] in which a conventional termination scheme based on a temperature change rate is disclosed.

According to this scheme, termination occurs when the temperature change rate reaches and/or exceeds a predetermined rate, in other words, when a trip point is reached and/or exceeded *on one occasion*.

However, the plural character of the wording of claim 1 of the main request ("times in a row") leaves no doubt that the value N=1 is excluded from the claimed subject-matter, according to which the temperature gradient must be determined to be larger than the predetermined threshold more than one time (in a row)

for the signal for notifying a fully charged state of the secondary battery to be generated.

4.6 Finally, any attempt to arrive at "N times in a row" on the basis of a combination of step ST29 and step ST25 would also fail. Step ST25 follows a determination at ST29 that the temperature gradient is *smaller* than a predetermined threshold. Moreover, claim 1 requires that the *same threshold* be used N times in a row ("larger than the predetermined temperature gradient threshold N times in a row"), and there is no disclosure that any threshold used at step ST25 is the same as the threshold at ST29.

4.7 Essentially similar arguments apply to the first and third embodiments of document D1. The Board therefore concludes that the subject-matter of claim 1 of the main request is new within the meaning of Article 54(1) EPC 1973. A similar conclusion is reached for independent method claim 7 for the same reasons, *mutatis mutandis*.

5. Inventive Step: Main Request

5.1 The purpose of the claimed invention is to determine reliably a fully charged state of a secondary battery thereby preventing overcharging (page 1, line 28 - page 3, line 5). The document D2 discloses arrangements having the same general purpose (paragraphs [0069]-[0070]). Document D1 is also concerned with avoiding a wrong determination that the battery is fully charged (paragraphs [0007],[0008]). The Board judges that either of these documents could plausibly be selected as the closest prior art, and that both possibilities may need to be considered. In the first instance the analysis will start from the document D2, which

corresponds to the document mentioned on page 2 of the description of the present application as filed.

5.2 Document D2 discloses a device for detecting a fully charged state of a secondary battery used for applications in which the secondary battery is charged and discharged repeatedly in a charged but not fully charged state (paragraph [0003]), comprising a battery temperature detecting section (196) for detecting a temperature of the secondary battery every first predetermined time (figure 1; paragraphs [0072],[0075]: sampling time dti); a temperature gradient operation section (CPU 190a) for calculating a temperature gradient (paragraph [0080]) indicating a temperature increase per unit time, every second predetermined time (i.e. every "RETURN" cycle in figure 6) that is longer than the first predetermined time, based on the temperature detected by the battery temperature detecting section; and a temperature gradient determination section (CPU 190a, see paragraph [0085]) for determining whether the temperature gradient calculated by the temperature gradient operation section is larger than a predetermined temperature gradient threshold (Thr1) preset according to a charged state of the secondary battery (paragraph [0084], final sentence).

Document D2 also discloses that when the temperature gradient determination section determines that the temperature gradient calculated by the temperature gradient operation section is larger than the predetermined temperature gradient threshold, the temperature gradient determination section outputs a signal for notifying a fully charged state of the secondary battery (paragraph [0085]: the CPU "carries out a charging stop process", which implies the sending

of a control signal to terminate charging, said signal being indicative that a fully charged state has been determined).

5.3 The device of claim 1 therefore differs from D2 in that the temperature gradient determination section outputs the signal for notifying a fully charged state when the temperature gradient is determined to be larger than the threshold *N times in a row, where N is a natural number* (the wording clearly excluding N=1, as mentioned above).

5.4 It is known that when a battery has reached a fully charged state, further charging results in an abrupt increase in the temperature gradient, i.e. the rate of change of temperature with time (description, page 1, lines 28-32), and hence a temperature gradient above a certain threshold may indicate a fully charged state. However, abrupt changes in the temperature gradient can also be caused by repeated charging and discharging, even if the battery is not fully charged. This may lead to a wrong determination that the battery has reached a fully charged state (description, page 1, line 33 - page 2, line 17).

The problem to be solved is therefore to determine more accurately a fully charged state, and in particular to avoid a wrong determination that the battery has reached such a state.

According to the invention, by requiring the temperature gradient to exceed the threshold N times in a row before concluding that the battery is fully charged, the chance of a premature and erroneous determination is reduced.

5.5 The document D2 also recognizes the problem that abrupt changes in the temperature gradient due to Joule heating during discharging may lead to a wrong determination that the battery is fully charged (paragraphs [0007],[0008]; figure 14c). The solution proposed in document D2 is to *correct the temperature gradient* by an amount which depends on the mean discharge current, thereby eliminating the effect of a temperature rise due to the discharge of the battery (paragraph [0082]). If the corrected temperature gradient exceeds the threshold value on a single occasion (not N times in a row) the charging stop process is triggered (paragraphs [0084]-[0085]). The document D2 therefore discloses a different solution to the problem to that proposed in the present application.

5.6 As mentioned above, document D1 is also concerned with preventing an erroneous determination that the battery is fully charged (paragraphs [0007],[0008]). The solutions proposed in D1 involve the provision of various steps prior to reaching the "CONTINUE CHARGING" state (ST9, ST24, ST41), including disabling and re-enabling temperature-based termination, suspending and restarting charging or including steps involving a counter or timer.

However, it was demonstrated above in relation to the discussion on novelty that D1 does not disclose the feature distinguishing claim 1 of the main request from D2, and the Board concludes that the skilled person would find no hint or suggestion in the prior art which would render obvious the incorporation of this feature into the device disclosed in document D2.

5.7 As this feature is disclosed in neither D1 nor D2, clearly the same conclusion would be reached if D1 were chosen as the closest prior art.

5.8 In view of the above considerations, the Board concludes that the subject-matter of claim 1 of the main request involves an inventive step within the meaning of Article 56 EPC 1973. A similar conclusion is reached for independent method claim 7 for the same reasons, *mutatis mutandis*. Claims 2 to 6 and 8 to 12 are dependent on claims 1 and 7, respectively.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the Examining Division with the order to grant a patent on the basis of:

- claims 1 to 12 of the main request filed with the letter dated 3 September 2013;
- description pages 1 to 6 and 8 of the main request filed with the letter dated 3 September 2013;
- description pages 7 and 9 to 12, as originally filed; and
- drawing sheets 1/6 to 6/6, as originally filed.

The Registrar: The Chairman:

S. Sánchez Chiquero G. Eliasson

Decision electronically authenticated