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DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
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ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,
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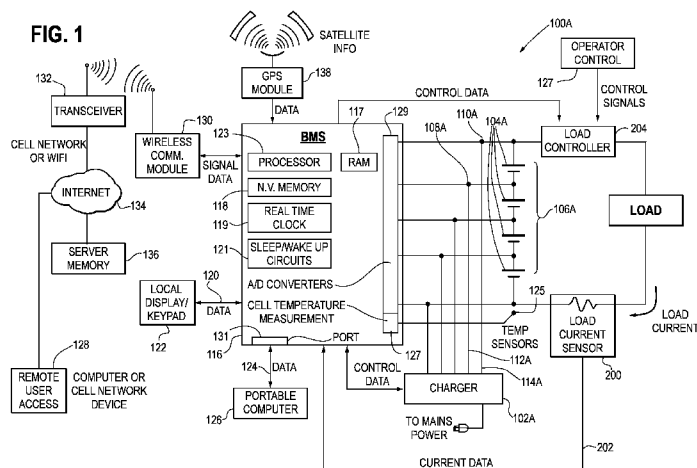
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[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR MANAGING MULTI-CELL BATTERIES



(57) Abstract: A method and apparatus for the intelligent management of multi-cell battery pack. A battery management system which may be mounted on board a vehicle facilitates battery management including monitoring the state of charge of the battery pack. Wireless communication equipment facilitate communication between the battery management system to a remote location. A battery charger controlled by the battery management system charges individual cells of the battery pack. A battery charging system and method, includes a high voltage charger for charging a group or string of series connected battery cells, and a group of individual cell chargers for charging individual ones of the cells. The charging technique includes detecting at least one cell being charged to a predetermined voltage, and then inhibiting the high voltage charger from further charging any of the cells. The individual cell chargers charge individual ones of the cells, except the at least one cell charged to the predetermined voltage. An individual cell charger and method of using it are disclosed. The voltage of each individual battery cell of a series connected cell configuration, is measured. A controlled power source charges the cells individually at an initial voltage. The voltage on each individual one of the charged cells is subsequently measured by a battery management system. The voltage of the controlled power source is incrementally increased to charge the cells individually at an incrementally higher voltage. The measuring and charging

[Continued on next page]



SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

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— *with international search report (Art. 21(3))*

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of each individual cell is repeated until the voltage on at least one of the cells reaches a predetermined voltage. Once the voltage on at least one of the cells reaches a predetermined voltage, the measuring and charging each individual cell continues at substantially the same last incremental voltage.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/030616**A. CLASSIFICATION OF SUBJECT MATTER*****H01M 10/46(2006.01)i, H02J 7/00(2006.01)i, G01R 31/36(2006.01)i***

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01M 10/46; B60L 3/00; G08B 91/00; H02J 7/00; B60L 11/00; G08G 1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: battery pack, charger, wireless, remote, high voltage, switch

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2009-0143935 A1 (HSU, ALAN) 04 June 2009 See abstract, paragraphs [0023]-[0029], claims 1-14, figure 1.	15-16 1-14
X A	JP 2002-123888 A (SUZUKI MOTOR CORP.) 26 April 2002 See abstract, paragraphs [0013]-[0042], claims 1-6, figures 1-7.	8 1-7, 9-16
A	US 05969624 A (SAKAI, SHOJI et al.) 19 October 1999 See abstract, columns 4-9, claims 1-39, figures 1-7.	1-16
A	US 2007-0188134 A1 (HUSSAIN, M. ABID et al.) 16 August 2007 See abstract, paragraphs [0056]-[0063], figures 1-4.	1-16
A	US 2008-0106234 A1 (YUN, CHANGYONG) 08 May 2008 See abstract, paragraphs [0035]-[0056], claims 1-19, figures 1-2.	1-16

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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Date of mailing of the international search report

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Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2011/030616**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group 1: Claims 1-16 relate to an intelligent battery management system or a method of managing batteries, characterized by a wireless communication equipment.

Group 2: Claims 17-30, 39-47 relate to a method, a system, or an individual cell battery charger for charging a lithium ion battery, characterized by an individual cell battery charger.

Group 3: Claims 31-38 relate to a method or an individual cell battery charger for charging series connected battery cells, characterized by switching the power sources using a switcher.

The inventions listed as groups 1-3 do not relate to a single general inventive concept under PCT Rule 13.1, because, under PCT Rule 13.2 they do not share the same or corresponding technical features.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-16

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2011/030616

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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