(54) Title: LEAD-ACID BATTERIES WITH FAST CHARGE ACCEPTANCE

(57) Abstract: An improved lead acid battery (LAB) battery may provide high charge acceptance and may be suitable for a wide range of applications, including a variety of new applications. The new battery can sustain 67% of the maximum capacity even at a very high charging rate of IOC. This battery may decrease the use of lead in comparison to prior lead acid battery designs by up to 50%. 
A. CLASSIFICATION OF SUBJECT MATTER
H01M 10/12(2006.01)i, H01M 4/14(2006.01)i, H01M 10/42(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 10/12; H01M 4/60; H01M 10/05; H01M 10/0565; H01M 4/04; H01M 10/26; H01M 2/00; H01M 4/14; H01M 10/42

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: lead acid battery, organic material, carbonyl, hydroxyl, cyclic structure, aromatic, quinone, 2,5-dihydroxy-1,4-benzoquinone

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Relevant to claim No.</th>
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<td>US 2014-0308581 (UNIVERSITY OF HOUSTON SYSTEM) 16 October 2014 See abstract ; paragraphs [0006]-[0053] ; claims 1-17 ; and figures 1-11.</td>
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<td>1-35</td>
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<td>POZOT, PHILIPPE et a l., &quot;Cl energy new deal for a sust ainab le world: from non-C02 generating energy sources to green elect ric tren ch cal storage devi ces&quot; , Energy &amp; Envi ronment a l Sci ence , 2011 , V o l. 4 , N o. 6 , pages 2003-2019 See abstract ; and pages 2011-2015.</td>
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<tr>
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<td>US 2012-0164539 (ZHAMU, ARUNA et a l.) 28 June 2012 See abstract ; and paragraphs [0027]-[0055].</td>
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<tr>
<td>A</td>
<td>US 2012-0258336 (JUN, FURUKAWA et a l.) 11 October 2012 See abstract ; and claims 1-9.</td>
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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 another 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
10 March 2017 (10.03.2017)

Date of mailing of the international search report
13 March 2017 (13.03.2017)

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Form PCT/ISA/210 (second sheet) (January 2015)
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<td></td>
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<td>JP 2016-514897 A</td>
<td>23/05/2016</td>
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<td>KR 10-2015-0139944 A</td>
<td>14/12/2015</td>
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<td>WO 2014-169122 Al</td>
<td>16/10/2014</td>
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<tr>
<td>US 2012-0164539 Al</td>
<td>28/06/2012</td>
<td>CN 103403922 A</td>
<td>20/11/2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 2014-506381 A</td>
<td>13/03/2014</td>
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<td>KR 10-2013-0143631 A</td>
<td>31/12/2013</td>
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<td>US 2012-0171574 Al</td>
<td>05/07/2012</td>
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<td>US 2013-0052489 Al</td>
<td>28/02/2013</td>
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<td>US 8859143 B2</td>
<td>14/10/2014</td>
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<td>US 8889298 B2</td>
<td>18/11/2014</td>
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<td>20/10/2015</td>
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<td>WO 2012-087698 Al</td>
<td>28/06/2012</td>
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<tr>
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<td>11/10/2012</td>
<td>AU 2010-287341 Al</td>
<td>19/04/2012</td>
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<td>AU 2010-287341 B2</td>
<td>22/05/2014</td>
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<td></td>
<td>CA 2772034 Al</td>
<td>03/03/2011</td>
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<td></td>
<td>CN 102714303 A</td>
<td>03/10/2012</td>
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<td>19/11/2014</td>
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<td>JP 2011-071112 A</td>
<td>07/04/2011</td>
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<td>JP 5797384 B2</td>
<td>21/10/2015</td>
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<td>KR 10-2012-0103562 A</td>
<td>19/09/2012</td>
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<td></td>
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