





— *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))*

**(88) Date of publication of the international search report:**  
29 January 2015

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/41035

## 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:

-- see extra sheet

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 additional fees, this Authority did not invite payment of additional fees.
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.:  
1-13a, 16/(1-13a)

### 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

International application No.  
PCT/US 14/41035

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01M 2/10, B60R 19/00 (2014.01)

CPC - B60L 11/1879, B60R 19/00, B60K 1/04, H01M 2/1083, B60L 11/1879

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)

IPC(8) - H01M 2/10, B60R 19/00 (2014.01)

CPC - B60L 11/1879, B60R 19/00, B60K 1/04, H01M 2/1083, B60L 11/1879

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
IPC(8) - H01M 2/10, B60R 19/00, B62D 21/15 (2014.01) CPC - B60L 11/1879, B60R 19/00, B60K 1/04, H01M 2/1083, B60L 11/1879, Y02T 10/705, H01M 2/1094, B60K 1/04; B62D 21/15\*; H01M 2/10\*; USPC- 180/68.5,232; 280/784; 429/99,100

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

PatBase, Proquest Dialog, Google Patents

Search terms: battery, fuel cell, mechanical switch, relay, vehicle, automobile, car, truck, accident, collision, impact, shock, stress, load-bearing, hinge, pivot, truss, lattice, collapsible, foldable

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category*     | Citation of document, with indication, where appropriate, of the relevant passages                                      | Relevant to claim No.                              |
|---------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| Y<br>---<br>A | US 5,156,225 A (MURRIN) 20 October 1992 (20.10.1992), Fig 3; abstract; col 2, ln 18-28; col 3, ln 41-47                 | 1-3, 13a, 16/(1-3,13a)<br>-----<br>4-12, 16/(4-12) |
| Y<br>---<br>A | US 2013/0049649 A1 (PARK et al.) 28 February 2013 (28.02.2013), Fig 1; abstract; para [0007], [0036], [0047]            | 1-3, 13a, 16/(1-3,13a)<br>-----<br>4-12, 16/(4-12) |
| Y<br>---<br>A | US 4,174,014 A (BJORKSTEN) 13 November 1979 (13.11.1979), Fig 1, 9; abstract; col 1, ln 35-39; col 4, ln 45-col 5, ln 2 | 2, 3, 16/(2, 3)<br>-----<br>4-12, 16/(4-12)        |
| Y<br>A        | US 2007/0020516 A1 (YOON) 25 January 2007 (25.01.2007), Fig 1-4; abstract; para [0006]-[0010]                           | 3, 16/3                                            |
| A             | US 2009/0145676 A1 (TAKASAKI et al.) 11 June 2009 (11.06.2009), entire document                                         | 1-13a, 16/(1-13a)                                  |
| A             | US 2012/0261206 A1 (YASUMI et al.) 18 October 2012 (18.10.2012), entire document                                        | 1-13a, 16/(1-13a)                                  |
| A             | WO 2011/038855 A1 (SCHAEFER et al.) 07 April 2011 (07.04.2011), entire document                                         | 1-13a, 16/(1-13a)                                  |

☐ Further documents are listed in the continuation of Box C.

|                                                                                                                                                                         |                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| * Special categories of cited documents:                                                                                                                                | "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                                              |
| "A" document defining the general state of the art which is not considered to be of particular relevance                                                                | "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                                                                     |
| "E" earlier application or patent but published on or after the international filing date                                                                               | "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 |
| "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) | "&" document member of the same patent family                                                                                                                                                                                                    |
| "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                                                                  |                                                                                                                                                                                                                                                  |

|                                                                                                                                                                                 |                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Date of the actual completion of the international search<br>14 November 2014 (14.11.2014)                                                                                      | Date of mailing of the international search report<br><b>03 DEC 2014</b>                   |
| Name and mailing address of the ISA/US<br>Mail Stop PCT, Attn: ISA/US, Commissioner for Patents<br>P.O. Box 1450, Alexandria, Virginia 22313-1450<br>Facsimile No. 571-273-3201 | Authorized officer:<br>Lee W. Young<br>PCT Helpdesk: 571-272-4300<br>PCT OSP: 571-272-7774 |

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/41035

Continuation of Box No. III -- Observations where unity of invention is lacking

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-13a and 16/(1-13a), drawn to a battery system comprising: a load bearing structure comprising battery cells and at least one mechanical switch; and an electrical connection coupled with the battery cells of the load bearing structure..

Group II: Claims 13b-14 and 16/(13b-14), drawn to a battery, the battery comprising a rate-sensitive component, wherein the rate-sensitive component is configured to deform into a first state to provide a first reaction force under a mechanical loading of a first magnitude, and the rate-sensitive component is configured to deform into a second state to provide a second reaction force under a mechanical loading of a second magnitude.

Group III: Claims 15 and 16/15, drawn to a battery cell, the cell comprising walls having an undulating profile, wherein a wavelength and an amplitude of the undulating profile along a loading direction are configured to absorb impact energy and to decrease deceleration of the battery cell in a collision; the battery cell having a first compressibility and is configured to provide a reaction force plateau.

Group IV: Claims 17-27, drawn to a method, comprising: using a battery as a load bearing structure in an electric vehicle, wherein the battery comprises battery cells; and using the battery to absorb energy during a collision by rearranging the battery cells arranged in a first arrangement into a second arrangement.

The inventions listed as Groups I through IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

### Special Technical Features:

Group I includes the special technical feature of at least one mechanical switch; and an electrical connection coupled with the battery cells of the load bearing structure, not included in the other groups.

Group II includes the special technical feature of a rate-sensitive component, not included in the other groups.

Group III includes the special technical feature of the cell comprising walls having an undulating profile the battery cell having a first compressibility and is configured to provide a reaction force plateau, not included in the other groups.

Group IV includes the special technical feature of a method including the step of absorbing energy during a collision by rearranging the battery cells arranged in a first arrangement into a second arrangement, not included in the other groups.

### Common Technical Features:

The only technical feature shared by Groups I-IV that would otherwise unify the groups, is a battery. The only additional technical feature shared by Groups I and IV is that would otherwise unify the groups, is a load bearing structure comprising battery cells. However, these shared technical features do not represent a contribution over prior art, because the shared technical features are disclosed by US 5,156,225 A (Murrin).

Murrin discloses a load bearing structure comprising battery cells (abstract).

Further, the only technical feature shared by Groups III and IV that would otherwise unify the groups, is using the battery to absorb energy during a collision. However, these shared technical features do not represent a contribution over prior art, because the shared technical features are disclosed by US 4,174,014 A (Bjorksten).

Bjorksten discloses using the battery to absorb energy during a collision (col 1, ln 46-50).

It would have been obvious to one of skill in the art to combine the load bearing structure comprising battery cells, as taught by Murrin, with the battery absorbing energy during a collision, as taught by Bjorksten, to provide structural components that incorporate the battery weight which will become applicable to enhance safety, particularly collision protection, and so that the car can be built of lighter materials without detracting from its safety, thereby saving fuel (see Bjorksten, col 1, ln 35-39).

As the technical feature was known in the art at the time of the invention, this cannot be considered a special technical feature that would otherwise unify the groups.

Therefore, Groups I-IV lack unity under PCT Rule 13.

Note: There are two claims numbered '13.' For purposes of this invitation, the first claim 13 is referenced as claim 13a and the second claim 13 is referenced as claim 13b. Claim 14 is interpreted as depending on claim 13b.