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(54) Title: POWER DISTRIBUTION UNIT AND FUSE MANAGEMENT FOR AN ELECTRIC MOBILE APPLICATION

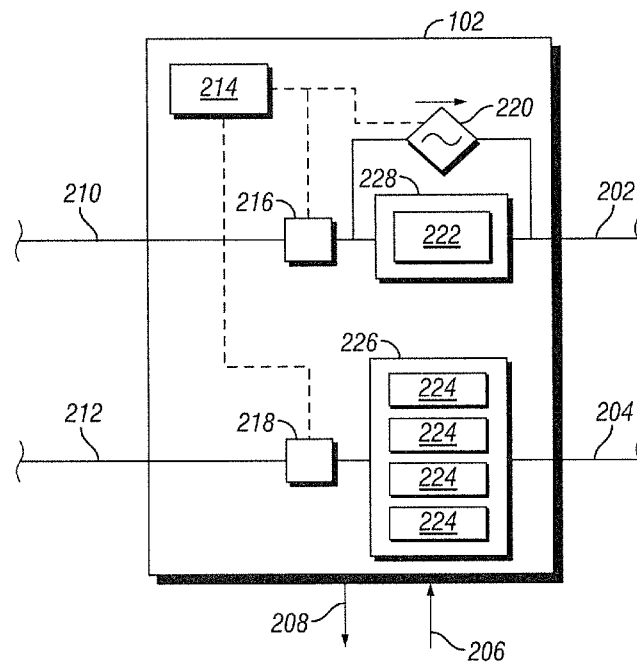


FIG. 2

(57) Abstract: A system include a vehicle having a motive electrical power path and a power distribution unit (PDU). The PDU includes a current protection circuit disposed in the motive electrical power path, the current protection circuit including a thermal fuse and a contactor in a series arrangement with the thermal fuse, and a high voltage power input coupling having a first electrical interface for a high voltage power source. The high voltage power output coupling includes a second electrical interface for a motive power load. The current protection circuit electrically couples the high voltage power input to the high voltage power output, and the current protection circuit is at least partially disposed in a laminated layer of the PDU. The laminated layer includes an electrically conductive flow path disposed between two electrically insulating layers.



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Published:

- *with international search report (Art. 21(3))*
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/080611

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02H3/087 H01H39/00 B60L3/04
ADD.
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)
H02H B60L H01H H05K G01R

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2009 023801 A1 (DAIMLER AG [DE]) 4 February 2010 (2010-02-04) paragraphs [0015] - [0020]; figures 1,2 -----	1-7
X	US 2008/137253 A1 (GEORGE TERRY A [US] ET AL) 12 June 2008 (2008-06-12) paragraphs [0023], [0027], [0028]; figure 3 -----	1
X	US 2013/154352 A1 (TOKARZ NICHOLAS PAUL [US] ET AL) 20 June 2013 (2013-06-20) paragraphs [0030] - [0034]; figures 6-8 -----	1,4-6
A	FR 3 041 143 A1 (MERSEN FRANCE SB SAS [FR]) 17 March 2017 (2017-03-17) pages 5-8; figure 1 -----	4-7
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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"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</p> <p>"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</p> <p>"&" document member of the same patent family</p>
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Date of the actual completion of the international search 7 June 2019	Date of mailing of the international search report 18/06/2019
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Colombo, Alessandro
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2018/080611

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 additional 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 an 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.:

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/EP2018/080611

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2001 078350 A (TAIHEIYO SEIKO KK) 23 March 2001 (2001-03-23) abstract; figures 1,2 -----	8-14
X	US 2013/062724 A1 (TOKUYAMA TAKESHI [JP] ET AL) 14 March 2013 (2013-03-14) paragraphs [0118] - [0135]; figures 16-17 -----	8
X	US 2014/009162 A1 (BARRENSCHEEN JENS [DE] ET AL) 9 January 2014 (2014-01-09) paragraphs [0003], [0025] - [0035]; figures 1,2,3 -----	15-24
X	DE 10 2012 224223 A1 (BOSCH GMBH ROBERT [DE]; SAMSUNG SDI CO [KR]) 10 July 2014 (2014-07-10) paragraphs [0023] - [0034]; figures 1,2 -----	15,16
X	JP 2016 205866 A (PANASONIC IP MAN CORP) 8 December 2016 (2016-12-08) -----	25-28
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X	US 2014/316735 A1 (JAO TONG-CHENG [TW] ET AL) 23 October 2014 (2014-10-23) paragraphs [0034] - [0037]; figure 3 -----	25
X	JP H10 322880 A (FURUKAWA ELECTRIC CO LTD) 4 December 1998 (1998-12-04) paragraphs [0018] - [0027]; figures 1-3 -----	30-40

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/080611

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-7

Protection system for vehicles with parallel pyro and thermal fuses. Main scope: to ensure safety and speed of interruption upon overcurrent.

2. claims: 8-14

High-voltage power distribution with a current protection disposed in a laminated layers. Main scope: to provide a high performance protection circuit with a compact design.

3. claims: 15-24

Power distribution unit for vehicles having a thermal fuse with current injection. Main scope: to provide a safety fuse with high reliability of operation also in case of low overcurrent.

4. claims: 25-29

Method for determining a null offset voltage for a fuse current sensor. Main scope: to increase accuracy in the measurement.

5. claims: 30-40

Protection for vehicles having a contactor in series with a thermal fuse. Main scope: to protect a vehicle with a proper balance between safety (with the fuse) and service restorability (with the contactor).
