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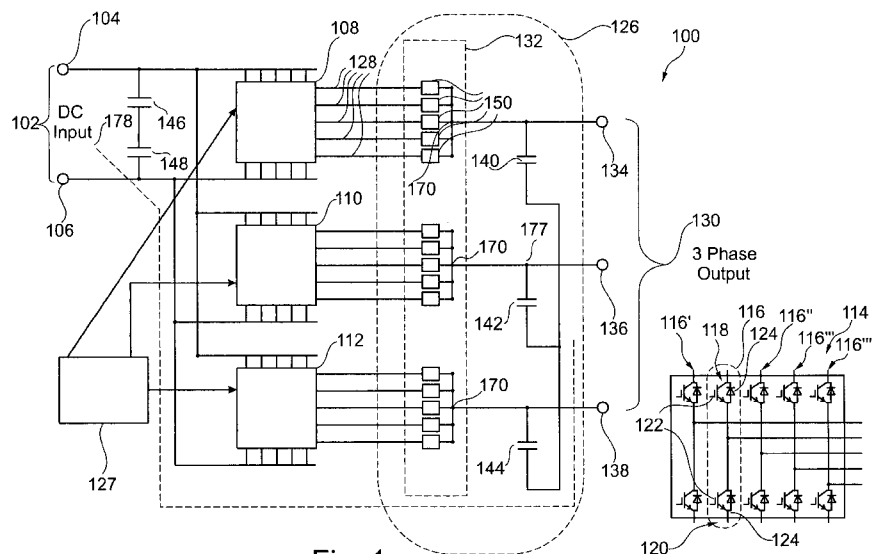


Fig. 1

(57) Abstract: An electronic circuit comprising a direct current interface at which a direct current is providable, an alternating current interface at which an alternating current is providable, a set of switchable half-bridges coupled to the direct current interface, each half-bridge comprising two blocks each having a switch and a diode, a control entity configured for switching the switches of the half-bridges with a predefined relative phase shift between different half-bridges, and a filter entity arranged between the alternating current interface and a plurality of parallel paths relating to the plurality of half-bridges wherein the filter entity comprises a coupled inductor inductively coupling the plurality of parallel paths.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/060453

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02M7/493
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)
H02M

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	US 6 449 181 B1 (RIEGER REINHARD [DE] ET AL) 10 September 2002 (2002-09-10)	1,5-23, 25-28, 32-34, 41-43
Y	the whole document	2-4
Y	GB 2 377 097 A (BOSCH GMBH ROBERT [DE]) 31 December 2002 (2002-12-31) abstract; figures 2,5	2-4
X	WO 2008/117166 A2 (EATON POWER QUALITY CORP [US]; OUGHTON JR GEORGE W [US]; PFITZER HANS-) 2 October 2008 (2008-10-02) page 7, line 25 - line 33; figure 5	38-40
X	WO 2007/103651 A2 (ADVANCED ENERGY IND INC [US]) 13 September 2007 (2007-09-13) page 6, line 5 - page 7, line 9	1

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
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- "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
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- "&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/060453

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 6449181	B1	10-09-2002	DE 19947476 A1	05-04-2001
			EP 1145416 A1	17-10-2001
			ES 2206322 T3	16-05-2004
			JP 4727882 B2	20-07-2011
			JP 2004507195 A	04-03-2004
			US 6449181 B1	10-09-2002
			WO 0126210 A1	12-04-2001

GB 2377097	A	31-12-2002	DE 10112818 A1	02-10-2002
			FR 2822307 A1	20-09-2002
			GB 2377097 A	31-12-2002

WO 2008117166	A2	02-10-2008	AT 486403 T	15-11-2010
			CN 101669274 A	10-03-2010
			EP 2130292 A2	09-12-2009
			US 2008239775 A1	02-10-2008
			WO 2008117166 A2	02-10-2008

WO 2007103651	A2	13-09-2007	CN 101411049 A	15-04-2009
			DE 07757483 T1	16-04-2009
			EP 1992062 A2	19-11-2008
			JP 2009529305 A	13-08-2009
			KR 20080106240 A	04-12-2008
			TW 200849794 A	16-12-2008
			US 2007211507 A1	13-09-2007
			US 2008291712 A1	27-11-2008
			US 2010034002 A1	11-02-2010
WO 2007103651 A2	13-09-2007			

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2012/060453

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.:

1-23, 25-28, 32, 33, 38-43

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-23, 25-28, 32, 33, 38-43

An electronic circuit comprising a direct current interface, an alternating current interface, a set of switchable half-bridges, a filter with a coupled inductor between the alternating current interface and a plurality of parallel paths relating to the plurality of half bridges, a control entity for switching the switches of the half bridges with a defined predefined phase shift between different half bridges and which is configured so that, at any time, one of the switches of each half bridge is on and the other one of the switches is off.

2. claims: 29-31

A control circuit which is adapted so that a third harmonic waveform is superimposed to a sinusoidal reference signal in a pulse width modulator generator.

3. claims: 34-37

A drive system for an electric or hybrid vehicle comprising a battery, a motor and an electronic circuit, wherein the electronic circuit is configured for charging the battery or supplying power to a grid from a battery.

4. claims: 24, 44-48

A coupled inductor with a plurality of magnetic structures, a plurality of coils, a first and a second magnetic coupling structure, characterized in that the second magnetic structure is spaced from each of the plurality of magnetic structures via a gap.
