

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

To:

see form PCT/ISA/220

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/IB2020/052514

International filing date (day/month/year)
19.03.2020

Priority date (day/month/year)
20.03.2019

International Patent Classification (IPC) or both national classification and IPC
INV. H02N2/18 H02K35/00

Applicant
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1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:



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Date of completion of
this opinion

see form
PCT/ISA/210

Authorized Officer

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Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:
 - ☐ the international application in the language in which it was filed.
 - ☒ a translation of the international application into English , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).
2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))
3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. ☐ forming part of the international application as filed:
 - ☐ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
 - ☐ in the form of an Annex C/ST.25 text file (Rule 13ter.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	<u>1-8</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	<u>1-8</u>
	No: Claims	
Industrial applicability (IA)	Yes: Claims	<u>1-8</u>
	No: Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Re Item V.

1 Reference is made to the following documents:

Reference is made to the following documents:

- D1 CHENG LUO ET AL: "Wideband energy harvesting for piezoelectric devices with linear resonant behavior",
IEEE TRANSACTIONS ON ULTRASONICS, FERROELECTRICS
AND FREQUENCY CONTROL, IEEE, US,
vol. 58, no. 7, 1 July 2011 (2011-07-01), pages 1294-1301,
XP011329748,
ISSN: 0885-3010, DOI: 10.1109/TUFFC.2011.1949
cited in the application
- D5 BEN-YAAKOV S ET AL: "Resonant rectifier for piezoelectric
sources",
APPLIED POWER ELECTRONICS CONFERENCE AND
EXPOSITION, 2005. APEC 2005. TWENTIETH ANNUAL IEEE
AUSTIN, TX, USA 6-10 MARCH 2005, PISCATAWAY, NJ,
USA, IEEE, US,
vol. 1, 6 March 2005 (2005-03-06), pages 249-253 Vol.1,
XP010809405,
DOI: 10.1109/APEC.2005.1452928
ISBN: 978-0-7803-8975-5
- D6 US 2015/326212 A1 (BOISSEAU SÉBASTIEN [FR] ET AL) 12
November 2015 (2015-11-12)

2 The present application concerns an active rectifying circuit for piezoelectric power harvesting applications according to claim 1 and a corresponding method according to claim 8. In particular, the circuit comprises means for active impedance matching between the input of the rectifier circuit and the output of the vibration energy harvester.

2.1 Principally, active impedance matching between in output and input of two electric components is well known. For power harvesting applications, D1 shows such a system. In this case, a square wave voltage is applied to the harvester (see sections III-IV).

- 2.2 The subject-matter of claim 1 of the present application differs from the circuit shown in D1 in the detailed arrangement, especially the particular arrangement of the power and control circuits as defined in the claim.
- The subject-matter of claim 1 is therefore novel (Article 33(2) PCT).
- 2.3 The technical problem can be considered to be to provide a simplified, more efficient circuit for energy harvesting system.
- This is fulfilled in the present invention by the proposed circuit.
- 2.4 The prior art does not suggest such a circuit arrangement. In D1, the comparator and operational amplifier act on MOSFETs being part of an active bridge circuit. This is not compatible with the arrangement as claimed in claim 1 which requires a passive bridge circuit within the circuit.
- D2 shows an arrangement where a comparator triggers two MOSFETs separate from the passive bridge circuit, but lacks the additional operational amplifier in the required configuration with the comparator (see fig. 6 and section IV).
- D3 also shows a similar arrangement where the MOSFETs are triggered by an unspecified circuit 111 (fig. 5, para. [0077]).
- 2.5 The skilled person therefore has no indication which would lead him to the circuit as claimed in claim 1, inventive activity thus being acknowledged (Article 33(3) PCT).
- 2.6 The above arguments also apply to the corresponding method of claim 8.

Re Item VII.

- 3 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in D2 and D3 is not mentioned in the description, nor are these documents identified therein.