(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 September 2015 (03.09.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/129910 A3

(51) International Patent Classification:
H03H 7/01 (2006.01) *H03H 7/38* (2006.01)
H03B 7/14 (2006.01) *H03H 11/52* (2006.01)
H03B 9/12 (2006.01) *H03B 7/08* (2006.01)

(21) International Application Number:
PCT/JP2015/056025

(22) International Filing Date:
24 February 2015 (24.02.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2014-039032 28 February 2014 (28.02.2014) JP
2015-023663 9 February 2015 (09.02.2015) JP

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

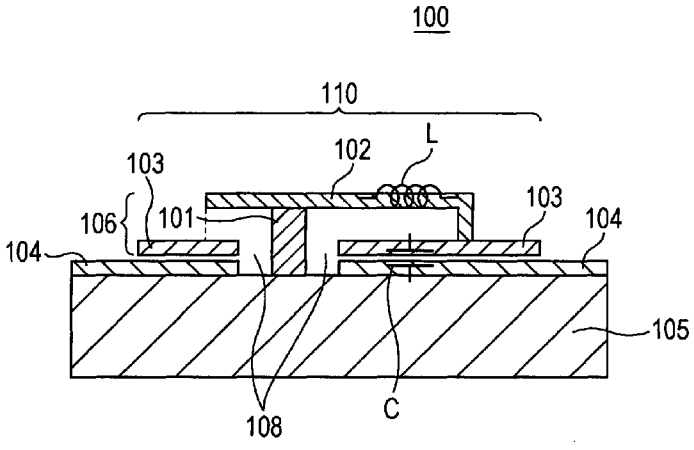
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

[Continued on next page]

(54) Title: ELEMENT FOR GENERATING OR DETECTING ELECTROMAGNETIC WAVES WHICH INCLUDES A RESONANCE UNIT AND A DIFFERENTIAL NEGATIVE RESISTANCE

FIG. 1



(57) Abstract: An oscillation element that oscillates an electromagnetic wave includes a negative resistance element (101) and a resonator (110) including a first conductor (106) and a second conductor (104), in which the negative resistance element and the resonator are arranged on a substrate (105), the negative resistance element is electrically connected to the first conductor and the second conductor, the first conductor and the second conductor are capacitively coupled to each other, and when a capacitance between the first conductor and the second conductor is set as C, an inductance of the first conductor and the second conductor is set as L_1, a speed of the oscillated electromagnetic wave in vacuum is set as c_0, a relative dielectric constant of the substrate is set as ε_r,and a diagonal line length of the substrate is set as d, a series resonant frequency $f_1$of the resonator satisfies $f_1 = 1/(2\pi\sqrt{(L_1C)})$, and $f_1 < C_0/[d\sqrt{\{(1+\varepsilon_r)/2\}}]$. The resonator may be of distributed constant type, wherein the resonator includes a first conductive layer (102), a second conductive layer (103), and a third conductive layer, wherein the first conductive layer is short-circuited to the second conductive layer, wherein the negative resistance element is connected to the first conductive layer and the third conductive layer, and wherein the second conductive layer and the third conductive layer are arranged opposite each other and are also capacitively coupled to each other to form a capacitance (C).

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— *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:
11 February 2016

INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2015/056025

A. CLASSIFICATION OF SUBJECT MATTER
INV. H03H7/01 H03B7/14 H03B9/12 H03H7/38 H03H11/52
H03B7/08
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)
H03H H03B

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 2012/105161 A1 (OUCHI TOSHIHIKO [JP] ET AL) 3 May 2012 (2012-05-03) paragraph [0008] - paragraph [0037]; figure 1	1-6,16
X	US 2013/328635 A1 (SEKIGUCHI RYOTA [JP]) 12 December 2013 (2013-12-12) paragraph [0030] - paragraph [0036]; figure 1A	1,3,4,7, 13-15
X	US 2012/119838 A1 (KOYAMA YASUSHI [JP] ET AL) 17 May 2012 (2012-05-17)	1-3,8,9, 17-20
A	paragraph [0031] - paragraph [0046]; figures 3A, 3B	10-12
A	US 2007/279143 A1 (ITSUJI TAKEAKI [JP]) 6 December 2007 (2007-12-06) figures 3B, 4B, 9B,10B, 11B, 12B	8-12, 17-20

☐ 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	Date of mailing of the international search report
7 December 2015	14/12/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Naumann, Olaf

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/056025

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.

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, 13-16

   Oscillation element comprising inter alia a resonator with first and second conductors, constraints on the resonator being defined in terms of equivalent circuit components

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2. claims: 8-12, 17-20

   Oscillation element comprising inter alia a resonator of a distributed constant type with first, second and third conductors in a particular spatial arrangement

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/JP2015/056025

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