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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 December 2008 (04.12.2008)

PCT

(10) International Publication Number
WO 2008/147183 A1

(51) International Patent Classification:
H01Q 7/00 (2006.01) *G06K 19/07* (2006.01)

(21) International Application Number:
PCT/NL2008/050291

(22) International Filing Date: 16 May 2008 (16.05.2008)

(25) Filing Language: Dutch

(26) Publication Language: English

(30) Priority Data:
07108368.7 16 May 2007 (16.05.2007) EP

(71) Applicant *(for all designated States except US)*: **NEDERLANDSE ORGANISATIE VOOR TOEGEPAST-NATUURWETENSCHAPPELIJK ONDERZOEK TNO** [NL/NL]; Schoemakerstraat 97, NL-2628 VK Delft (NL).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **THEEUWES, Johannes Adrianus Cornelis** [NL/NL]; Lijmbeekstraat 241, NL-5612 NE Eindhoven (NL). **DOODEMAN, Gerardus Johannes Nicolaas** [NL/NL]; Braak 122, NL-5501 DM Veldhoven (NL).

(74) Agent: **HATZMANN, M.J.**; Vereenigde, Johan de Wittlaan 7, NL-2517 JR Den Haag (NL).

(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, BR, BW, BY, BZ, CA, CH, 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, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, 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, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

(54) Title: ANTENNA FOR RFID TAG

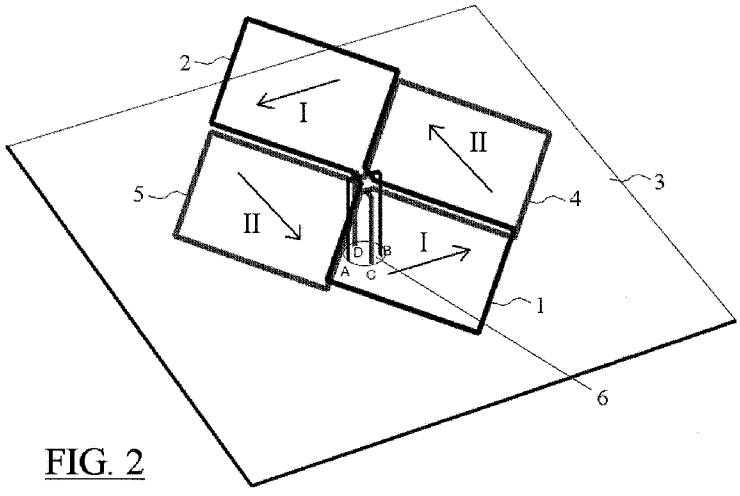

FIG. 2

(57) Abstract: Antenna, especially suitable for communication with an RFID tag, comprising a first double quad antenna having closed squares (1,2) which meet at one vertex and are cut open at that location (A, B) and interconnected two by two. A second double quad antenna is provided, equal to the first one, which is rotated a quarter of a turn with respect to the first antenna around an imaginary axis through the common vertices of both double quad antennas. The quads (1, 2) of the first antenna and the quads (3, 4) of the second antenna may be located in planes which are somewhat underneath each other. An RF signal source may be connected to the vertices (A, B) of the first double quad antenna and, moreover, to those (C, D) of the second double quad antenna, e.g. via a propagation delay element realizing a phase shift which causes a circular or oval RF field.

WO 2008/147183 A1

Title: Antenna for RFID tag

Field of the invention

The invention refers to an antenna which bundles an RF signal for the benefit of reading out RFID tags with a narrow bundle.

Background of the invention

A well-known antenna in literature is a "double quad" or "Doppelquad" antenna. A double quad antenna, shown in figure 1, comprises two mainly closed squares 1 and 2, mainly lying in one antenna plane and constituted by filamentary conductors, each side of which having a length of a quarter of the wavelength at which the antenna has to operate. Both squares meet diagonally, i.e. the diagonals of both squares starting from that meeting point are in line. In a corner where both squares meet, both squares are fed by, as it were, cutting them open there, at the points A and B. When a high frequent source is connected, an electric field will arise in both squares having the same direction as the field between the connection points A and B. Behind the double quad antenna, mainly parallel to the antenna plane, a ground plane 3 is provided which shields the power radiated towards the ground plane.

A disadvantage of the known antenna is that the near field readability is moderate. For information: "In antenna design, the near field is that part of the radiated field nearest to the antenna, where the radiation pattern depends on the distance from the antenna. Beyond the near field is the far field." (© Wikipedia).

Summary of the invention

The invention aims to improve the near field readability of the antenna. To that end the invention preferably provides adding a second double quad antenna, of which the antenna plane is mainly parallel to the antenna plane of the first double quad, and which is rotated a quarter of a turn w.r.t. the first double quad around an imaginary axis perpendicular to both antenna planes and mainly through the respective common vertices or feed points of both double quad antennas.

Preferably the second double quad antenna has mainly the same dimensions as the first one. Further, the relevant ribs of the squares of the first and second double quad are preferably located at small distance (e.g. 1 to 2 mm) to each other. The quads of the first antenna and those of the second antenna may be located either in the same plane or in different planes. For example, the quads of the first antenna may be located in a first plane and the quads of the second antenna in a second plane, located below or above the first one.

When an RF signal source is connected to the feed points A and B (figure 1) of the first double quad, the two squares connected to these points will arouse an electric field. The added, second double quad antenna also comes into resonance because always two sides of a square of the connected first antenna will electromagnetically couple with sides of the second antenna. As a result the second antenna arouses an electric field which is equally aligned, i.e. directed to the same direction. However, between the feed points of the second antenna, indicated hereinafter with C and D, no potential difference occurs. The whole behaves like four quad antennas which together provide for bundling of the radiation.

However, preferably, the same RF signal source is connected to the points C and D via a delay line, arousing ("passively") an electric field which is, however, perpendicular to the first field. The operation of the second double quad is equal to the operation of the first one. A delay time which provides 90 degrees phase shift arouses a circularly polarized field aroused by the four quad antennas. By varying the delay time the radiation diagram may be adapted to oval polarization.

As a result of the addition of the second, orthogonally located double quad antenna a composition of four actively radiating antennas arises which can be driven into two polarization directions, independently from each other. In this way a strong bundling can be achieved by means of a compact antenna.

Electrical coupling between the two orthogonally located double quad antennas can be provided via a plane below the (preferably common) antenna plane of the quads.

The two orthogonally located double quads with circular polarization, each double quad acting as a passive radiator of the other one, results in good near field bundling, due to which this combination is very well fit for short distance reading of e.g. RFID tags.

Exemplary embodiment of the invention

Figure 1 schematically shows a prior art double quad antenna as discussed above;

Figure 2 schematically shows an exemplary embodiment of a fourfold quad antenna.

The antenna shown in figure 2 consists of two double quad antennas, each consisting of two mainly closed squares 1, 2 and

3, 4 respectively, mainly located in one antenna plane and formed by filamentary conductors. The sides of each quad have a length of a quarter of the operational wavelength of the antenna. Of each antenna 1-2 and 3-4 respectively both squares meet each other diagonally. Both squares of antenna 1-2 are fed via the nodes A and B; the squares of antenna 3-4 are fed via the nodes C and D. Connected to an RF source, an electric field arises in the squares 1 and 2, the direction of which is indicated by the arrows I. The squares 3 and 4 are fed via the nodes C and D; the resulting electric field has a direction which is indicated by the arrows II. As can be seen, the directions I and II are transverse to each other.

Also this configuration comprises a base 3 which screens the radiated power in the direction of that base.

The antenna plane of the second double quad antenna 3-4 - the (in this case) common plane through the quads 3 and 4 - is mainly parallel to the antenna plane - the (in this case) common plane through the quads 1 and 2 - of the first double quad, while the second double quad antenna is rotated a quarter of a turn with respect to the first double quad around an imaginary axis perpendicular to both antenna planes and mainly through the respective feed points (or common vertices) of both double quad antennas.

Preferably, the second double quad antenna mainly has the same dimensions as the first one; however, different dimensions may be chosen. Further, the ribs of the squares of the first and second double quad preferably are located at a small distance (e.g. 1 to 2 mm) from each other. In the shown exemplary embodiment (somewhat) below each other, because the antenna planes of the quads 1-2 respectively 3-4 are not in the same

plane; in the shown exemplary embodiment the plane of the second double quad antenna 3-4 is located below the plane of the first double quad antenna 1-2.

There is further provided a readout device for RFID tags with an antenna as described here and an RF signal source which is connected to the feed points.

If the an RF signal source would only be connected to the feed points A and B of the first double quad, then the two squares connected to these nodes will arouse an electric field. The added second double quad antenna will come into resonance too because always two sides of a square of the connected first antenna electromagnetically couple with the relevant sides of the second antenna. By that the second antenna will arouse an equally aligned, i.e. pointing in the same direction, electric field (in figure 2 the arrows I and II would have the same direction). The whole would behave like four quad antennas which together provide bundling of the radiation.

In figure 2, however, by the feed points C and D it is indicated that - preferably - the same RF signal source as to which the points A and B of the first double quad are connected, is also connected - via a (not shown) delay line - to the points C and D, causing an electric field II to be aroused which is perpendicular to the first field I. The operation of the second double quad is equal to the operation of the first one. Besides, the delay time causes a delay time which provides a 90 degrees phase shift, causing the four quad antennas together to generate a circularly polarized field. By varying the delay time the radiation diagram may be adapted to an oval polarization.

When the readout device or the environment thereof includes

metal constructions in the neighborhood of the antenna, the circularly polarized field may obtain an elliptical rather than circular shape when the phase difference is 90 degrees. When it is desired to generate a circularly polarized field, the phase difference can be set to deviate a little from 90 degrees, so that a circularly polarized field is generated. The desired setting can be experimentally adjusted, by measuring the resulting field. To that end, the readout device is preferably provided with one or more transmission lines of adjustable length between the signal source and the feed points. Instead of adjustable transmission lines, also other phase controls can be used.

Claims

1. Antenna, especially suitable for communication with an RFID tag, comprising a first double quad antenna, formed by a pair of mainly closed squares (1, 2) each formed by a conductor, each side of which having a length of a quarter of the relevant operational wavelength, which squares meet each other at one vertex and are cut open there and interconnected two by two,

wherein a second double quad antenna is provided, formed, like the first double quad antenna, by a pair of mainly closed squares (3,4), each formed by a conductor, which squares also meet each other at one vertex and either are cut open and interconnected two by two there (C, D), or are not cut open;

of which second double quad antenna the plane of its squares, is mainly parallel to the plane of the squares of the first double quad;

and wherein the first and the second double quad antenna are rotated a quarter of a turn with respect to each other around an imaginary axis perpendicular to the respective planes of their squares and mainly going through the respective common vertices of both double quad antennas.

2. Antenna according to claim 1, **wherein** the second double quad antenna mainly has the same dimensions as the first double quad antenna.

3. Antenna according to claim 1 or 2, **wherein** the ribs of the squares of the first and second double quad are situated at a small distance from each other.

4. Antenna according to claim 3, **wherein** the ribs of the squares of the first and second double quad are situated at a distance of 1 to 2 mm from each other.

5. Antenna according to any of the preceding claims, **wherein** the quads (1, 2) of the first antenna are situated in a first plane and the quads (3, 4) of the second antenna in a second plane underneath or above it.

6. Antenna according to any of the preceding claims, **wherein** an RF signal source is connected to the two by two interconnected cut open vertices (A, B) of the first double quad antenna and, besides, to the two by two interconnected cut open vertices (C, D) of the second double quad antenna.

7. Antenna according to claim 6, **wherein** the RF signal source is connected to the two by two interconnected cut open vertices (C, D) of the second double quad antenna via a propagation delay element.

8. Antenna according to claim 7, **wherein** the propagation delay element is dimensioned to provide a phase shift of 90 degrees for the relevant operational frequency.

9. Antenna according to claim 7, **wherein** the propagation delay element is dimensioned to provide a phase shift of more or less than 90 degrees for the relevant operational frequency.

10. A readout device comprising an RF signal source and an antenna according to any one of the preceding claims, wherein the RF signal source is connected to feed points of the antenna.

11. A readout device according to claim 10, further provided

with a transmission line of adjustable length between the RF signal source and at least one of the feed points of the antenna.

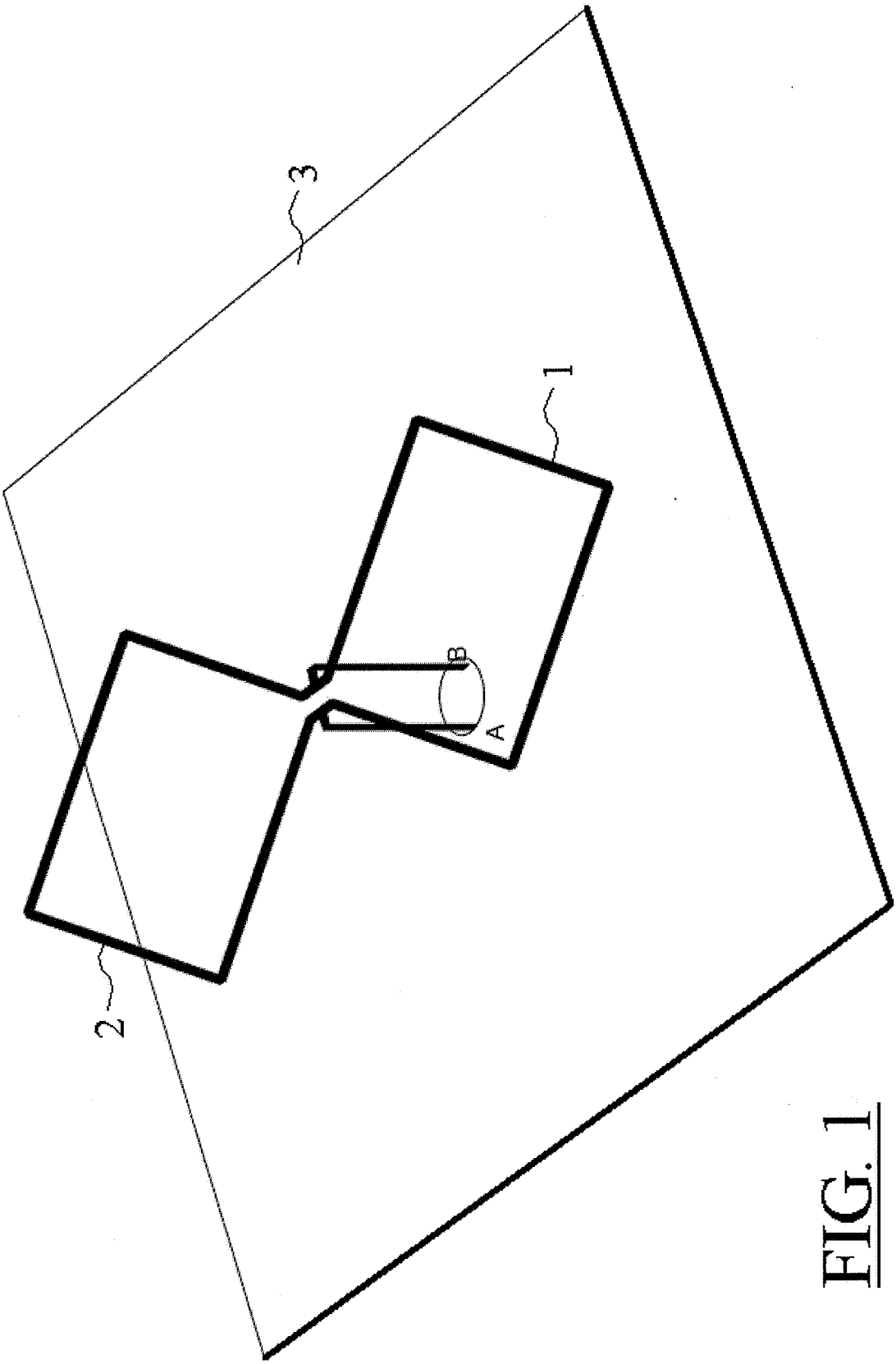

FIG. 1

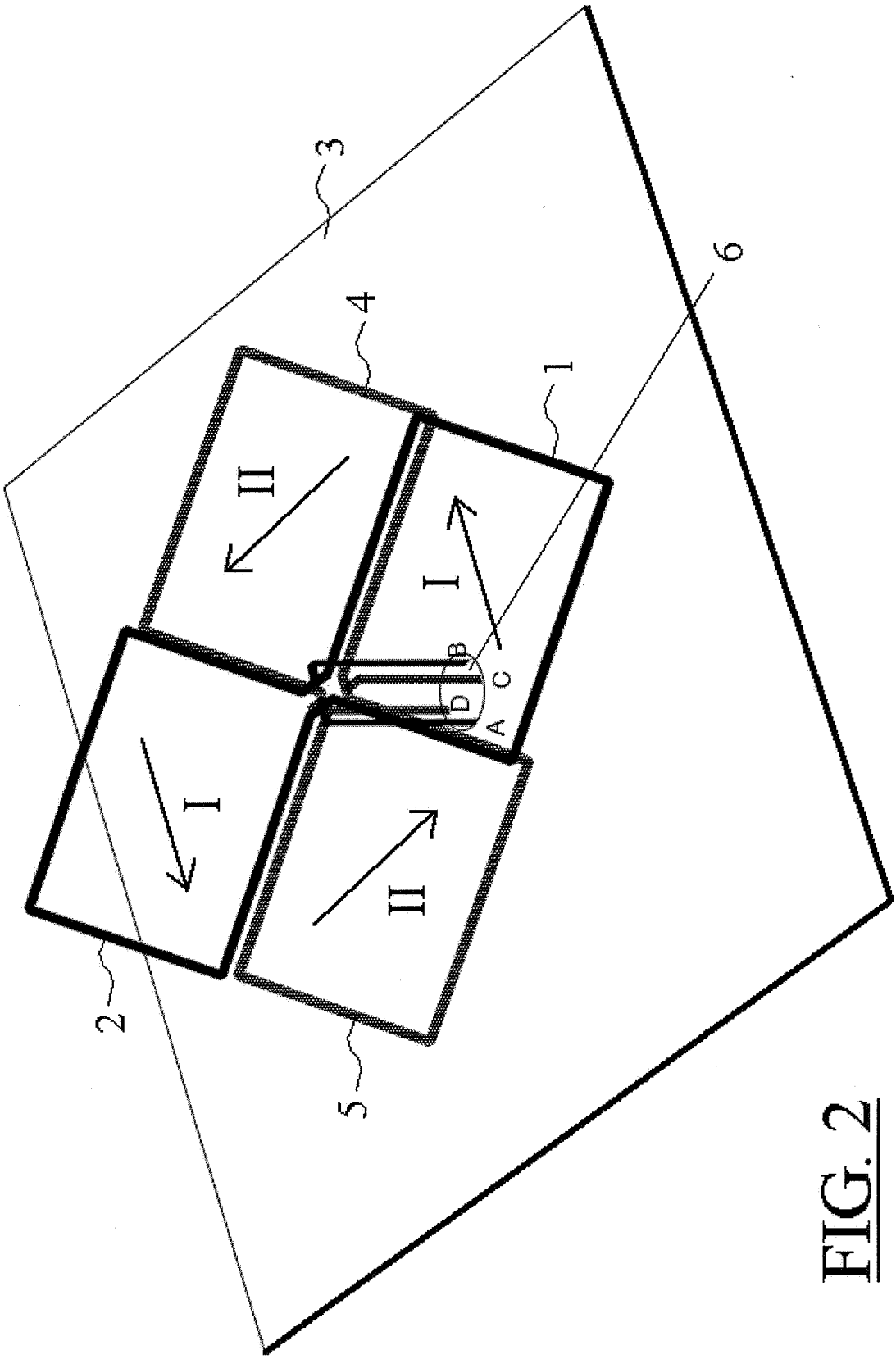

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2008/050291

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01Q7/00
ADD. G06K19/07

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)
H01Q G06K

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 practical, 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.
A	DE 196 03 803 A1 (KOCH NIELS [DE]) 14 August 1997 (1997-08-14) column 1, line 7 - line 15; claim 1; figure 10	1-11
A	FR 2 864 354 A1 (COMMISSARIAT ENERGIE ATOMIQUE [FR]) 24 June 2005 (2005-06-24) abstract; figure 1	1-11
A	US 5 142 292 A (CHANG LUKE C [US]) 25 August 1992 (1992-08-25) abstract; figures 1,4	1-11

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

☒ See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 July 2008	04/08/2008

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, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Marot-Lassauzaie, J

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/NL2008/050291

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