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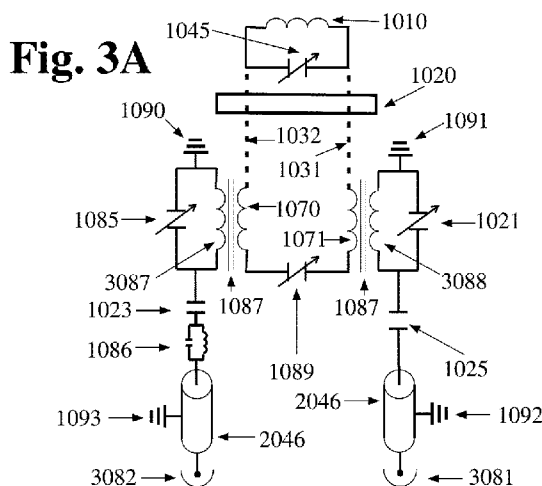
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(54) Title: INDUCTIVE COUPLING IN MULTIPLE RESONANCE CIRCUITS IN A NUCLEAR MAGNETIC RESONANCE PROBE AND METHODS OF USE



(57) Abstract: In various embodiments of the invention, inductive coupling can be to a secondary coil rather than a primary coil in order to optimize the topology of the NMR probe. In addition, by coupling to a secondary coil using a detection coil located below the lower insulator the RF homogeneity and signal to noise can be improved together with the NMR probe topology. By effecting inductive coupling to an inductor in a multiple resonance circuit, rather than to the sample inductor parameters associated with the NMR, probe construction can be arranged to increase RF homogeneity and signal to noise, while reducing space utilization constraints. In various embodiments of the invention, the primary mode in a secondary coil can be split into two modes with a resonator with inductive coupling to the secondary coil.



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International application No
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A. CLASSIFICATION OF SUBJECT MATTER
 INV. G01R33/36 G01N24/00 G01N24/08 G01N24/12
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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)
 A61B G01R H01Q G01N

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.
A	<p>BOWYER PAUL ET AL: "Using magnetic coupling to implement 1H, 19F, 13C experiments in routine high resolution NMR probes", JOURNAL OF MAGNETIC RESONANCE, vol. 261, 10 November 2015 (2015-11-10), pages 190-198, XP029343326, ISSN: 1090-7807, DOI: 10.1016/J.JMR.2015.10.010 magnetic coupling in NMR probes; paragraph [1.introduction]; figure C1 inductive coupling requires to physically move the idler to provide coupling and uncoupling to the sample coil; page 191</p> <p style="text-align: center;">----- -/--</p>	1-25

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 10 October 2017	Date of mailing of the international search report 17/10/2017
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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 Glasser, Jean-Marc
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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>US 2014/057792 A1 (BREY WILLIAM W [US] ET AL) 27 February 2014 (2014-02-27) moving loops adjusts RF coupling/tuning/matching but affects resolution; paragraph [0023] NMR probe with multiple RF coils; paragraph [0026] Single fixed loop 30 replaces the moving tuning and coupling loops for a coil pair in the conventional art; trimming capacitors 32, 34.; paragraph [0079] Adjustable capacitors for tuning and coupling of first & second RF coils; claim 15; figures 2c, 4</p> <p style="text-align: center;">-----</p>	1-25
A	<p>VAN HECKE P ET AL: "DOUBLE-TUNED RESONATOR DESIGNS FOR NMR SPECTROSCOPY", JOURNAL OF MAGNETIC RESONANCE, ACADEMIC PRESS, ORLANDO, FL, US, vol. 84, no. 1, 1 August 1989 (1989-08-01), pages 170-176, XP000068464, ISSN: 1090-7807 parallel-tuned circuit inserted in series-tuned circuit yields two resonance frequencies; figures 2, 3 inductive coupling of loop which slide over the resonator cylinder for matching; page 172; figure 3 inductive coupling; matching by adjusting loop-to-resonator distance; figure 3(2)</p> <p style="text-align: center;">-----</p>	1-25
X	<p>KUHNS P L ET AL: "Inductive coupling and tuning in NMR probes; Applications", JOURNAL OF MAGNETIC RESONANCE, ACADEMIC PRESS, LONDON, GB, vol. 78, no. 1, 1 June 1988 (1988-06-01), pages 69-76, XP023958244, ISSN: 0022-2364, DOI: 10.1016/0022-2364(88)90157-6 [retrieved on 1988-06-01] Primary, secondary and loop coils; figures 2,3c</p> <p style="text-align: center;">-----</p>	16-23

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/JP2017/010178

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014057792	A1	US 2014057792	27-02-2014
		US 2014320131	30-10-2014
