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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, 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, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, 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.

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[Continued on next page]

(54) **Title:** DETECTING HAZARDOUS MATERIALS IN CONTAINERS UTILIZING NUCLEAR MAGNETIC RESONANCE BASED MEASUREMENTS

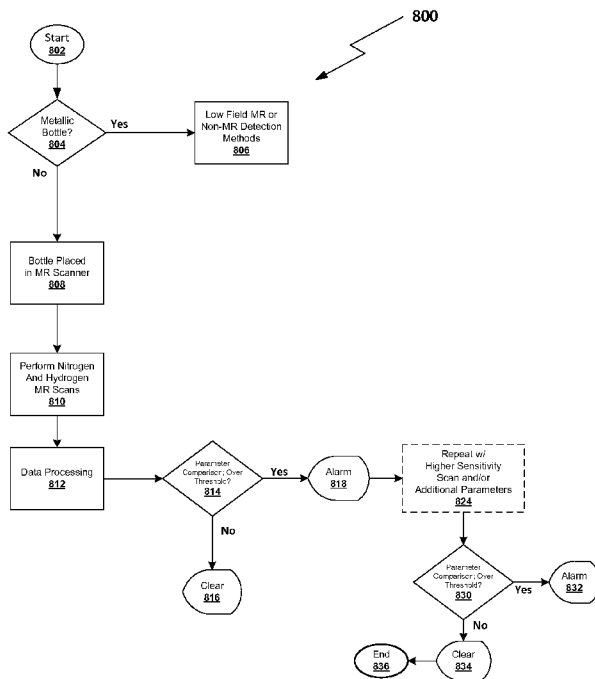


FIG. 8

(57) **Abstract:** A method of detecting hazardous materials in containers utilizing nuclear magnetic resonance (NMR) technology. The presence of precursors (e.g., H2O2) and/or nitrogen in the liquid in the container is determined by placing the container in a static magnetic field, exciting the container with electromagnetic pulses having a frequency corresponding to proton NMR and 14N NMR, and receiving radio frequency (RF) signals through a probe. The excitation pulses are configured to enable detection of the presence of precursors and nitrogen in the container, and may comprise a sequence of short RF pulses. The presence of nitrogen and/or explosive precursors is determined by detecting and evaluating NMR measurement signal amplitudes and relaxation times from the received RF signals. An apparatus comprising a magnet that generates a magnetic field and a probe that generates RF pulses and receives NMR measurement signals from the sampled container in accordance with the aforementioned method.

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INTERNATIONAL SEARCH REPORT

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PCT/US12/53575

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - G01V 3/32 (2013.01) USPC - 324/309 According to International Patent Classification (IPC) or to both national classification and IPC</p>																										
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) IPC(8): G01V 3/32 (2013.01) USPC: 324/300, 301, 307-310, 321; 850/47, 48</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) MicroPatent (US-G, US-A, EP-A, EP-B, WO, JP-bib, DE-C.B, DE-A, DE-T, DE-U, GB-A, FR-A); IP.com; Google/Google Scholar; IEEE Search Terms Used:(static or constant) nearIO (magnetic adj field) and relax 5 and (nuclear adj magnetic adj resonance or magnetic adj resonance) and magnetic adj field and rf and explosiv* and (liquid or fluid)</p>																										
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:10%;">Category*</th> <th style="width:70%;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="width:20%;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>US 7,759,938 B2 (PRADO, P et al.) July 20, 2010, column 7, lines 20-59, column 8, line 45 to column 9, line 6</td> <td>20</td> </tr> <tr> <td>Y</td> <td></td> <td>1-6, 10-11, 15-19, 21, 22</td> </tr> <tr> <td>Y</td> <td>US 7,355,402 B1 (TAICHER, G et al.) April 8, 2008, figures 1-2, column 5, lines 14-67</td> <td>1-6, 10-11, 15-19, 21, 22</td> </tr> <tr> <td>Y</td> <td>US 5,500,591 A (SMITH, J et al.) March 19, 1996, column 4, lines 12-65, column 8, lines 1-37</td> <td>1-6, 10-11, 15-19, 22</td> </tr> <tr> <td>Y</td> <td>US 5,698,979 A (TAICHER, G et al.) December 16, 1997, column 2, lines 5-25, column 9, line 55 to column 10, line 65</td> <td>18</td> </tr> <tr> <td>Y</td> <td>US 6,392,408 B1 (BARRALL, G et al.) May 21, 2002, column 5, lines 40-55</td> <td>4-6</td> </tr> <tr> <td>A</td> <td>US 2010/0090698 A1 (BLUMICH, B et al.) April 15, 2010, entire document</td> <td>1-22</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 7,759,938 B2 (PRADO, P et al.) July 20, 2010, column 7, lines 20-59, column 8, line 45 to column 9, line 6	20	Y		1-6, 10-11, 15-19, 21, 22	Y	US 7,355,402 B1 (TAICHER, G et al.) April 8, 2008, figures 1-2, column 5, lines 14-67	1-6, 10-11, 15-19, 21, 22	Y	US 5,500,591 A (SMITH, J et al.) March 19, 1996, column 4, lines 12-65, column 8, lines 1-37	1-6, 10-11, 15-19, 22	Y	US 5,698,979 A (TAICHER, G et al.) December 16, 1997, column 2, lines 5-25, column 9, line 55 to column 10, line 65	18	Y	US 6,392,408 B1 (BARRALL, G et al.) May 21, 2002, column 5, lines 40-55	4-6	A	US 2010/0090698 A1 (BLUMICH, B et al.) April 15, 2010, entire document	1-22
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Date of the actual completion of the international search 30 April 2013 (30.04.2013)		Date of mailing of the international search report <p align="center" style="font-size: 1.2em;">13 MAY 2013</p>																								
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