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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, 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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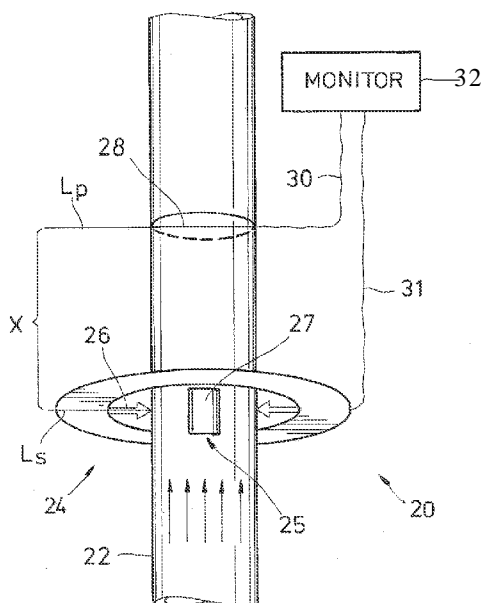
**Declarations under Rule 4.17:**

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.1 7(H))

[Continued on next page]

(54) **Title:** ELECTROMAGNETICALLY HEATED THERMAL FLOWMETER FOR WELLBORE FLUIDS

**FIG. 1**



(57) **Abstract:** A method of measuring multiphase flow of components in a wellbore fluid mixture by selectively heating components (e.g. oil and water) in the flow with electromagnetic energy, and detecting the heated components at a known distance downstream. The flow and velocity of components in the flow stream can be estimated with the present method. Example types of electromagnetic waves include infrared, microwaves, and radio waves. The different components can be heated simultaneously or at different times. The heated components can be detected with one or more temperature probes, and oil wet or water wet probes can be used to improve thermal contact to the corresponding components in the fluid stream.





## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/US2012/043065****A. CLASSIFICATION OF SUBJECT MATTER*****E21B 47/10(2006.01)i, E21B 43/12(2006.01)1, E21B 47/00(2006.01)1, GOIF 1/56(2006.01)1***

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)

IPC: E21B 47/10; E21B 43/12; E21B 47/00; GOIF 1/56 ; E21B 49/00; E21B 47/06; G01F 13/00; G0IN 23/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) &amp; Keywords: measure, electromagnetic wave, fluid, heating, sensing, velocity and similar terms

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	W0 2004-079161 A1 (SERVICE PETROL IERS SCHLUMBERGER et al.) 16 September 2004 See page 3, line 6 - page 4, line 12 and figures 1, 2.	1-20
A	US 2008-0066534 A1 (REID, LENNOX et al.) 20 March 2008 See paragraphs 0071 - 0074 and figures 1, 4, 5.	1-20
A	US 5461909 A (ARNOLD, DAN M.) 31 October 1995 See column 7, lines 24 - 60 and figures 1, 3, 4.	1-20
A	US 6874361 B1 (MELTZ, GERALD et al.) 5 April 2005 See column 5, lines 6 - 55 and figure 1.	1-20

 Further documents are listed in the continuation of Box C. See patent family annex.

\* Special categories of cited documents:

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"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

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