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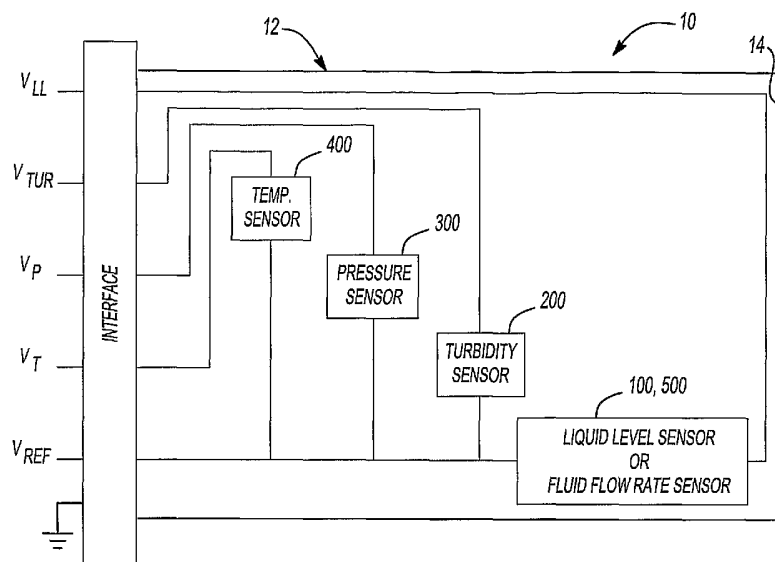
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: MULTI-FUNCTION SENSOR



(57) Abstract: A multi-function sensor is disclosed for measuring the conditions within a container, such as fluid level, turbidity, temperature and pressure. The sensor incorporates a fluid level sensor module, a turbidity sensor module, a temperature sensor module and a pressure sensor module. The fluid level sensor module utilizes a plurality of thermocouple junctions grouped in pairs with the pairs being spaced along a line extending generally in the direction in which the liquid level may vary. The thermocouple junctions are connected in series and produce a signal indicative of the level along the sensor. Turbidity, temperature, and pressure sensor modules may also be incorporated in the multi-function sensor. Alternatively, a fluid flow rate sensor module may be included in place of the liquid level sensor module.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/13662

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G01F 23/24, 1/69

US CL : 73/295, 204.24

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)

U.S. : 73/295, 204.24, 204.19, 204.25, 753; 356/337, 338, 339, 342, 441

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/0032532 A1 (Babel et al) 14 March 2002 (14.03.2002), paragraph 0024.	1,2,13,14
Y		3-
Y	US 4,785,665 (McCulloch) 22 November 1988 (22.11.1988) Figure 5.	10,12,15,17,18,20,23- 4,5,9,10,12
Y	US 4,471,661 (Edwards, Jr) 18 September 1984 (18.09.1984), Abstract	3,15
Y	US 2003/0117623 (Tokhtuev et al) 26 June 2003 (26.06.2003) Figure 2.	6,12,24
Y	US 6,134,952 (Garver et al) 24 October 2000 (24.10.2000), Figure 1; columns 6 and 7.	7,25
Y	US 5,831,159 (Renger) 3 November 1998 (03.11.1998), column 4, lines 36-45.	8-10,18,20,21,23,26
Y	US 6,595,049 (Maginnis, Jr. et al) 22 July 2003 (22.07.2003), Figure 1.	17,18,20,23



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:		"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent published on or after the international filing date	"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
"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)	"&"	document member of the same patent family
"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		

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/13662

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:
Please See Continuation 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 additional fees, this Authority did not invite payment of any 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.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/13662

BOX III. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

Group I, claim(s) 2 and 3, drawn to a multi-function sensor which senses fluid level, turbidity, temperature and pressure.

Group II, claim(s) 4-12, drawn to a multi-function sensor which senses liquid level and turbidity using specific electrical, thermal, and optical means.

Group III, claim(s) 14 and 15, drawn to a multi-function sensor which senses fluid flow rate, turbidity, temperature and pressure.

Group IV, claim(s) 16-27, drawn to a multi-function sensor which senses fluid flow rate and turbidity using specific electrical, thermal, and optical means.

The inventions listed as Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The only feature these two groups have in common is a fluid level sensor in combination with a turbidity sensor, but this is not a special technical feature because Babel et al. (US 2002/0032532) teaches a sensor with the combination of a fluid level sensor and a turbidity sensor (Par. 0024).

The inventions listed as Groups I and III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The only feature in common is the combination of a turbidity sensor, temperature sensor, and pressure sensor, but this is not a special technical feature because Babel et al. (US 2002/0032532) teaches a sensor with the combination of a turbidity sensor, pressure sensor, and temperature sensor (Par. 0024).

The inventions listed as Groups I and IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The only feature in common is a turbidity sensor, but this is not a special technical feature because Babel et al. (US 2002/0032532) teaches a turbidity sensor as part of a multi-sensor (Par. 0024).

The inventions listed as Groups II and III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The only feature in common is a turbidity sensor, but this is not a special technical feature because Babel et al. (US 2002/0032532) teaches a turbidity sensor as part of a multi-sensor (Par. 0024).

The inventions listed as Groups II and IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The only feature in common is a turbidity sensor which uses specific optical means to sense turbidity, but this is not a special technical feature because Tokhtuev et al (US 2003/0117623) teaches a turbidity sensor which uses a light source 6 and a light detector 7 which receives reflected light from the light source.

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The inventions listed as Groups III and IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The only feature in common is the combination of a fluid flow rate sensor and a turbidity sensor, but this is not a special technical feature because Babel et al. (US 2002/0032532) teaches the combination of a fluid flow rate sensor and a turbidity sensor (Par. 0024).