Internal distribution code:
(A) [-] Publication in OJ
(B) [-] To Chairmen and Members
(C) [-] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 19 May 2011

Case Number: T 2231/08 - 3.4.02

Application Number: 04704117.3

Publication Number: 1590636

IPC: G01F1/74, G01F1/66, G01N29/02

Language of the proceedings: EN

Title of invention:
MEASUREMENT OF ENTRAINED AND DISSOLVED GASES IN PROCESS FLOW LINES

Applicant:
Cidra Corporate Services, Inc.

Headword:

Relevant legal provisions:
EPC 1973 Art. 52(1), 56

Keyword:
Inventive step (yes)

Decisions cited:

Catchword:

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 2231/08 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 19 May 2011

Appellant: (Applicant)	Cidra Corporate Services, Inc. 50 Barnes Park North Wallingford, CT 06492 (US)
Representative:	Klunker / Schmitt-Nilson / Hirsch Patentanwälte Destouchesstrasse 68 80796 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted 4 July 2008 refusing European application No. 04704117.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: A. Klein
Members: F. Maaswinkel
B. Müller

Summary of Facts and Submissions

I. The appellant lodged an appeal against the decision of the examining division, refusing the European patent application 04704117.3.

II. According to the decision of the examining division the patent application did not fulfil the requirements of Articles 52(1) and 56 EPC 1973 since the subject-matter of the independent claims according to the main and auxiliary requests 1 and 2 did not involve an inventive step in view of the disclosure in the following documents:

D1: US-B-6 354 147
D2: EP-A-0 484 876.

III. In the notice of appeal the appellant requested that the decision under appeal be set aside and a patent be granted. With the statement containing the grounds of appeal the appellant filed a set of claims according to a main request which was based on the claims as originally filed, and also filed sets of claims according to a first, second and third auxiliary request.

IV. In a communication under Rule 100(2) EPC the board objected that the independent claims according to the main request lacked an essential feature and therefore did not meet the requirements of Article 84 EPC 1973. It was observed that the independent claims of the first auxiliary request included the corresponding feature. Furthermore the board pointed out a number of deficiencies in the application documents and remarked that an amended set of documents in which these were

overcome could possibly also meet the further provisions of the Convention.

V. The appellant filed a revised main request supported by a set of claims based on the previous first auxiliary request and revised description pages. According to the appellant, the previous auxiliary requests 2 and 3 were maintained as new auxiliary requests 1 and 2, respectively.

VI. The documents comprising the main request include:

Claims:	1 to 20, as received with the letter of 17 January 2011;
Description:	pages 3 - 6, 8, 10, 11, 16, 18 and 19 as published; pages 2 and 2a received with the letter of 29 May 2007; pages 1, 2b, 7, 9, 12 - 15, 17 and 20 received with the letter of 17 January 2011;
Drawings:	sheets 1/7 - 7/7 as published.

VII. The wording of independent claim 1 of the main request reads as follows:

" A device (10) having a first module (14) arranged in relation to a process line (12) for providing a first signal containing information about sensed entrained air/gas in a fluid or process mixture flowing in the process line at a process line pressure, characterized by the device comprising:

a bleed line (16) coupled to the process line (12) for bleeding a portion of the fluid or process mixture from the process line at a bleed line pressure that is lower than the process line pressure, wherein the bleed

line and flow rates are sized to minimize the amount of stock bleed off while maintaining sufficiently high flow rates to maintain sufficiently homogenous flow within a bled-off liquid test section such that a measured gas volume fraction within the bleed line is representative of the amount of gas dissolved in the fluid or process mixture;

a second module (18) arranged in relation to the bleed line (16), for providing a second signal containing information about sensed bleed line entrained air/gas in the fluid or process mixture flowing in the bleed line; and

a third module (20) responsive to the first signal and the second signal, for providing a third signal containing information about a dissolved air/gas flowing in the process line (12) based on a difference between the sensed entrained air/gas information and the sensed bleed line entrained air/gas information ".

The wording of independent claim 10 reads as follows:

" A method for measuring entrained and dissolved gas in a fluid or process mixture flowing in a process line (12) at a process line pressure, comprising the steps of:

measuring a first entrained gas in the fluid or process mixture flowing in the process line (12) and providing a first signal containing information about the same, characterized by

bleeding a portion of the fluid or process mixture from the process line (12) into a bleed line (16) having a bleed line pressure that is lower than the process line pressure, wherein the bleed line and flow rates are sized to minimize the amount of stock bleed off while maintaining sufficiently high flow rates to maintain sufficiently homogenous flow within a bled-off

liquid test section such that a measured gas volume fraction within the bleed line is representative of the amount of gas dissolved in the fluid or process mixture;

measuring a second entrained gas in the fluid or process mixture flowing in the bleed line (16) providing a second signal containing information about the same; and

responding to the first signal and the second signal, and determining a dissolved air/gas flowing in the process line based on a difference between the first entrained air/gas information and the second bleed line entrained air/gas information ".

Claims 2 to 9 and 11 to 20 are dependent claims.

The wording of the claims of the auxiliary requests is not relevant for the purpose of the present decision.

VIII. The appellant's arguments may be summarised as follows:

The present invention is directed toward measuring entrained and dissolved gases in process flow lines. Dissolved gases are dissolved within the fluid mixture on a molecular level as compared to entrained gases which exist in gaseous form (e.g., small gas bubbles). Entrained gases can typically be detected by monitoring the compressibility of the fluid flow and correlating the compressibility to the volumetric percentage of entrained air. Dissolved gases, in contrast, have a negligible effect on the compressibility of the mixture. The present invention measures the amount of dissolved gas within a process flow at an operating pressure by bleeding a portion of the process flow into a bleed line. After the portion of flow enters the bleed line, it is diposed at a second pressure lower

than the operating pressure. The difference between the operating pressure and the bleed line flow pressure propels the flow into the bleed line. The lower pressure within the bleed line flow also causes some of the dissolved gas to change into entrained gas. The invention measures the amount of dissolved gases within the process flow (at operating pressure) by measuring the amount of entrained gas within the bleed line flow (at lower pressure, e.g. ambient) and within the process flow (at higher pressure), and comparing the two amounts of entrained gas. The amount of entrained gas within the bleed line flow is a sum of the amount of entrained gas from the process flow, plus an amount of entrained gas created from dissolved gas. The "third module" is the processor which compares the entrained gas determinations from the process line and the bleed line to determine the amount of dissolved gas within the process flow.

In its decision the examining division started from the disclosure in D1. This document relates to fluid parameter measurement in pipes and more particularly to measuring speed of sound and parameters related thereto of fluids in pipes using acoustic pressures. By means of a single measurement module as shown in Fig. 1, at least one parameter of at least one fluid in a pipe is measured using a spatial array of acoustic pressure sensors placed at predetermined axial locations along the pipe. Starting with Dl the examining division regards it as the objective technical problem to be solved by the person skilled in the art to obtain a measurement of the amount of gas dissolved in the process fluid. For solving this problem, according to the examining division, the skilled person would contemplate document D2 for modifying the apparatus of Dl in that he would provide for a bleed or bypass line

as in D2 in which he would find it obvious to install a second (acoustic measurement) module, similar to the module of Dl installed in the process line, in order to measure the amount of entrained gas in the bleed line.

This document D2 is directed to a device for dynamically measuring bubble content of flowing liquid at either high pressure or low pressure, and for measuring the bubble quantity of dissolved gas in the flowing liquid. The difference between the bubble content of the liquid at low pressure and that of the liquid at high pressure can be determined as the bubble quantity of the dissolved gas bubbled in the liquid due to the change in the pressure thereof (p. 5, lines 4 to 6). As particularly set out with reference to Figures 1 to 3, there are two different concepts disclosed therein: one of the two preferred embodiments (embodiment 1) is an integrated type device which is installed in the conveyance passage whereas the other embodiment (embodiment 2) is a separate type device which is installed in a bypass of the conveyance passage. With the device according to embodiment 1, a flowing liquid containing bubbles does not need to be extracted from a passage for the liquid for measuring the bubble content, whereas the separate type device according to embodiment 2 can be used in a severe environment of high or low temperature (p. 6, l. 5 to 22). According to D2 (p. 4, l. 25 to 55), the bubble-containing liquid is caused to flow through the conveyance passage or the bypass. The volumetric flow rate, pressure and temperature of the liquid set at the high pressure by the pressure regulation valves are measured, the mass flow rate of the liquid is then measured, and the volumetric flow rate, pressure and temperature of the liquid set at the low pressure of the downstream pressure regulation valve are thereafter

measured (page 4, l. 50 to 55). Therefore, no parallel measurements in a process line and bleed line, respectively, comparable to the present invention are made. The device of D2 shown in Figures 3 and 4, in contrast to the present invention, has a bypass line 2 off of a main line 1. A pump 3 is used to propel the flow and to increase the pressure of the flow within the bypass line 2 to a pressure greater than that within the main line 1. Pressure regulation valves are required within the bypass line 2 to regulate the pressure of the flow between a high pressure region and a low pressure region. The pressure within the "low pressure region" must still be higher than that of the flow within the main flow line, because the bypass line 2 connects to the main flow line to return the bled fluid flow to the fluid flow within the main line. Clearly, D2 does not teach comparing a measurement obtained from the process line to a measurement of the fluid which has been diverted from the process line into a bypass line at a reduced pressure in a manner that no further pump is needed for bleeding off the fluid, as required for the bypass line in D2, and in a manner that the main flow in the process line is substantially not affected. Document D2 teaches two different concepts which are described in a manner that they may not be combined with each other, namely an integrated type device installed in the conveyance passage (embodiment 1) and, alternatively, a separate type device installed in the bypass line (embodiment 2). D2 does not teach the combination of two measurement modules, one of which installed in a process line and the other one installed in a bleed or bypass line. In consequence, when considering modifying the apparatus of Dl, the skilled person would rather modify the apparatus of Dl, when contemplating document D2, in the direction of an integrated type device

(embodiment 1 of D2) installing respective pressure regulation valves (11) for making sequential measurements at high and low pressure, respectively, or in the direction of the separate type device (embodiment 2) shifting the measurement module from the process line to the bypass line as taught in D2.

On the other hand, the core of the present invention and the distinguishing features of the invention over D2 lie in the simplistic nature of the present device versus that disclosed in D2. By utilizing a first measuring device in the process line and a second measuring device in the bleed line at naturally occurring lower pressure and comparing the two measurements, the present invention device avoids many if not all of the problems of the device described in D2. A person of skill in the art will recognize that in an oil/gas production environment, there is considerable merit to a more robust device such as that described and claimed in the present application. It is believed that the combination of documents Dl and D2 does not teach the concept of the present invention in that two different measurements at different pressures are made in parallel by two differently arranged modules, one of which installed with respect to the process line and the other one installed with respect to the bleed line. As the presently claimed invention distinguishes in several aspects as outlined above over the combination of documents Dl and D2, the invention is regarded new and inventive over the prior art.

Reasons for the Decision

1. The appeal is admissible.

2. *Main Request*

2.1 Amendments

The Board is satisfied that the set of claims of the main request finds support in the patent application as originally filed. Also the objected deficiencies in the description have been overcome by the filed amendments.

2.2 *Patentability - Claim 1*

2.2.1 In the decision under appeal there was no objection of lack of novelty against the claims. With respect to the available prior art, the board concurs with the examining division that document D1 discloses in Figure 1 a device having a first module (schematically indicated as "10") for providing a first signal containing information about a mixture of one or more fluids flowing in a process line 12 at a process line pressure (according to col. 6, l. 7 - 13, signals concerning a mixture of fluids are determined, in col. 2, l. 34 and 35 it is disclosed that the "fluids" in the mixture are defined as a liquid or a gas; see also col. 8, l. 8 and 9; and col. 21, l. 5 and 6). Therefore the definition of "entrained gases" on p. 1, 4th paragraph of the published patent application ("Entrained gases are gases that exist in a gaseous form, mixed in the process fluid") covers the expression "mixture of fluids" in document D1.

2.2.2 In point 2.3 of the decision the examining division noted that the subject-matter of claim 1 differed from the disclosure in document D1 in the features of the characterising part of claim 1, viz. the bleed line;

the second module; and the third module as defined in the claim.

2.2.3 According to point 2.4 of the decision, the technical problem solved by the invention is the measurement of the amount of gas dissolved in the process fluid. In this respect the examining division made reference to p. 2, l. 10 and 11 of the published patent application, where it is disclosed "*Thus, to accurately monitor problems associated with entrained and dissolved gases, it is desirable to be able to measure both quantities*".

2.2.4 However, by making reference to this passage of the patent application in the formulation of the technical problem, an element towards the solution of the objective technical problem is introduced, because the solution of the underlying technical problem is based on the recognition that entrained and dissolved gases in a processing fluid behave differently and, more in particular, that their compressibility properties are different. It appears that this information is not obtainable from document D1: rather, this document does not make such a distinction and merely refers to the measurement of volume fractions of a fluid mixture, e.g. oil/water, oil/gas, water/gas (see col. 3, l. 4 and 5; and col. 21, l. 5 and 6; see also claim 13 of D1). Indeed, by specifying possible constituents "oil", "water" and "gas" in connexion it is implicitly clear that in document D1 no particular interest in measuring the compressibility of the constituents of the mixture is expressed, because the compressibility of a gas is generally quite different from the compressibility of a fluid. In document D1 only the measurement of the volume fraction of the constituents of a fluid mixture is addressed, therefore, starting from this disclosure, the objective technical problem may be seen as

improving the device, in particular for the measurement of volume fractions, in a gas/fluid mixture.

2.2.5 In its assessment that the subject-matter of claim 1 lacked an inventive step over the combined teachings of documents D1 and D2 the examining division had argued that the skilled person would have combined the second embodiment shown in Fig. 4 of document D2 with the measurement module of document D1.

2.2.6 The board concurs with the appellant that document D2 discloses two, mutually excluding, embodiments: in the first embodiment, shown in Fig. 1 of D2, the measurement section is in the conveyance passage, which, according to D2 (p. 5, 2nd para) has the advantage that the flowing liquid containing bubbles does not need to be extracted from a passage for the liquid for measuring the bubble content of the liquid. This measurement principle is quite different from the subject-matter of claim 1.

2.2.7 According to D2, the second embodiment in Figures 3 and 4 is preferably used in a severe environment of high or low temperatures (p. 5, 3rd para). In this embodiment the entire device is placed in a bypass of the conveyance passage. In particular the measurement device of this embodiment includes a first high-pressure section including a pump 3 for circulating the fluid and for pulverising the bubbles and subsequently a low-pressure section.

2.2.8 To the board it appears that the skilled person would not have any compelling reason for combining the measurement device of the second embodiment of document D2 with the one disclosed in document D1 since both devices offer complete solutions for specific aims.

However, even if the skilled person would have contemplated to include the bubble content measurement detector 19 of this embodiment of D2 as a bypass in the process line 12 of the device of document D1 such a combination device would still not show the technical features of claim 1, since the claim defines that the bleed line is coupled to the process line for bleeding a portion of the fluid or process mixture at a bleed line pressure that is lower than the process line pressure and that it has the further restrictions of claim 1. Nor would such a combination include the third module as defined in claim 1.

2.2.9 Hence, whereas the bubble content measuring detector of document D2 requires a high-pressure and a low-pressure section, in which the high-pressure section includes a pump for pulverising the bubbles, the bleed line of the device of claim 1 of the main request is arranged for providing a low pressure. The appellant has argued that the advantage of employing a bleed line is its simplicity, because it works at a naturally occurring lower pressure. Neither document D1, nor document D2, discloses or hints at this solution.

2.2.10 It is concluded that the subject-matter of claim 1 is not obtainable from the available prior art in an obvious way and that it therefore involves an inventive step.

2.3 *Claim 10*

2.3.1 Independent claim 10 of the main request defines a method for measuring entrained and dissolved gas in a fluid or a process mixture in which the method steps correspond to the apparatus features of claim 1 of the main request. In particular the fluid is bled into a

bleed line having a bleed line pressure lower than the process line pressure. This method is novel and not obvious for the same reasons as those given for the corresponding device claim 1.

2.4 *Claims 2 - 9 and 11 - 20.*

2.4.1 These claims are dependent claims and are equally allowable.

3. For the above reasons, the board finds that the appellant's main request meets the requirements of the EPC and that a patent can be granted on the basis thereof.

4. Since the main request is allowable, there is no need to address the auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent on the basis of the following documents:

Claims: 1 to 20 of the main request as received with the letter of 17 January 2011;
Description: pages 3 - 6, 8, 10, 11, 16, 18 and 19 as

published under the PCT;
pages 2 and 2a received with the letter of 29 May 2007;
pages 1, 2b, 7, 9, 12 - 15, 17 and 20 received with the letter of 17 January 2011;

Drawings: sheets 1/7 - 7/7 as published under the PCT (corrected version).

The Registrar: The Chairman:

M. Kiehl A. Klein