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(54) Title: SAMPLER

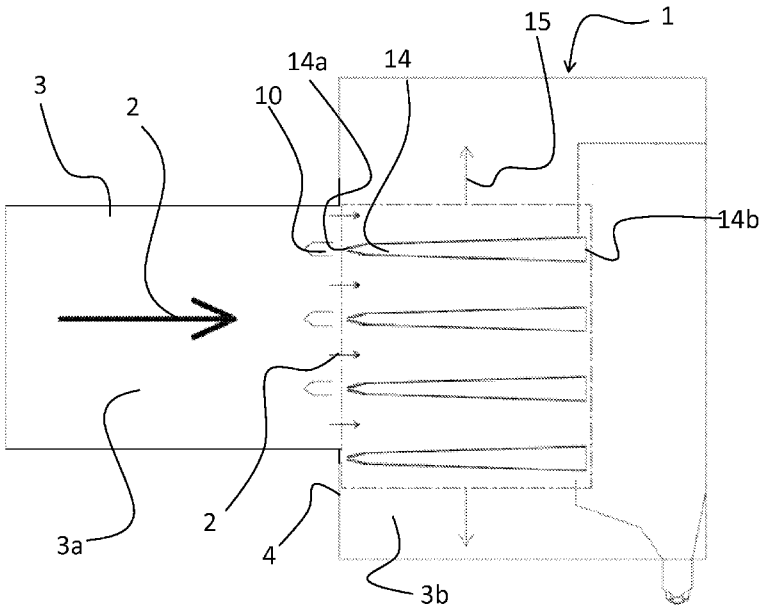


Fig.2

(57) Abstract: Sampler (1) for taking samples from a process flow (2) flowing in a flowing channel (3). The sampler (1) comprises at least two sample cutters (14) for separating a sample flow from the process flow (2), the sample cutter (14) comprising an inlet (14a) for receiving the sample flow into the sample cutter (14), and a flow diverter (10) for controlling a state of the inlet (14a) between an open state and a closed state so that in said open state the sample flow is separated from the process flow (2) and arranged to flow into the sample cutter (14) and in said closed state the process flow (2) remains unseparated.

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SAMPLER

FIELD OF THE INVENTION

The present invention relates to a sampler, and more particularly to a sampler as defined in the preamble of independent claim 1.

BACKGROUND OF THE INVENTION

The invention relates to a sampler taking slurry samples containing solids from a large and essentially horizontally flowing process flow. The sampler comprising a sample cutter is normally at least partly immersed in the process flow such that samples can be taken from the process flow. The solids-bearing process flow is conducted into a sample cutter which is then conducted through the sample cutter as a sample flow into another sampling unit or to further processing. Samplers may comprise multiple sample cutters forming a sample unit and samplers may also comprise multiple sample units which are typically arranged one after the other. Typically only a small part of the process flow is conducted to the sample cutter while most of the process flow flows past the sample cutter. Normally the process of taking samples is continuous such that when it is started the sample cutter takes samples all the time until the process is ended.

One of the disadvantages associated with the above process is that the sample taken from the process flow may be not representative in quality because the process flow coming toward the sampler may be inhomogeneous containing more less or different solids in the flow which does not enter the sampler and the sample taken from the process flow may indicate that there is more, less or different solids than there actually are in the average process flow and then the sample gives a wrong indication.

Another disadvantage with such arrangements that have an immovable sample cutter without a flow diverter is that the sample flow is taken from the same spot all through the process and there may be points that collect the material flowing with the process flow and suddenly discharge so that the sample taken from the process flow may provide skewed data by the exceptional selection of the sample.

BRIEF DESCRIPTION OF THE INVENTION

An object of the present invention is thus to provide a sampler for taking samples so as to alleviate the above disadvantages. The object of the

invention is achieved by a sampler, which is characterized by what is stated in the independent claim. The preferred embodiments of the invention are disclosed in the dependent claims.

The invention is based on the idea of providing a sampler, which comprises at least two sample cutters for taking the sample from the process flow and at least one flow diverter that is arranged in relation with the sample cutter such that from time to time the flow diverter closes and opens the passage for part of the process flow to enter the sample cutter.

The invention relates to a sampler for taking samples from a process flow flowing in a flowing channel. Said process flow is arranged to flow in a flowing channel and the direction where the process flow flows is called a flow direction. According to the invention the sampler comprises at least two sample cutters for separating a sample flow from the process flow and a flow diverter. The sample cutter comprises an inlet for receiving the sample flow into the sample cutter and said flow diverter is arranged for controlling a state of the inlet between an open state and a closed state so that in said open state the sample flow is separated from the process flow and arranged to flow into the sample cutter and in said closed state the process flow remains unseparated.

During a closed state the flow diverter and the sample cutter are arranged in line in the flow direction such that the flow diverter prevents the process flow to enter the sample cutter. During an open state the sample cutter and the flow diverter are not in line so that the process flow can freely enter the sample cutter to form a sample flow. In other words during an open state the sample cutter is offset relative to the flow diverter in the flow direction of the process flow such that the process flow is arranged to enter into the sample cutter for forming a sample flow. So the sample cutter is arranged to move in relation to the flow diverter such that during the closed state the sample cutter and the flow diverter are in line in the flow direction of the process flow such that the flow diverter is arranged to prevent the process flow from entering into the sample cutter and during the open state the sample cutter is offset relative to the flow diverter in the flow direction of the process flow such that the process flow is arranged to enter into the sample cutter for forming a sample flow.

The sample cutter and the flow diverter are arranged movable in relation to each other so that the state of the sample cutter can be changed

from a closed state to an open state and vice versa. Another possible way of changing the state of the inlet of the sample cutter is that the sample cutter is arranged movable in relation to the flow diverter for changing the state of the inlet of the sample cutter.

There are at least two sample cutters and preferably multiple sample cutters grouped together for forming a sampling unit.

In a preferred embodiment of the invention the sample cutter is arranged to move laterally across the process flow such that during the open state the sample cutter is not in line with the flow diverter for the process flow to be separated as a sample flow and such that during the closed state the sample cutter and the flow diverter are arranged in line in the flow direction so that the process flow will pass the sample cutter and no sample flow is created.

The solids containing slurry, i.e. the process flow, flows along a flowing channel and there is a sampler arranged in a fluid communication with the channel. The sample cutter may be mechanically connected to the channel or it may be arranged only in a fluid communication with the channel for example over the flowing channel such that a fluid communication is arranged between a part of the flowing channel and the sample cutter for allowing part of the process flow to flow into the sample cutter during an open state. The flowing channel preferably extends through the sample cutter such that while part of the process flow enters the sample cutter the rest of the process flow continues flowing in the flowing channel. The flowing channel may be arranged such that when the part of the process flow enters the sample cutter the rest of the process flow is conducted onto a lower level in the flowing channel. The flowing channel is preferably arranged in a horizontal or substantially horizontal direction and the sample cutter is arranged with respect to the flowing channel such that the process flow coming through the flowing channel continues its flow into the sample cutter during the open state of the sample cutter. There may be two or more sample cutters that are arranged adjacently or spaced from one another and at least partly immersed in the process flow proceeding in the horizontal or substantially horizontal direction. The group of sample cutters is called a sampling unit.

In a preferred embodiment of the invention the sample cutter is arranged movably in relation to the process channel such that the sample cutter is arranged to move laterally across and in relation to the process flow such that an inlet of the sample cutter is toward the flow direction of the

process flow in the flowing channel. The sample cutters can be arranged to move individually or as a sampling unit. The individual sample cutters may be moved synchronously or asynchronously with respect to each other in the sampling unit. The sample cutter comprises an inlet for the process flow to enter the sample cutter, i.e. an input aperture. The sample cutter comprises a channel through said cutter and an exit for the sample flow to exit the sample cutter. The process flow that flows through the sample cutter is called a sample flow.

In a preferred embodiment of the invention the sample cutter is arranged to start its movement when it is in line with the flow diverter and the movement of the sample cutter is preferably essentially smooth and the speed of the sample cutter is preferably steady so that the sample taking phase is not disrupted.

An advantage of the sampler of the invention is that the flow diverter forms a position in which the sample cutter may come to rest and the samples can be taken every now and then so that spot check type of sample results are taken from a nonhomogeneous flow. Another advantage of the sampler according to the invention is that the space in which the sample cutters or the sampling unit moves is shorter than when having one sample cutter moving across the entire process flow.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following the invention will be described in greater detail by means of preferred embodiments with reference to the attached drawings, in which

Figure 1 shows a sampler according to the invention;

Figure 2 shows the sampler in figure 1 seen from above in a closed state; and

Figure 3 shows the sampler in figure 1 seen from above in an open state.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows the sampler 1 according to the invention. During a sample-taking phase in which the sampler is arranged to take samples from a process flow 2 a sample cutter 14 is arranged in a fluid communication with the flowing channel 3 in which the process flow 2 (illustrated as an arrow) is arranged to flow. The sample cutter 14 may be structurally connected to the

flowing channel 3 or it may be arranged independently so that the flowing channel and the sample cutter 4 are separate units and only in a fluid communication with each other. In the embodiment shown in figure 1 the flowing channel 3 is arranged in two levels such that before the sample cutter 14 the flowing channel 3 is upper than after the sample cutter 14, this is an advantageous arrangement but not necessary. Although figure 1 shows multiple sample cutters 14 arranged adjacently the invention also covers an embodiment where there are only two sample cutters 14. Before the sample cutter 14 in the flow direction of the process flow there is a flow diverter 10 arranged in connection with the flowing channel 3. In this figure the flow diverter 10 is arranged to close an inlet 14a of the sample cutter 14 so that the process flow 2 cannot enter into the sample cutter 14. In a preferable embodiment of the invention the separate sample cutters 14 or the sampling unit comprising multiple sample cutters 14 is arranged movably in relation to the flowing channel 3 such that the sample cutter 14 moves laterally across the flowing channel 3 having the inlet 14a toward the flow direction of the process flow in the flowing channel. A part of the process flow 2 that enters into the sample cutter 14 is arranged to flow through the sample cutter 14 and exit the sample cutter 14 through an outlet 14b. From the outlet 14b the sample, i.e. the part of the process flow 2 that has flown through the sample cutter 14, is collected for further use in the process.

Figure 2 shows the sampler 1 shown in figure 1 from above. In this figure the sample cutter 14 is in line with the flow diverter 10 such that the process flow 2 coming along the flowing channel 3 does not enter into the sample cutter 14 but flows pass the sample cutter 14. The flow diverter 10 comprises a wedge-like body having a point part and a base part, the flow diverter 10 is arranged in the flowing channel 3 such that said point part is arranged toward the flow direction of the process flow 2 and said base part is arranged toward the inlet of the sample cutter 14 during the closed state. In this closed state samples from the process flow 2 are not taken and the process flow can continue its free flow. The inlet 14a of the sample cutter 14 stays behind the wedge like flow diverter 10 so that even though the inlet 14a may not be sealed the flow diverter 10 closes the inlet 14a such that process flow 2 cannot enter into the sample cutter 14. The wedge like flow diverter 10 has a sharp tip toward the direction wherefrom the process flow comes such that the tip splits the process flow 2 smoothly and does not affect its flowing. In

this embodiment of the invention the sample cutters 14 are arranged in a unit such that the unit can be moved laterally across the process flow 2 such that the inlets 14a face toward the process flow 2 flowing toward the sample cutters 14. The arrows 15 show the movement of the sample cutter unit which is across the process flow 2.

As can be seen from the figures 1-3 the flowing channel 3 has a first channel section 3a having a first width and a second channel section 3b having a second width. The second channel section 3b has a greater width than the first channel section 3a. The sample cutters 14 are arranged in the second channel section 3b of the flowing channel 3. The second channel section 3b comprises an expansion wall 4 that is arranged to protrude away from the first channel section 3a at a downstream end of the first channel section 3a for forming the width of the second channel section 3b. In other words the expansion wall 4 widens the first channel section 3a into the second channel section 3b. The sample cutters 14 are arranged to move in the second channel section 3b such that the side wall 4 is arranged to close the inlet 14a of at least one of the sample cutters 14 during the closed state. As can be seen in figure 2 three of the sample cutters 14 are closed by the flow diverters 10 and one of the sample cutters 14 is closed by the expansion wall 4 so that the process flow 2 can freely flow pass the sample cutters 14 and no samples are taken from the process flow 2.

Figure 3 shows another position of the sample cutters 14 in which the sample cutters 14 are moved laterally across the process flow 2 from the position shown in figure 2 in which the sample cutters 14 are in a closed state into a position in which the process flow 2 flows toward the inlet 14a of a sample cutter 14 to enter into the sample cutter 14 and forms a sample flow which flows through the sample cutter 14 and exits the sample cutter 14 through an outlet 14b. Now all the sample cutters 14 are in an open state such that the flow diverters 10 are in between the adjacent sample cutters 14. The arrow 15 shows the movement direction of the sample cutters 14 or the sampling unit.

It will be obvious to a person skilled in the art that, as the technology advances, the inventive concept can be implemented in various ways. The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

CLAIMS

1. A sampler (1) for taking samples from a process flow (2) flowing in a flowing channel (3), **characterized** in that the sampler (1) comprises

at least two sample cutters (14) for separating a sample flow from the process flow (2), the sample cutter (14) comprising an inlet (14a) for receiving the sample flow into the sample cutter (14), and

a flow diverter (10) for controlling a state of the inlet (14a) between an open state and a closed state so that in said open state the sample flow is separated from the process flow (2) and arranged to flow into the sample cutter (14) and in said closed state the process flow (2) remains unseparated.

2. A sampler (1) according to claim 1, **characterized** in that the sample cutter (14) and the flow diverter (10) are arranged movable in relation to each other.

3. A sampler (1) according to claim 1 or 2, **characterized** in that the sample cutter (14) is arranged movable in relation to the flow diverter (10) for changing the state of the inlet (14a) of the sample cutter (14).

4. A sampler (1) according to any preceding claim, **characterized** in that said sample cutter (14) is arranged to move in relation to the flow diverter (10) such that during the closed state the sample cutter (14) and the flow diverter (10) are in line in the flow direction of the process flow (2) such that the flow diverter (10) is arranged to prevent the process flow (2) from entering into the sample cutter (14) and during the open state the sample cutter (14) is offset relative to the flow diverter (10) in the flow direction of the process flow (2) such that the process flow (2) is arranged to enter into the sample cutter (14) for forming a sample flow.

5. A sampler (1) according to any preceding claims, **characterized** in that the sample cutter (14) is arranged to move laterally in relation to the process flow (2) such that the inlet (14a) of the sample cutter (14) is toward the flow direction of the process flow (2).

6. A sampler (1) according to any preceding claims, **characterized** in that the flow diverter (10) is arranged in connection with the flowing channel (3) and before the sample cutter (14) in the flow direction of the process flow (2).

7. A sampler (1) according to any preceding claims,

characterized in that the flow diverter (10) comprises a wedge-like body having a point part and a base part, the flow diverter (10) is arranged in the flowing channel (3) such that said point part is arranged toward the flow direction of the process flow (2) and said base part is arranged toward the inlet of the sample cutter (14) during the closed state.

8. A sampler (1) according to any preceding claims, **characterized** in that the flowing channel (3) has a first channel section (3a) having a first width and a second channel section (3b) having a second width which is greater than the first width and the sample cutters (14) are arranged in the second channel section (3b) of the flowing channel (3).

9. A sampler (1) according to claim 8, **characterized** in that the second channel section (3b) comprises an expansion wall (4) that is arranged to protrude away from the first channel section (3a) at a downstream end of the first channel section (3a) for forming the width of the second channel section (3b).

10. A sampler (1) according to claim 9, **characterized** in that the sample cutters (14) are arranged to move in the second channel section (3b) such that the side wall (4) is arranged to close the inlet (14a) of at least one of the sample cutters (14) during the closed state.

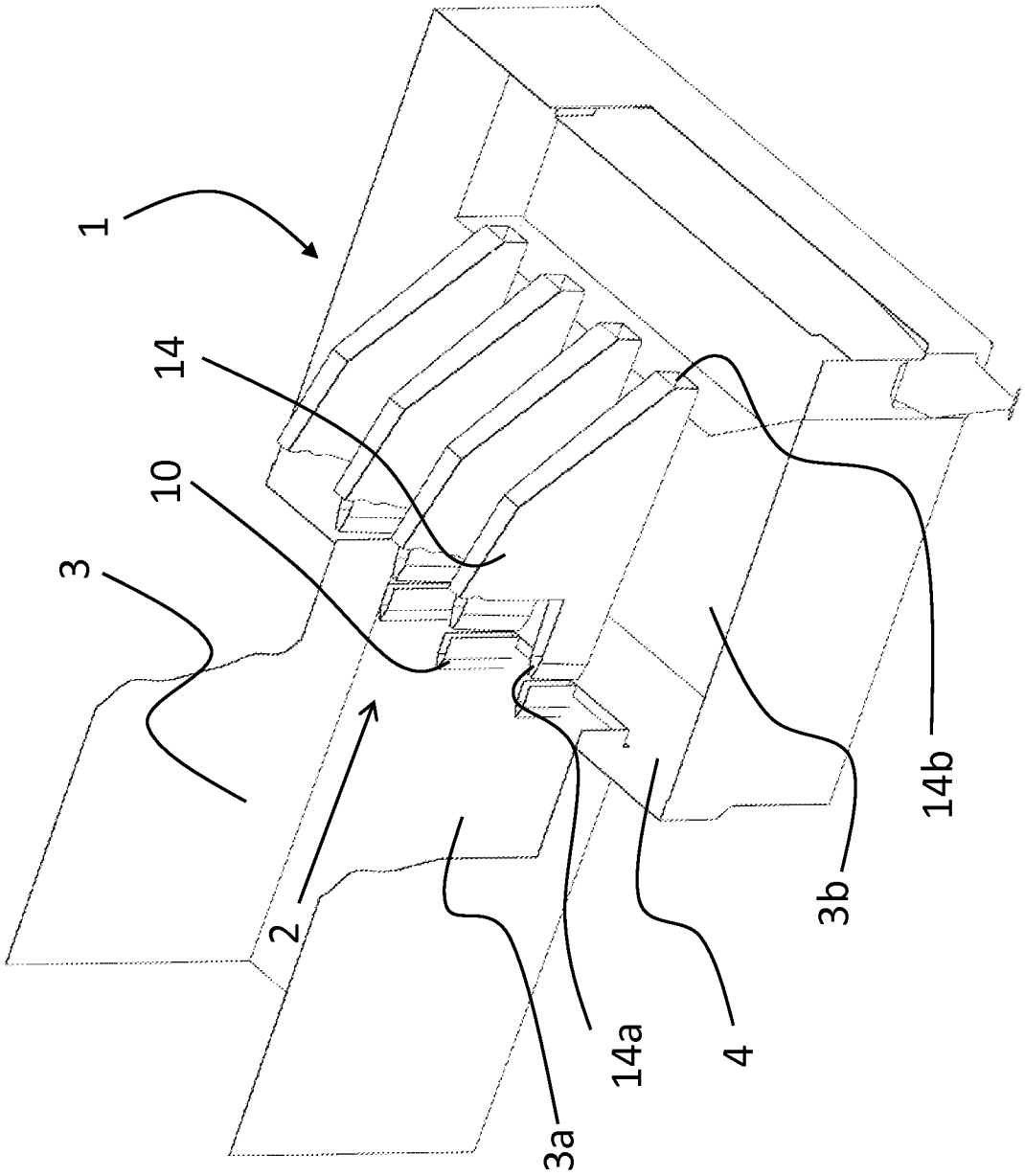


Fig.1

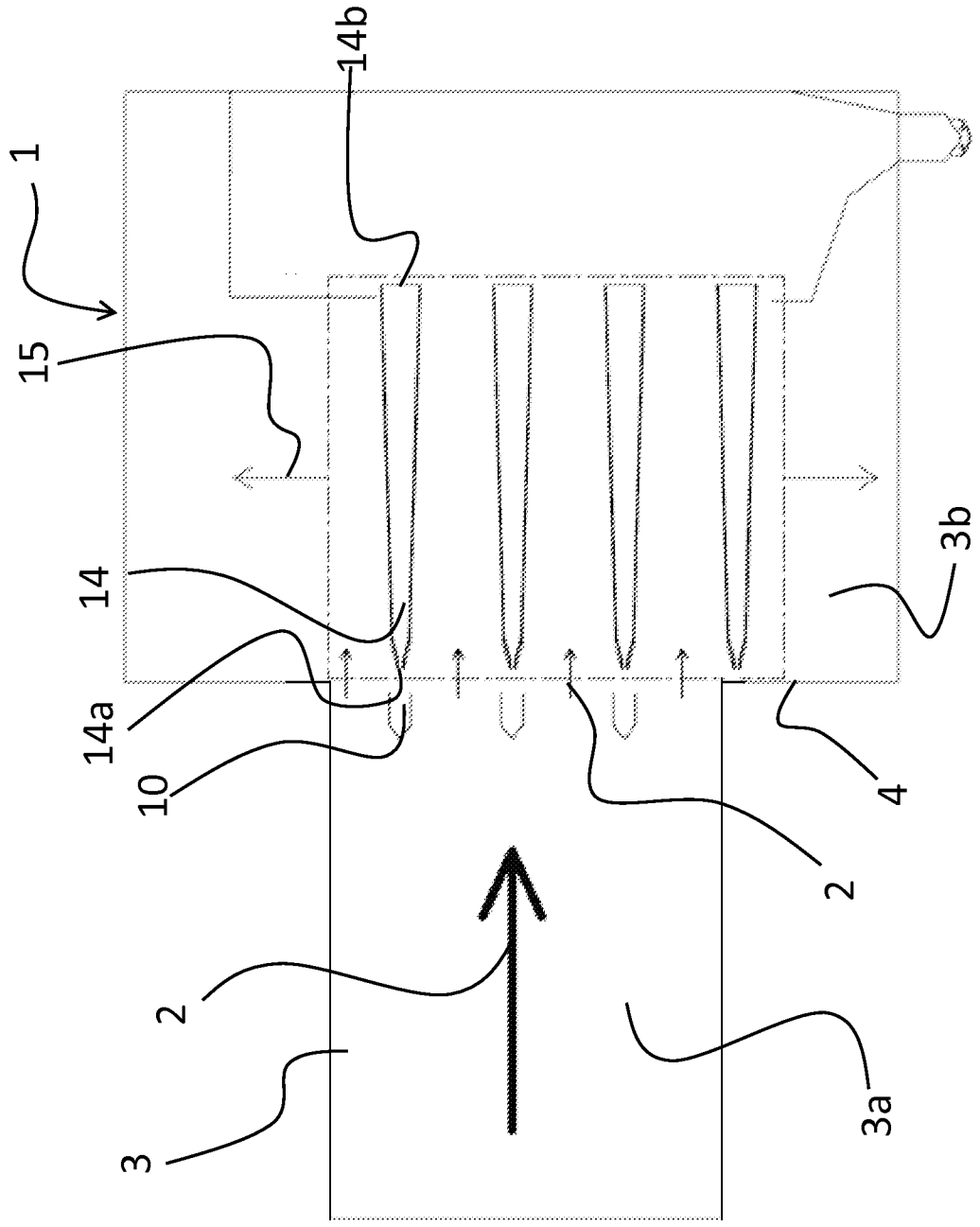


Fig.2

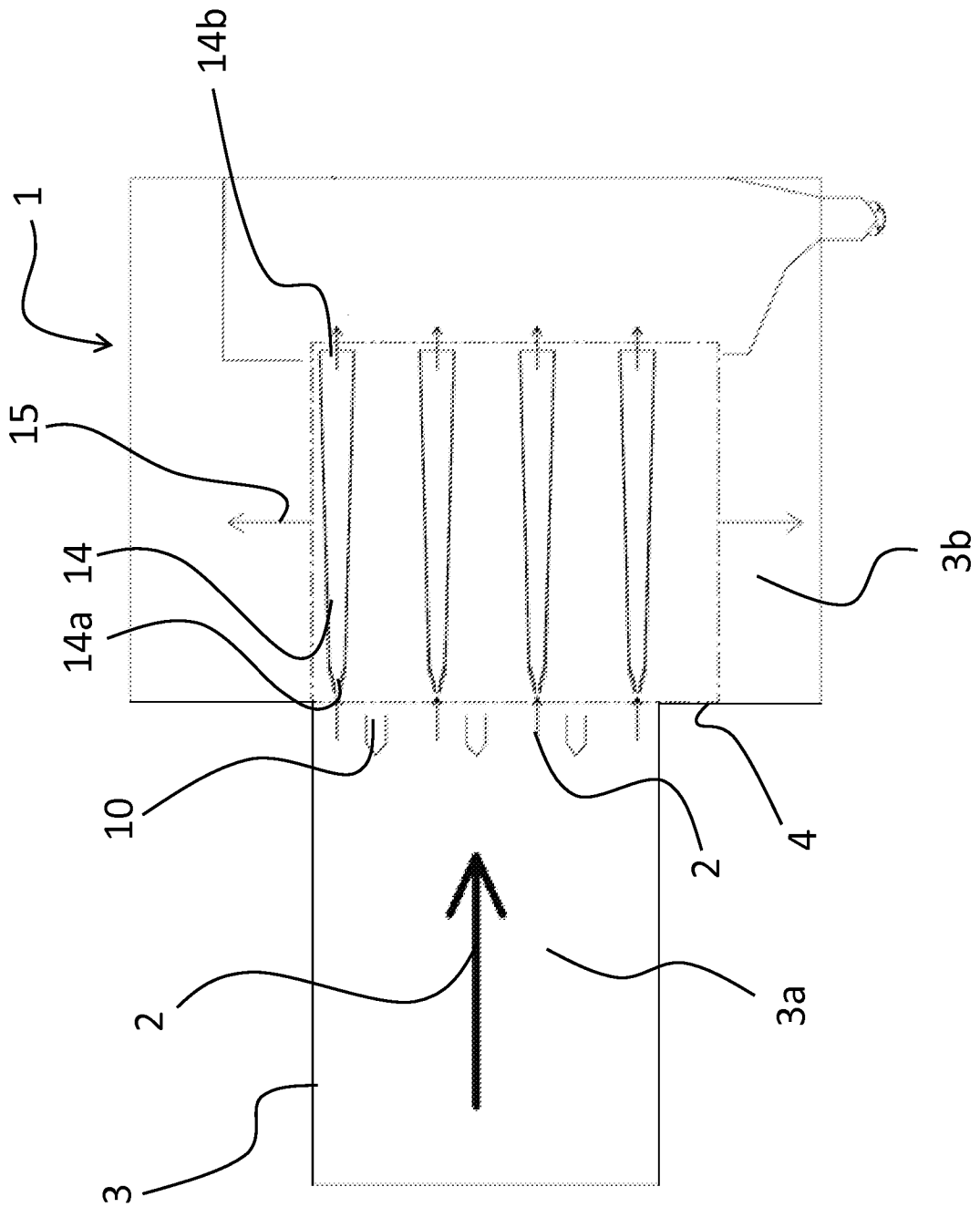


Fig.3

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2015/050627

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01N1/20
ADD. G01N1/10

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)
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.
X	CHRISTIAN VON ALFTHAN ET AL: "Sampling for on-stream analysis and composite samples", RECENT ADVANCES IN MINERAL PROCESSING PLANT DESIGN, SME, OCT 1, 2009; MINERAL PROCESSING PLANT DESIGN SYMPOSIUM ; (TUCSON, ARIZ.) : 2009.09.30-10.03, LITTLETON, COLO. : SME, C2009, US, 30 September 2009 (2009-09-30), pages 155-163, XP008166730,	1-3,5,6, 8-10
Y	figure 7 page 7	4,7

X	WO 03/069313 A1 (OUTOKUMPU OY [FI]; VON ALFTHAN CHRISTIAN [FI]) 21 August 2003 (2003-08-21)	1-3,5,6
Y	figures 3-4 page 8, line 26 - page 9, line 4	4,7

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 November 2015	30/11/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Bockstahl, Frédéric

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INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2015/050627

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3 509 770 A (MORTON JAMES L) 5 May 1970 (1970-05-05) figure 2 column 3, line 3 - line 33	4,7
A	US 3 474 675 A (STRAND ERLING K) 28 October 1969 (1969-10-28) figures 1-2 column 2, line 48 - line 56 column 3, line 42 - line 55	1-10
A	US 2 303 085 A (MADDOX GERALD C) 24 November 1942 (1942-11-24) figures 1-4 page 1, column 2, line 38 - line 55 page 2, column 1, line 1 - line 10	1-10

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/FI2015/050627

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