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(54) Title: METHOD IN EVALUATING THE CONDITION / STATE OF PRESS FELT OF PAPER MACHINE OR EQUIVALENT

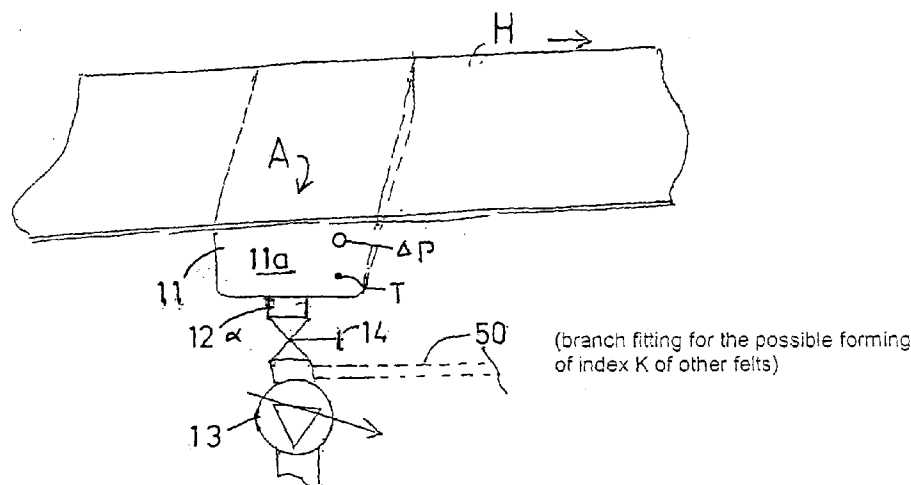


FIG 1

(57) Abstract: The invention relates to a method in monitoring the condition of felt (H) in a paper machine, a board machine or equivalent. In the method according to the invention, based on air volume (Q) of a Uhle box (11), an area (A) and vacuum (Δp) of the Uhle box, an air permeability index (K) of the felt (H) is calculated. It is the air volume (Q) having permeated the felt (H) via a suction surface of the Uhle box over the area (A) of the Uhle box and vacuum (Δp) being across the felt.

Method in evaluating the condition/state of press felt of paper machine or equivalent

- 5 The invention relates to a method in evaluating the condition/state of the press felt of a paper machine or equivalent.

The lifetime of the felts of a paper-machine press in high-speed machines is typically from three to five weeks, after which they are replaced with new ones. The
10 felts are typically reconditioned by water jets and by vacuumed Uhle boxes. If required, the felts can also sometimes be cleaned with chemicals.

With the method according to this invention, it is possible to evaluate the condition of the felt with a continuous method based on its air permeability and, on the
15 basis of this, to time felt cleanings, felt replacements correctly, and to prevent replacing the felt too early as well as to compare the functioning of different felts during their whole lifetime.

The condition of the felt has been traditionally evaluated based on the vacuum or
20 dewatering measurements of the Uhle box, and felt cleanings and replacements have been typically timed either based on these measurements or often only on empirical information.

It has been difficult to evaluate the actual condition of the felt with known methods, due to which the timing of cleanings and replacements is done in time before
25 problems on the paper machine start to occur.

If the reconditioning of the felt is done with blowers, also vacuum cannot be reliably used in evaluating the state of the felt (the blower always gives constant
30 vacuum). Also water volume measurements do not always correlate properly with the condition/state of the felt.

A problem of methods based on modern technique is evaluating the actual condition of the felt sufficiently well for timing cleanings and replacements.

- 5 In the method according to the invention, air permeance i.e. permeability of the press felt of the paper machine is continuously calculated based on the operation of a reconditioner of the felt, such as Uhle boxes. Based on a calculated air permeability coefficient, it is possible to evaluate the clogginess of the felt and to time, more precisely than with traditional methods, felt replacements, required
10 cleanings and to anticipate starting runnability problems before they occur.

In the method according to the invention, air volume exiting from the Uhle box is either measured or calculated based on vacuum (Δp) of the Uhle box and opening angles (α) of the valve.

15

In the method according to the invention, based on the air volume of the Uhle box, the area and the vacuum of the Uhle box is calculated air permeability K of the felt which is the air volume having permeated the felt through a suction surface of the Uhle box over the area and the vacuum of the Uhle box across the felt.

20

This air permeability K can be reported in different units, e.g.

$$- (\text{m}^3/\text{s}) / \text{m}^2 / 1 \text{ kPa} = \text{m/s/1 kPa}$$

$$- (\text{m}^3/\text{h}) / \text{m}^2 / 1 \text{ kPa} = \text{m/h/1 kPa}$$

- 25 When the paper machine has a continuous reproducible measuring method of the felt condition, the lifetime of the felt can be maximised and the cleanings and replacements of felts can be timed correctly. Similarly, it is possible to reliably observe differences from the conventional graphics which indicate e.g. damages or being out of order of the felt.

30

Also the efficiency of different felt reconditioning methods (=high-pressure cleanings, vacuum of the Uhle box, chemical cleanings) can be compared to each other even continuously (on-line) as the machine runs.

- 5 In the invention, it has thus been realised to form a curve of the permeability coefficient

$$K = \frac{Q}{A \cdot \Delta p}$$

where Q = air flow volume passed through the suction surface of the Uhle box in a time unit (e.g. m^3/s), A = area of the suction surface of the Uhle box (m^2), and

- 10 Δp = pressure difference across the felt (vacuum e.g. kPa).

In the method, an air permeability coefficient K is formed at each operating point of the lifetime of the felt, which coefficient K is the air volume permeating the felt Q (m^3/s)/ A (m^2)/ Δp (kPa) where Δp is vacuum at the operating point in question.

- 15 Air volume Q can be obtained so that an opening position α of a shut-off valve 14 in an air flow channel 12 after a suction box 11 percentually and vacuum Δp related to the valve opening α in question are observed or the air volume Q in the channel 12 and the vacuum Δp related to the air volume are directly measured. Based on the opening position α of the shut-off valve 14, it is however possible to
- 20 simply define the air volume passed through the shut-off valve.

- Hence, it is possible to create a curve related to the index K which correlates with the permeability of the felt. By creating a set of curves related to each run and felt H , the set of curves related to each position and felt used in it are obtained and it
- 25 is possible to monitor the cloggiess level of the felt and to observe changes occurring in it e.g. changes differing from the conventional. Then, it is possible to prepare for the felt replacement and thus machine damages and unwanted shut-downs can be prevented. It is e.g. possible to observe if the felt starts calendering and clogging too quickly. The above-mentioned on-line measurement of the air
- 30 volume permeating the felt can be done on the paper machine continuously or

from time to time with sufficient intervals, whereby the continuous evaluation of the felt condition is provided.

Based on the on-line based measurement of air volume permeating the felt according to the invention, it is possible to observe the condition of the felt, to perform different applicability measurements of felt grades etc. In the invention, it is thus possible to create a set of lifetime curves related to each felt and position, based on which set of curves, it is possible to monitor the conduct of new felts and to perform required measures when differences from the conventional occur.

10

A method in evaluating the condition/state of a press felt according to the invention is characterised by what is presented in the claims.

The invention will now be described with reference to some advantageous embodiments of the invention shown in the figures of the accompanying drawings, to which the invention is, however, by no means intended to be solely defined.

Fig. 1 shows the principle of measuring permeability of a felt which is based on observing the air permeability of the felt H and observing equivalent vacuum and creating a permeability index K based on these, which index is created at each operating point from the lifetime of the felt as shown in Fig. 2

20

$$K = \frac{Q}{A \cdot \Delta p}$$

Fig. 2 illustratively shows forming a graph f_1 of the permeability index K i.e. forming a geometric curve related to it. Time is in the horizontal axis of coordinates and the index K in the vertical axis of coordinates. As time passes, the felt H is clogging and the value of the index K is decreasing.

25

Fig. 3 illustratively shows a performed test run for the felt H. First, the conduct of the felt H is monitored before a cleaning 2, the situation after the cleaning is clearly visible in the shown geometry as an increase of the index K at a point 3 and, as the third stage, a replacement of the felt H with a new felt at the point 3 is visible in the geometry. The presentation shows a graphic curve of the permeability index K which describes the different stages of the permeability of the felt.

Fig. 4A shows a blower system of Uhle boxes on the press section P of the paper machine in which it is possible to apply the method according to the invention for monitoring the state of each felt.

Fig. 4B shows the use of a vacuum pump 13 after a water separator 15. The forming principle of the index K is the same as in Fig. 4A.

Figs. 5A and 5B show in a time-permeability K diagram the monitoring of the permeability of the felt for two different felts on the press section of the paper machine.

Fig. 1 shows the principle of a measuring method according to the invention. Felt H of the press section P of a paper machine is brought across a suction box 11. The suction box 11 is connected via a pipe 12 to a blower 13, a pump or equivalent. Before the blower 13 in the flow direction of air, there is a valve 14 by means of which air flow volume is definable in the pipe 12. The apparatus can comprise a water separator 15 before the blower 13, the vacuum pump or equivalent.

In the invention, it has been realised to form the permeability coefficient i.e. the permeability index K of the felt H. The coefficient K in question is formed of the expression $Q/\text{permeance area } A/\Delta p$, where Δp is pressure difference across the felt H, Q is air flow from the suction box 11 via a suction surface A, and the permeance area is the suction area A of the Uhle box. An opening angle α of the

valve 12 defines the air flow volume. Vacuum can be measured from the suction box 11 from a chamber 11a e.g. by a sensor T. The blower 13 can be connected to one or more measurement targets and, hence, it is possible to observe the state of each felt H at different times with the same blower settings.

5

Fig. 2 shows the forming of the permeability index K and the forming of a geometric curve f_1 related to it. It is also characteristic of the method according to the invention that, based on the air volume flowed via the Uhle box i.e. suction box 11, the area and the vacuum of the Uhle box, the air permeability K of the felt is calculated which is the air volume having permeated the felt through the suction
10 surface A of the Uhle box over the area A and the vacuum Δp of the Uhle box 11 across the felt.

As shown in Fig. 2

$$K = \frac{Q}{A \cdot \Delta p}$$

15

From a felt replacement moment 1a to a felt replacement moment 2a, the permeability K decreases depending on the position of the felt and the type of the felt. The permeability K of the felt is monitored for the whole lifetime of the felt and required measures are performed e.g. based on a computer run and its monitoring.
20 Computer-based, it is possible to form based on measurements a permeability curve K and, based on it, it is possible to automatically give alarms when the permeability differs from conventional values, whereby the programme has recorded the permeability values related to each felt and position and the variations of the index K in question for the part of each felt type in the different stages of the felt
25 related to the felt replacement as well as to the felt cleanings. If deviations from the normal occur, measures are taken in order to prevent greater damages. In the figure, there is a branch fitting 50 for producing the index K of several different felts H using the same blower 13.

Fig. 3 shows a graphic presentation f_i of a test run. The monitoring of the state of the felt H starts at a point 1. In a situation 2, a cleaning of the felt has been performed and, in a situation 3, the felt has been replaced by a new one in the position in question. Time is in the horizontal axis of coordinates, the permeability coefficient K in the vertical axis of coordinates.

Fig. 4A shows a blower system of Uhle boxes on the press section P of a paper machine in which it is possible to apply the method according to the invention. As shown in the figure, the blower 13 can be connected to several different suction boxes 11 and, by vacuum produced by the same blower, it is possible to perform observations and measurements related to each felt. Each measurement occasion is related to one felt at a time. Hence, it is possible to form an index K in each different position and, in it, for each felt H.

Fig. 4B shows an embodiment in which, based on the vacuum pump 13 after the water separator 15, the forming of the permeance index K of the felt H is performed. Common for all of the above-mentioned embodiments is that the testing is based on forming the permeance index K of the felt in which index K the air volume Q having permeated the felt is measured over the suction area A and the vacuum Δp across the felt.

$$K = \frac{Q}{A \cdot \Delta p}$$

The forming of the index K can be implemented e.g. in the following way. The pressure sensor T is in the suction box 11 in its vacuum chamber 11a or in a pipe starting from the suction box. The proportional valve 14 in the pipe 12 between the suction box 11 and the blower 13 is adjusted so that the vacuum Δp provided by the blower 13 in the suction box 11 in the chamber 11a stays constant. From the opening position α of the valve 14 and the vacuum across it, it is then possible to define the air volume Q. The vacuum Δp in the chamber 11a is kept constant by

changing the opening α of the valve 14 whereby Q changes. The index K is calculated or automatically produced at different points in time of use of the felt H.

Fig. 5A shows the permeability index K, the valve opening related to the suction
5 box. Fig. 5A shows a felt position in connection with a pick-up roll.

Fig. 5B shows the forming of the permeability index of the felt in another position
e.g. in connection with the third felt of the press.

A paper machine or equivalent means a paper machine, a board machine or a
10 pulp-drying machine.

Claims

1. A method in monitoring the condition of felt (H) in a paper machine, a
5 board machine or equivalent, **characterised** in that, in the method according to the invention, based on air volume (Q) of a Uhle box (11), an area (A) and vacuum (Δp) of the Uhle box, an air permeability index (K) of the felt (H) is calculated which is the air volume (Q) having permeated the felt (H) via a suction surface of the Uhle box over the area (A) of the Uhle box
10 and the vacuum (Δp) being across the felt, that is

$$K = \frac{Q}{A \cdot \Delta p}$$

2. A method in monitoring the condition of the felt in the paper machine, the
board machine or equivalent according to claim 1, **characterised** in that,
15 in the method is formed such an air permeability index of the felt

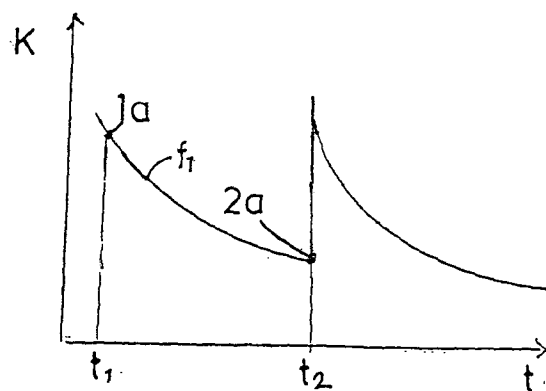
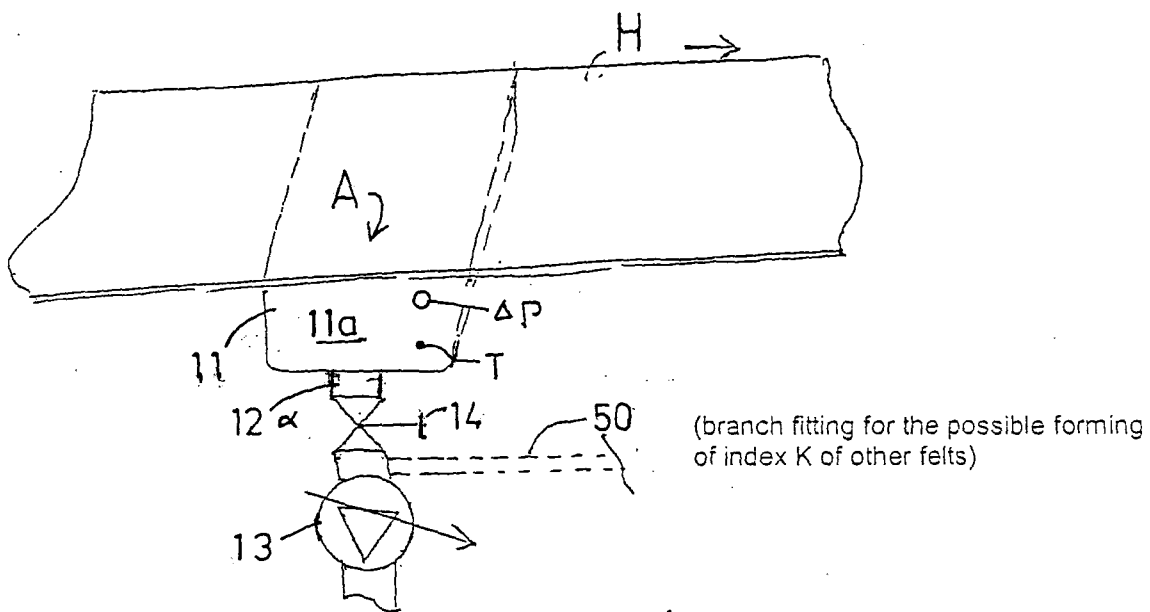
$$K = \frac{Q}{A \cdot \Delta p}$$

where Q = air flow volume passed through the suction surface of the Uhle
box in a time unit (m^3/s), A = area of the suction surface of the Uhle box
(m^2), and Δp = pressure difference (kPa) across the felt (vacuum) and, in
20 the method, a graph (f_1) is formed of measuring results (K) at different
points in time.

3. A method according to the previous claim, **characterised** in that, in the
method, a curve approximating the conduct of the felt is created related to
25 the felt and the felt type from the air permeability index (K) with automatic measurements.

4. A method according to claim 1, 2 or 3, **characterised** in that, in the method, the air permeability index (K) is defined from an opening position (α) of a valve (14) adjusting the flow of air volume (Q) sucked via the felt (H) and by measuring vacuum with a sensor (T) from a chamber (11a).
5. A method according to claim 1, 2, 3 or 4, characterised in that, in the method, vacuum Δp is provided by a blower (13) or a vacuum pump or equivalent and, from a suction line of the blower (13), there is a branch fitting (50) to at least one other felt (H) for producing its index (K).
6. A method according to any one of preceding claims, characterised in that, in the method, the permeability index (K) of the felt is monitored in the paper machine for the lifetime of the felt and it is compared to a standard permeability index (K) related to the felt type (H) in question for the felt type in question related to the position in question, which comparison and monitoring index (K) for the felt (H) in question is formed based on test runs or experience.
7. A method according to any one of preceding claims, characterised in that the blower (13) produces vacuum (Δp) for several Uhle boxes (11), whereby through the same blower/pump (13) it is possible to perform the monitoring of the permeability of the felt (H) felt-specifically for each felt separately by keeping then the settings of the Uhle boxes of the other felts constant.
8. A method according to any one of preceding claims, characterised in that, in the method, a permeability function (f_1) related to the permeability index (K) of the felt is created based on automatic measurements and the deviation of the created function (f_1) in question at a point in lifetime is compared to the air permeability index (K) of a standard felt (H) at the

comparison point in time in question and, if the deviation at the point in question exceeds a certain tolerance range, an alarm is given.



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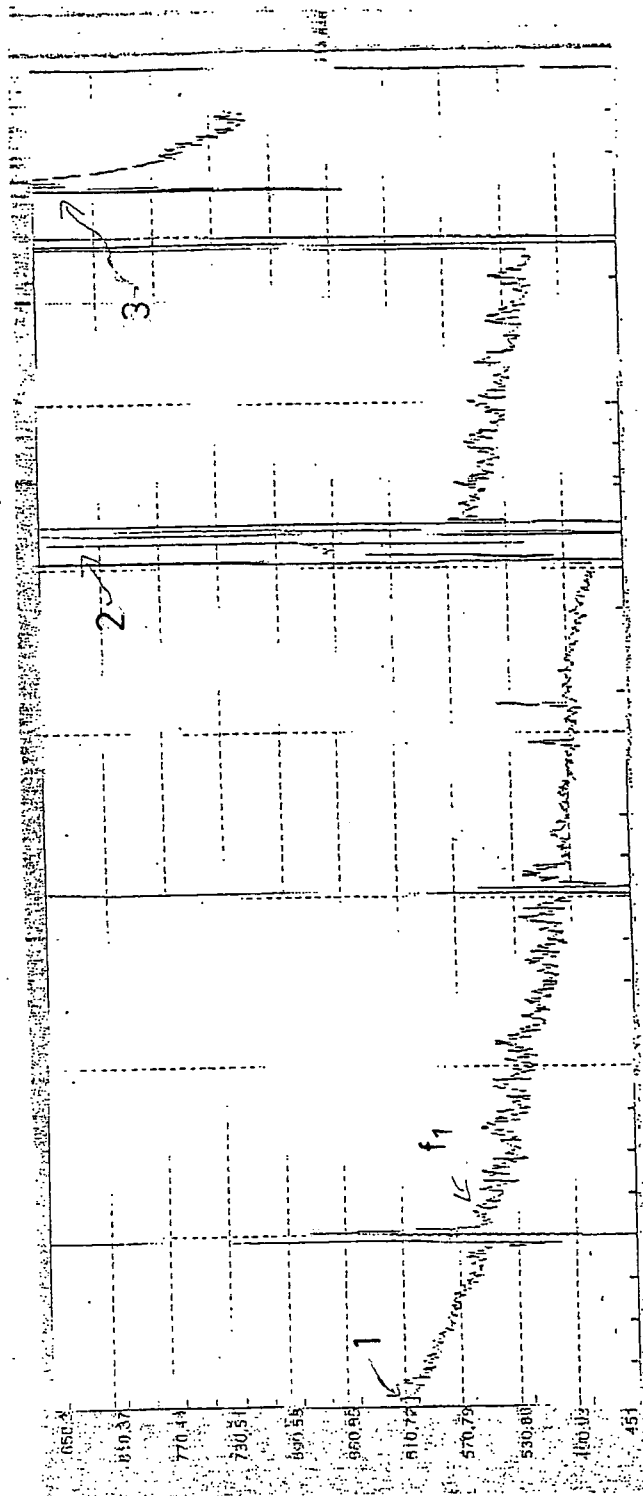


FIG 3

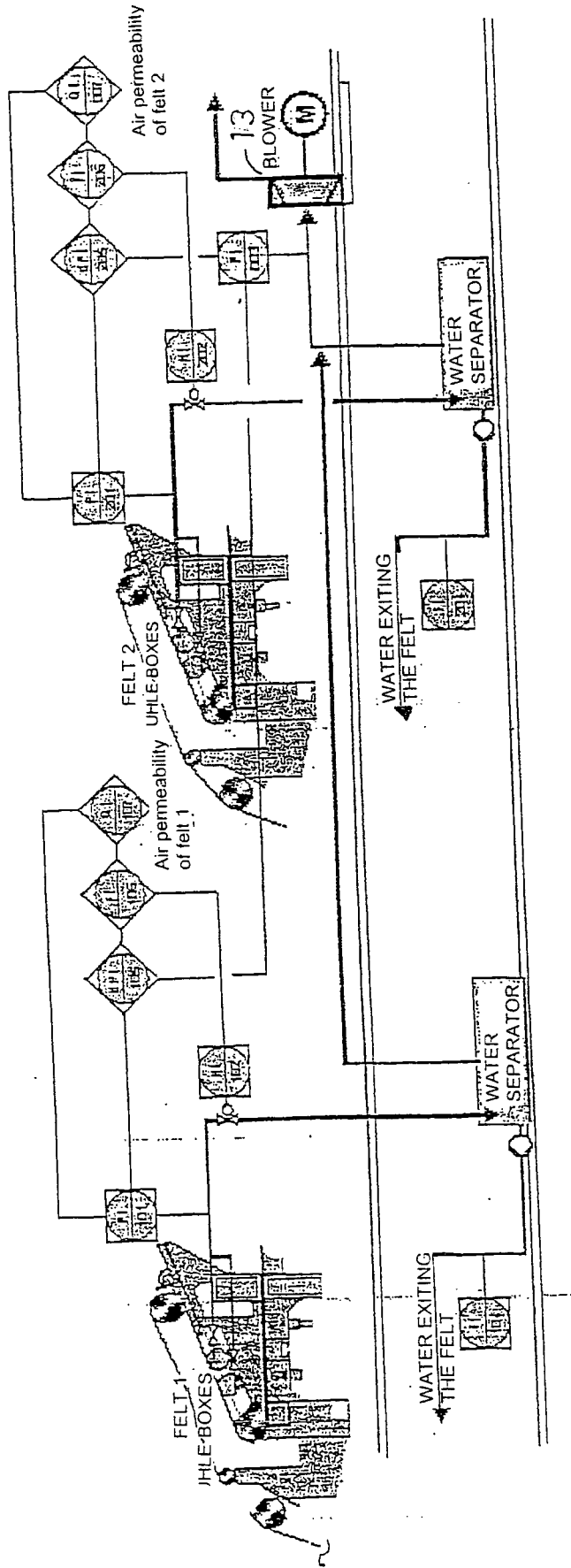


FIG 4A

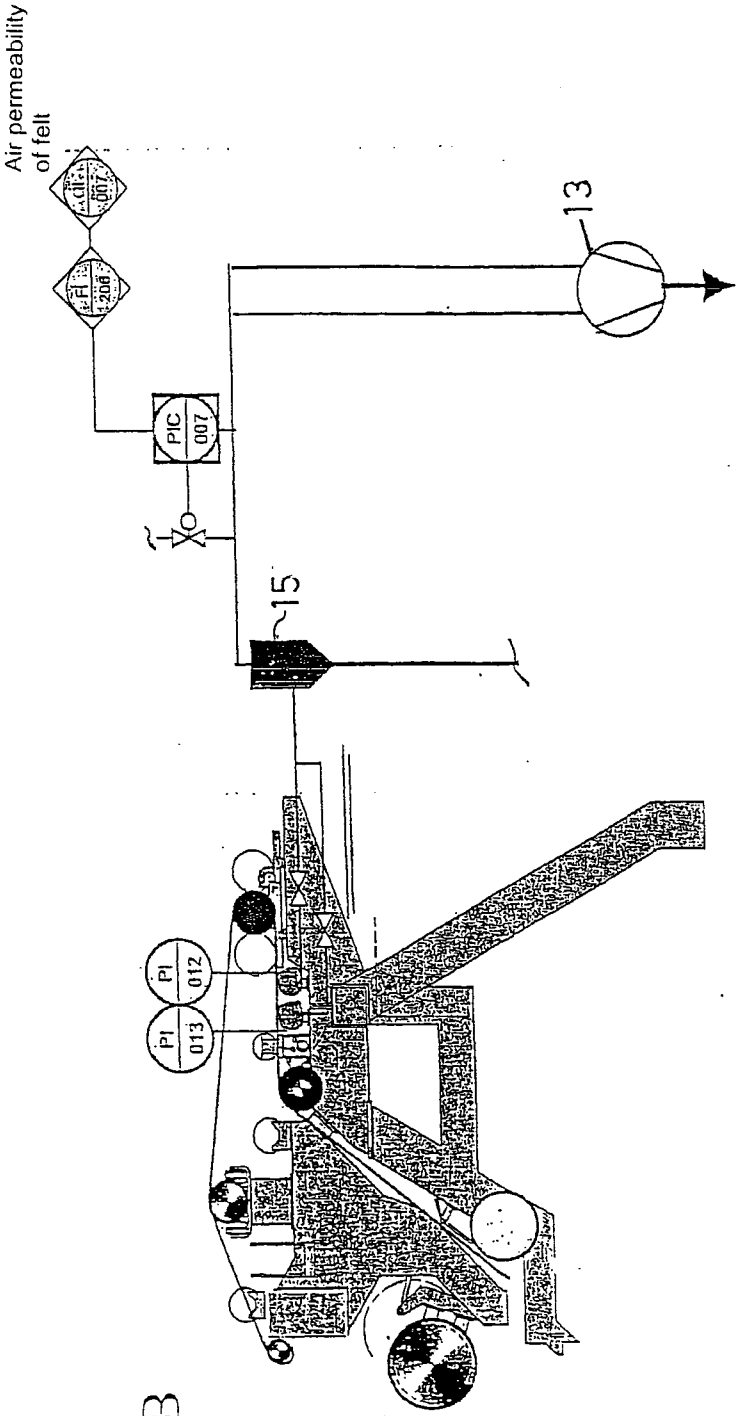


FIG 4B

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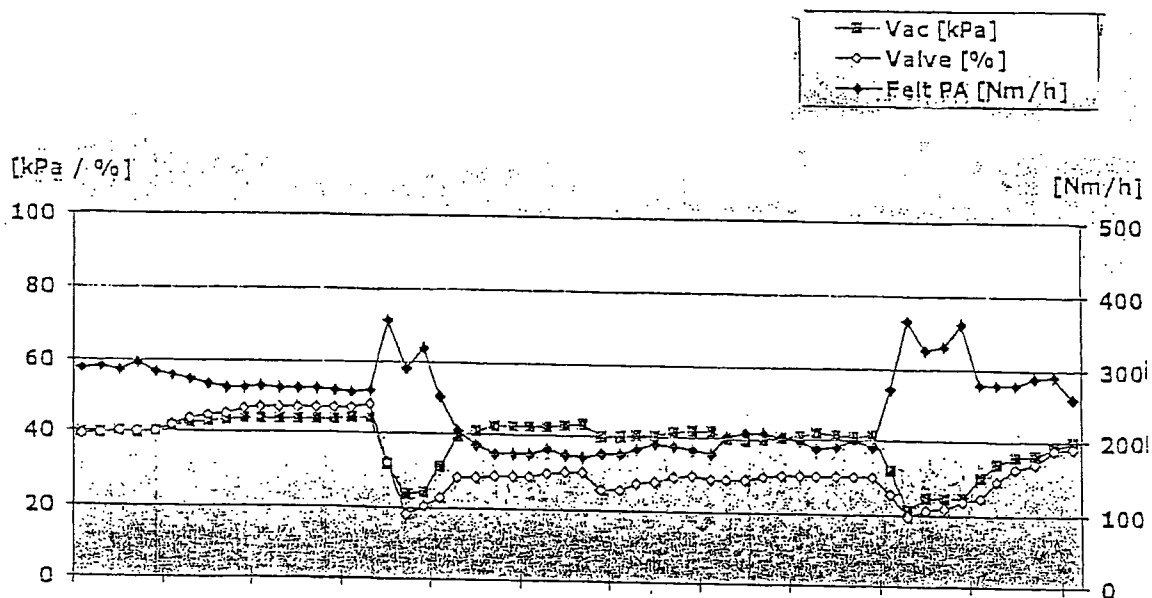


FIG 5A

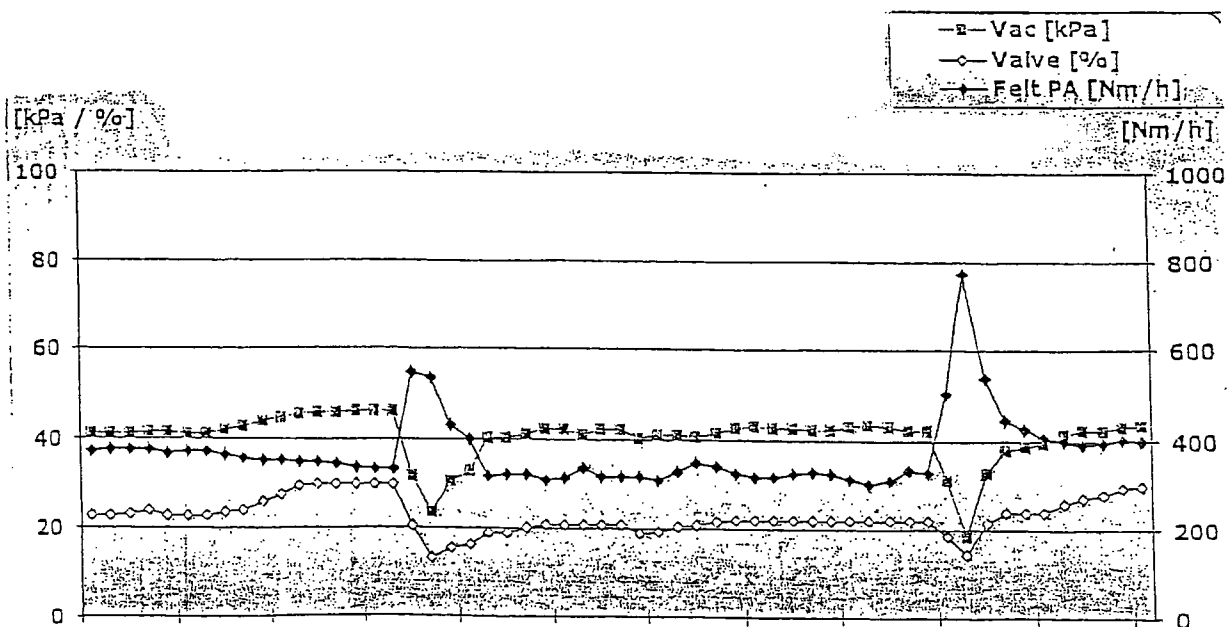


FIG 5B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2008/050367

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC8: G01N, D21F, D21G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
FI, SE, NO, DKElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal; WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	abstract; column 1, lines 5- 14; column 2, line 18- column 3, line 10; column 7, lines 19- 58; column 9, line 63- column 10, line 47; fig. 1	1-3, 5-8
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X	US 4401147 A (BECK DAVID A et al.) 30 August 1983 (30.08.1983) abstract; column 1, line 1- column 2, line 7	1
Y	abstract; column 1, line 1- column 2, line 7	1-3, 8

☒ 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 but 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	

Date of the actual completion of the international search 25 September 2008 (25.09.2008)	Date of mailing of the international search report 03 October 2008 (03.10.2008)
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2008/050367

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	abstract; column 1, lines 32- 67; column 4, line 27- column 5, line 47	1-3, 8
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/FI2008/050367

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US 3808876 A	07/05/1974	None	

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CLASSIFICATION OF SUBJECT MATTER

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D21G 9/00 (2006.01)