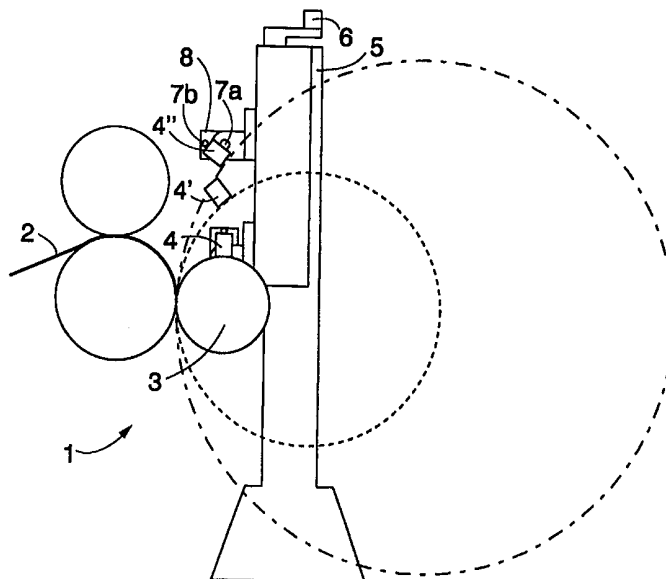




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<p>(21) International Application Number: PCT/FI98/00770</p> <p>(22) International Filing Date: 29 September 1998 (29.09.98)</p> <p>(30) Priority Data: 973856 1 October 1997 (01.10.97) FI</p> <p>(71) Applicant (for all designated States except US): VALMET AUTOMATION INC. [FI/FI]; Panuntie 6, FIN-00620 Helsinki (FI).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only): MOISIO, Hannu [FI/FI]; Kortekuja 1, FIN-36220 Kangasala (FI).</p> <p>(74) Agent: KOLSTER OY AB; Iso Roobertinkatu 23, P.O. Box 148, FIN-00121 Helsinki (FI).</p>	<p>(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> <i>In English translation (filed in Finnish).</i></p>	

(54) Title: METHOD AND APPARATUS FOR MEASURING PAPER COLOUR



(57) Abstract

The invention relates to a method and apparatus for measuring paper colour. Paper colour is measured from the surface of a paper roll (3) on a winder (1). As the size of the paper roll (3) grows a measuring device is moved in such a way that the angle between the measuring device (4) and the surface of the paper roll (3) is kept substantially constant and, at the same time, the distance of the measuring device (4) from the surface of the paper roll (3) remains substantially constant.

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METHOD AND APPARATUS FOR MEASURING PAPER COLOUR

The invention relates to a method for measuring paper colour, whereby paper colour is measured from the surface of a paper roll on a winder during the winding of the paper in such a way that the angle between a measuring device and the surface of the paper roll is kept substantially constant.

The invention further relates to an apparatus for measuring paper colour, the apparatus comprising a measuring device which is arranged to measure paper colour from the surface of a paper roll on a winder during the winding of the paper, and to means for keeping the angle between the measuring device and the paper roll constant.

The article "An on-line sensor for the measurement of paper colour" in the publication "Appita Vol. 44 No. 2" describes a method and apparatus in which paper colour is measured on the winder. In this case the caliper of the paper to be measured and its background colour cannot affect the measurement result because a thick layer of paper is very quickly formed on the winder, and the paper provides for the colour measurement an even backing which also has the same colour as the sample to be measured. The measuring device is immovably arranged at a distance from the winder, therefore background light easily interferes too much with the measurement result, and the measuring device is also difficult to calibrate. As the circumference of the paper roll grows, distance to the roll surface must be measured and the measurement angle adjusted on the basis of the measurement, which makes the apparatus complex and cumbersome. Further, the growing circumference of the paper roll changes the distance between the measuring device and the paper surface, which in turn changes the measurement geometry of the apparatus, i.e. the focusing of a light beam directed from the measurement apparatus on the surface of the paper, whereby the measurement provided is inaccurate.

An object of the invention is to provide a method and apparatus allowing the above mentioned drawbacks to be avoided.

The method of the invention is characterized in that as the size of the paper roll grows, a measuring device is moved in such a way that the distance of the measuring device from the surface of the paper roll remains substantially constant.

The apparatus of the invention is further characterized in that the apparatus comprises means for keeping the distance of the measuring device from the surface of the paper roll constant as the size of the paper roll grows.

An essential idea of the invention is that paper colour is measured
5 on a winder, the angle between a measuring device and the paper surface remaining substantially constant and the measuring device being moved, as the roll size grows, in such a way that the distance of the measuring device from the roll surface also remains substantially constant. An idea of a preferred embodiment is that the measuring device is arranged to move in line
10 with the central axis of the roll. An idea of another preferred embodiment is that the measuring device is arranged to move in relation to two joints in such a way that as the roll size grows the measuring device turns, thus keeping the measurement angle substantially constant.

An advantage of the invention is that since paper is very quickly
15 formed on the winder, the paper provides for the colour measurement an even surface which also has the same colour as the sample to be measured. In this case neither the backing nor the opacity of the paper to be measured affects the result of the colour measurement. In addition, because the distance of the measuring device from the paper on the roll surface is small, the disturbing
20 effect of background light can be eliminated and an accurate measurement is obtained. Likewise, the measurement geometry remains unchanged. In addition, since the measuring device moves as the roll size grows, the angle between the measuring device and the paper surface is simple to adjust. The measuring device being arranged to move in line with the central axis of the
25 roll, the measurement angle can be kept constant all the way without turning the measuring device. The invention is particularly well suited for measuring the colour of thin paper grades.

The invention will be described in greater detail in the accompanying drawings in which

30 Figure 1 is a schematic side view of a measurement arrangement according to the invention;

Figure 2 illustrates the measurement arrangement of Figure 1 seen from the rear of a paper machine;

35 Figure 3 is a schematic side view of another measurement arrangement of the invention; and

Figure 4 illustrates the measurement arrangement of Figure 3 seen from the rear of the paper machine.

Figure 1 illustrates a winder 1 winding paper 2 produced by a paper machine on a roll 3. For the sake of clarity, support structures of the roll 3 are not shown in Figure 1. A measuring device 4 is arranged to measure the colour of the paper 2 from the surface of the roll 3. The measuring device 4 is arranged to move vertically on a beam 5, controlled by a motor 6. As the size of the roll 3 grows the measuring device 4 is lifted upwards.

A continuous line illustrates an empty roll 3. A line of dots and dashes, in turn, illustrates the outlines of the roll 3 when the roll is full. A dashed line illustrates the outlines of the roll 3 with some paper wound on the roll. As the amount of paper on the roll 3 increases, the measuring device 4 is arranged to turn in such a way that the angle of the measuring device in relation to the paper on the surface of the roll 3 remains unchanged. Reference numeral 4' illustrates the position of the measuring device when there is some paper on the roll 3 but it is not yet full. For the sake of clarity, the illustration in Figure 1 does not show the support structures of the measuring device. Reference numeral 4'' illustrates the position of the measuring device when the roll 3 is full. The apparatus comprises, arranged to the beam 5, a support beam 8 pivotably arranged in relation to a first joint 7a, the support beam being, in turn, provided with the measuring device 4 pivotably arranged in relation to a joint 7b. The joints 7a and 7b allow the angle of the measuring device 4 in relation to the surface of the roll 3 to be kept substantially constant. For the sake of clarity, control devices for controlling the turning of the support beam 8 and the measuring device 4 are not shown in Figure 1. The measuring device 4 is provided with distance sensors which allow a desired measurement distance to be kept as the paper roll grows. As the roll 3 grows, the measuring device 4 moves according to Figure 1, maintaining a constant distance from the surface of the roll 3. The turning angles of the support beam 8 and the measuring device 4 each correspond to a particular vertical position of the measuring device 4, the angles in question thereby being easy to determine in the system as functions of the measuring device height, which makes a relatively simple control system possible. Paper colour is thus measured when paper 2 is wound with the winder 1. The measurement advantageously takes place during the paper making process, although it can also be carried out in

connection with other phases, during the winding of the paper 2 after a separate coating phase, for example.

Figure 2 shows the arrangement of Figure 1 seen from the rear of the paper machine. Figure 2 shows an empty roll 3 and the outlines of the roll 3 when it is full, illustrated with a line of dots and dashes. Figure 2 further shows support structures 9 of the winder 1. The apparatus shown in Figures 1 and 2 requires fairly little space, so it is easy to arrange in connection with a paper machine winder.

For instance, in web break situations and when paper is packed on the surface of the paper roll 3, the distance sensors issue a command to move the measuring device 4 away from the roll 3 by impact of a motor 12 to a position shown with a dashed line in Figure 2. Information about a web break can also be brought to the apparatus from the outside. The measuring device 4 can also be guided to the position shown with the dashed line for the duration of roll change and/or standardization and/or calibration. For standardization and calibration a fixed head of the colour meter can be arranged at a point shown with a dashed line in Figure 2. Standardization, for example, can therefore be carried out at the point in question about once an hour when the roll becomes full and the measuring device 4 must therefore be moved to the point in question anyway. By means of the motor 12 the measuring device 4 can also be made to move back and forth along the surface of the roll 3, transversely to the moving direction of the paper 2, i.e. parallel to the axis of the roll 3. The measurement can thus be taken, when desired, at any point of the roll 3 and, in addition, the measurement can be carried out in such a way that as the measuring device 4 moves back and forth, it continuously measures substantially the entire area of the roll 3. The support beam 8 can also extend over the entire width of the paper to be wound. The measuring device 4 then moves back and forth along the support beam 8 and the measurement is performed as a continuous measurement, as described above.

Figure 3 illustrates another measurement arrangement according to the invention. The measuring device 4 and the support beam 8 are in this application arranged to move along a slide beam 10 arranged on beams 5a and 5b. The measuring device 4 is arranged to measure perpendicularly to the surface of the roll 3 and to move in line with the movement of the central axis of the roll when the roll 3 is filled. In this case, as the roll 3 grows bigger, the

angle of the measuring device 4 need not be changed, instead it is sufficient that the measuring device 4 is only moved along the slide beam 10.

Figure 4 shows a solution according to Figure 3, seen from the rear of the paper machine. The support beam 8 is arranged to turn in relation to a joint 11. The support beam 8 and the measuring device 4 can then be turned to a position shown with a dashed line in Figure 4, e.g. in web break situations, for the duration of roll change or for standardization or calibration.

The measuring device 4 can be placed above the roll 3 at a distance of for instance about 0.5 metres from the edge, thereby avoiding measurement of the edge zone, which does not represent full paper quality. The measurement geometry of the measuring device 4 can be for instance $45^\circ/0^\circ$, as is known per se, which means that the angle of incidence of light is 45° and paper colour is measured perpendicularly to the paper surface. The distance of the measuring device from the paper surface can then be less than 10 mm, most preferably less than 5 mm. A typical distance in this case is $3 \text{ mm} \pm 0.1 \text{ mm}$. Other type of geometry is also possible in the measuring device 4, the distance of the measuring device 4 from the paper surface then being possibly even longer. An essential feature is that by means of the measuring device structure and distance the preventing of diffused light has been taken into consideration in the apparatus, diffused light thus having no essential influence on the measurement result.

The drawings and the related description are only meant to illustrate the inventive idea. The details of the invention may vary within the scope of the claims.

CLAIMS

1. A method for measuring paper colour whereby paper (2) colour is measured from the surface of a paper roll (3) on a winder (1) during the winding of the paper (2) the angle between a measuring device (4) and the surface of the paper roll (3) being kept substantially constant, **characterized** in that as the paper roll (3) size grows, the measuring device (4) is moved in such a way that the distance of the measuring device (4) from the paper roll (3) surface remains substantially constant.
2. A method according to claim 1, **characterized** in that as the measuring device (4) moves when the paper roll (3) is filled, the measuring device (4) is turned in relation to at least two joints (7a, 7b) to keep the angle of the measuring device (4) constant in relation to the surface of the paper roll (3).
3. A method according to claim 1, **characterized** in that the measuring device (4) is moved in line with the movement of the central axis of the paper roll (3) as the paper roll (3) is filled.
4. A method according any one of the preceding claims, **characterized** in that during the measurement the distance of the measuring device (4) from the surface of the paper roll (3) is less than 10 mm.
5. A method according any one of the preceding claims, characterized in that during the measurement the measuring device (4) is moved back and forth transversely in relation to the moving direction of the paper (2).
6. An apparatus for measuring paper colour, the apparatus comprising a measuring device (4) which is arranged to measure paper (2) colour from the surface of a paper roll (3) on a winder (1) during the winding of the paper (2) and means for keeping the angle between the measuring device (4) and the surface of the paper (3) constant, **characterized** in that the apparatus comprises means for keeping the distance of the measuring device (4) from the paper roll (3) constant as the size of the paper roll (3) grows.
7. An apparatus according to claim 6, **characterized** in that the apparatus comprises, arranged to a beam, a support beam (8) pivotably arranged in relation to a first joint (7a) and, arranged to the support beam (8), the measuring device (4) pivotably arranged in relation to a second joint (7b), the turning of the measuring device (4) in relation to the joints (7a, 7b) thus

allowing the angle of the measuring device (4) in relation to the surface of the paper roll (3) to be kept constant when the size of the paper roll (3) grows.

5 8. An apparatus according to claim 6, **characterized** in that the measuring device (4) is arranged on a slide beam (10) in such a way that as the size of the paper roll (3) grows the measuring device (4) can be moved in line with the central axis of the paper roll (3) in the same direction with the movement of the central axis.

10 9. An apparatus according to any one of claims 6 to 8, **characterized** in that in a measurement situation the measuring device (4) is arranged at a distance of less than 10 mm from the surface of the paper roll (3).

10. An apparatus according to any one of claims 6 to 9, **characterized** in that the apparatus comprises means for guiding the measuring device (4) away from the paper roll (3), when necessary.

15 11. An apparatus according to any one of claims 6 to 10, **characterized** in that the apparatus comprises means for moving the measuring device (4) back and forth transversely in relation to the moving direction of the paper (2).

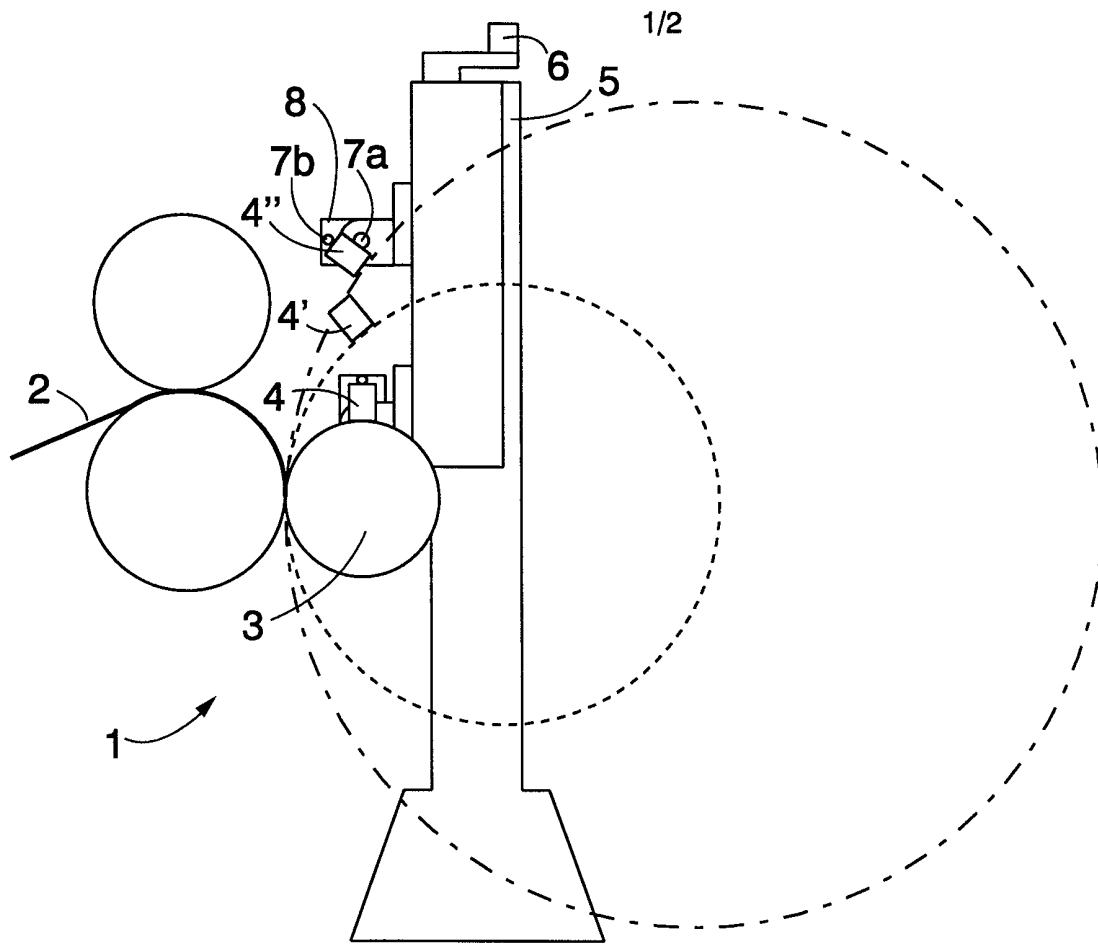


FIG. 1

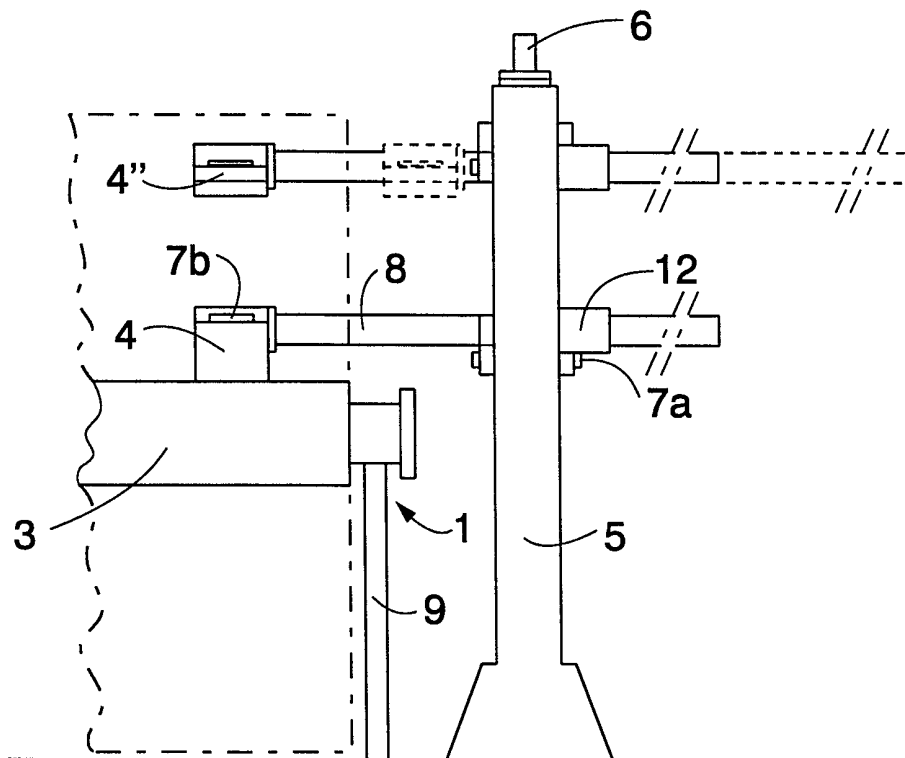


FIG. 2

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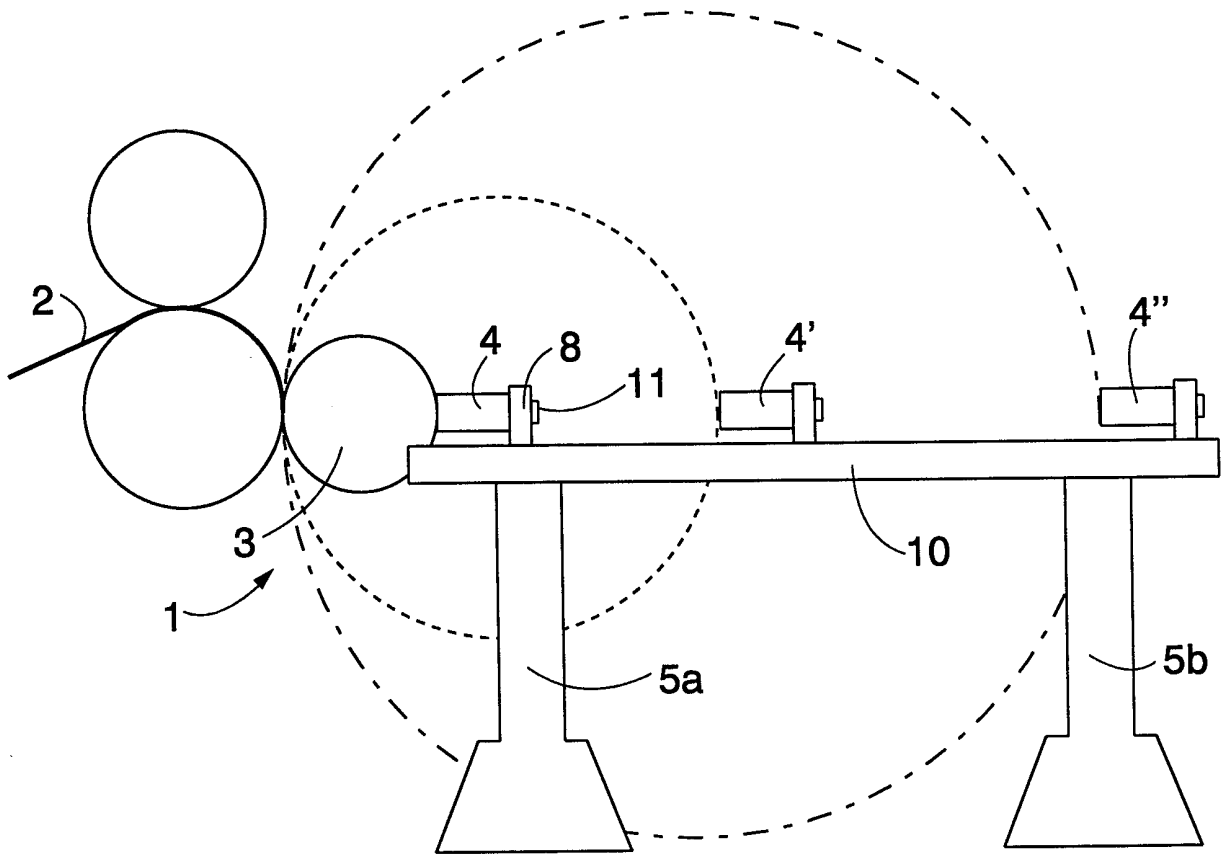


FIG. 3

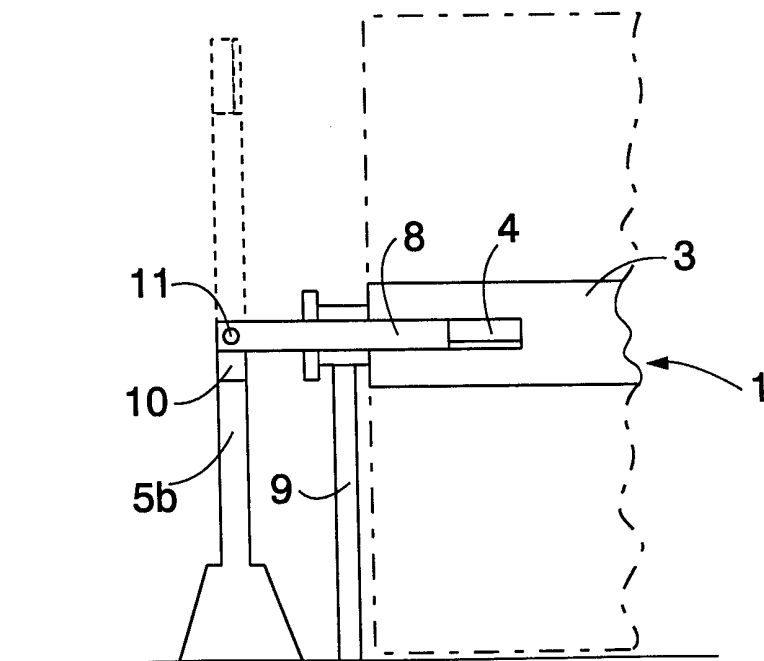


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00770

A. CLASSIFICATION OF SUBJECT MATTER		
IPC6: G01N 21/86, G01N 21/89 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)		
IPC6: G01N		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
SE,DK,FI,NO classes as above		
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.
Y	US 5047652 A (KHAIM LISNYANSKY ET AL), 10 Sept 1991 (10.09.91), figure 2, abstract	1,4-6,9,11
A	--	2,7-8,10
Y	EP 0710569 A1 (ALTECH COMPANY LIMITED), 8 May 1996 (08.05.96), claim 1	1,4-6,9,11
A	US 5082529 A (GARY N.BURK), 21 January 1992 (21.01.92)	1-11
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INTERNATIONAL SEARCH REPORT

Information on patent family members

21/12/98

International application No.

PCT/FI 98/00770

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