**PCT** WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

| (51) International Patent Classification 7 : | | (11) International Publication Number: | WO 00/61861 |
|---|---|---|---|
| D21D 5/02 | A1 | (43) International Publication Date: | 19 October 2000 (19.10.00) |

(21) International Application Number: PCT/SE00/00422

(22) International Filing Date: 3 March 2000 (03.03.00)

(30) Priority Data:
9901280-9 8 April 1999 (08.04.99) SE

(71) Applicant *(for all designated States except US)*: VALMET FIBERTECH AB [SE/SE]; S-851 94 Sundsvall (SE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: FORSLUND, Kjell [SE/SE]; Bruksgårdsvägen 4, S-863 31 Sundsbruk (SE). KRISTRÖM, Klas [SE/SE]; Stänkvägen 13, S-860 30 Sörberge (SE).

(74) Agent: SUNDQVIST, Hans; Valmet Fibertech AB, S-851 94 Sundsvall (SE).

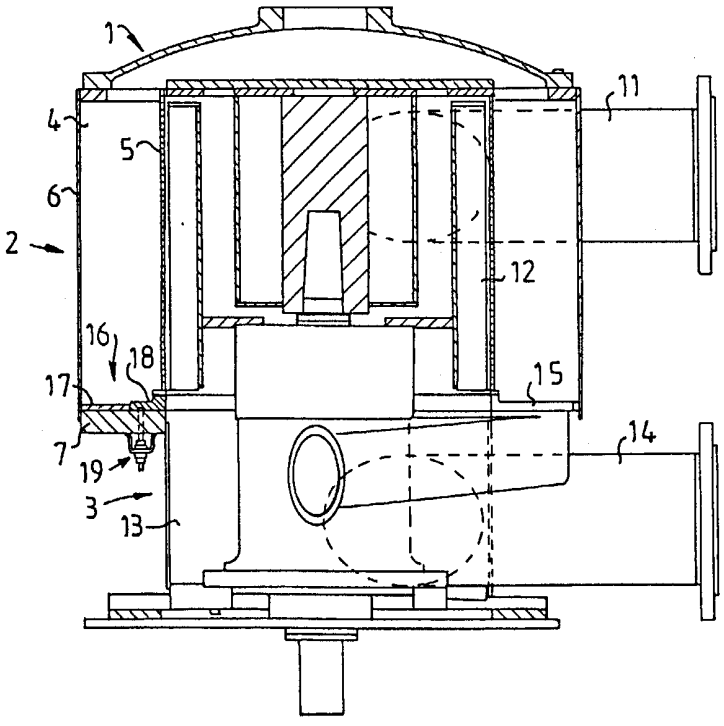
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, 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).

**Published**
*With international search report.*

(54) Title: SCREENING APPARATUS WITH SLOTRING MOVEABLE IN AXIAL DIRECTION

(57) Abstract

Screening apparatus for separating fibrous suspensions, preferably pulp suspensions. The screening apparatus comprises a screen housing (1) with a screen chamber (4), which inward is defined by a rotary tubular screen means (5) with a knob ring (8) located lowermost on the screen means (5), outward is defined by an outer defining surface (6), and downward is defined by a bottom portion (7). Between the knob ring (8) and the slot ring (9) a gap (10) is formed. The screening apparatus further comprises an inlet (11) for fibrous suspension to the screening apparatus, a reject outlet (15) for reject from the screen chamber (4) and an accept outlet (14) for accept from the screening apparatus. For adjusting the gap (10), the slot ring (9) is moveable by means of at least one gap adjustment device (19) in axial direction in relation to the bottom portion (7). Every gap adjustment device (19) is located in the bottom portion (7) and can be operated from the outside of the screening apparatus.



*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AL** | Albania | **ES** | Spain | **LS** | Lesotho | **SI** | Slovenia |
| **AM** | Armenia | **FI** | Finland | **LT** | Lithuania | **SK** | Slovakia |
| **AT** | Austria | **FR** | France | **LU** | Luxembourg | **SN** | Senegal |
| **AU** | Australia | **GA** | Gabon | **LV** | Latvia | **SZ** | Swaziland |
| **AZ** | Azerbaijan | **GB** | United Kingdom | **MC** | Monaco | **TD** | Chad |
| **BA** | Bosnia and Herzegovina | **GE** | Georgia | **MD** | Republic of Moldova | **TG** | Togo |
| **BB** | Barbados | **GH** | Ghana | **MG** | Madagascar | **TJ** | Tajikistan |
| **BE** | Belgium | **GN** | Guinea | **MK** | The former Yugoslav Republic of Macedonia | **TM** | Turkmenistan |
| **BF** | Burkina Faso | **GR** | Greece | | | **TR** | Turkey |
| **BG** | Bulgaria | **HU** | Hungary | **ML** | Mali | **TT** | Trinidad and Tobago |
| **BJ** | Benin | **IE** | Ireland | **MN** | Mongolia | **UA** | Ukraine |
| **BR** | Brazil | **IL** | Israel | **MR** | Mauritania | **UG** | Uganda |
| **BY** | Belarus | **IS** | Iceland | **MW** | Malawi | **US** | United States of America |
| **CA** | Canada | **IT** | Italy | **MX** | Mexico | **UZ** | Uzbekistan |
| **CF** | Central African Republic | **JP** | Japan | **NE** | Niger | **VN** | Viet Nam |
| **CG** | Congo | **KE** | Kenya | **NL** | Netherlands | **YU** | Yugoslavia |
| **CH** | Switzerland | **KG** | Kyrgyzstan | **NO** | Norway | **ZW** | Zimbabwe |
| **CI** | Côte d'Ivoire | **KP** | Democratic People's Republic of Korea | **NZ** | New Zealand | | |
| **CM** | Cameroon | | | **PL** | Poland | | |
| **CN** | China | **KR** | Republic of Korea | **PT** | Portugal | | |
| **CU** | Cuba | **KZ** | Kazakstan | **RO** | Romania | | |
| **CZ** | Czech Republic | **LC** | Saint Lucia | **RU** | Russian Federation | | |
| **DE** | Germany | **LI** | Liechtenstein | **SD** | Sudan | | |
| **DK** | Denmark | **LK** | Sri Lanka | **SE** | Sweden | | |
| **EE** | Estonia | **LR** | Liberia | **SG** | Singapore | | |

# SCREENING APPARATUS WITH SLOTRING MOVEABLE IN AXIAL DIRECTION

This invention relates to a screening apparatus for separating fibrous suspensions, preferably pulp suspensions. The screening apparatus comprises a screen housing with a screen chamber, which inward is defined by a rotary tubular screen means, outward is defined by an outer defining surface, and downward is defined by a bottom portion. Lowermost on the screen means a knob ring is located. Between the knob ring and a slot ring a gap is formed. The screening apparatus further comprises an inlet for fibrous suspension to the screening apparatus, a reject outlet for reject from the screen chamber (2) and an accept outlet for accept from the screening apparatus.

A screening apparatus of this kind is used at coarse and fine screening of pulp suspensions, preferably for fractionating or separating impurities and other foreign matter not desired to be included in the final product, such as shives, knots, coarse particles, scrap, stones or incompletely digested or not refined chip pieces.The screening apparatus usually is pressurized.

The pulp suspension to be screened is introduced via an inlet to the screen chamber where the accepted fraction, the accept, flows through the rotating screen means and into an accept chamber. The accept is then guided down into a lower accept chamber and out through the accept outlet.

The lower accept chamber has the same outer diameter as the screen chamber and is located below the same.

The pulp suspension portion, which does not pass through the screen means (the reject) is discharged via the reject outlet, which usually is provided as a tangential outlet in the lower portion of the screen chamber.

Upon rotation of the screen means, a certain pump effect is obtained in the gap between the knob ring and slot ring. This implies that accept passes through the gap and out into the screen chamber and, thus, prevents pulp suspension from the screen chamber to pass

through the gap. In order to increase the pump effect in the gap, the knob ring and slot ring can be given a greater extension in radial direction.

The slot ring constitutes one unit with the bottom portion.

When the screening apparatus is in operation, the knob ring and slot ring are subjected to wear. Thereby the gap increases in size, which results in that greater amounts of accept can pass through the gap, at the same time as the pump effect deteriorates. As a consequence thereof, pulp suspension from the screen chamber can pass through the gap. The gap preferably shall not be wider than the greatest opening in the screen means.

For controlling the gap width, the screening apparatus is stopped, emptied and scavenged. Thereafter the screening apparatus is dismantled for making the gap width accessible to be measured. If the gap width is too great, it can be adjusted either by exchanging the entire screen means or by repairing the knob ring and/or slot ring in such a way that its original thickness is restored.

The measuring of the gap width is very tedious and troublesome. In cases when the gap is found to be too great, high costs will be involved in addition for repairing, alternatively exchanging parts, which requires additional time. Due to the fact that it is so troublesome and expensive to change the gap width, the screen is kept in operation far too long even if the gap width is greater than desirable.

The present invention indicates an apparatus, at which the measuring and adjusting of the gap width can be carried out much faster and considerably simpler than by known art. The gap width thereby can be adjusted as often as it is required for maintaining always a desired gap width.

The slot ring at the invention is movable in axial direction in relation to the bottom portion by means of at least one gap adjustment device. Every gap adjustment device is located in the bottom portion and can be operated from the outside of the screening

apparatus. The gap width thereby can be measured and adjusted without requiring the screening apparatus to be emptied of pulp suspension, cleaned and dismantled.

The bottom portion preferably has its lower side on the outside of the screening apparatus. This implies that the lower accept chamber, which in known art is located below the screen chamber, is given a limited outer diameter, so that the lower accept chamber has a diameter, which preferably at maximum is of equal size as the diameter of the lowermost portion of the screen means.

The slot ring usually has not such a great extension in radial direction. Depending on the design of the screening apparatus, the lower accept chamber can be in the way for the gap adjustment device. The slot ring, therefore, preferably is located on a support means provided in the screen chamber at the bottom portion. The support means is given at least such an extension in radial direction, that the gap adjustment device can be placed easily accessible outside the lower accept chamber.

The slot ring should be located so that pulp suspension substantially cannot pass between the slot ring and bottom portion, that is between the screen chamber and lower accept chamber.

Another advantage obtained when the screening apparatus comprises a support means is the possibility of making at least a part of the support means exchangeable. This exchangeable part can then be utilized as wearing part.

When the reject outlet is an opening in the bottom portion of the screen chamber, and the support means is located entirely or partially over the opening in the bottom portion, a corresponding opening is made in the support means. The reject outlet thereby becomes the congruent portion of the two openings. The support means can be formed as an outer support ring and an inner support ring. By placing the opening for the reject outlet in the outer support ring, and arranging the outer support ring pivotal, the congruent portion of the two openings can be changed by turning the outer support ring, whereby the reject outlet can be controlled.

The characterizing features of the invention are apparent from the attached claims.

The invention is described in greater detail in the following, with reference to the accompanying drawings illustrating examples of embodiments.

Fig. 1 shows a preferred embodiment of a screening apparatus according to the invention,

Fig. 2 shows an embodiment of the gap adjustment device and the gap in Fig. 1,

Figs. 3 and 4 show other embodiments of the invention,

Fig. 5 shows the reject outlet.

The screening apparatus in Fig. 1 comprises a pressurized screen housing 1 with an upper portion 2, the diameter of which is greater than the lower portion 3 of the screen housing 1. In the upper portion 2 of the screen housing a screen chamber 4 is located which inward is defined by a rotation symmetric rotary tubular screen means 5, outward is defined by an outer defining surface 6, and downward is defined by a bottom portion 7, which has its lower side on the outside of the screening apparatus.

Between a knob ring 8 located on the lowermost portion of the screen means 5 and a slot ring 9 a gap 10 is formed.

The fibrous suspension to be separated, which in this case is a pulp suspension, is introduced via an inlet 11 in the upper portion 2 of the screen housing 1 to the screen chamber 4. The accepted fraction (the accept) of the pulp suspension flows through the rotating screen means 5 and into an accept chamber 12. The accept flows thereafter down to a lower accept chamber 13 and out through the accept outlet 14.

The pulp suspension portion in the screen chamber 4 which does not pass through the screen means 5, flows out through a reject outlet 15 in the bottom portion 7.

Upon rotation of the screen means 5 a pulp effect in the gap 10 is obtained. By increasing the width of the gap 10 in radial direction, this pump effect is increased.

Owing to the pump effect, accept flows from the accept chamber 12 through the gap 10 and out into the screen chamber 4. The pulp suspension in the screen chamber 4 is thereby prevented from flowing into the accept chamber 12.

The slot ring 9 is located tightly fitting on a support means 16, which is provided in the screen chamber 4 at the bottom portion 7. The support means 16 extends over the entire bottom portion 7 and is divided into an outer and an inner support ring 17, 18 where the slot ring 9 is formed as one unit with the inner support ring 18. The outer support ring 17 is detachably fastened on the bottom portion 7. The inner support ring 18 with the slot ring 9 is by means of at least one gap adjustment device 19 movable in axial direction. Every gap adjustment device 19 is located at the bottom portion 7 and operable from the outside of the screening apparatus. The gap width, thus, can be changed from the outside of the screening apparatus.

The gap adjustment device 19 comprises a screw means 20, which has threads with a definite pitch. The screw means 20 extends through a hole in the bottom portion 7 and is fastened in the inner support ring 17, and extends further through a hole in a yoke 21 attached below the bottom portion 7. On the screw means 20, on the respective side of the hole in the yoke 21, an inner and, respectively, outer nut 22, 23 is located.

When the gap width is to be changed, and thereby the slot ring 9 to be moved in axial direction, the slot ring 9 is moved by the gap adjustment device 19 all the way to the knob ring 8. From this position the slot ring 9, and thereby the inner support ring 18, are moved by the gap adjustment device 19 back from the knob ring 8 until the desired gap width is achieved. For moving the screw means 20, and thereby the slot ring 9, the nuts 22 and 23 are turned. Knowledge of the pitch angle of the threads of the screw means 20

and of the turned angle of the nuts 22 and 23 renders it possible to calculate the width of the gap 10.

The gap adjustment device, of course, can be designed in a different way. The hole through the bottom portion, for example, can be threaded on the inside, and the threads of the screw means thereby work against the threads in the hole of the bottom portion, when the slot ring is to be moved.

The outer support ring 17 is arranged so against the inner support ring 18, that the pulp suspension substantially cannot pass between the outer and inner support ring 17, 18 and, thus, substantially cannot pass between the inner support ring 18 and bottom portion 7. The outer and inner support ring 17, 18 must run overlap so much that they are located against each other even when the slot ring 9 is moved up against the knob ring 8.

When the gap adjustment device is of the kind appearing from the embodiment shown, preferably four gap adjustment devices 19 are arranged symmetrically on the bottom portion 7.

When the support means 16 is formed as one unit, i.e. when the outer and inner support ring 17, 18 are formed as one unit, the support means 16 should extend all the way out to the outer defining surface 6 of the screen chamber, in order to prevent pulp suspension from penetrating in between the support means 16 and bottom portion 7 when the gap width is being adjusted. In this case the gap adjustment device 19 must be arranged so as to ensure that the support means 16 is not tilted when the gap width shall be changed. This can be effected by also arranging the gap adjustment devices 19, which work against the outer support ring 17.

In Fig. 3 another embodiment of the invention is shown. The outer support ring 17 here is one unit with the bottom portion 7, and the extension of the inner support ring 18 in axial direction coincides with the extension of the slot ring 9 in radial direction.

Fig. 4 shows still another embodiment of the invention. The inner support ring 18 is curved and partially guided in a groove between the bottom portion 7 and outer support ring 17.

When the reject outlet 15 is an opening of a definite size in the bottom portion 7 of the screen chamber 4, a corresponding opening of a definite size is provided in the support means 16. The reject outlet 15 thereby becomes the congruent portion of the two openings. By placing the reject outlet 15 in the outer support ring 17 and enabling the outer support ring 17 to rotate, the size of the congruent portion of the two openings can be changed by turning the support ring 17. In Fig. 5 the reject outlet 15 is shown when the outer support ring 17 is turned so that the two openings are not congruent entirely.

In the lower portion of the screen chamber 4 coarse impurities are collected. The impurities follow along in the rotation of the screen means 5, before they are moved out through the reject outlet 15. The bottom portion 7 of the screen chamber 4 and the lower portion of the outer defining surface 6 of the screen chamber are thereby subjected to wear. The support means 16 preferably is arranged so as to extend over the entire bottom portion 7, and the outer support ring 17 is made detachable on the bottom portion 7. The outer support ring 17, thus, can be exchanged when it is worn and thereby serve as an exchangeable wear piece as protection against wear in the screen chamber 4. In order to protect also portions of the outer defining surface 6 of the screen chamber, the support means (16) can be placed so that it extends a distance up over the outer defining surface 6 of the screen chamber.

The gap width can be adjusted without requiring the screening apparatus to be dismantled and emptied of pulp suspension. In this case a certain portion of pulp suspension is found in the gap. By rotating the screen means and at the same time slowly to move the slot ring against the knob ring, the gap is cleaned. If it is desired to adjust the gap width with very high accuracy, the screening apparatus, however, must be emptied and scavenged clean, before adjustment of the gap width is carried out. The scavenging operation is carried out in that, for example, water is fed into the screening apparatus through one of its inlets or outlets.

The fact, that the slot ring shall be located so that fibrous suspension substantially cannot pass between the slot ring and bottom portion, implies in the case when the slot ring tightly fitting abuts the support means, that fibrous suspension substantially shall not be allowed to pass between the support means and bottom portion.

In order to prevent fibrous suspension from passing between the slot ring and bottom portion and, thus, between the screen chamber and lower accept chamber, a sealing means, for example, can be placed in the lower accept chamber.

The screen means 5 can be of any kind of screen means with screen openings of a suitable size for passing through the desired portion of the pulp suspension. The screen means, for example, can have slits with openings between 0.1 mm and 0.5 mm, or holes with hole diameter between 0.1 mm and 12 mm.

A screening apparatus according to the invention, of course, can be used both detached and in combination with other screening apparatuses in a common screen housing.

The inlets and outlets of the screening apparatus, of course, can be located in other places and their number be greater than indicated at the embodiment shown.

The invention, of course, is not restricted to the embodiments shown, but can be varied within the scop of the attached claims with reference to description and Figures.

# Claims

1. Screening apparatus for separating fibrous suspensions, preferably pulp suspensions, comprising a screen housing (1) with a screen chamber (4), which inward is defined by a rotary tubular screen means (5) with a knob ring (8) located lowermost on the screen means (5), outward defined by an outer defining surface (6), and downward defined by a bottom portion (7), a gap (10) between the knob ring (8) and a slot ring (9), where the screening apparatus further comprises an inlet (11) for fibrous suspension to the screening apparatus, a reject outlet (15) for reject from the screen chamber (4) and an accept outlet (14) for accept from the screening apparatus, **characterized in** that the slot ring (9) is movable in axial direction in relation to the bottom portion (7) by means of at least one gap adjustment device (19) and located so that fibrous suspension substantially is prevented from passing between the slot ring (9) and bottom portion (7), that every gap adjustment device (19) is located in the bottom portion (7) and operable from the outside of the screening apparatus.

2. Screening apparatus as defined in claim 1, **characterized in** that the gap adjustment device (19) comprises a rotary screw means (20) with threads of a definite pitch, where the screw means (20) is arranged to move in relation to the bottom portion (7) and together with the slot ring (9).

3. Screening apparatus as defined in claim 1 or 2, **characterized in** that a support means (16) is provided in the screen chamber (4) at the bottom portion (7), on which support means the slot ring (9) is tightly fitting located, and where at least a portion of the support means (16) is movable in axial direction together with the slot ring (9).

4. Screening apparatus as defined in claim 3, **characterized in** that the support means (16) comprises an outer support ring (17) and an inner support ring (18) , where the slot ring (9) is located on the inner support ring (18), and the inner support ring (18) is movable in axial direction together with the slot ring (9).

5. Screening apparatus as defined in any one of the claims 3 or 4, **characterized in** that the support means (16) extends over the entire bottom portion (7).

6. Screening apparatus as defined in claim 5, **characterized in** that the outer support ring (17) is detachable.

7. Screening apparatus as defined in claim 6, **characterized in** that the support means (16) extends at least partially over the outer defining surface (6) of the screen chamber (4).

8. Screening apparatus as defined in any one of the claims 5, 6 or 7, **characterized in** that the reject outlet (15) is provided as the congruent opening of a hole of definite size in the bottom portion (7) and a hole of definite size in the outer support ring (17), where the outer support ring (17) is rotary, so that the opening of the reject outlet (15) is adjustable.

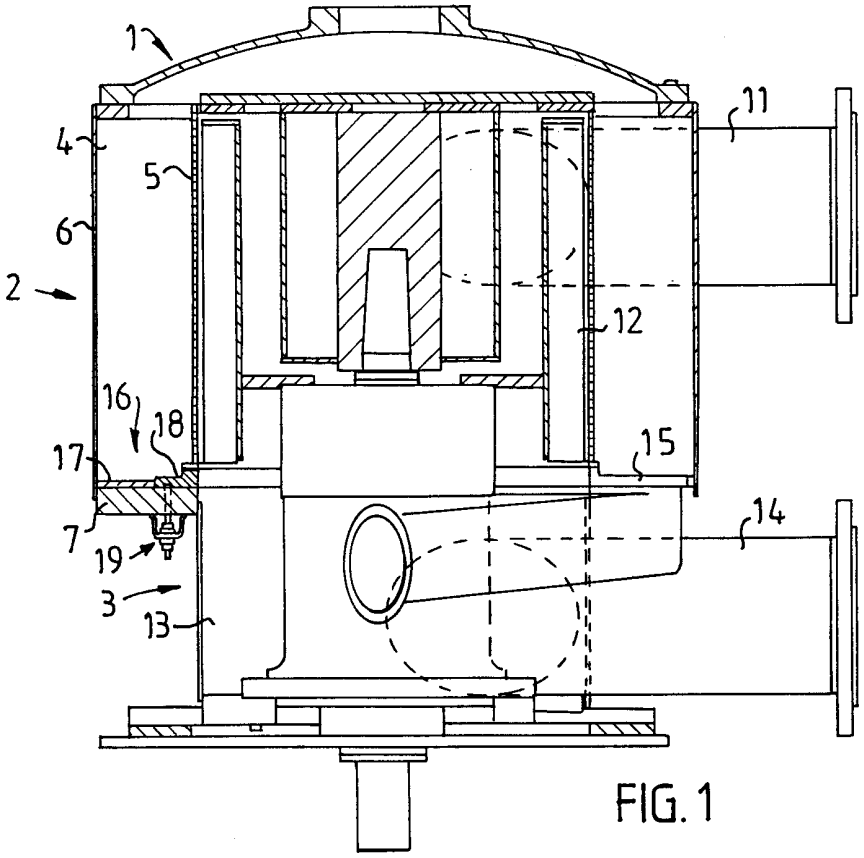



FIG. 1

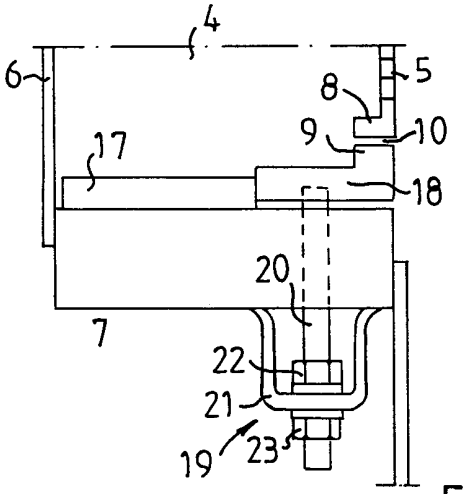



FIG. 2

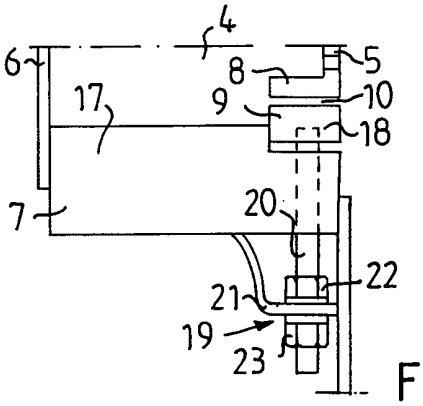



FIG.3

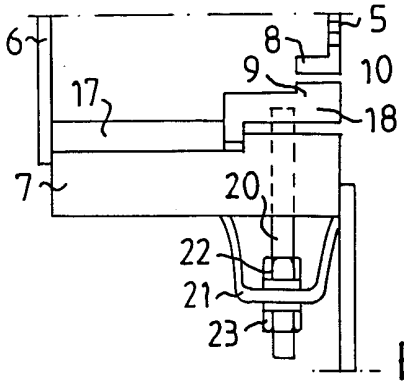



FIG. 4

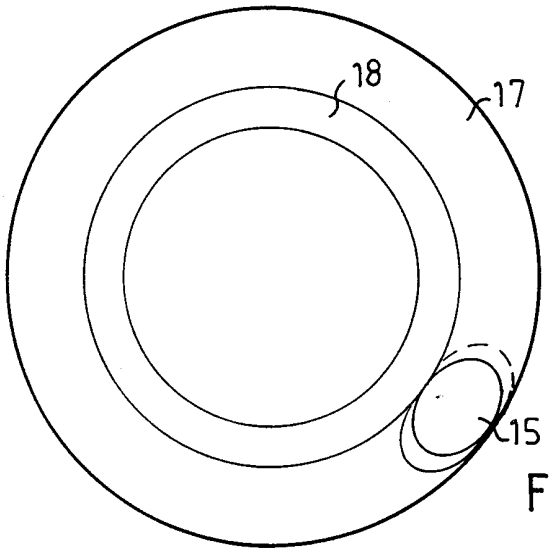



FIG.5

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/00422

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21D 5/02
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)

IPC7: D21D, B07B

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. |
|---|---|---|
| A | US 3953325 A (DOUGLAS G. NELSON), 27 April 1976 (27.04.76), column 2, line 6 - line 11 | 1 |
| A | US 1175293 A (T. QVILLER), 14 March 1916 (14.03.16), page 1, line 79 - line 85 | 1 |
| A | WO 9846822 A1 (SUNDS DEFIBRATOR INDUSTRIES AB), 22 October 1998 (22.10.98) | 1 |

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 7 July 2000 | 13 -07- 2000 |
| Name and mailing address of the ISA/<br>Swedish Patent Office<br>Box 5055, S-102 42 STOCKHOLM<br>Facsimile No. +46 8 666 02 86 | Authorized officer<br>Helena Hemphälä/MP<br>Telephone No. +46 8 782 25 00 |

Form PCT/ISA/210 (second sheet) (July 1992)

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/SE 00/00422

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| US 3953325 A | 27/04/76 | BR 7307446 D | 00/00/00 |
| | | CA 982518 A | 27/01/76 |
| | | GB 1448577 A | 08/09/76 |
| | | JP 49092304 A | 03/09/74 |
| | | SE 406781 B,C | 26/02/79 |
| US 1175293 A | 14/03/16 | NONE | |
| WO 9846822 A1 | 22/10/98 | AU 3874497 A | 19/03/98 |
| | | AU 7091898 A | 11/11/98 |
| | | EP 0922365 A | 16/06/99 |
| | | SE 509289 C | 11/01/99 |
| | | SE 9701369 A | 15/10/98 |