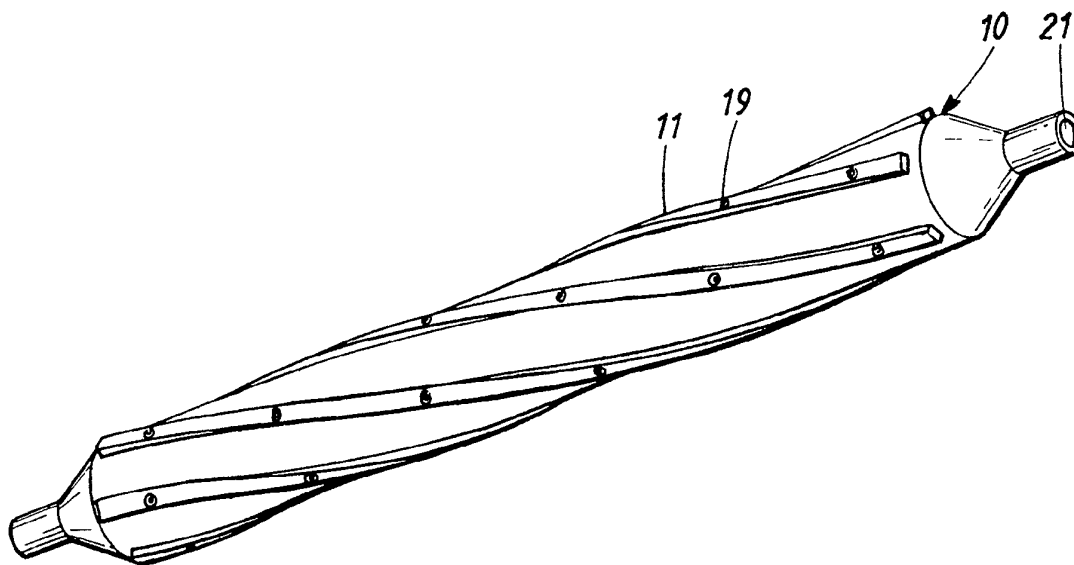


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/SE94/01114</p> <p>(22) International Filing Date: 23 November 1994 (23.11.94)</p> <p>(30) Priority Data: 9303924-6                      26 November 1993 (26.11.93)      SE</p> <p>(71) Applicant (for all designated States except US): MÖLNLYCKE AB [SE/SE]; S-405 03 Göteborg (SE).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only): ANDERSSON, Anders [SE/SE]; Skeppargränd 4A, S-444 31 Stenungsund (SE).</p> <p>(74) Agents: GRAUDUMS, Valdis et al.; Albihn West AB, P.O. Box 142, S-401 22 Göteborg (SE).</p>		<p>(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LT, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ).</p> <p><b>Published</b> <i>With international search report.</i></p>

(54) Title: EXPANDABLE SHAFT AND ITS USE FOR WINDING ELONGATED MATERIAL SUCH AS PAPER STRIPS



## (57) Abstract

Expandable shaft for winding elongated material, especially soft paper and other nonwoven material. The shaft (10) has a number of radial openings (13) or grooves (22, 24) which house longitudinal blades (23), bars (11) or the like in such a way that these are movable by means of activating means (14, 15, 25) in a radial direction between a retracted and a projected position, whereby a variable effective diameter of the shaft is created. The radial openings (13) or grooves (22, 24) are arranged with a spiral formed inclination in the longitudinal direction of the shaft (10) and the retractable and projectable blades (23) or the bars (11) housed therein are arranged with a corresponding spiral form along the shaft.

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EXPANDABLE SHAFT AND ITS USE FOR WINDING ELONGATED  
MATERIAL SUCH AS PAPER STRIPS.

5

TECHNICAL FIELD:

The present invention relates to an expandable shaft for  
winding elongated material, especially soft paper and other  
10 nonwoven material, which shaft has a number of radial  
openings or grooves which house elongated blades, bars or  
the like in such a way that these are movable in a radial  
direction between a retracted and a projected position,  
thereby bringing about a variable effective diameter of the  
15 shaft which also includes activating means within the shaft  
to bring about the radial movement of the blades or the  
bars between the retracted and projected positions.

BACKGROUND OF THE INVENTION:

20 Rolls of toilet-paper, kitchen rolls or rolls of cleaning  
material for large consumer purposes are usually produced  
by rolling the paper on a thin tube-shaped core, usually a  
sleeve of cardboard. This cardboard sleeve usually adds  
extra cost to the production of paper-rolls and, in  
25 addition, it is left over when the paper has been consumed  
and must be discarded.

Paper-rolls without cores where the paper is drawn out from  
the centre of the roll are known earlier from for instance  
30 SE-B-399 694. To avoid collapse of the hole at the centre  
according to this publication it is proposed that the  
innermost paper turns are fixed to each other by means of  
water having optionally an addition of a binder. In this  
manner, a reinforcing core is made from the innermost turns  
35 which, however, are not completely glued to each other and  
can be rolled off together with the rest of the paper strip  
and used as the rest thereof. The winding of the paper

strip occurs on an expandable winding shaft which after the winding, is contracted so that it can easily be removed from the thus formed paper-roll.

5 One example of an expandable winding shaft of said kind is shown in EP-A-0 408 246.

10 From SE-B-455 367 a coreless toilet paper-roll is known from which the paper can be rolled off from the periphery of the roll. The winding shaft has a relatively small diameter, approximately 10-15 mm, and has a polygonal or a cog wheel resembling section form, whereby the centre hole, which is formed when the paper strip is wound on the shaft and this has been removed, will have alternating radially  
15 outwardly directed pressure grooves and inwardly arched parts. The winding shaft is solid, that means not expandable, and its corners or cogs can possibly be helically shaped along the shaft to describe a good vicious circle and to avoid noise during the winding up on a so called  
20 supporting roller machine. Due to its small diameter the shaft can be removed without substantial problems from the paper-roll after the winding has terminated.

THE OBJECTS OF THE INVENTION AND MAIN FEATURES:

25 The object of the present invention is to bring about an expandable winding shaft of the kind mentioned in the preamble which can be used for paper-rolls of any dimension and diameter of the centre hole. The winding shaft should further bring about a certain reinforcing of the centre  
30 hole in the paper roll so that the need for a further reinforcement such as humidifying is reduced or can even be eliminated.

35 This has been attained by arranging the radial openings or grooves as a spiral shaped inclination in the longitudinal direction of the shaft and that the retractable and

projectable blades or bars therein are arranged with a corresponding spiral shape along the shaft.

5 The invention includes further use of the winding shaft for winding elongated material, especially soft paper or other nonwoven material.

DESCRIPTION OF DRAWINGS:

10 The invention will in the following be described in more detail in connection with some embodiment examples shown in the attached drawings.

15 Fig. 1 shows in perspective a winding shaft having spiral formed twisted bars.

Fig. 2a & b are sections of a first embodiment of an expandable shaft in the projected and retracted position respectively.

20 Fig. 3a & b are sections of another embodiment of the invention.

Fig. 4a & b are sections of a third embodiment of the invention.

25 Fig. 5a & b are sections of a fourth embodiment of the invention.

30 Fig. 6a & b are sections of a fifth embodiment of the invention.

DESCRIPTION OF EMBODIMENT EXAMPLES:

35 The winding shaft 10 according to Fig. 1 has a number, preferably at least four, of spiral shaped twisted longitudinal bars 11, which are retractable and projectable in some of the ways which appear from the following figures.

With reference to Fig. 2a and b, the shaft 10 is hollow and has an outer tube 12 provided with a number of bored holes along the periphery. The holes 13 are arranged in rows at a certain distance from each other and with a spiral formed inclination. Within the outer pipe 12 an expandable bulb 14 has been arranged, at the outer side of which longitudinal segments 15 of a rigid material have been arranged. The segments 15 have the same spiral formed inclination as the holes 13, which are arranged in rows in the outer tube 12 and are arranged in front of these. The outer tube 12 and the segments 15 are non-rotatably connected to each other. Within the bulb 14 an inner tube 16 has been arranged, against which the bulb 14 retracts in the retracted position according to Fig. 2b.

15

In the holes 13 in the outer tube 12 pins 17 have been slidably inserted, which pins have a supporting surface 18 which abuts against the segments 15. Against the pins 17 bars 11 have been screwed 19, which extend along the outer tube 12 with the same spiral formed inclination as the hole rows 13. The bars 11 can possibly consist of shorter lengths which are joined in connection with the mounting.

20

The bulb 14 is made to expand by means of compressed air which is fed to the space 20 between the bulb 14 and the inner tube 16 via a support pipe 21. When the bulb 14 expands the bars 11 will, via the segments 15 and the tops 17 cooperating with these, be pushed radially outwards to their projected positions shown in Fig. 2a which is maintained during the winding of the elongated material. After winding is terminated the bulb 14 is emptied of compressed air so that it will retract to the initial position shown in Fig. 2b at which the bars 11 are in their retracted position and the effective diameter of the shaft 10 has been reduced so that the roll of elongated material

30

35

can easily be removed from the shaft 10. The removal occurs through a twisting movement of the shaft 10.

5 The embodiment according to the Fig. 3a and b differs from the above-described in that the outer tube 12 has longitudinally spiral formed twisted slots 22 arranged opposite the segments 15 and have the same inclination as them. The bars 11 are in this case screwed 19 directly against the segments 15. In their retracted position, Fig. 3b, the bars 10 11 are retracted completely in the slots 22, so that the shaft 10 obtains a smooth surface which facilitates the removal of the material roll from the shaft.

15 In the embodiment shown in Fig. 4a and b the bars 11 have been formed in one piece with the segments 15. In other aspects this embodiment will function in a way corresponding to the one described above.

20 The embodiment according to Fig. 5a and b differs from the one shown in Fig. 4a and b in that the bars 11 have been provided with blade-shaped parts 23 which have a curvature corresponding to that of the outer tube 12.

25 In the embodiment according to Fig. 6a and b the shaft 10 comprises a rod which has a number of grooves 24 which extend with spiral form along the rod. In the example shown the grooves have a substantially T-formed section. In the bottom of each groove 24 an expandable bulb 25 has been arranged and connected to a compressed air aggregate (not shown). The bars 11, having an inclination corresponding to 30 that of the groove 24, are further arranged in the groove 24 and fixed to the respective bulb 25. In the expanded position of the bulbs 25, Fig. 2a, the bars 11 will protrude outside the periphery of the shaft 10 whereas in 35 their contracted position (Fig. 2b) they are completely accommodated in the grooves 24. Each bar 11 can possibly

consist of several parts which are joined before or during the mounting.

5 In all embodiments, the twisted shape of the components included in the shaft 10 can for example be obtained by extrusion with a continuous casting tool which has the desired spiral formed twisted shape. A suitable material for the outer tube 12, the segments 15 and the bars 11 is a so-called composite material which gives higher precision and allows simpler production than metal.  
10

The spiral formed twisted expandable shaft 10 can be used for winding elongated material especially soft paper and other nonwoven material both on so-called support roller machines in which the winding shaft is arranged between a pair of supporting rollers which rotate and on centrally driven rolling machines in which the winding shaft itself rotates. In both types of rolling machines the paper will be wound up on the shaft when this is rotated whereupon after winding is terminated, the shaft is removed from the thus formed paper roll. During the winding the shaft is in its expanded position, whereby the spiral formed twisted bars 11 or blades 23 will provide a central hole in the paper roll having radial impressions which extend spiral formed along this centre hole. These impressions reinforce the central hole and prevents it collapsing. The spiral form of the impressions further increases the stiffening effect.  
15  
20  
25

30 To further stiffen the central hole a humidification of the innermost turns of the paper strip can occur in a known way, for example by means of a nozzle. The need for humidification is however reduced and can possibly be completely eliminated due to the stiffening of the central hole that can be obtained through the spiral formed twisted bars or blades.  
35



The invention is naturally not limited to the embodiment examples shown but can be varied within the scope of the patent claims. Thus, the expanding of the shaft can for example be carried out in a mechanical way, for example through a cam mechanism.

Claims

5

1. Expandable shaft for winding elongated material, especially soft paper and other nonwoven material, which shaft has a number of radial openings (13) or grooves (22, 24) which house longitudinal blades (23), bars (11) or the like in such a way that these are movable in a radial direction between a retracted and a projected position, thereby bringing about a variable effective diameter of the shaft, said shaft also comprising activating means (14, 15, 25) arranged within the shaft to bring about the radial movement of the blades (23) or the bars (11) between a retracted and a projected position, c h a r a c t e r - i z e d i n that the radial openings (13) or the grooves (22, 24) are arranged with a spiral formed inclination in the longitudinal direction of the shaft (10) and that the retractable and projectable blades (23) or the bars (11) housed therein are arranged with a corresponding spiral form along the shaft.

15

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2. Expandable shaft according to claim 1, c h a r - a c t e r i z e d i n that the shaft (10) comprises an outer tube (12) having said radial openings (13) or grooves (22) and activating means arranged therein having segments (15) arranged opposite said openings (13) or grooves (22) and with a spiral formed inclination corresponding thereto, and which segments cooperate with the blades (23) or bars (11) housed in the openings or grooves.

35

3. Expandable shaft according to claim 2, c h a r - a c t e r i z e d i n that the blades (23) or bars (11) are connected to pins (17) which are received in said

radial openings (13) and which cooperate with the segments (15).

5 4. Expandable shaft according to claim 2, c h a r -  
a c t e r i z e d i n that the outer tube (12) has radial  
grooves (22) and that the bars (11) or the blades (23) are  
housed in the grooves and are connected to said segment  
(15).

10 5. Expandable shaft according to claim 2, c h a r -  
a c t e r i z e d i n that the bars (11) or the blades  
(23) are formed in one piece with the segments (15).

15 6. Expandable shaft according to claim 1, c h a r -  
a c t e r i z e d i n that the shaft (10) has a number of  
longitudinal grooves (24) which are twisted spirally in the  
longitudinal direction of the shaft, that in the bottom of  
said grooves (24) activating means (25) are arranged which  
co-operate with the bars (11) or blades received in the  
20 grooves.

25 7. Use of an expandable shaft according to any or  
several of claims 1-6 for winding an elongated material,  
especially soft paper or other nonwoven material, whereby  
during the winding of the material strip on the shaft (10)  
the shaft is in its expanded position with the spiral  
formed blades (23) or the bars (11) in projected position,  
whereby spiral formed impressions in the central hole of  
the material strip are made which remain after retraction  
30 of the blades or bars and withdrawal of the shaft from the  
thus formed material roll.

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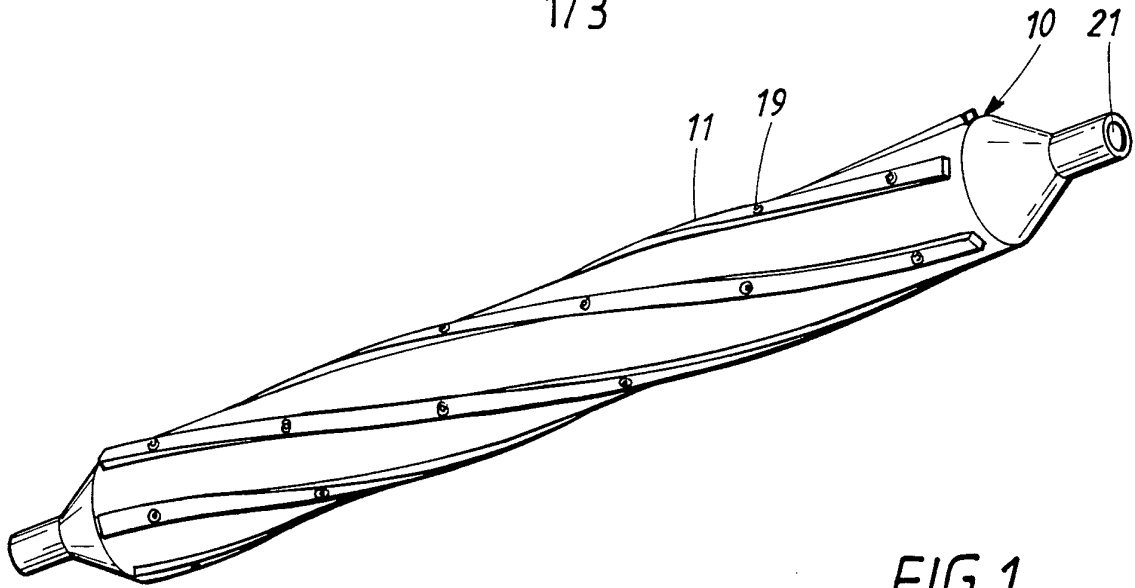


FIG. 1

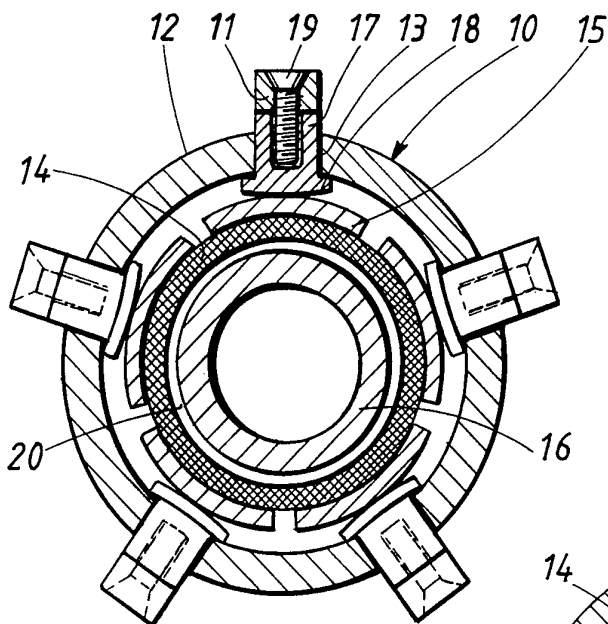


FIG. 2a

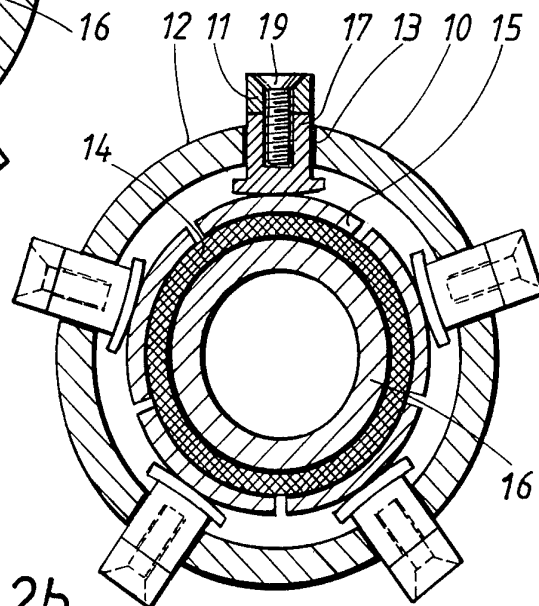


FIG. 2b

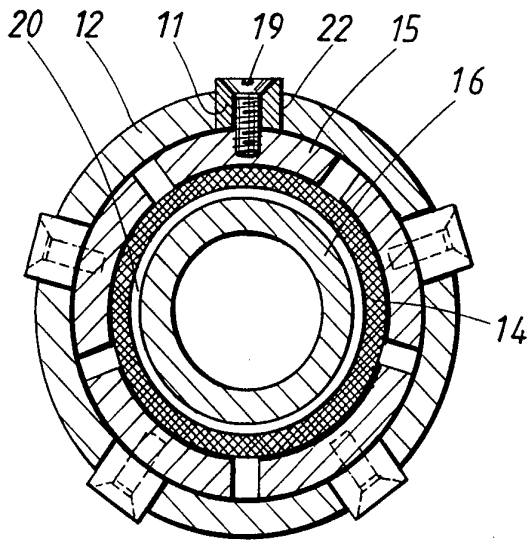


FIG. 3a

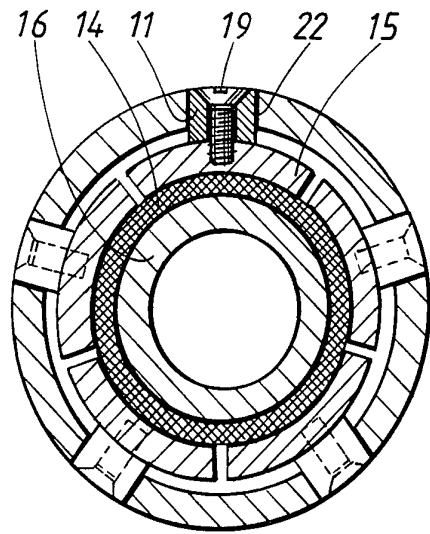


FIG. 3b

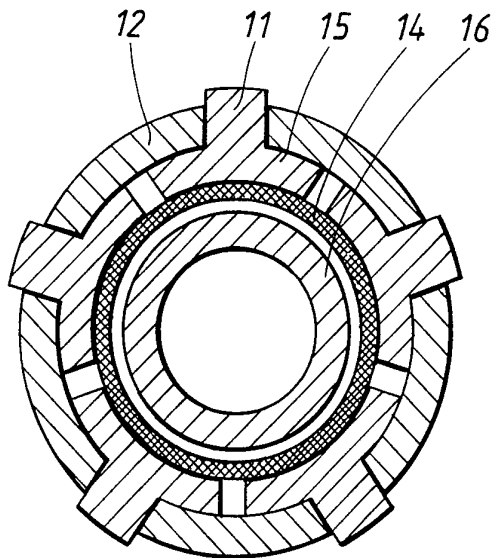


FIG. 4a

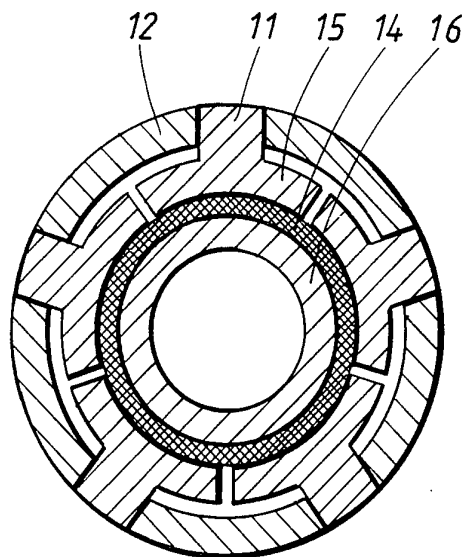


FIG. 4b

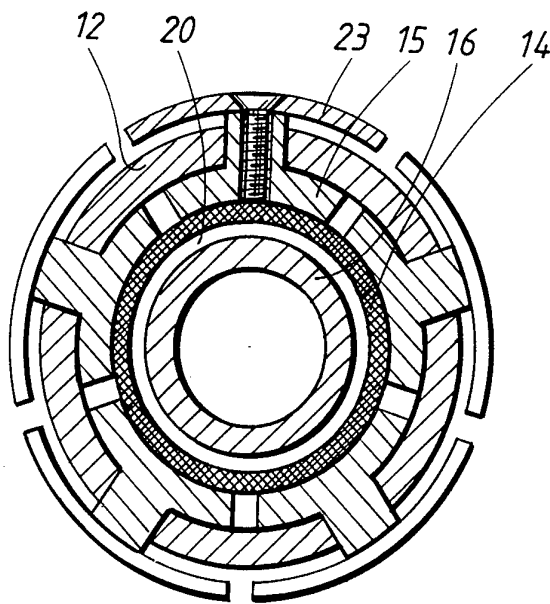


FIG. 5a

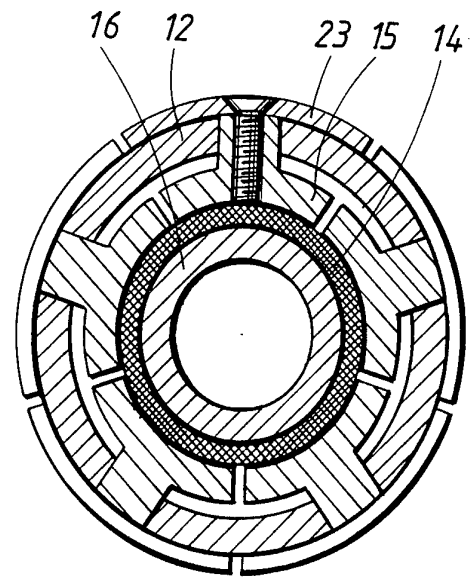


FIG. 5b

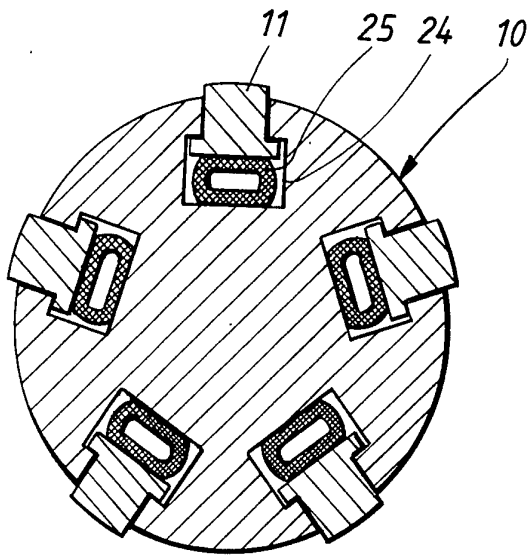


FIG. 6a

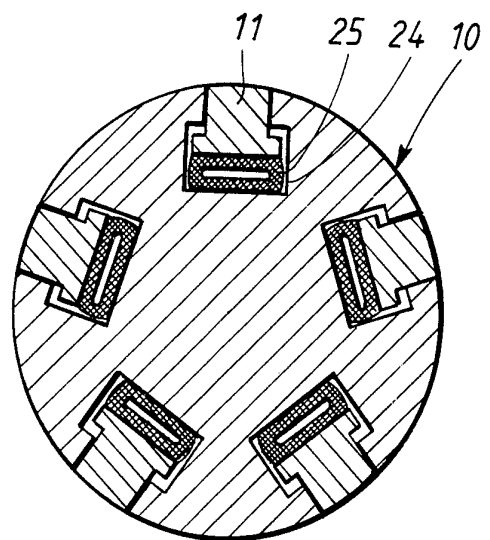


FIG. 6b

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 94/01114

A. CLASSIFICATION OF SUBJECT MATTER		
IPC6: B65H 75/24 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
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IPC6: B65H		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
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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.
P	SE, A, 9203009 (LARS AXEN), 14 April 1994 (14.04.94), claim 7 --	1-7
A	SE, B, 399694 (MÖLNLYCKE AB), 27 February 1978 (27.02.78), the whole document --	1-7
A	SE, B, 455367 (MASASHI KOBAYASHI), 11 July 1988 (11.07.88), figure 14B --	1-7
A	NO, B, 124827 (OTTAR HOVEN), 12 June 1972 (12.06.72), the whole document --	1-7
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CH, A, 457073 (POLYTYPE AG), 31 July 1968 (31.07.68), the whole document  --	1-7
A	EP, A2, 0408246 (DEUBLIN COMPANY), 16 January 1991 (16.01.91), abstract  --	1-7
A	US, A, 2991954 (M.F. LACEY), 11 July 1961 (11.07.61), figure 1  --	1-7
A	US, A, 4436252 (W. BÜRKLE ET AL), 13 March 1984 (13.03.84), figure 1, abstract  -- -----	1-7



INTERNATIONAL SEARCH REPORT  
Information on patent family members

09/02/95

International application No.

PCT/SE 94/01114

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE-A- 9203009	14/04/94	NONE	
SE-B- 399694	27/02/78	BE-A- 854783 CA-A- 1084473 DE-A,C- 2722622 FR-A,B- 2351901 GB-A- 1554619 JP-C- 1276108 JP-A- 52151450 JP-B- 59052062 NL-A- 7705389 SE-A- 7605683	18/11/77 26/08/80 08/12/77 16/12/77 24/10/79 16/08/85 15/12/77 18/12/84 22/11/77 20/11/77
SE-B- 455367	11/07/88	AU-B- 565446 AU-A- 2131883 CA-A- 1223567 CH-A,B- 660293 DE-A,C- 3241920 DK-A- 8304977 FR-A,B- 2554799 GB-A,B- 2120206 JP-C- 1423610 JP-A- 58200719 JP-B- 62034664 NL-B- 191117 NL-A- 8204499 SE-A- 8306035 SU-A- 1369670 US-A- 4487378	17/09/87 23/05/85 30/06/87 15/04/87 24/11/83 10/05/83 17/05/85 30/11/83 15/02/88 22/11/83 28/07/87 01/09/94 16/12/83 03/05/85 23/01/88 11/12/84
NO-B- 124827	12/06/72	NONE	
CH-A- 457073	31/07/68	NONE	
EP-A2- 0408246	16/01/91	CA-A- 2016907 JP-A- 3219113	10/01/91 26/09/91
US-A- 2991954	11/07/61	NONE	
US-A- 4436252	13/03/84	DE-A,C- 3134146 EP-A- 0073311	17/03/83 09/03/83