



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.10.2008 Bulletin 2008/40

(51) Int Cl.:
B66D 1/36 (2006.01) B66D 1/50 (2006.01)

(21) Application number: **08152369.8**

(22) Date of filing: **06.03.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
 Designated Extension States:
AL BA MK RS

(71) Applicant: **Kalmar Industries OY AB**
33101 Tampere (FI)

(72) Inventor: **Rahja, Mikko**
FI-33480, Ylöjärvi (FI)

(74) Representative: **Salonen, Esko Tapani**
Forssén & Salomaa Oy
Lautatarhankatu 8 B
00580 Helsinki (FI)

(30) Priority: **29.03.2007 FI 20075203**

(54) **Equipment for preventing formation of a slack rope on a rope drum**

(57) The invention concerns equipment for preventing formation of a slack rope on a rope drum (1). On its outer periphery the rope drum (1) has one or more spiral rope grooves (2), which extend around the rope drum (1) and which extends/extend mainly over the entire axial length of the rope drum (1). In connection with the rope drum (1) is arranged a pressing roller (4), which is loaded flexibly against the rope drum (1) and which has an axis of rotation essentially in parallel with the rope drum's (1) axis of rotation and which presses the rope (3) to be rolled against the rope drum (1) to keep the rope (3) in the rope groove (2). According to the invention, a guide ring (6) or other such device is placed in a rope groove (2) next to the rope (3) rolling up on the rope drum (1) to roll against the rope drum (1), so that the rolling point of said guide ring (6) or other such device on the rope drum (1) is in a groove next to the rope (3) rolling up on the rope drum (1) essentially in a plane extending through the axes of rotation of the pressing roller (4) and the rope drum (1). The rope (3) rolling up on the rope drum (1) is hereby guided and supported on one side by the rope layer already rolled up on the rope drum (1) and on the opposite side by said guide ring (6) or other such device.

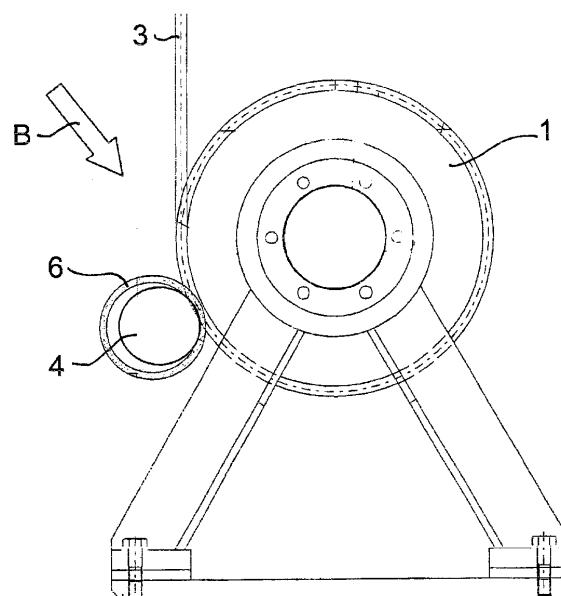


FIG. 1A

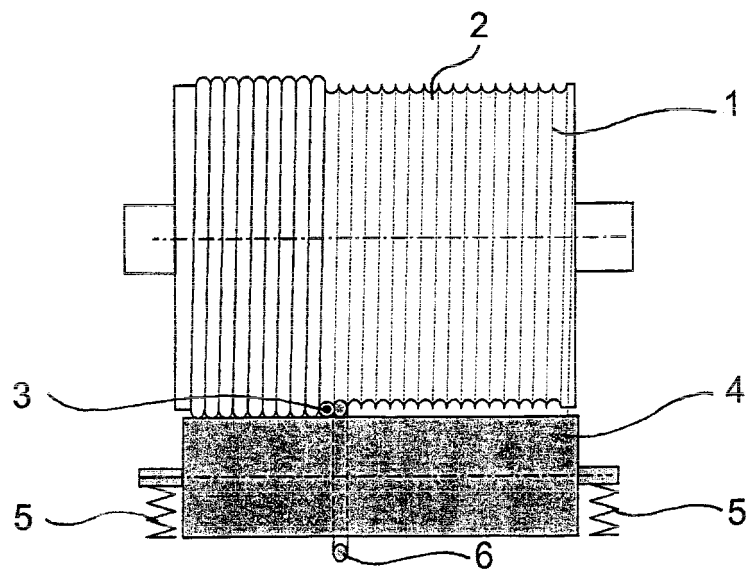


FIG. 1B

Description

[0001] The present invention concerns equipment for preventing formation of a slack rope on a rope drum, which on its outer periphery has one or more spiral rope grooves extending around the rope drum, which rope groove/grooves extends/extend mainly over the entire axial length of the rope drum, and in connection with the rope drum a pressing roller is arranged, which is loaded flexibly against the rope drum and has an axis of rotation essentially in parallel with the rope drum's axis of rotation, and which pressing roller presses the rope to be rolled against the rope drum in order to keep the rope in the rope groove.

[0002] The invention is thus related to winches and rope drums, in which the rope is rolled up into the rope groove in the drum. Such applications are typically rope drums of various hoisting equipment intended for different purposes. As regards hoisting equipment, the intention is to design it in such a way that the angular deviation between the rope and the groove in the rope drum is kept under 4 degrees. The rope is hereby guided properly into the rope groove, whereby it will not wear too much.

[0003] Special situations will occur when the load to be hoisted or the rope's own weight ("rasko") will no longer keep tight the rope being rolled off the drum or being rolled up on the drum. A so-called slack rope results. Depending on the layout of the hoisting equipment this has a different ability to deal with a slackening rope. Such a situation is especially difficult, where the rope leaving the drum begins rising upwards. The slackening rope will hereby heap up against the drum. A phenomenon well known with fishing rod reels will occur; the rope or, for example, the fishing line will behave like a spring coming loose.

[0004] Efforts have been made to cope with the problem with various restricting or guiding bars, which prevent the rope from rising out of the groove. However, the result is often a jam as the slackening rope is wedged against the guiding bar.

[0005] Better results have been obtained with various pressing rollers, which press the rope against the drum and bring about friction in between the rope and the drum. Hereby, the rope is not allowed to slacken. Typically, the pressing roller's diameter is shorter than the drum's diameter, it is a flexible and/or spring-suspended and bearing-mounted roller, which rotates around its axis, which is in parallel with the drum axis. With such an arrangement, the rope can be rolled off the drum so that it can not become entangled. However, in a rolling up/off situation the arrangement does not ensure that the rope is guided properly into the groove. Having left the drum, a rope which is starting upwards will not remain upright but will fall over to one side. If you are lucky, the falling direction is another than the next empty groove, and the rope can be guided into the proper groove. But if the direction is this worse side, the rope will fall into the gap between drum and pressing roller, whereby it will escape

from its groove.

[0006] As regards the state of the art, reference is also made to the publications DE 800244 and FR 1128691. These publications present equipment for preventing formation of a slack rope on a rope drum, where a guide ring is placed in a rope groove next to the rope rolling up on the rope drum, whereby the rope rolling up on the rope drum is guided and supported on one side by the rope layer already rolled up on the drum and on the opposite side by the guide ring. However, in the solutions according to these publications no pressing roller is used in connection with the rope drum, and due to the structure it would not even be possible to use it to press the rope against the rope drum. Using a pressing roller would result in an additional safeguard to make sure that the rope will remain in the correct groove, but in these solutions such an additional safeguard is thus lost.

[0007] It is an objective of the present invention to bring about a new kind of equipment for preventing formation of a slack rope on a rope drum, which equipment avoids drawbacks associated with the state of the art and which brings about exact and proper rolling up and rolling off of the rope on the rope drum. To achieve this aim, the invention according to the independent claims is mainly characterized in that in a rope groove next to the rope being rolled up on the rope drum a guide ring, guide link or other such is placed to roll against the rope drum in such a way that the rolling point of said guide ring, guide link or other such device on the rope drum is in the groove next to the rope being rolled up on the rope drum essentially in a plane extending through the axes of rotation of the pressing roller and the rope drum, whereby the rope being rolled up on the rope drum is guided and supported on one side by the rope layer already rolled up on the rope drum and on the opposite side by said guide ring, guide link or other such device.

[0008] When using a guide ring or other such device, it is mounted around either the pressing roller or the rope drum. The diameter of the guide ring is larger than the diameter of the pressing roller or, correspondingly, of the rope drum inside it, so that in between the guide ring or other such device and the pressing roller or, correspondingly, the rope drum a gap is left on the side opposite to the rolling point on the rope drum.

[0009] The cross section of the guide ring or other such device suitably has a profile similar to the rope groove formed in the rope drum with a typically semi-circular profile. The profile of the guide ring or other such device is most suitably formed in such a way that the peripheral surface coming against the even outer surface of the pressing roller at the guide ring's rolling point on the rope drum is planar and, correspondingly, the rope drum's peripheral surface entering the rope groove is essentially of the same shape as the rope groove's profile.

[0010] The guide ring or other such device may be a rigid ring and made of a metal material, for example, of steel. On the other hand, the guide ring may also be a flexible ring and its material may be, for example, rubber,

plastic or some other such flexible material. Furthermore, the guide ring may be formed by several interconnected parts, which are assembled in the form of a ring. The guide ring may also consist of a profile using more than one rope groove.

[0011] When a guide link is used, it is a link having a figure-of-eight shape, which is mounted around both the pressing roller and the rope drum in such a way that its first link extends around the pressing roller and its second link extends around the rope drum. Each link of the guide link having a figure-of-eight shape has a diameter, which is larger than that of the pressing roller and, correspondingly, of the rope drum inside it, so that a gap will remain between the concerned link and the pressing roller or, correspondingly, the rope drum on the side opposite to the rolling point on the rope drum. The guide link is formed of a rope, a spring or other such of a flexible material that can be bent into a figure-of-eight shape as an endless link.

[0012] In comparison with the state of the art distinct advantages are achieved with the invention, of which the following advantages, among others, can be presented. The solution according to the invention is simple and cheap. With simple steps it can be fitted and mounted afterwards in already existing rope drum solutions. The invention is reliable in operation and it prevents the rope from becoming slack on the rope drum and guides it under mechanical control into the rope groove. There are very few moving parts, only one at the minimum, and there is little need for adjustment, almost no need at all. Other advantages and characteristic features of the invention will emerge hereinafter from the detailed description of the invention.

[0013] In the following, the invention is described in greater detail by referring to advantageous embodiments of the invention shown in the figures of the appended drawing. In the figures of the drawing:

Figure 1A is a schematic view from one side of equipment in accordance with a first advantageous embodiment of the invention.

Figure 1B is a schematic and simplified view of the equipment shown in Figure 1A as seen from the direction B.

Figure 2A is a schematic view side view of equipment in accordance with another advantageous embodiment of the invention.

Figure 2B is a schematic and simplified view of the equipment shown in Figure 2A as seen from the direction B.

Figure 3A is a schematic side view of equipment in accordance with another advantageous embodiment of the invention.

Figure 3B is a schematic and simplified view of the equipment shown in Figure 3A as seen from the direction B.

[0014] In the figures of the drawing, the rope drum is indicated by reference number 1. Rope drum 1 is provided with a spiral rope groove 2 located on its outer periphery and extending mainly over its entire axial length around the drum. Instead of one uniform rope groove 2 the rope drum may also have several separate rope grooves. Rope drum 1 is bearing-mounted to rotate in a supporting body and it is provided with a suitable drive, with the aid of which the rope 3 is rolled up on the rope drum 1 into the rope groove 2. Correspondingly, when the rope drum 1 is rotated in the opposite direction the rope 3 will be released from the rope drum 1. Against the rope drum 1 a pressing roller 4 is arranged, which presses the rope 3 against rope drum 1 causing friction between the rope 3 and the rope drum 1 with the intention to prevent the rope 3 from slackening and to keep the rope 3 in the rope groove 2. As shown in the figures, the pressing roller 4 has a diameter smaller than the rope drum 1 and it is a roller that is bearing-mounted to rotate and its axis of rotation is essentially in parallel with the axis of rotation of the rope drum 1. The pressing roller 4 is mounted flexibly, for example, with the aid of the springs 5 shown in the figures, which springs 5 press the pressing roller 4 against rope drum 1 allowing rolling off of the rope 3 from the rope drum 1, without any possibility for the rope 3 to become entangled even in the very difficult situation shown in the figures, where rope 3 is leaving and begins rising upwards from the rope drum 1.

[0015] However, in a rolling situation the described utilization of a pressing roller 4 does not solve proper guiding of rope 3 into the rope groove 2. A rope 3 which is leaving upwards will not remain upright after leaving the rope drum 1, but it will fall over to one side. If you are lucky, the direction in which rope 3 is falling is some other than the next empty rope groove 2, whereby the rope 3 may be guided into the correct rope groove 2. However, if the direction of falling is unfavourable, the rope 3 will fall over into the gap between rope drum 1 and pressing roller 4 and will miss its groove. For this reason, the present invention has developed a solution, which is based on the observation that when the rope 3 falls over on the rolled-up side, the next rope layer together with the pressing roller 4 will guide the rope 3 into its own rope groove 2.

[0016] On the opposite empty side the problem is solved in such a way that in the groove 2 next to the rope 3 a guide ring 6, 7, 8 is placed to function as an endless rope. The guide ring rolls in the adjacent groove 2 and functions like a rope layer on the other side. Thus, the guide ring 6, 7, 8 guides the rope 3 into its own groove. The pressing roller 4 presses this guide ring against rope drum 1 and the point of contact is always on the same line. The guide ring is rolling in a rising groove remaining at all times in the groove next to the rope 3, which is

rolling up/off.

[0017] The idea according to the invention can be implemented in several alternative ways, of which a first way is presented in Figures 1A and 1B. In the embodiment shown in these figures, the guide ring 6 has a diameter which is somewhat longer than the pressing roller 4, and it is mounted to rotate around the pressing roller's 4 axis of rotation. Guide ring 6 is fitted in a groove next to the rope 3 rolling up on the rope drum 1. The guide ring 6 remains in this groove 2 all the time beside the rope 3, which is rolling up, and the pressing roller 4 is pressing it against the rope drum 1. The rope groove 2 formed in rope drum 1 typically has a semi-circular profile, whereby the guide ring's 6 cross-section can preferably be circular or, in the embodiment of figures 1A and 1B, it may be formed planar at its inner periphery and round at its outer periphery. The guide ring's 6 planar inner periphery will hereby come against the pressing roller's 4 even outer surface and the outer periphery with its round surface will travel in the rope drum's rope groove 2. The guide ring 6 may of course also have some other such cross-section, which is suitable for rolling in the rope groove's 2 typically semi-circular profile.

[0018] Figures 2A and 2B show another embodiment of the solution according to the invention. In this embodiment, the guide ring 7 has a diameter, which is somewhat longer than the rope drum's 1 diameter, and it is mounted on top of the rope drum 1 to rotate around the rope drum's 1 axis of rotation. The diameter of the guide ring 7 must be so much longer than the rope drum's 1 diameter that a gap is left between the guide ring 7 and the ridges of the rope drum's 1 rope grooves 2 located on the side opposite to the pressing roller 4, which gap allows the guide ring 7 to place itself freely on top of the rope drum 1 while the rope drum 1 is rotating. Guide ring 7 is fitted in a rope groove 2 next to the rope 3 rolling up on the rope drum 1. Guide ring 7 remains at all times in this groove 2 beside the rolling-up rope 3 as the pressing roller 4 is pressing it against rope drum 1. In the embodiment of Figures 2A and 2B, guide ring 7 suitably has a circular cross-section or else this is such that it is well adapted for rolling in the rope groove's 2 typically semi-circular profile. Thus, a suitable cross-sectional shape is such that the guide ring's 7 cross-section is semi-circular at its inner surface, that is, at its surface placed against rope groove 2, and planar at its outer surface, that is, at its surface placed against pressing roller 4. In this embodiment, too, the guide ring's 7 cross-section can also be some other, which is suitable for rolling in the rope groove's 2 typically semi-circular profile. Guide ring 7, like the guide ring 6 according to Figures 1A and 1B, may be formed of several interconnected parts, which are put together in the shape of a ring.

[0019] Of the solutions according to the invention Figures 3A and 3B show one more embodiment. In this embodiment, the guide ring is replaced by a flexible and endless guide link 8, which is bended into a figure-of-eight shape, so that it extends in the manner of two guide

rings around rope drum 1 on the one hand and around pressing roller 4 on the other hand, whereby each half of the guide link travels through the gap between pressing roller 4 and rope drum 1. As in the embodiments described earlier, the guide link 8 is also in the solution of Figures 3A and 3B fitted in a groove next to the rope 3 rolling up on rope drum 1. As the link is bent into a figure-of-eight shape, it fills two adjacent grooves in the manner shown in Figure 3B. Guide link 8 remains all the time in these grooves 2 beside the rolling up rope 3 as pressing roller 4 is pressing it against rope drum 1. Thus, guide link 8 functions as a guide for rope 3, as the rope layer rolled up on the rope drum 1 and located on the other side of rope 3. Guide link 8 may be formed, for example, of a rope, a spring or of some other flexible material, which can be bent into a figure-of-eight shape.

[0020] In the embodiment shown in Figures 3A and 3B, the endless guide link 8 uses two rope grooves 2 in the gap between rope drum 1 and pressing roller 4, as is clearly shown in Figure 3B. Also the guide rings 6, 7 according to Figures 1A - 2B may consist of such a profile, which uses more than one rope groove 2. These guide rings may also be formed of several interconnected parts. The guide ring may be formed of a rigid material, such as steel or some other metal material, or of some flexible and/or bending material, for example, of rubber, plastic or other such.

[0021] All embodiments of the invention thus have the common feature that in connection with the rope drum 1 a pressing roller 4 is arranged to roll against the rope drum 1. The axes of rotation of rope drum 1 and pressing roller 4 are typically in parallel. Furthermore, in all embodiments a guide ring 6, 7 or other such device is placed in a groove next to the rolling rope 3, which guide ring can be mounted either around pressing roller 4 or around rope drum 1, or instead there may be a guide link 8, which with a figure-of-eight shape travels around both pressing roller 4 and rope drum 1. The guide ring 6, 7 has a diameter, which is somewhat longer than the pressing roller 4 or rope drum 1 located inside it. Correspondingly, the diameters of the guide link 8 with a figure-of-eight shape are longer than the pressing roller/rope drum located inside them. The rolling point of guide ring 6, 7 or correspondingly of guide link 8 on the rope drum 1 is always in the rope groove or grooves 2 next to the rolling rope 3 in a plane extending through the axes of rotation of pressing roller 4 and rope drum 1. In order to remain in the correct position, guide ring/guide link 6, 7, 8 gets its guidance primarily from the sides of rope groove 2. Alternatively, the guide ring/guide link 6, 7, 8 may also get guidance from the ridges of rope groove 2 instead of the sides of the groove. The guide ring/guide link 6, 7, 8 guides the rope 3 into a rope groove 2 located in between itself and the rolled-up layer of rope.

[0022] The invention was described above by way of example by referring to the figures in the appended drawing. However, the invention is not intended to concern only the examples shown in the figures, but different em-

bodiments of the invention may vary within the scope of the inventive idea defined in the appended claims.

Claims

1. Equipment for preventing formation of a slack rope on a rope drum (1), which on its outer periphery has one or more spiral rope grooves (2), which extend around the rope drum (1) and which extends/extend mainly over the entire axial length of the rope drum (1), and in connection with the rope drum (1) there is arranged a pressing roller (4), which is loaded flexibly against the rope drum (1) and which has an axis of rotation essentially in parallel with the rope drum's (1) axis of rotation, which pressing roller presses the rolling rope (3) against the rope drum (1) to keep the rope (3) in the rope groove (2), **characterized in that** in the rope groove (2) beside the rope (3) rolling up on the rope drum (1) a guide ring, guide link (6, 7, 8) or other such device is placed to roll against the rope drum (1), so that the rolling point of said guide ring, guide link (6, 7, 8) or other such device on the rope drum (1) is in the groove beside the rope (3) rolling up on the rope drum (1) essentially in a plane extending through the axes of rotation of the pressing roller (4) and the rope drum (1), whereby the rope (3) rolling up on the rope drum (1) is guided and supported on one side by the rope layer already rolled up on the rope drum (1) and on the opposite side by said guide ring, guide link (6, 7, 8) or other such device.
2. Equipment according to claim 1 for preventing formation of a slack rope on a rope drum, **characterized in that** the guide ring (6) or other such device is mounted around the pressing roller (4).
3. Equipment according to claim 1 for preventing formation of a slack rope on a rope drum, **characterized in that** the guide ring (7) or other such device is mounted around the rope drum (1).
4. Equipment according to claim 2 or 3 for preventing formation of a slack rope on a rope drum, **characterized in that** the guide ring (6, 7) has a diameter, which is longer than the pressing roller (4) or, correspondingly, the rope drum (1) located inside it, so that a gap is left between the guide ring (6, 7) or other such device and the pressing roller (4) or, correspondingly, the rope drum (1) on the side opposite to the rolling point located on the rope drum (1).
5. Equipment according to some preceding claim for preventing formation of a slack rope on a rope drum, **characterized in that** the cross-section of the guide ring, guide link (6, 7, 8) or other such device has a profile corresponding to the rope groove (2) formed

in the rope drum (1) typically with a semi-circular profile.

6. Equipment according to some claim 1 - 4 for preventing formation of a slack rope on a rope drum, **characterized in that** the profile of the guide ring's (6, 7) or other such device's cross-section is formed so that the peripheral surface coming against the even outer surface of the pressing roller (4) at the guide ring's (6, 7) rolling point on the rope drum (1) is planar and, correspondingly, the peripheral surface coming into the rope drum's (1) rope groove (2) has a shape essentially corresponding to the rope groove's (2) profile.
7. Equipment according to some preceding claim for preventing formation of a slack rope on a rope drum, **characterized in that** the guide ring (6, 7) or other such device is a rigid ring.
8. Equipment according to claim 7 for preventing formation of a slack rope on a rope drum, **characterized in that** the guide ring (6, 7) or other such device is made of metal material, especially steel.
9. Equipment according to some claim 1 - 6 for preventing formation of a slack rope on a rope drum, **characterized in that** the guide ring (6, 7) or other such device is a flexible ring.
10. Equipment according to claim 9 for preventing formation of a slack rope on a rope drum, **characterized in that** the guide ring (6, 7) or other such device is of a material which is rubber, plastic or some other such flexible material.
11. Equipment according to some preceding claim for preventing formation of a slack rope on a rope drum, **characterized in that** the guide ring (6, 7) or other such device is formed of several interconnected parts, which are assembled in the shape of a ring.
12. Equipment according to some preceding claim for preventing formation of a slack rope on a rope drum, **characterized in that** the guide ring (6, 7) or other such device consists of a profile, which uses more than one rope groove (2).
13. Equipment according to claim 1 for preventing formation of a slack rope on a rope drum, **characterized in that** the guide link (8) is a link with a figure-of-eight shape, which is mounted around both the pressing roller (4) and the rope drum (1) so that its first link travels around the pressing roller (4) and the second link travels around the rope drum (1).
14. Equipment according to claim 13 for preventing formation of a slack rope on a rope drum, **character-**

ized in that each link of the guide link (8) with a figure-of-eight shape has a diameter, which is longer than the pressing roller (4) and, correspondingly, of the rope drum (1) located inside it, so that a gap is left between the concerned link and the pressing roller (4) or, correspondingly, the rope drum (1) on the side opposite to the rolling point on the rope drum (1).

15. Equipment according to claim 13 or 14 for preventing formation of a slack rope on a rope drum, **characterized in that** the guide link (8) is formed of a rope, a spring or some other such flexible material, which can be bent into a figure-of-eight shape as an endless link.

15

20

25

30

35

40

45

50

55

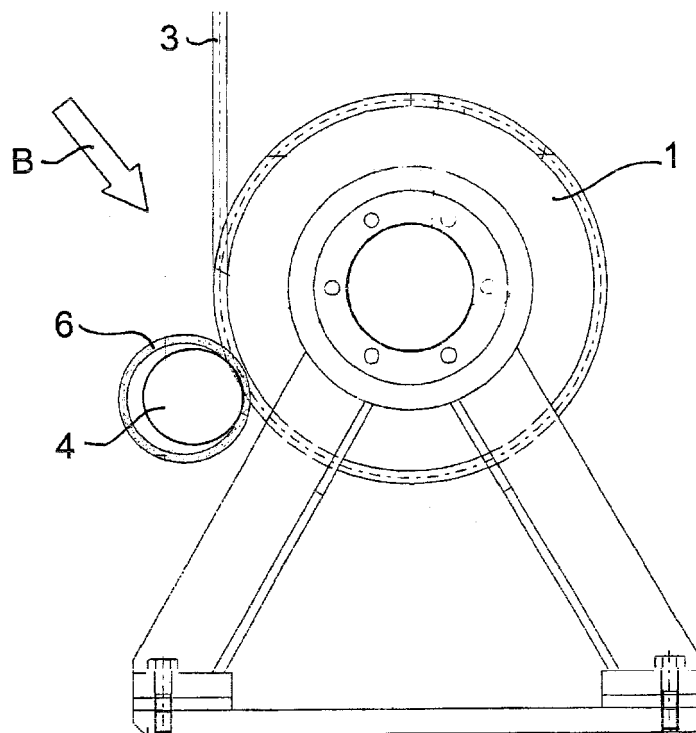


FIG. 1A

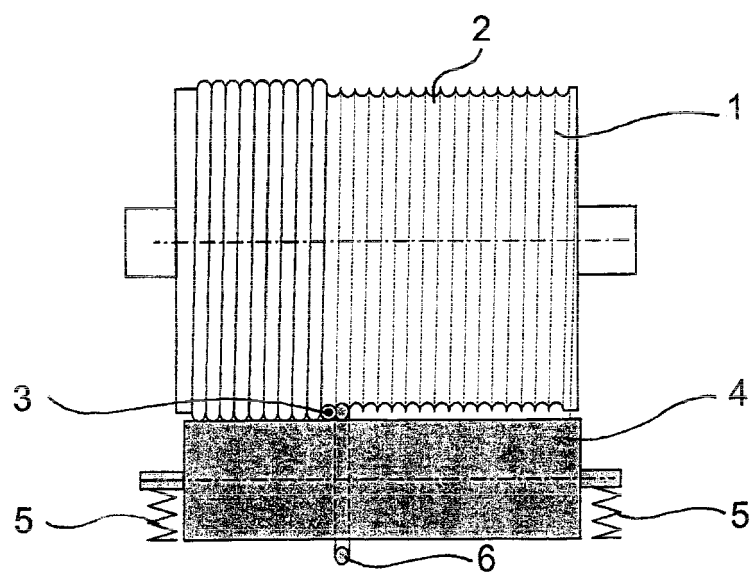


FIG. 1B

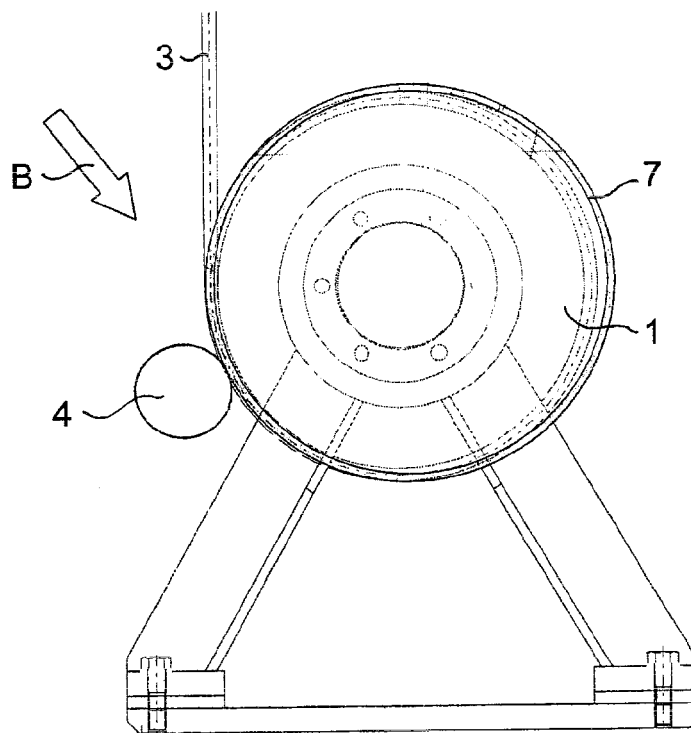


FIG. 2A

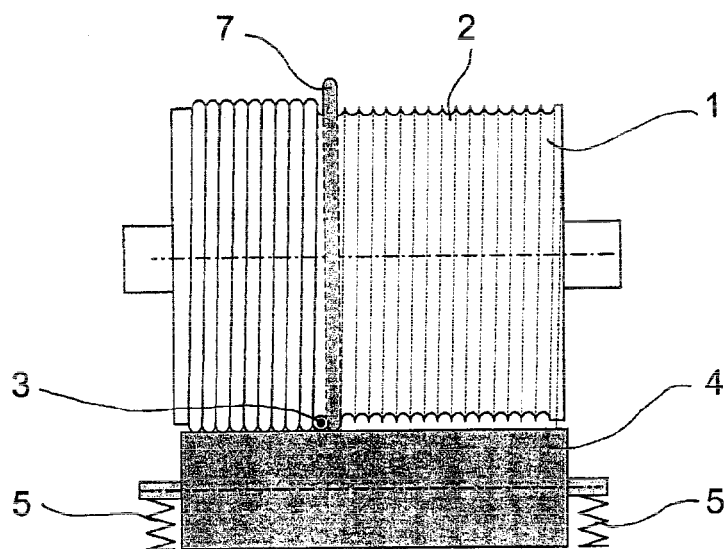


FIG. 2B

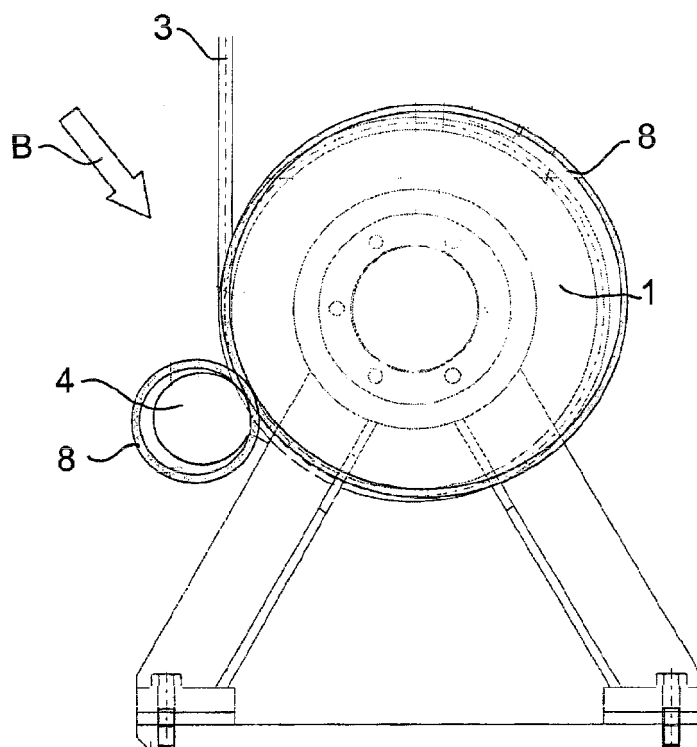


FIG. 3A

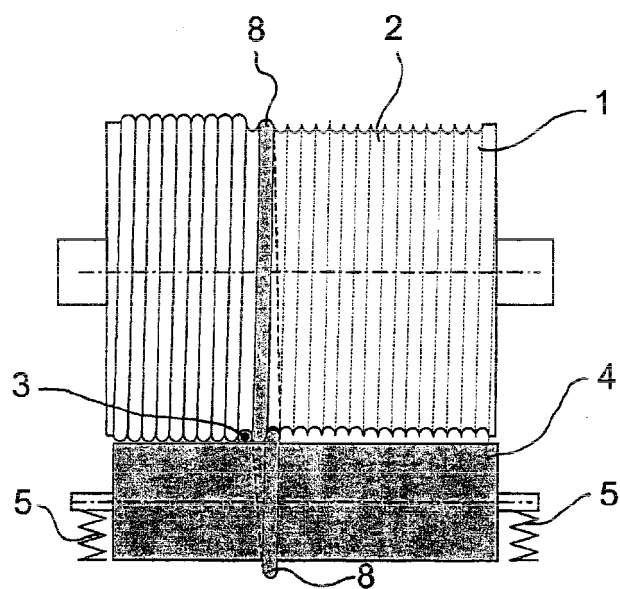


FIG. 3B

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 800244 [0006]
- FR 1128691 [0006]