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(54) Title: METHOD AND APPARATUS FOR LUBRICATING A ROPE LAID FROM WIRES

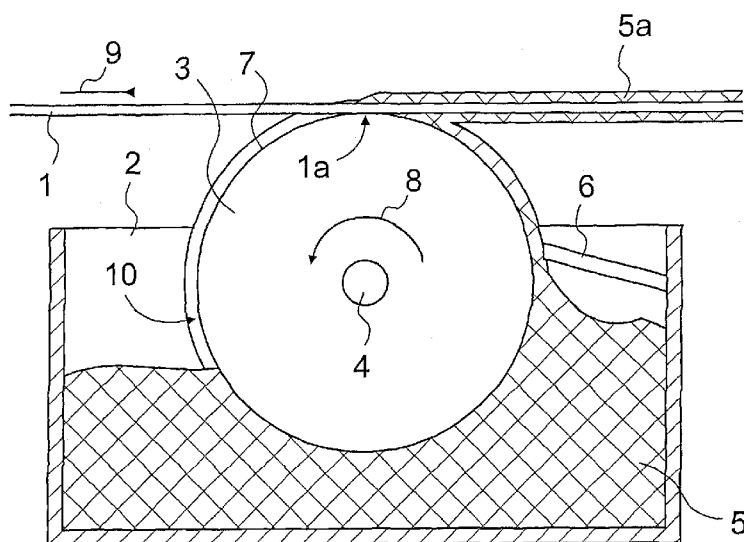


Fig. 1

(57) Abstract: The object of the invention is a method and an apparatus for lubricating a rope laid from wires in the manufacturing phase of the rope. By means of the invention lubricant, e.g. lubricant (5) containing solid substances such as grease, a grease compound or a paste, is spread onto at least one wire (1) of each strand of the rope to be laid. The lubricant (5) is spread onto the wire (1) is dispensed onto the endless surface (10) moving in a different direction with respect to the direction of movement of the wire (1) and is conveyed on the aforementioned endless surface (10) into contact with the wire (1).



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**METHOD AND APPARATUS FOR LUBRICATING A ROPE LAID FROM WIRES**

The object of the invention is a method as defined in the preamble of claim 1 and an apparatus as defined in the  
5 preamble of claim 7 for lubricating a rope laid from wires.

In the following the method and the apparatus of the invention are jointly referred to as the solution according to the invention.

10

Elevator hoisting ropes laid from wires are generally lubricated with some suitable lubricant. Lubrication improves the operation of ropes and reduces the wearing of the ropes, in which case the service life of the ropes  
15 lengthens. Lubrication also prevents ropes from rusting. Ropes are usually lubricated in connection with manufacture, e.g. such that when laying the strands of ropes from steel wires, lubricant is sprayed into the strand to be manufactured. One prior-art lubricant used is paraffin oil.  
20 A problem, however, when lubricating the strands by spraying paraffin oil is that the amount of lubricant adhering to a strand is difficult to control, owing to which the lubrication result can be uneven and/or a strand can contain too much or too little of the lubricant. Another problem  
25 when using paraffin oil is that the rope becomes slippery, due to which it can be difficult to get the friction factor between the traction sheave and the rope to meet the values required by elevator regulations. If the friction factor is too small, the ropes can slip on the traction sheave, which  
30 causes problems and can also be a safety risk. A problem with paraffin oil is also that when the ropes get hot the structure of the oil thins, in which case the oil can easily detach from the rope.

A contributory factor in the invention is the concept that a  
35 better alternative to paraffin or oil mixed with paraffin for lubricating a rope, and more particularly a steel rope, would be a lubricant containing solid substances, such as

grease, a grease compound or a paste, but owing to their structure these are extremely difficult to spread onto the wires forming the strands of the rope. Of course, the invention is also suitable for spreading lubricants that do not contain solid substances. The spreading will not succeed by spraying or brushing, so these substances are not generally used for lubricating one wire of the rope in the manufacturing phase of the rope.

10 The aim of this invention is to eliminate the aforementioned drawbacks and to achieve a simple and inexpensive solution for lubricating a rope in the manufacturing phase of the rope, which solution will enable consistent lubrication of the rope and lengthen the lifetime of the rope, and will  
15 also improve the friction factor between the traction sheave and the rope. The characteristic features of the method according to the invention are presented among the features presented in claim 1. Likewise the characteristic features of the apparatus according to the invention are presented  
20 among the features presented in claim 7. Other embodiments of the invention are characterized by what is disclosed in the other claims.

Some inventive embodiments are also discussed in the  
25 descriptive section of the present application. The inventive content of the application can also be defined differently than in the claims presented below. The inventive content may also consist of several separate inventions, especially if the invention is considered in the  
30 light of expressions or implicit sub-tasks or from the point of view of advantages or categories of advantages achieved. In this case, some of the attributes contained in the claims below may be superfluous from the point of view of separate inventive concepts. Likewise the different details presented  
35 in connection with each embodiment of the invention can also be applied in other embodiments. In addition it can be

stated that at least some of the subordinate claims can at least in some situations be deemed to be inventive in their own right.

5 One advantage of the solution according to the invention is that the amount of lubricant can be accurately controlled, owing to which the lubrication result is consistent and the desired amount of lubricant is placed into the rope. Another advantage is that the service life of the rope is longer  
10 than with ropes lubricated with conventional methods. In addition, one advantage is that the friction factor between the traction sheave and the rope is sufficiently large owing to the amount of lubrication being correct and the lubricant having a friction factor higher than that of paraffin, in  
15 which case the rope does not slip on the traction sheave. A further advantage is that the lubricant stays tightly on the rope and does not detach from it easily, e.g. from the effect of centrifugal force, even if the rope becomes very hot. In this case higher speeds can be used safely. A  
20 further advantage is that the arrangement is simple and inexpensive to implement.

The implementation of the invention is fairly easy to conceive in structures wherein lubricant is surrendered from  
25 the lubricating surface to a wire of a rope moving in the opposite direction to this surface, or perpendicular or almost perpendicular to this surface. The concept of the invention, however, also covers other applications in which the directions of movement of a wire to be lubricated and a  
30 lubricating surface differ from each other. By dispensing lubricant to the lubricating surface and by fitting the speed of the lubricating surface and the wire to be lubricated, the amount of lubricant coming onto the wire and preferably also an even distribution in the direction of the  
35 wire can be set. This setting is not necessarily constant, but instead it must be fitted according to the conditions

and material parameters at the time of manufacturing the rope or the strand, or even according to the situation at each time of operation.

- 5 The invention is suitable for spreading lubricants that cake easily or are very tough, e.g. for spreading greases, grease compounds, pastes or other such lubricants that either contain or do not contain solid substances.
- 10 Ropes, more particularly steel ropes, that are lubricated with a lubricant comprising solid substances, such as grease, a grease compound or a paste or corresponding, are also within the scope of the inventive concept. The lubricating is performed preferably onto a wire or strand of
- 15 the rope before closing the lay structure of the rope. A lubricant of this type of rope is preferably a lubricant of the anti-fretting type or anti-seize type. A lubricant of this type of rope suitably contains one or more of the following solid substances: calcium hydroxide, calcium
- 20 carbonate, calcium hydrogen carbonate, organic calcium compounds, urea, urea compounds, metal soaps, barium compounds, phosphorus compounds, zinc oxide, zinc compounds.

In the following, the invention will be described in detail by the aid of one example of its embodiment with reference to the attached drawings, wherein

5

Fig. 1 presents a simplified and diagrammatic side view of one partially sectioned apparatus according to the invention for lubricating one wire of a rope,

10 Fig. 2 presents a simplified and diagrammatic end view of a partially sectioned apparatus according to Fig. 1 for lubricating one wire of a rope,

Fig. 3 presents a simplified and diagrammatic side view of a second partially sectioned apparatus according to the invention for lubricating one wire of a rope,

15 Fig. 4 presents a simplified and diagrammatic top view of a partially sectioned apparatus according to Fig. 3 for lubricating one wire of a rope, and

Fig. 5 presents a simplified and diagrammatic side view of a third partially sectioned apparatus according to  
20 the invention for lubricating one wire of a rope.

Figs. 1 and 2 present a simplified and diagrammatic view of one partially sectioned apparatus according to the invention for lubricating one wire 1 of one strand of a rope. The  
25 apparatus comprises at least a lubricant reservoir 2, which contains lubricant 5 comprising solid substances such as grease, a grease compound or a paste. A disk-shaped means 3, such as a disk, a wheel or a drum, that is provided with an endless surface 10 and that rotates in its position along  
30 with its axis 4 is disposed in connection with the reservoir 2, the endless surface 10 of the outer rim of which disk-shaped means is arranged to collect and dispense lubricant 5 from the reservoir 2. The axis 4 of the disk-shaped means 3 is connected to a drive motor 11, which is controlled by a  
35 control system 11a such that the speed of rotation of the disk-shaped means 3 with respect to the travel speed of the

wire 1 is such that a lubricant layer 5a of the desired thickness forms on the wire 1 as the wire 1 detaches from its contact point 1a with the disk-shaped means 3. In Fig. 1 the lubricant layer 5a is sectioned for the sake of clarity, such that also the wire 1 is visible. In addition, the disk-shaped means 3 in Fig. 2 is drawn so as to be fully visible, although it would normally be sectioned.

The outer rim of the disk-shaped means 3 comprises a groove 7 in the direction of the plane of rotation of the disk-shaped means 3, which groove extends around the whole rim. The depth and width of the groove 7 are greater than the diameter of the wire 1, so that the wire 1 fits into the groove 7 well and when it travels via the groove 7 the wire 1 empties the groove 7 of lubricant 5, adhering the lubricant to itself as a lubricant layer 5a. The disk-shaped means 3 is disposed in the reservoir 2 such that its bottom part is submerged in the lubricant 5 that is in the reservoir 2. In order for the adherence of the lubricant 5 to the wire 1 to be as good as possible, and so that detachment of the lubricant from the wire 1 does not appear as the wire 1 parts from the disk-shaped means 3, the disk-shaped means 3 is arranged to rotate in the opposite direction to the direction of movement 9 of the wire 1. The arrow 8 in Fig. 1 illustrates the direction of rotation of the disk-shaped means 3. The apparatus also comprises a scraper 6 for collecting and removing excess lubricant 5 from the endless surface 10 of the disk-shaped means 3.

Figs. 3 and 4 present a diagrammatic view of a second partially sectioned apparatus according to the invention for lubricating one wire 1 of a rope. For the sake of clarity, the situation of Fig. 3 is presented to be such that the lubricant 5 has not yet had time to leave along with the disk-shaped means 3, in which case no lubricant layer 5a is yet seen on the wire 1 either. In addition, the disk-shaped



means 3 in Fig. 3 is drawn so as to be fully visible, although it would normally be sectioned. The solution of Figs. 3 and 4 differs from the solution according to Figs. 1 and 2 in that the disk-shaped means 3 does not comprise a groove 7, but instead the rim has a flat endless surface 10, and in that the plane of rotation of the disk-shaped means 3 is essentially perpendicular with respect to the direction of movement of the wire 1. The wire 1 touches the lubricating oil on the rim, i.e. on the endless surface 10, at the contact point 1a. Here, also, the apparatus comprises a scraper 6 for collecting and removing excess lubricant 5 from the endless surface 10 of the disk-shaped means 3.

Fig. 5 presents a simplified and diagrammatic view of a third partially sectioned apparatus according to the invention for lubricating one wire 1 of a rope. Here the figure is viewed in the direction of the rope to be laid and the figure presents the wires 1, 17 of one 7-wire strand of a rope in the position in which they are going into the laying process and are still a distance from each other.

The apparatus according to Fig. 5 comprises at least a lubricant reservoir 2, which contains lubricant 5 comprising solid substances such as grease, a grease compound or a paste. A drive wheel 12 rotating in its position along with its axis 4a, e.g. by means of a drive motor 11, is disposed in the reservoir 2, the bottom part of which drive wheel is submerged in the lubricant 5 that is in the reservoir 2. Above the drive wheel 12 is a diverting pulley 13, which rotates freely on its axis. A flexible conveyor means 14, such as a wire, a band or a belt, which has been tightened to a suitable tension with tensioning wheels 15 and 16, is placed around the drive wheel 12 and the diverting pulley 13, which tensioning wheels are also arranged to guide the passage of the free part of the conveyor means 14 such that wires 1, 17 used in the laying of the rope do not remain

inside the conveyor means 14. This enables replacement of the conveyor means 14 without a need to detach the wires 1, 17 used in the laying of the rope. The drive wheel 12 and the diverting pulley 13 are, in the vertical direction to each other, on different sides of the wires 1, 17 to be laid.

At any given time, a part of the conveyor means 14 rotating around the drive wheel 12 always travels in the lubricant of the lubricant reservoir 2, in which case lubricant 5 adheres to the outer surface, i.e. the endless surface 10, of the conveyor means 14, which lubricant transfers upwards towards the center wire 1 of one strand of the rope to be laid as the conveyor means 14 moves. Thus, the endless surface 10 of the conveyor means 14 is arranged to collect and dispense lubricant 5 from the reservoir 2. The apparatus additionally comprises a scraper 6 for collecting and removing excess lubricant 5 from the endless surface 10.

The center wire 1 is positioned in the vertical plane with respect to the endless surface 10 such that the center wire 1 presses the endless surface 10 essentially in the horizontal direction at the common contact point 1a of both of them. The axis 4a of the drive wheel 12 is connected to a drive motor 11, which is controlled by a control system 11a such that the speed of rotation of the conveyor means 14 with respect to the travel speed of the wire 1 is such that a lubricant layer 5a of the desired thickness forms on the wire 1 as the wire 1 detaches from its contact point 1a.

30

With the method according to the invention the rope to be laid from wires is lubricated in the manufacturing phase of the rope e.g. such that lubricant 5 containing solid substances, such as grease, a grease compound or a paste, is spread onto at least one wire 1 of each strand of the rope to be laid such that the lubricant 5 to be spread onto the

wire 1 is dispensed onto the endless surface 10 moving in a different direction with respect to the direction of movement 9 of the wire 1 and is conveyed on the aforementioned endless surface 10 into contact with the wire 1. In this case the lubricant 5 to be spread onto the wire 1 is dispensed e.g. onto the outer rim of a rotating disk 3 and the lubricant 5 is spread onto the wire 1 by guiding the wire 1 to pass in a groove 7 that is in the rim of the rotating disk 3 and is in the direction of the plane of rotation of the disk 3, and also by rotating the disk 3 in its position around its axis 4 by means of a drive motor 11 in the opposite direction with respect to the direction of movement 9 of the wire 1.

Another method for lubricating the rope to be laid is such that the lubricant 5 to be spread onto the wire 1 is dispensed onto the outer rim of a rotating disk 3 and the lubricant 5 is spread onto the wire 1 by guiding the wire 1 to pass touching the rim of the disk 3 such that the plane of rotation of the disk 3 is essentially perpendicular with respect to the direction of movement 9 of the wire 1.

Correspondingly, one method for lubricating the rope to be laid is further that the lubricant 5 to be spread onto the wire 1 is dispensed onto the endless surface 10 of an unending conveyor means 14, such as a band, a belt or a wire, and the lubricant 5 is spread onto the wire 1 by guiding the wire 1 to pass touching the endless surface 10 of the conveyor means 14 such that the plane of rotation of the conveyor means 14 is essentially perpendicular with respect to the direction of movement 9 of the wire 1.

What all the aforementioned methods, however, have in common is that the lubricant 5 is dispensed onto the moving endless surface 10 by rotating a part of the distance of the endless

surface 10 at a time in a reservoir 2 containing lubricant 5.

It is obvious to the person skilled in the art that 5 different embodiments of the invention are not only limited to the examples described above, but that they may be varied within the scope of the claims presented below. Thus, for example, the dispensing of the lubricant onto an endless surface can be performed in a different manner to what is 10 described above. The dispensing can be performed e.g. by means of one or more nozzles.

It is also possible that instead of the center wire of a strand, some other wire of the strand is lubricated. In 15 addition, more than one wire can be lubricated at the same time, e.g. 2, 3 or all the wires of a strand.

## CLAIMS

1. Method for lubricating a rope to be laid from wires in the manufacturing phase of the rope, in which method  
5 lubricant (5), such as grease, a grease compound or a paste, is spread onto at least one wire (1) of each strand of the rope to be laid, characterized in that the lubricant (5) to be spread onto the wire (1) is dispensed onto an endless surface (10) moving in a different direction with respect to  
10 the direction of movement (9) of the wire (1) and is conveyed on the aforementioned endless surface (10) into contact with the wire (1).

2. Method according to claim 1, characterized in that the  
15 lubricant (5) to be spread onto the wire (1) is dispensed onto the outer rim of a rotating disk (3) and the lubricant (5) is spread onto the wire (1) by guiding the wire (1) to pass in a groove (7) that is in the rim of the disk (3) and is in the direction of the plane of rotation of the disk (3)  
20 and also by rotating the disk (3) in its position around its axis (4) in the opposite direction with respect to the direction of movement (9) of the wire (1).

3. Method according to claim 1, characterized in that the  
25 lubricant (5) to be spread onto the wire (1) is dispensed onto the outer rim of a rotating disk (3) and the lubricant (5) is spread onto the wire (1) by guiding the wire (1) to pass touching the outer rim of the disk (3) such that the plane of rotation of the disk (3) is transverse, preferably  
30 essentially perpendicular, with respect to the direction of movement (9) of the wire (1).

4. Method according to claim 1, characterized in that the lubricant (5) to be spread onto the wire (1) is dispensed  
35 onto the endless surface (10) of an unending conveyor means (14) and the lubricant (5) is spread onto the wire (1) by

guiding the wire (1) to pass touching the endless surface (10) of the unending conveyor means (14) such that the direction of movement of the conveyor means (14) is transverse, preferably essentially perpendicular, with respect to the direction of movement (9) of the wire (1).

5. Method according to any of the preceding claims, **characterized** in that the lubricant (5) is dispensed onto the moving endless surface (10) by rotating a part of the distance of the endless surface (10) at a time in the reservoir (2) containing lubricant (5).

6. Method according to any of claims 1-4 above, **characterized** in that the lubricant (5) is dispensed onto the moving endless surface (10) by means of one or more nozzles.

7. Apparatus for lubricating a rope to be laid from wires in the manufacturing phase of the rope, which apparatus comprises means for spreading a lubricant (5), such as grease, a grease compound or a paste onto at least one wire (1) of each strand of the rope to be laid, **characterized** in that the apparatus comprises at least an endless surface (10) moving in a different direction with respect to the direction of movement (9) of the wire (1) and dispensing means for dispensing lubricant (5) onto the endless surface (10), and in that the wire (1) is arranged into contact (1a) with the lubricant (5) dispensed onto the endless surface (10).

30

8. Apparatus according to claim 7, **characterized** in that the endless surface (10) is the surface of the outer rim of a disk (3) provided with an axis of rotation (4), which surface comprises a groove (7) in the plane of rotation of the disk (3), into which the wire (1) to be lubricated is disposed and which groove (7) is fitted to comprise partly

or wholly the contact point (1a) of the wire (1) and the lubricant (5) dispensed onto the disk (3), and which disk (3) is arranged to rotate in its position around its axis (4) in the opposite direction with respect to the direction  
5 of movement (9) of the wire (1).

9. Apparatus according to claim 7, **characterized** in that the endless surface (10) is the surface of the outer rim of a disk (3) provided with an axis of rotation (4), which disk  
10 is arranged to rotate in its position around its axis (4) in the transverse, preferably essentially perpendicular, direction with respect to the direction of movement of the wire (1).

15 10. Apparatus according to claim 7, **characterized** in that the endless surface (10) is the surface of an unending conveyor means (14) and in that the direction of movement of the conveyor means (14) is transverse, preferably essentially perpendicular, with respect to the direction of  
20 movement of the wire (1).

11. Apparatus according to any of claims 7-10, **characterized** in that the dispensing means for dispensing lubricant (5) onto an endless surface (10) comprises a lubricant reservoir  
25 (2), into the lubricant (5) in which the disk (3) or the unending conveyor means (14) is partly submerged and is arranged to take lubricant (5) along with it.

12. Apparatus according to any of claims 7-10, **characterized**  
30 in that the dispensing means for dispensing lubricant (5) onto an endless surface (10) comprises one or more nozzles.

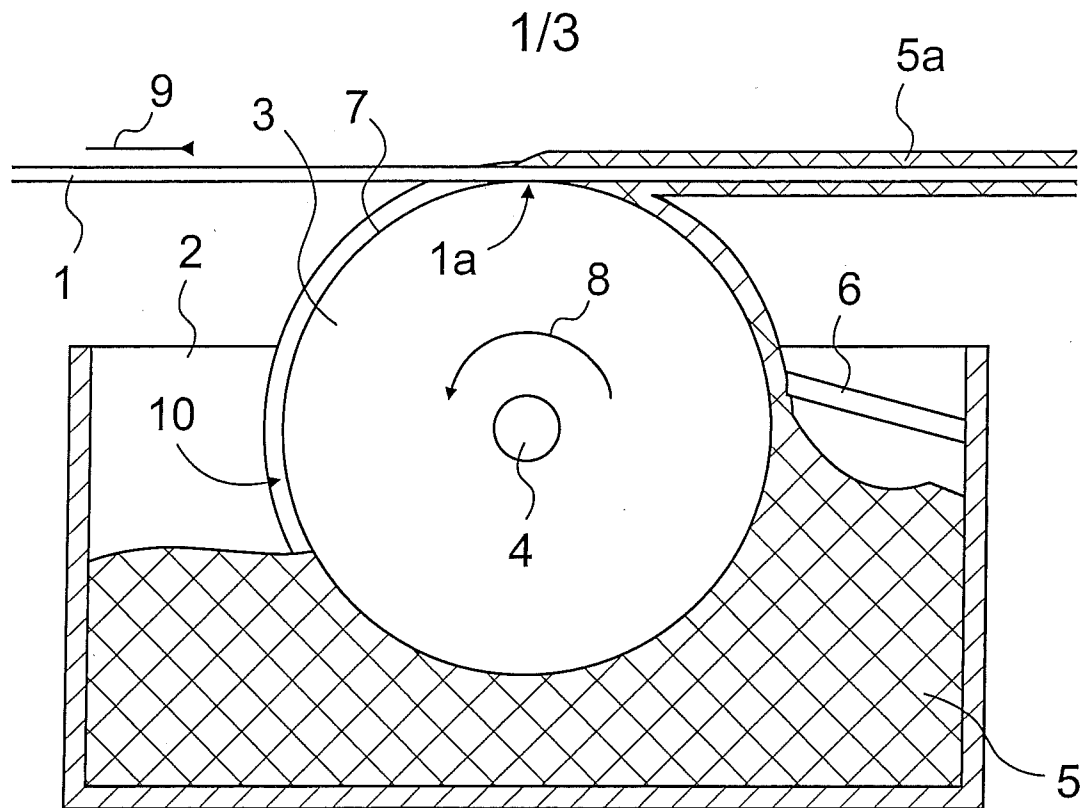


Fig. 1

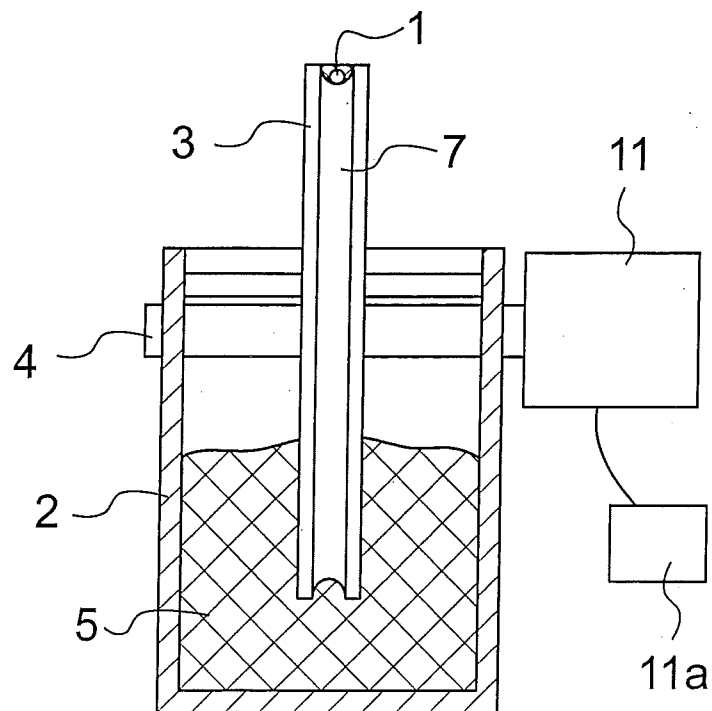


Fig. 2



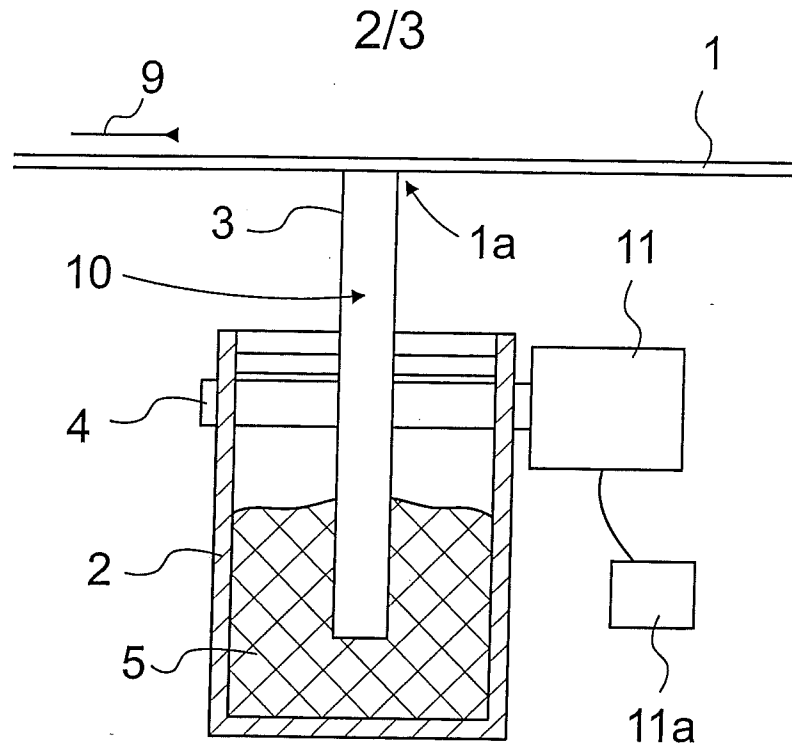


Fig. 3

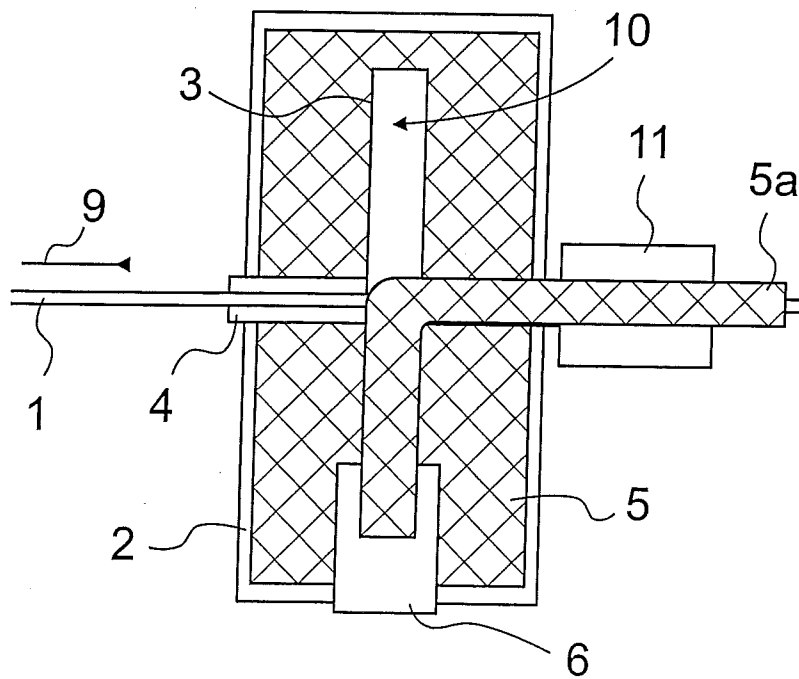


Fig. 4

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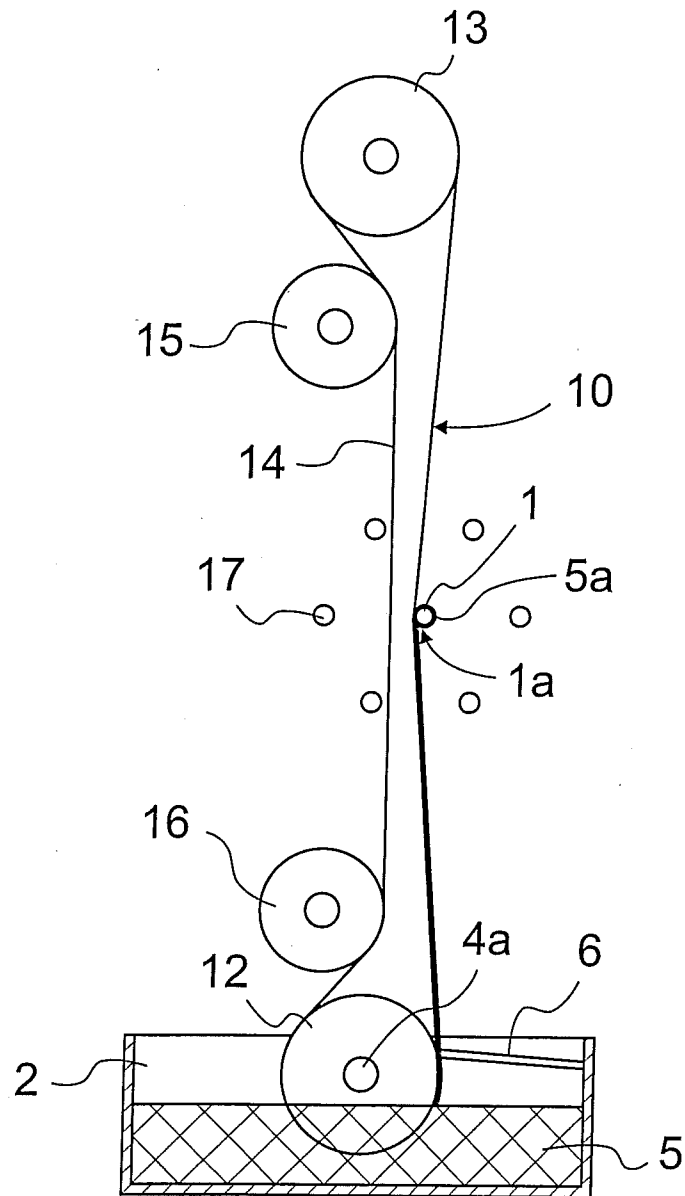


Fig. 5

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2010/050407

## A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B21F, C23C, D07B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                | Relevant to claim No. |
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| Y         | page 2, lines 24, claims 1, 4, figure 1                                                                           | 2, 4, 6, 8, 10, 12    |
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☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

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Date of the actual completion of the international search

22 June 2010 (22.06.2010)

Date of mailing of the international search report

16 July 2010 (16.07.2010)

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**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.  
PCT/FI2010/050407

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INTERNATIONAL SEARCH REPORT

International application No.  
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CLASSIFICATION OF SUBJECT MATTER

Int.Cl.  
**D07B 7/12** (2006.01)