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(54) Title: METHOD AND APPARATUS FOR BREAKING BUNDLES OF LOGS

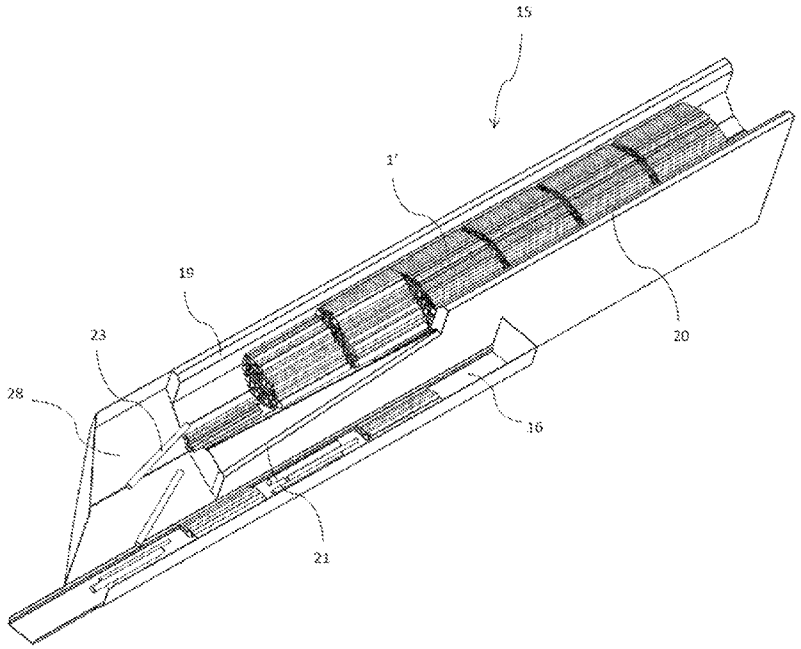

Fig. 4

(57) Abstract: A method and apparatus for breaking log bundles, in which method log bundles (1') are fed onto a bundle transport conveyor (15) carrying the bundles (1') and transporting them forward in the longitudinal direction of the log bundle (1'). The log bundles (1, 1') are kept on the bundle feed conveyor (15) by means of side barriers (19, 20) arranged on its long sides and the bundles of wood (1') are moved forward between the side barriers (19, 20) of the bundle transport conveyor. The logs (17, 23) of the log bundle (1') are allowed to drop over at least one side barrier (20) becoming lower in transport direction in relation to the wood-supporting level (18) of the bundle transport conveyor (15) on the long edge of the feed conveyor.

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METHOD AND APPARATUS FOR BREAKING BUNDLES OF LOGS

Field of the invention

The present invention relates to a method and arrangement for breaking log bundles into a constant flow. Most preferably the invention relates to feeding wood debarked at forest into a large-capacity chipping line.

Background art

The conventional technology by means of which the log bundles transported to the production site have been broken into smaller batches for processing is formed by a receiving table for the bundles and an elevator, subsequent to which loose bark can be removed from the logs by means of a roller system. The problem with such an apparatus is loose bark, the amount of which can still be e.g. 3% of the amount of the wood to be fed in the logs. Another problem is the difficulty of reaching sufficient capacity with short or small-diameter pieces logs. The transport means of the receiving table and the elevator are formed by chains provided with scrapers. The problem of chains is that they wear fast. Their repair, replacement as well as the replacement of the wear plates below the chains cause high operating costs.

Publication FI 121302, EP 1937450 discloses a method of breaking bundles by means of a cylinder-like drum. This tumbling drum works when it is sufficiently long. However, the drum is another additional apparatus on the chipping line and it increases the investment costs.

Another known device is the bundle feed conveyor according to FI 83181, US5063981, used for feeding log bundles into the debarking drum. The conveyor is reliable and its operation costs have been found to be essentially lower than those of a chain conveyor used for the same task.

The purposes of and summary of the invention

The purpose of the various embodiments of the present invention is to provide an apparatus with low construction and maintenance costs for feeding logs into a large-capacity chipping line.

The invention is defined by the features of the independent claims. Some especial embodiments are described in the dependent claims.

According to the first embodiment of the invention the log bundles are fed into a conveyor supporting the bundles and transporting them forward in the longitudinal direction of the logs in the log bundle. The log bundles are kept on the conveyor by means of side barriers arranged on both long sides of the conveyor. The log bundles are transported forward with the conveyor and logs of a bundle are allowed to drop over at least one a side barrier which is becoming lower along the long side of the conveyor in relation to the level of the conveyor.

According to a second feature of the invention the apparatus for breaking log bundles comprises a conveyor for transporting log bundles in the longitudinal direction of logs and a first and second side barrier located on the long sides of the conveyor. At least one of the side barriers is becoming lower in relation to the level of the conveyor in the transport direction of the conveyor for allowing logs to drop over the barrier of the conveyor.

According to a third feature of the invention the apparatus comprises a subsequent conveyor located beside the barrier that becomes lower, the transport direction of the conveyor being the same as that of the conveyor for transporting log bundles.

According to a fourth feature of the invention the apparatus comprises a full-height side barrier and a side barrier becoming lower and at least one wedge extending from the full-height side barrier to the portion that becomes lower of the barrier becoming lower.

According to a fifth feature of the invention the wedges are movable in the transport direction of the conveyor.

According to a sixth feature of the invention the wedges are movable in transverse direction relative to the conveyor.

Brief description of the figures

The invention and its details are disclosed in more detail with reference to the appended drawing, in which:

Fig. 1 illustrates a typical chipping line for debarked wood;

Fig. 2 illustrates a solution for feeding debarked wood by means of which at least some embodiments of the invention can be carried out;

Fig. 3 illustrates a breaker-conveyor of bundles by means of which at least some of the embodiments of the invention can be carried out;

Fig. 4 illustrates a fully loaded breaker-conveyor of bundles of figure 3;

Fig. 5 illustrates an additional function in the breaker-conveyor of bundles according to the invention for carrying out some embodiments of the invention.

Fig. 6 illustrates a conveyor by means of which at least some of the embodiments of the invention can be carried out, and

Fig. 7 illustrates a conveyor by means of which at least some of the embodiments of the invention can be carried out.

Definitions:

In this disclosure a log bundle means a unified log bundle formed for transport, or other bundle consisting of a number of logs to be lifted onto a conveyor by means of a loading apparatus, from which bundle the logs must be separated for chipping or other processing. The various embodiments of the apparatus and method according to the invention allow accomplishing a sufficiently constant feed of logs, the feed capacity being superior, however. Additionally bark of the logs is not a problem because it can be removed at a position of the apparatus group selected for this purpose. The operating costs of the apparatus are essentially lower than those of chain conveyors. The end part of bundle feed conveyors is constructed so that the log bundle collapses gradually to the next conveyor. The gradual collapse is achieved by forming the upper part of at least one sidewall to become lower either in steps or continuously.

Detailed description of the invention

Conventionally the logs debarked in forest are fed to the receiving table 2 in bundles 1 with a loader (figure 1). The receiving table 2 is formed by a chain conveyor provided with scrapers, the conveyor being wider than the length of the wood to be transported. The logs are loaded onto the table transversely in relation to the transport direction. The slowly transporting receiving table 2 transports the logs 3 to the elevator 4, which is also a chain conveyor provided with scrapers. Due to the steep elevation angle the scrapers (not shown) transport 1 to 4 logs 3' at a time. The transport speed of the elevator 4 is essentially higher than that of the receiving table 2. The flow of wood from the elevator 4 to the first transport conveyor 5 is steady. The first transport conveyor 5 is on 90 degree angle in relation to the transport direction so that logs 3" are positioned on the first transport conveyor 5 parallel with its transport direction. Typically the first transport conveyor 5 is a belt or chain conveyor.

From the first transport conveyor 5 the logs are moved by the roller system 6 and possibly the transport conveyor of the chipper 7 to the chipper 8. The roller system 8 separates loose bark from the flow of wood. The bark falls on the first bark conveyor 9 under the roller system 6.

Depending on the efficiency of the debarking made in the forest some bark will be carried into the process with the wood. Some of the bark is attached to the logs and some is loose. Loose bark can cause jamming and other disturbances at the receiving table 2 and the elevator 4 as well as the pocket 10 between them and the ramp 11 subsequent to the elevator. Some of the bark falls under the receiving table 2 and the elevator 4, from where the bark and debris is collected by means of a scraper conveyor 12. From the scraper conveyor 12 the bark is typically transported further to the first conveyor 9 by means of one or more bark conveyors 13.

Figure 2 illustrates as a process chart the apparatus for feeding debarked wood to the feed line of the chipper 8. This apparatus allows carrying out at least some of the embodiments of the invention. The log bundles 1 are loaded onto the bundle feed conveyor 15 that can be a lamella conveyor or a chain conveyor. The speed of the bundle feed conveyor 15 is relatively slow because the bundles with a large cross-section provide the necessary

capacity. Typically the speed is from 0.01 to 0.08 m/s. The cross-section of the loaded bundle can be the size of the forestry truck or train wagon or smaller depending the jaw size of the loader. The bundle feed conveyor 15 is provided with high side barriers, a full-height side barrier 19 and the side barrier 20 that becomes lower to prevent breaking of the bundles 1 and to prevent them from falling off the bundle feed conveyor 15. The full-height side barrier 19 is arranged on one side of the conveyor 15, on the edge parallel with the transport direction, and the side barrier that becomes lower is arranged on the opposite edge. The other side barrier, the barrier 20 that becomes lower, of the bundle feed conveyor 15 opens at its end either as a slope or stepwise, whereby the log bundle 1' is allowed to gradually collapse over the portion 21 that becomes lower of the side barrier 20 that becomes lower. On the side of the side barrier 20 that becomes lower there is the next conveyor 16 of the process, parallel with the bundle feed conveyor 15, that receives the falling logs 17 and transports them forward at a considerably higher speed. The speed of the next conveyor 16 divides the logs falling over the part 21 of the barrier that becomes lower into individual logs or groups of a few logs so that the flow of wood is suitable for the capacity of the chipper 8. The highest speed of the next conveyor is defined by the largest reception capacity of the chipper and the lowest speed so that the logs falling over the part 21 of the barrier that becomes lower do not accumulate into too large groups on the next conveyor 16. The gradual breaking of the log bundle produces a sufficiently constant flow of logs that can be chipped continuously.

The rest of the chipping line is like that shown in Figure 1. The chipping line as shown in Figure 2 allows eliminating the receiving table 2 and elevator 4 shown in Figure 1. Neither is a scraper conveyor 12 and a second bark conveyor 13 needed for transporting loose bark. All of the loose bark is separated from the flow of logs on the roller system 6'.

The method according to the invention can also be used for feeding logs with bark into the drum. In a situation where stones are to be removed from a flow of logs prior to debarking a conveyor corresponding to the chain conveyor is provided subsequent to the bundle feed conveyor. Subsequent to this there is a roller system prior to the drum. The spaces between the rollers of the roller system are large enough for removing the stones. The roller system can also be provided with a special stone trap.

Figures 3 and 4 illustrate a bundle feed conveyor 15 according to some embodiments of the invention. The bundle feed conveyor comprises a conveyor part which is here formed by reciprocating lamellae 18 and high side barriers, a full-height side barrier 19 and a side barrier 20 that becomes smaller. There are 4 pieces of moving transport means 18 in this conveyor. Towards its end the second side barrier, the side barrier 21 that becomes lower, slopes downwards at the part 21 of the barrier that becomes smaller towards the end 15 of the bundle feed conveyor. The downward slope or becoming lower can become lower in a continuous straight line, become lower in a stepwise manner or as an arc or as a combination of these. Right at the end part 22 of the bundle feed conveyor 15 the bottom also opens as a dropping trough 29 guiding the last pieces of wood 23 (figure 23) of the bundle to fall on the next conveyor 16. The transport means of the bundle feed conveyor 15 do not have to extend to the end of the bundle feed conveyor 15 because the bundles arriving from behind push the last pieces of wood of the currently breaking bundle along the slide bottom 24. The transport means end later on the side of the full-height side barrier 19 than on the side of the side barrier 20 becoming lower. In the embodiment of figures 3 and 4 the transport means of the bundle feed conveyor 15 are formed by a lamella conveyor having four lamellae 18 arranged side by side. Now the upper lamella 26 of the barrier becoming lower ends at the region of the beginning of the part becoming lower 21 of the barrier. The upper lamella 25 of the full-height barrier continues further in relation to it in the transport direction of the conveyor 15 but it also ends before the end part 22 of the bundle transport conveyor 15 and continues as a slide bottom 24.

The logs fall from the bundle transport conveyor 15 to the next conveyor 16 running partly parallel with the bundle feed conveyor 15. The next conveyor 16 must extend at least to the dropping area defined by the part becoming lower 21 of the barrier and the dropping trough 29 of the conveyor. Typically the next conveyor 16 is a chain conveyor or belt conveyor. A roller system is also possible in some cases.

Alternatively the transport means of the bundle feed conveyor are formed by chains. Typically the chain conveyor has a flat bottom. The chains can end in the same capstan drum or many drums in which case the chains end at different positions. The bottom part of the end can also be formed by a slide bottom as in figure 3. Most preferably, in a flat bottom conveyor the bottom also opens diagonally towards the end of the conveyor.

In a method according to the invention the logs do not have to be formed by bundles, but when using a loader with smaller jaws the logs are more or less mixed instead.

Figure 5 shows an additional function added to the bundle feed conveyor. In order to ensure the gradual breaking of the log bundle stationary or movable wedges 27 can be added to the full-height barrier 19 of the bundle feed conveyor. The wedges 27 push the logs from the bundle in lateral direction one layer at a time over the open edge 21. The wedges 27 also have an "activating" effect on the solid log bundle. The activating effect increases the continuous and even breaking of the log bundle. The activating effect can be enhanced as the wedges move along the barrier against the transportation direction of the log bundle in the direction of the arrow N. The wedge group can move as a unit as shown in figure 5 or each wedge 27 can move separately. No actuator needed for moving the wedge group has been shown. It can be hydraulic, pneumatic, electric screw jack or a gear drive. The wedge group is provided with a movement backwards before the next bundle for achieving a continuous operation. It can also be considered that the wedges 27 are pushers movable transversely in the transport direction of the bundle transport conveyor 15. In figure 5 the wedges are triangular but other shape alternatives are also possible.

An example of two different bundle feed conveyors (Fig 6 to 7) is shown in figures 6 and 7 by means of which the conveyor part of the bundle feed conveyor 15 can be formed. The example of Figure 6 is a lamella conveyor and that of Figure 7 is a chain conveyor.

The lamella conveyor of this example is provided with four lamellae 18 extending in the length of the lamella conveyor and arranged in an arc in cross-section. The lamellae 18 are carried by support rolls 30 fastened to the conveyor frame through bearings. Each lamella 18 is moved back and forth with hydraulic cylinder or other actuator. The logs and log bundles placed on the lamella conveyor are moved in the transport direction by the movement of the lamellae. As has been mentioned above, the upper lamella 19 of the full-height barrier extends farther in the transport direction than the upper lamella 26 of the barrier becoming lower. The advantage of the lamella conveyor as a part of the invention is the location of the drive. Each lamella 18 has their own hydraulic cylinder and in principle they can be located in any part of the conveyor. This allows the lamellae to end at different points. If necessary, the sliding surface of the end can be made shorter.

The chain conveyor is formed of a number of parallel chains 31 running as a loop via the capstan drum. Such a chain conveyor is well known from a number of different uses. If it is desired to have the chains of the full-height side barrier 19 to extend further, two or more capstan drums are needed. If there are more capstan drums, more drives and a more expensive structure are required. It could be difficult to arrange drives on the side where the pieces of wood fall. The chain conveyor of the example is also suitable for use as the chain conveyor subsequent to the bundle feed conveyor 15. However, in that case the number of chains is usually limited to eight.

In addition to the examples described above other conveyors suitable for transporting logs can be used.

In addition to the above-mentioned embodiments it should be mentioned that both sides of the bundle transport conveyor can become lower, whereby the breaking of the log bundles takes place on both sides of the bundle transport conveyor.

Reference numbers.

1, 1' log bundle
2 receiving table
3, 3', 3'', 3''' logs
4 elevator
5 first transport conveyor
6, 6' roller system
7 feed conveyor for the chipper
8 chipper
9 first bark conveyor
10 pocket
11 ramp
12 scoop conveyor
13 second bark conveyor
15 bundle feed conveyor
16 subsequent conveyor
17 falling logs
18 lamellae
19 full-height side barrier
20 side barrier becoming lower
21 the part of the barrier that becomes lower
22 end part of conveyor 1
23 last logs
24 sliding bottom
25 upper lamella of the full-height barrier
26 upper lamella of the barrier becoming lower
27 wedge
28 dropping trough
29 frame of the lamella conveyor
30 support roller
31 chain

Claims:

1. A method of breaking log bundles , in which method:
   - log bundles (1') are fed to the bundle feed conveyor (15) carrying the bundles (1') and transporting them forward in the longitudinal direction of the log bundle (1'),
   - log bundles (1, 1') are kept on bundle feed conveyor (15) by means of side barriers (19, 20) arranged on both of its long sides,
   - log bundles (1') are transported forward on the bundle transport conveyor between the side barriers (19, 20), and
   - the logs (17, 23) of the log bundle (1') are allowed to drop over at least one side barrier (20) becoming lower in transport direction in relation to the wood-supporting level (18) of the bundle transport conveyor (15) on the long edge of the feed conveyor.

2. A method according to claim 1, wherein the logs (17, 23) of the log bundle (1') are allowed to fall over the side barrier (20) becoming lower onto the next conveyor (16) having the same transport direction as the bundle transport conveyor (15) and a higher transport speed than the bundle transport conveyor (15).

3. A method according to claim 1 or 2, wherein the log bundles (1, 1') are held on the bundle feed conveyor (15) by means of side barriers (19, 20) arranged on both of its long sides, the barriers comprising a full-height side barrier (19) and a side barrier (20) becoming lower and the logs (17) of the log bundle (1) are pushed from the direction of the full-height side barrier (19) towards the side barrier (20) becoming lower.

4. A method according to claim 3, wherein the log bundles (1, 1') are held on the bundle feed conveyor (15) by means of side barriers (19, 20) arranged on both of its long sides, the barriers comprising a full-height side barrier (19) and a side barrier (20) becoming lower and the logs (17) of the log bundle (1') are pushed from the direction of the full-height side barrier (19) towards the side barrier (20) becoming lower by means of at least one wedge (27) being moved in the transport direction of the bundle transport conveyor (15).

5. A method according to claim 3, wherein the log bundles (1, 1') are held on the bundle feed conveyor (15) by means of side barriers (19, 20) arranged on both of its long sides, the barriers comprising a full-height side barrier (19) and a side barrier becoming lower (20) and the logs (17) of the log bundle (1') are pushed from the direction of the full-height side barrier (19) towards the side barrier becoming lower (20) by means of at least one fixed wedge (27).

6. A method according to claim 3, wherein the log bundles (1, 1') are held on the bundle feed conveyor (15) by means of side barriers (19, 20) arranged on both of its long sides, the barriers comprising a full-height side barrier (19) and side barrier becoming lower (20) and the logs (17) of the log bundle (1') are pushed from the direction of the full-height side barrier (19) towards the side barrier becoming lower (20) by means of at least one wedge being moved transversely in relation to the transport direction of the bundle transport conveyor (15).

7. An apparatus for breaking log bundle (1'), comprising:

- a bundle transport conveyor (15) for transporting log bundles (1') forward in the longitudinal direction of the logs of the bundle (1'),
- a first (19) and second (20) side barrier located on the long sides of the bundle transport conveyor (15) and wherein
- at least one of the side barriers (19, 20) of the conveyor becomes lower in relation to the wood-supporting level (18) of the bundle transport conveyor (15) in the transport direction of the bundle transport conveyor (15) for allowing the logs (17, 23) of the log bundle (1') to fall over the side barrier becoming lower (20) of the bundle transport conveyor (15).

8. An apparatus according to claim 7 comprising a subsequent conveyor (20) located next to the side barrier becoming lower (20) of the bundle transport conveyor (15) having the same transport direction as the bundle transport conveyor (15).

9. An apparatus according to claim 7 or 8 comprising a full-height side barrier (19) and a side barrier becoming lower (20) located on the long sides of the bundle transport conveyor

(15) and at least one wedge (27) at the full-height side barrier (19) extending towards the part becoming lower (21) of the side barrier becoming lower (20).

10. An apparatus according to claim 9 wherein at least one wedge is movable in the transport direction of the bundle transport conveyor (15).

11. An apparatus according to claim 9 wherein at least one wedge is movable transversely to the transport direction of the bundle transport conveyor (15).

12. An apparatus according to any of claims 7 to 11 wherein the bundle transport conveyor (15) comprises a lamella conveyor having parallel forward and back moving lamellae.

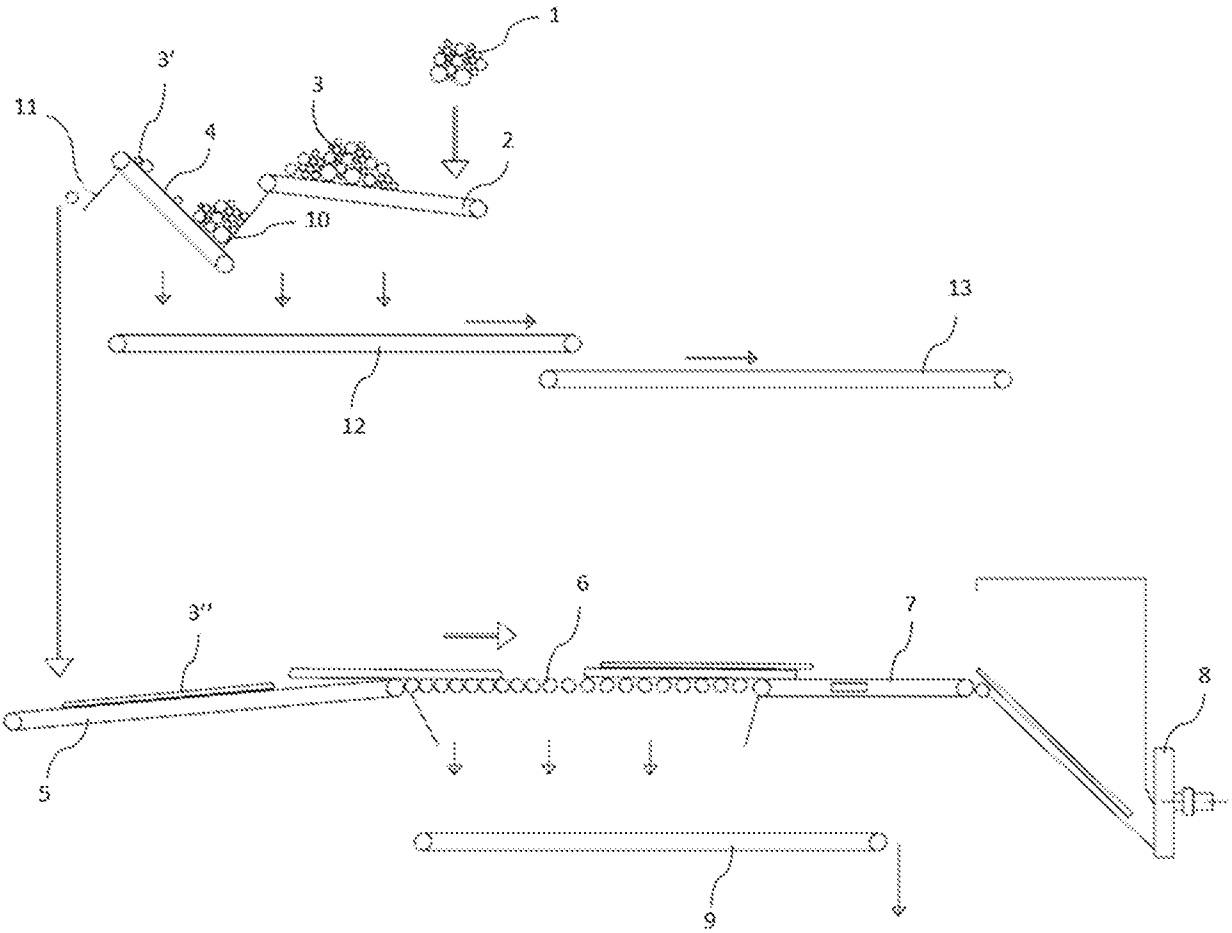

Fig. 1

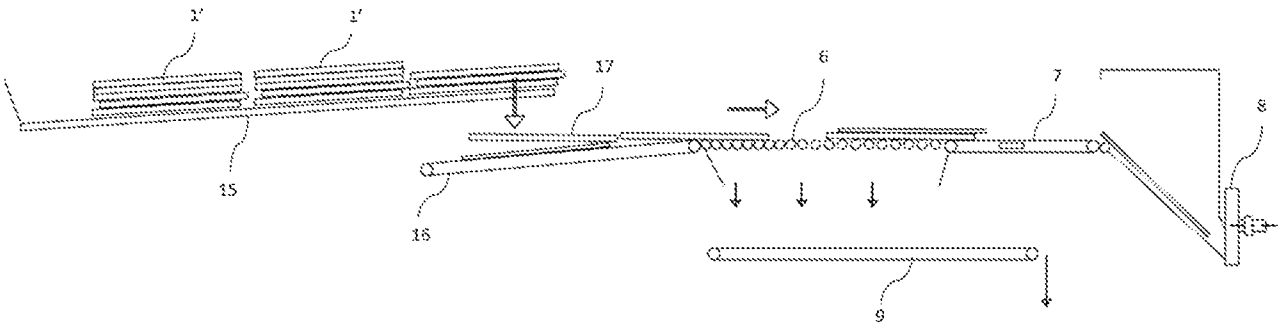

Fig. 2

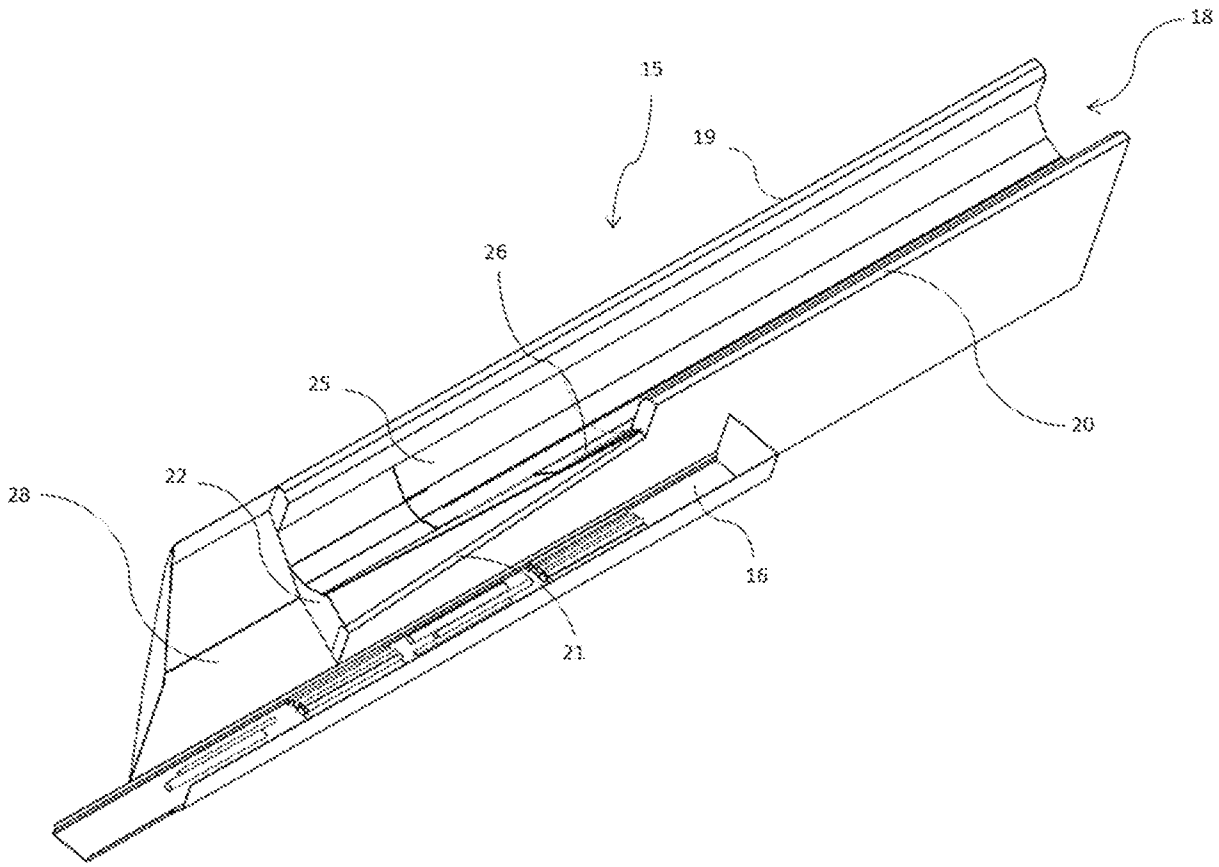

Fig.3

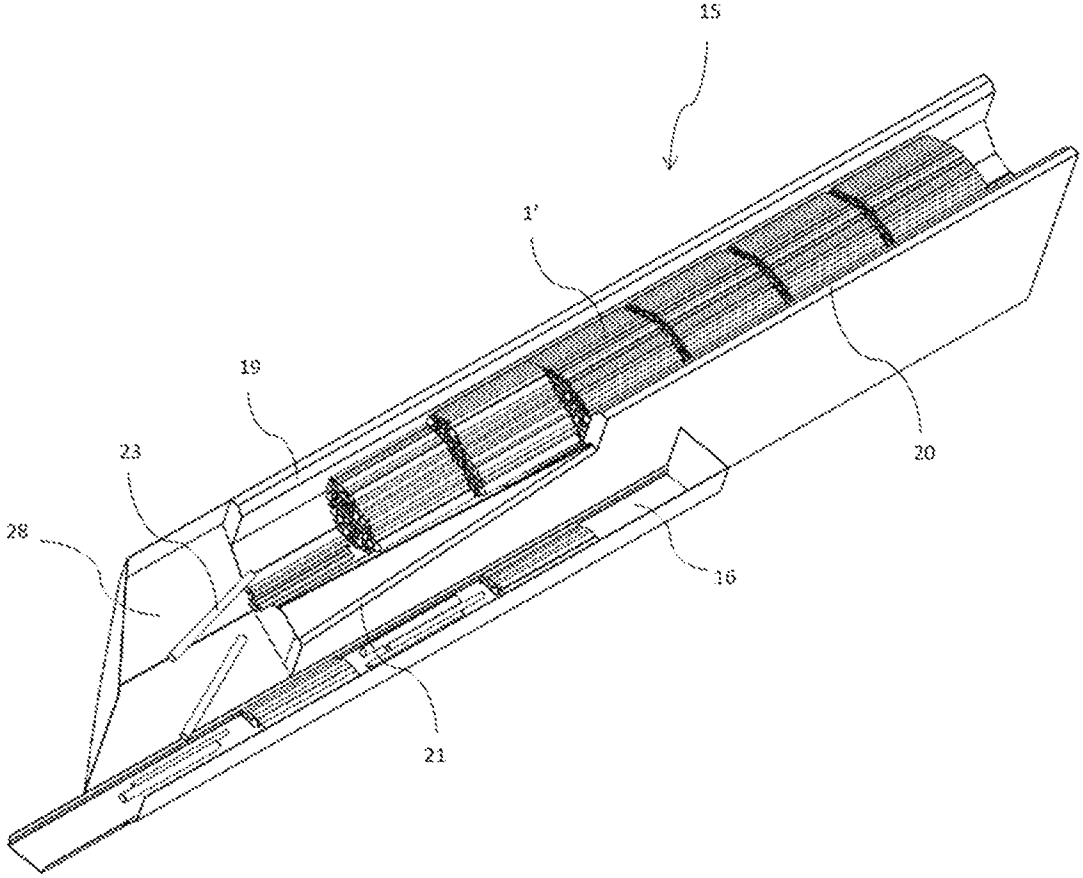

Fig. 4

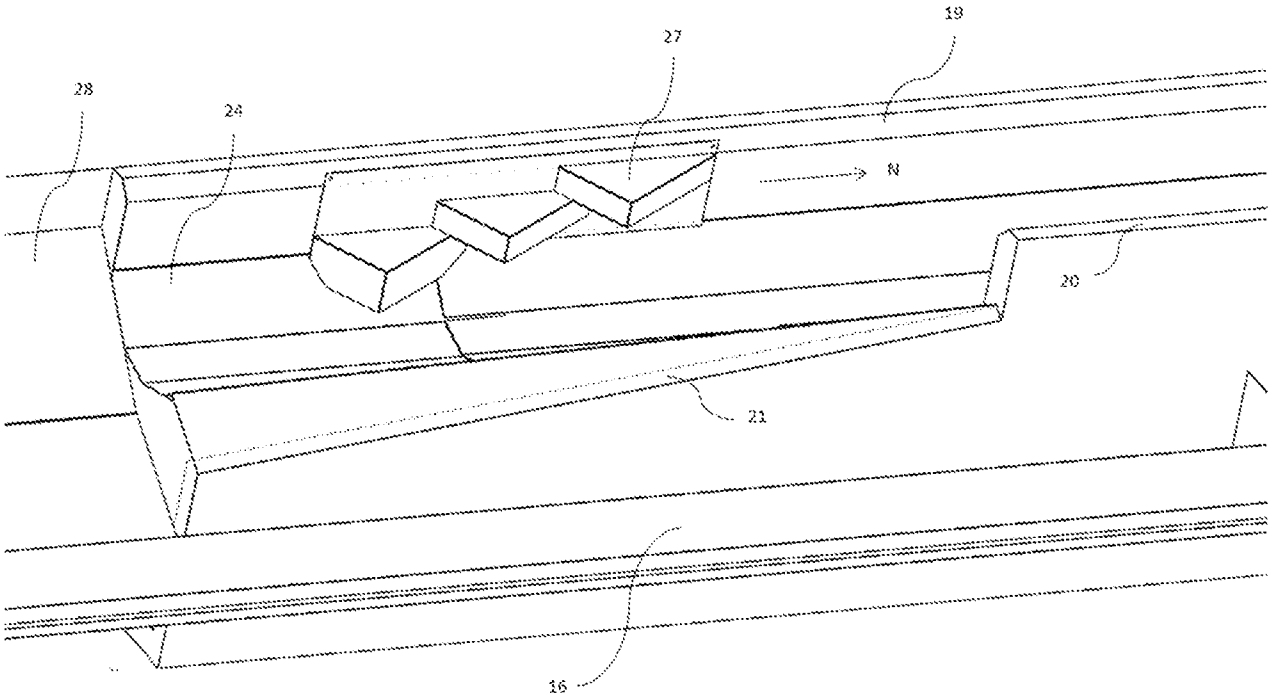

Fig. 5.

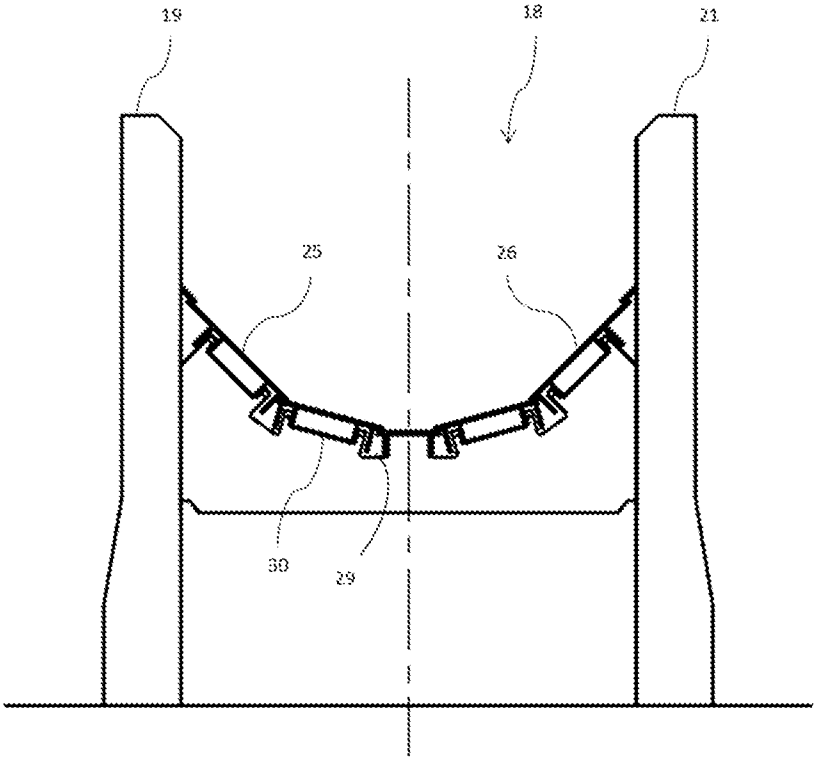

Fig. 6

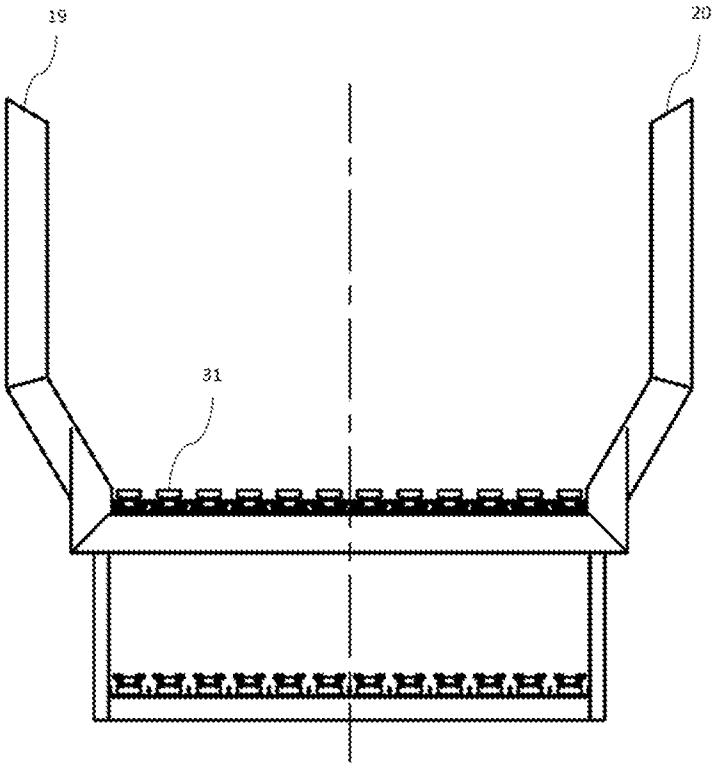

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2018/050253

A. CLASSIFICATION OF SUBJECT MATTER
INV. B27L1/04 B27B31/08 B65G47/32 B65G47/52 B65G47/82
ADD.

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)
B27L B27B B65G

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2004/250910 A1 (TOHKALA ANTTI [FI] ET AL) 16 December 2004 (2004-12-16) abstract figures paragraph [0012] - paragraph [0014] -----	1-3,7,8, 12 5,6,9,11
Y	CH 707 448 A1 (FERAG AG [CH]) 15 July 2014 (2014-07-15) abstract paragraph [0138] figure 3f -----	5,6,9,11
A	EP 1 937 450 A1 (METSO PAPER INC [FI]) 2 July 2008 (2008-07-02) paragraph [0010] figures -----	2

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"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

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Date of the actual completion of the international search	Date of mailing of the international search report
29 June 2018	09/07/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Hamel, Pascal

INTERNATIONAL SEARCH REPORT

Information on patent family members

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