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(54) Method and arrangement for cutting a moving web

(57) The invention relates to a method and an arrangement for cross-cutting a moving mineral wool web. The mineral wool web is cut in the cross direction of the web with the aid of a cutting device arranged on a first bridge extending across the moving web. During cutting the first bridge with its cutting device is moved in the motion direction of the web and with a speed, which is adapted to the speed of the web, so that a substantially perpendicular cutting line is obtained in the cross direction of the web. In addition the mineral wool web is cut in the cross direction of the web with at least a cutting device arranged on a second bridge extending across the web, adjacent the first bridge. The distance between the bridges is kept substantially constant during the cutting.

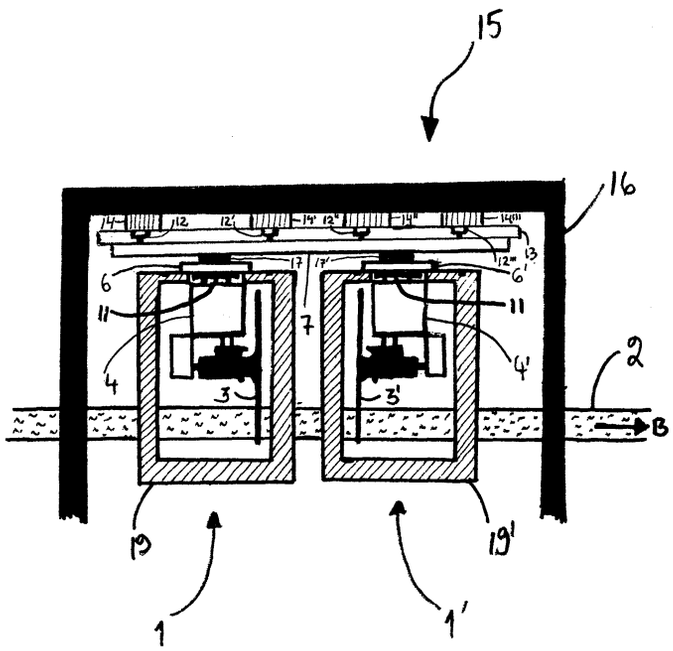

FIG. 2

EP 1 356 904 A1

Description

[0001] The present invention relates to a method and an arrangement for cross-cutting a moving web. The present invention relates particularly to the cross-cutting of a continuous web of mineral wool in the making of mineral wool.

[0002] Mineral wool, e.g. rock wool, is made by melting suitable mineral-containing raw materials, such as diabase, limestone and slag in a melting furnace. The obtained silicate-containing mineral melt is discharged from the melting furnace in the form of a melt jet to a fiberising apparatus, such as a spinning machine, in which the melt is formed into mineral fibres. A binder may be applied on the formed mineral fibres, either during the fibre formation or after it.

[0003] The formed mineral fibres are collected as a fibre mat, which can be processed in several different manners, for instance by oscillating, curing and compressing. The processed fibre mat moves forward in the process, in the form of a continuous web. The finished fibre mat, i.e. the mineral wool web, will be cut both in the longitudinal direction of the web, i.e. in the web's direction of motion, and in the cross direction of the web, i.e. in a direction perpendicular to the web's direction of motion. This provides mineral wool slabs having a desired width and length. The cut mineral wool slabs are weighed in order to control their surface weight, and the accepted slabs are then transported to a packing machine.

[0004] The cutting of the mineral wool web is an important step in the process. An aim is to minimise material losses in the form of falsely cut products and amount of reject generated in the cutting. The patent application WO 94/27793 presents a method and a cutting device for cutting a moving mineral wool web in the cross direction of the web. The cutting device comprises a bridge suspended transversely above the mineral wool web, and a driving apparatus arranged in connection with the bridge. The driving apparatus transports the cutting device in the web's direction of motion during the cutting, so that the motion of the bridge follows the velocity of the mineral wool web, and a perpendicular cut is obtained across the whole width of the wool web. When the cutting is completed the cutting device is returned to its initial position in order to make the next cut.

[0005] The amount of produced mineral fibres per time unit has increased in the making of mineral wool. Then the collecting velocity and thereby also the velocity of the web has been increased in the manufacturing process, in order to keep the surface weight at a reasonably low level despite this fact, and in order to keep the collected primary mats thin. The web velocities have increased substantially, from about 18 m/min up to 25 m/min. It is estimated that the web speeds will rise above 30 m/min in the future.

[0006] It is well known that mineral wool can be used for many purposes. It is used amongst others as insulation material in house building, as acoustic panels, and for other insulation purposes. Among other things the purpose of use and the wool quality of the mineral wool slabs determine their size, i.e. their width and length, and their density. A production line will produce mineral wool slabs of different qualities and for different purpose of use. Therefore, the length of the slabs may vary considerably from one product to the next, for instance between 0.4 m and 4 m.

[0007] The increased web speeds have caused problems in the cross cutting of the mineral wool web, particularly in the cutting of short mineral wool slabs. When you use cutting devices described in WO 94/27793, and other corresponding devices, the web speed is limited by the power and durability of their driving apparatus. The driving apparatus of the cutting device has a certain maximum power, which cannot be exceeded, i.e. the bridge with the cutting device has a certain maximum speed, with which it can be transported in the direction of the web during the cutting operation. The speed of the web cannot exceed this maximum speed, because the speed of the cutting device should follow the speed of the wool web. Thus the cross-cutting of the mineral wool web has become a bottleneck in the process of making mineral wool. The speed of the wool web must be reduced before the cutting stage of the process. Further, in the cutting of short slabs, when there is a short interval between two cuttings, the driving apparatus does not have time to move the bridge with the cutting device to its initial position before the next cutting should be performed.

[0008] Therefore an object of this invention is to provide a method and an arrangement in the making of mineral wool, where the above-mentioned disadvantages have been minimised.

[0009] An object is also to provide a method and an arrangement for cutting, which allows the web line speed to be increased in the making of mineral wool.

[0010] A further object of this invention is to provide a method and an arrangement which makes it possible to cut the mineral wool web in the cross direction at short cutting intervals.

[0011] These objects are attained with a method and an arrangement having the characteristics presented below in the characterising parts of the independent claims.

[0012] A typical method according to the present invention comprises the following steps:

- cutting the mineral wool web in the cross direction of the web with a first cutting device, which is arranged on a first bridge extending across the moving web,
- moving, during the cutting, the first bridge with the first cutting device in the web's direction of motion with a speed being adapted to the speed of the web, so that a perpendicular cutting line is obtained in the cross direction of the web,

- cutting the mineral wool web in addition in the cross direction of the web with at least one further cutting device arranged on a further bridge, which extends across the web adjacent the first bridge, and
- keeping the distance between the bridges constant or substantially constant during the cutting.

[0013] A typical arrangement according to the present invention comprises:

- a first cutting device comprising a rotating cutting blade arranged on a first bridge, which is arranged to extend across the mineral wool web;
- a first measuring unit connected to a measuring means, which measures the speed of the web, and to a first driving device;
- a first driving device, with which the first bridge and the first cutting device are transported in the web's direction of motion during the cutting and with a speed, which is adapted to the speed of the web, and
- at least one further cutting device arranged on a further bridge, which extends across the web adjacent the first bridge or at a distance from it, which distance is arranged to be kept constant or substantially constant during the cutting.

[0014] Thus, it has now been found, that it is possible to double the number of cuts per time unit by arranging a second cutting device on a second bridge adjacent to the first bridge with the first cutting device. Thus the invention makes it possible to keep the speed of the moving mineral wool web high, also when cutting relatively short mineral wool slabs. At the same time the present invention enables an improved control of the length of the cutting interval, i.e. the length of the mineral wool slabs.

[0015] A typical cutting device comprises a rotating cutting blade arranged in a carriage means, which can be used as a first and a second cutting device in the present invention. The cutting blades in use have usually thin rotating blades, which are made of a hard metal with a thickness of 2 to 5 mm, preferably 2.5 to 3 mm. During cutting the carriage means for the cutting blades can move back and forth on their respective bridges, which extend across the mineral wool web. On the other hand the bridges are arranged on rails or corresponding guiding means, which are fixed on each side of the mineral wool web, so that the bridges can move back and forth in the web direction during the cutting.

[0016] A measuring unit connected to measuring means measures the speed of the mineral wool web. The measuring unit is also connected to the driving devices of the bridges, which devices move the bridges in the web's direction of motion with a speed, which is adapted to the speed of the web during the cutting. The bridges will thus accelerate to a speed, which substantially equals the speed of the web during the cutting. When the speed of the web is reached, the carriage means are driven across the web, and at the same time the rotating cutting blades arranged in the carriage means make a cut through the web.

[0017] Thus, according to the present invention, at least a second cutting device is arranged on a second bridge next to the first bridge with the first cutting device, at a distance from the first bridge. The distance between the bridges, on which the cutting devices are arranged, will be controlled by an electronic control system. The bridges are equipped with position sensors, such as pulse encoders, which are connected to the control system. The desired distance between the bridges, i.e. the desired distance between the cutting blades and the length of the mineral wool slabs, is entered to the system, and then the driving devices move the bridges to the desired distance from each other. The electronic control system comprising a positions sensor, controls the distance between the bridges and/or the distance to a predetermined reference point, so that the distance between the bridges is kept constant during the cutting. Different types of pulse encoders or other corresponding transducers can be used as position sensors. In some cases the position sensors can be integrated in the driving devices of the bridges, such as servomotors.

[0018] According to an embodiment of the present invention each of the first and the second bridges are provided with their own driving devices in order to have an independent control of the bridges.

[0019] With the aid of the electronic control system it is possible to adjust with great accuracy the distance between the bridges, and thus between the blades of the cutting devices, so that the differences in the slab lengths will be only a few millimetres, which makes it possible to produce mineral wool slabs with a constant length. This minimises the number of mineral wool slabs, which must be rejected due to an erroneous cutting length.

[0020] The electronic control system for adjusting the distance between the bridges makes it also easy to adjust the cutting intervals according to the production requirements. If it is desired to change the cutting interval, then the distance between the bridges can easily be changed by entering a new cutting distance value to the control system. When cutting long slabs, i.e. when the cutting distance is long, and/or when the web speed is low, then the second bridge with the second cutting device can be simply disconnected, when required, and the cutting can be made in a traditional manner. Therefore the present invention provides an improved flexibility in the cutting of mineral wool webs. The invention enables a cutting of slabs with different lengths without any major changes in the construction of the process equipment. The electronic control system can also be connected to the control circuits of the rest of the production process, in some commonly known way. This makes it possible to change the cutting length from a centralised process control room.

[0021] According to an embodiment of the present invention the bridges can be mechanically interconnected with fastening means, such as adjusting screws, which can control the distance between the cutting devices.

[0022] According to an embodiment of the present invention the first and second bridges with their cutting devices are advantageously arranged in a common frame, which extends across the mineral wool web.

[0023] According to a preferred embodiment of the present invention with two cutting devices, the cutting devices are located on opposite sides of the mineral wool web in their starting position, i.e. before the cutting procedure. Thus the second cutting device has its starting position on the opposite side of the mineral wool web, as seen from the starting position of the first cutting device. A starting position is considered to be that position where the cutting device, i.e. the cutting blade, is located at the edge of the mineral wool web. The cutting devices move in opposite directions across the mineral wool web during the cutting. This prevents the mineral wool web from moving sideways during the cutting, and this provides a better right-angled cutting of the web. As the first and second cutting devices on each bridge perform the cutting from opposite directions, this will prevent a twisting of the mineral wool web when the cutting blades meet and cut through the web.

[0024] According to an embodiment of the present invention it is possible to arrange several cutting devices next to each other on their respective bridges. The number of cutting devices can be for instance three or four. This enables yet higher web speeds, or a cutting of even shorter mineral wool slabs.

[0025] Some embodiments of the invention are described in more detail below with reference to the enclosed figures, in which

Figure 1 shows schematically an embodiment of an arrangement for cutting a mineral wool web according to the present invention, seen in the mineral wool web's direction of motion,

Figure 2 shows schematically an embodiment of an arrangement for cutting a mineral wool web according to the present invention, seen from the side, i. e. perpendicular to the mineral wool web's direction of motion, and

Figure 3 shows schematically an embodiment of an arrangement for cutting a mineral wool web according to the present invention, seen from above.

[0026] Figure 1 shows schematically an arrangement 15 for cutting a mineral wool web according to the present invention. The arrangement 15 is seen against the motion direction of the mineral wool web 2, and figure 1 shows only one of the cutting blades 3 arranged next to each other. The cutting blade 3 is arranged in a carriage means 4, which is driven by a motor 5. During the cutting the carriage means 4 moves back and forth on a bridge 6, which extends across the mineral wool web 2. The bridge 6 is arranged in guiding means 7, 7', which are fastened on each side of the mineral wool web 2, so that the bridge 6 can move back and forth in the web's 2 direction of motion during the cutting. The bridge 6 is driven with a servomotor 8. Figure 1 shows also the power transmitting cardan shafts 9, 9' and a gearbox 10 for the bridge 6.

[0027] Figure 2 shows schematically, as seen from the side, i.e. perpendicular to the motion direction of the mineral wool web 2, an arrangement 15 according to the present invention, which comprises a first cutting device 1 and a second cutting device 1'. The cutting devices 1, 1' are arranged adjacent each other. Figure 2 shows the motion direction of the mineral wool web 2 with an arrow B. Both the first and the second cutting devices 1, 1' comprise a rotating cutting blade 3, 3'. Each cutting blade 3, 3' is arranged in its carriage 4, 4', which travel in a guiding means 11, 11' back and forth on a bridge 6, 6', which extends across the moving mineral wool web 2. Each bridge 6, 6' is arranged in its carriage 17, 17', which travel in a guiding means 7 for bridges. A corresponding guiding means for bridges is arranged on the other side of the mineral wool web, but this is not shown in figure 2. During cutting the bridges travel in the motion direction B of the mineral wool web.

[0028] Figure 2 shows also safety switches 12, 12', 12", 12"', which are arranged in a support frame 13 being attached to the frame 16 via suspension beams 14, 14', 14", 14"'. The safety switches 12, 12', 12", 12"' limit the motion of the cutting device 3, 3' sideways across the mineral wool mat in case any faults in the rest of the control system occur. Figure 2 also shows the supporting frames 19, 19' of the guiding means 11, 11'.

[0029] Figure 3 shows schematically an arrangement 15 according to the present invention as seen in a top view. A cross-section A in the centre of the figure is shown in order to illustrate the mutual positions of the cutting blades 3, 3' at a moment during the cutting. If both cutting blades 3, 3' are located on the same side of the mineral wool web 2 at the beginning of the cutting, then the distance L between the blades 3, 3' is kept constant during the whole cutting, and this distance L is then the desired length of the cutting. If the blades 3, 3' are located on opposite sides of the mineral wool web at the beginning of the cutting, then the desired cutting length equals the distance L between the cutting blades 3, 3' at that moment when they pass each other during the cutting process.

[0030] In figure 3 the cutting blades 3, 3' are arranged in carriages, which are not shown in the figure. Both cutting blades 3, 3' are driven by their own motor 5, 5'. The carriages are arranged on their respective bridges 6, 6', which extend across the mineral wool web 2. The bridges 6, 6' are arranged in guiding means 7, 7', which are fastened on each sides of the mineral wool web 2, so that the bridges 6, 6' can travel back and forth in the

motion direction of the web 2 during the cutting. Each bridge 6, 6' is driven by its own servomotor 8, 8'. Figure 3 shows also the power transmitting cardan shafts 9, 9', 9", 9"' and gear boxes 10, 10' for the bridges 6, 6'. Both bridges 6, 6' are arranged in a common frame 16, which extends across the mineral wool web 2.

[0031] The line speed of the web can be essentially increased in the production of mineral wool by using the present invention in the cross-cutting of the mineral wool web, as the invention allows an increased number of cuttings per time unit. In total this means that the cross-cutting of the mineral wool web, which previously was a bottleneck in the production process of mineral wool, now can be made with the same speed as the other process stages before the cutting.

[0032] In addition the present invention allows cutting the mineral wool web in the cross direction at short cutting intervals, which increases the variation possibilities in the mineral wool production. You can cut shorter products and easily change the cutting length, when desired, as the cutting length can be simply determined by the electronic control system. The electronic control system is also easily combined with other control and regulating systems, which facilitates a total control and regulation of the mineral wool production.

[0033] The present invention allows reducing the number of falsely cut mineral wool slabs. The invention entails that the cutting can be made with a substantially higher accuracy using an electronic control system. When cutting is made from opposite sides, according to the invention, then the cutting can be made more perpendicular than with previous cutting methods and arrangements. It is a fact that by using only one blade the blade will push the mineral wool slab sideways, and then the cut tends to be oblique. This problem does not occur in the embodiment of the present invention using two blades, and this provides a mineral wool slab, which is cut at right angles.

[0034] Even if the invention was described with reference to what at present seems to be the most practical and preferred embodiments, it is appreciated that the invention shall not be limited to the embodiments described above, but the invention is intended to cover also different modifications and equivalent technical solutions within the scope of the enclosed claims.

Claims

1. A method for cutting a moving mineral wool web, which method includes

   - cutting the mineral wool web in the cross direction of the web with a first cutting device, which is arranged on a first bridge extending across the moving web, and
   - moving the first bridge with the first cutting device in the web's direction of motion with a speed being adapted to the speed of the web during the cutting, so that a perpendicular or substantially perpendicular cutting line is obtained in the cross direction of the web,

   characterised in that

   - the mineral wool web is cut in the cross direction of the web with at least a second cutting device arranged on a second bridge, which extends across the web adjacent the first bridge, and **in that**
   - the distance between the bridges is kept constant or substantially constant during the cutting.

2. A method according to claim 1, **characterised in that** the distance between the bridges and/or between the bridges and a predetermined reference point is controlled with an electronic control system comprising a position sensor connected to the bridges.

3. A method according to claim 1, **characterised in that** the starting point of the second cutting device is located on the opposite side of the mineral wool web, as seen from the starting point of the first cutting device.

4. A method according to claim 1, **characterised in that** the first and the second cutting devices move in opposite directions across the mineral wool web during the cutting.

5. A method according to claim 1, **characterised in that** a plurality of cutting devices are arranged on adjacent bridges, which extend across the web, and that the distance between the bridges is kept constant or substantially constant during the cutting.

6. An arrangement for cutting a moving mineral wool web comprising

   - a first cutting device comprising a rotating cutting blade arranged on a first bridge, which is arranged to extend across the mineral wool web,
   - a first measuring unit connected to a measuring means, which measures the speed of the web, and to a first driving device,
   - a first driving device, with which the first bridge with the first cutting device are transported in the web's direction of motion during the cutting with a speed, which is adapted to the speed of the web,

   characterised in that the arrangement comprises at least a second cutting device arranged on a sec-

ond bridge, which extends across the web adjacent the first bridge at a distance from it, which distance is arranged to be kept constant or substantially constant during the cutting.

7. An arrangement according to claim 6, **characterised in that** an electronic control system is arranged in connection with the bridges in order to control the distance between the bridges and/or between the bridges and a predetermined point of reference.

8. An arrangement according to claim 6, **characterised in that** the electronic control system comprises a position sensor connected to the bridges.

9. An arrangement according to claim 6, **characterised in that** the bridges are mechanically interconnected with the aid of fastening means.

10. An arrangement according to claim 6, **characterised in that** each bridge is provided with its own driving device in order to make the control of the bridges independent of each other.

11. An arrangement according to claim 6, **characterised in that** more than two cutting devices are arranged on their respective bridges, which next to each other extend across the web, at a distance from each other.

12. An arrangement according to claim 6, **characterised in that** the starting position of the second cutting device is arranged on the opposite side of the mineral wool web, as seen from the starting position of the first cutting device.

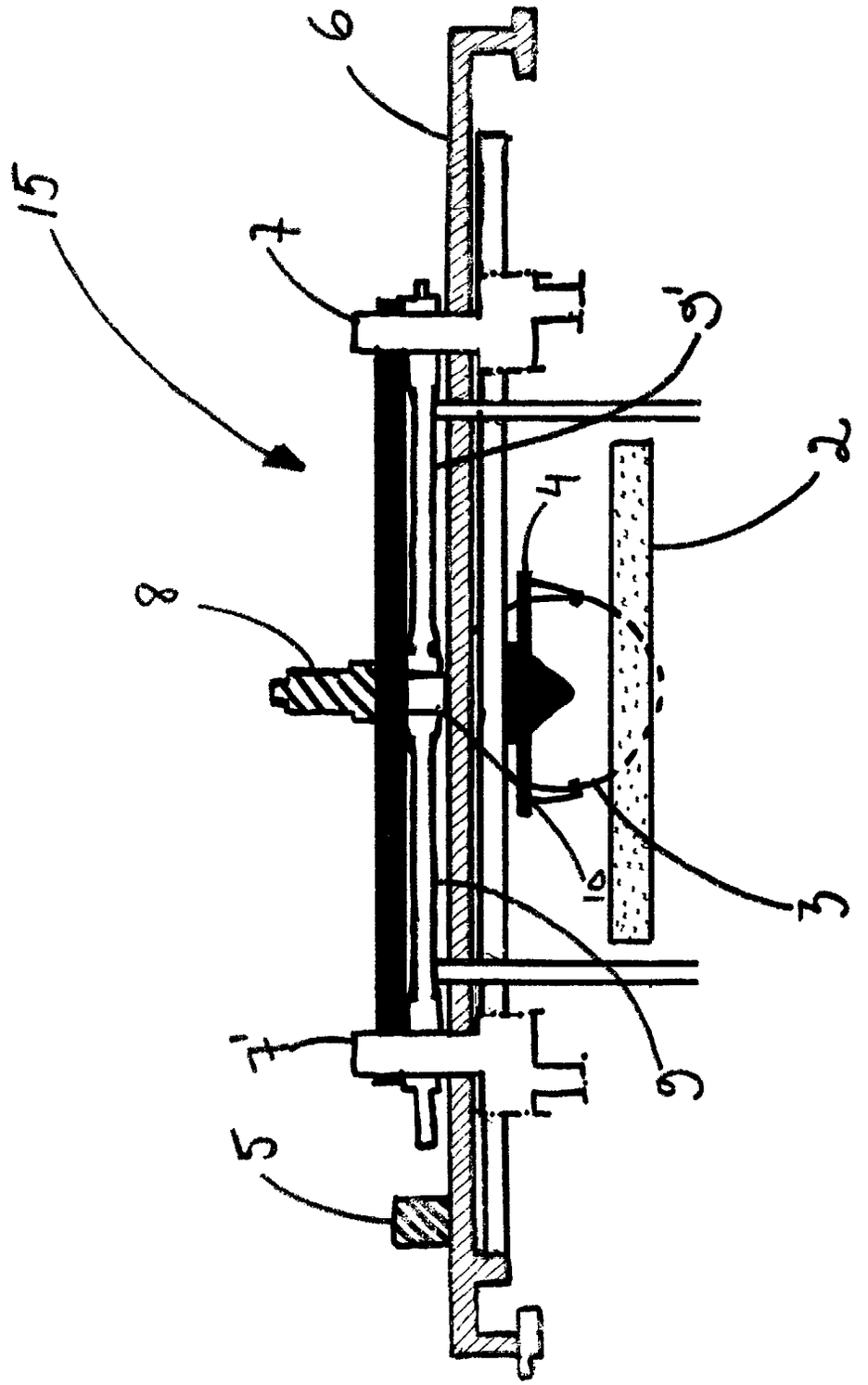

FIG. 1

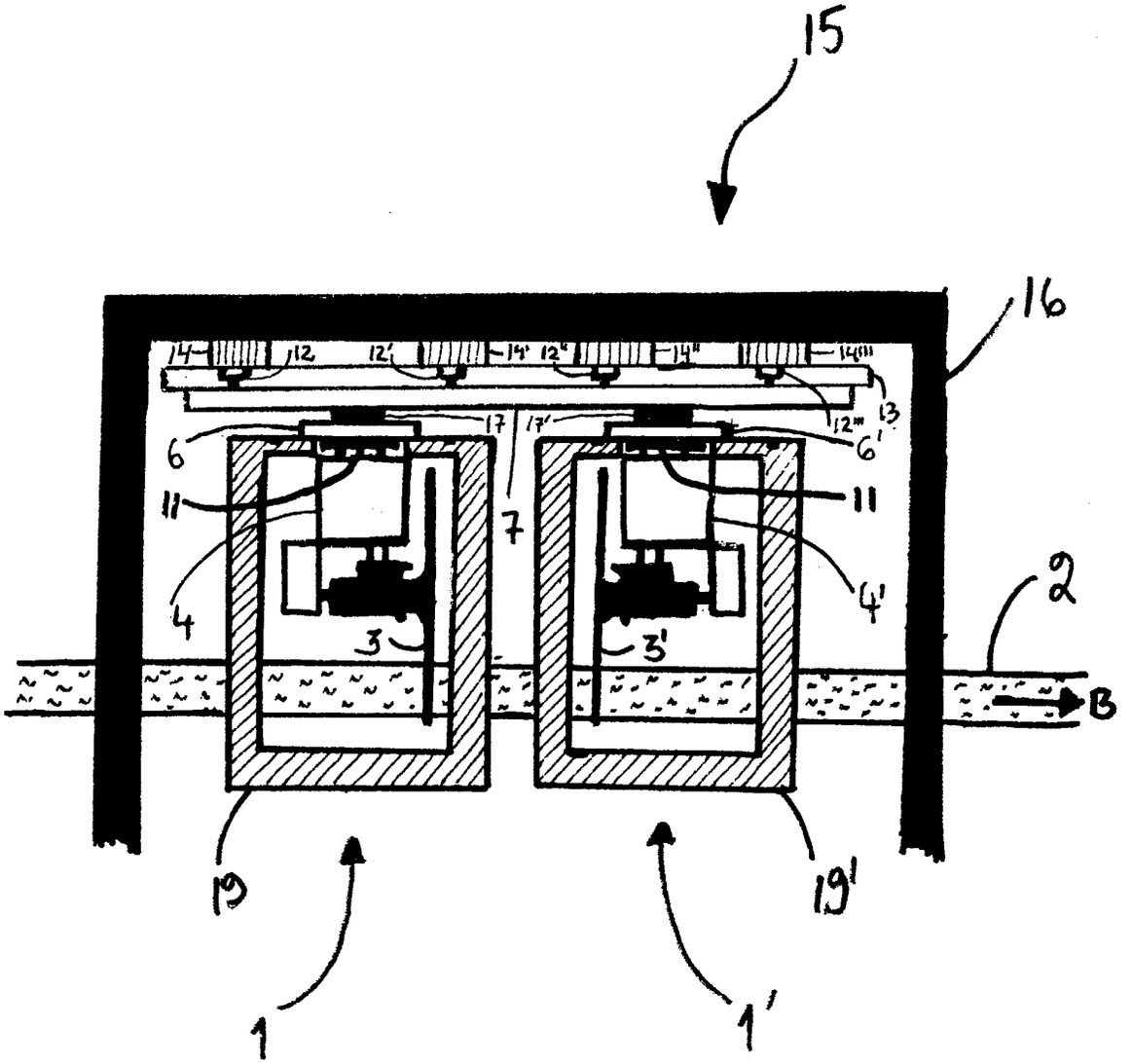

FIG. 2

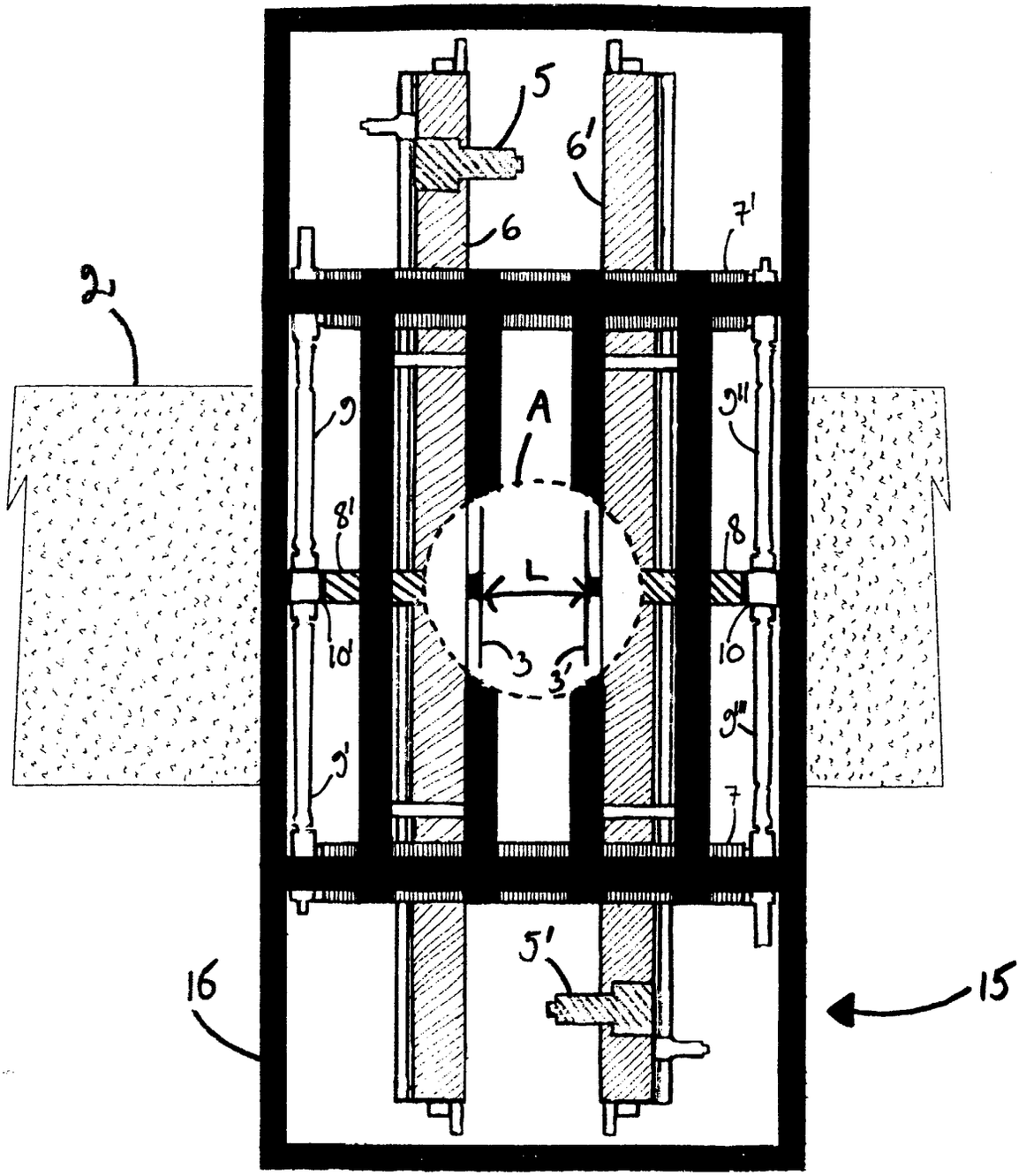

FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 39 6035

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	21 July 2003	Wimmer, M

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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