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(54) METHOD FOR FEEDING A PLURALITY OF YARNS TO A WARPING MACHINE AND APPARATUS FOR PERFORMING THE METHOD

(57) A creel (12) comprising a frame (16) which supports a battery of spools (14) arranged on multiple horizontal rows and a series of yarn guiding eyelets (18) arranged to guide and support the yarns along their path from the spools (14) to an output end (12c) of the creel (12). The yarns are fed to a warping machine (10) by respective yarn feeders (23), each of which comprises a yarn winding reel (24) which is individually motorized. The yarns in output from the spools (14) are diverted toward the output end (12c) by yarn guiding means. The yarn feeders (23) associated with a same row of spools (14) are all supported at the output end (12c) and are subjected to control means adapted to adjust the rotation rate of the yarn winding reels (24) as a function of the signals received from respective load cells (26) functionally arranged between the yarn winding reels (24) and the warping machine (10), so as to stabilize the tension of the respective yarns fed to the warping machine (10) at a fixed or variable preset level.

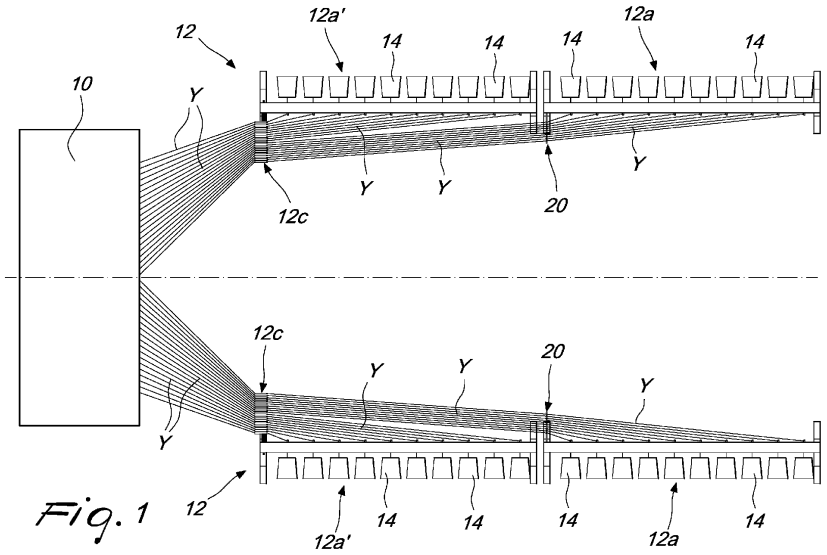

Fig. 1

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Description

[0001] The present invention relates to a method for feeding a plurality of yarns to a warping machine and an apparatus to perform said method.

[0002] As is known, a plurality of yarns can be conventionally fed to a warping machine by one or more creels.

[0003] A creel generally comprises a battery of spools which are supported by a frame extended on a vertical plane with their axes at right angles to said vertical plane. The spools are generally arranged in multiple vertically aligned horizontal rows, e.g., eight horizontal rows each containing one hundred spools, for a total of eight hundred spools supported by a single creel.

[0004] Typically, the warping machine can be fed by a pair of creels of the abovementioned type arranged in front of each other.

[0005] Considering the large number of spools in each row, the creels can have a longitudinal extension of several dozens of meters, e.g., thirty meters in the example described above.

[0006] In a simpler known solution, the warping machine picks up the yarns directly from the respective spools through a series of yarn guiding eyelets that are necessarily arranged to guide and support the yarns along their path toward the warping machine, which, as mentioned, depending on the position of the spool in the respective creel, can extend over several dozens of meters.

[0007] The main drawback of this solution is that it provides no control over the tension with which the yarn is fed to the warping machine.

[0008] More complex known solutions provide that each one of the yarns is taken up from its respective spool and transferred to the warping machine by a respective motorized pulley located proximately to the output end of the spool. Typically, the motorized pulley is arranged with a vertical axis so as to divert the yarn by 90° in the direction of the warping machine after a 3/4-turn winding.

[0009] In some known solutions, the rotation rate of the motorized pulley is controlled by a load cell placed immediately upstream of the warping machine, i.e., depending on the position of the spool in the respective row, a few meters to several tens of meters away from the motorized pulley.

[0010] One drawback of this solution is that the great distance between the load cell and the motorized cell inevitably impairs the precision of the adjustment, due to various factors that may bias the control, such as the frictions to which the yarn is subjected in passing through the yarn guiding eyelets interposed between the motorized pulley and the load cell, the elasticity of the yarn, and the like.

[0011] In other known solutions, a first load cell placed proximate to the motorized pulley controls the rotation rate of said pulley so as to maintain the tension at a preset level at the exit of the yarn from the spool, while a second load cell arranged directly upstream of the warping machine transmits control signals to the motorized pulley so as to stabilize the tension proximate to the warping machine at a programmed level.

[0012] This solution, as well as the previous one, has the drawback that the friction between the yarn and the yarn guiding eyelets inevitably increases the tension of the yarn downstream of the motorized pulley in an uncontrolled manner and with no possibility of reducing it. As a result, the tension at the warping machine cannot be adjusted below a certain value, which for some processes and/or types of yarn may be too high with respect to the requirements.

[0013] Moreover, since as a rule all the yarns must be fed at the same tension, this circumstance is particularly unwelcome since it forces to set the tension of all the yarns, even those that arrive from the spools closest to the warping machine and therefore less subject to friction, to the level of the yarns that arrive from the more distant spools, which for the above reasons may be too high.

[0014] Therefore, the aim of the present invention is to provide a method for feeding a plurality of yarns to a warping machine that overcomes the abovementioned drawbacks of the background art and, in particular, that makes it possible to adjust with high precision the actual tension at which the yarns are fed to the warping machine and, for each yarn, to set said tension to any value, even a relatively low one, regardless of the distance between the spool from which the yarn arrives and the warping machine.

[0015] An object of the invention is to provide an apparatus for performing the method described above.

[0016] This aim and objects and other advantages that will become more apparent hereinafter are achieved by a method having the characteristics described in claim 1, while the dependent claims define other advantageous, albeit secondary, characteristics of the invention.

[0017] The invention is now described in greater detail, with reference to some preferred but not exclusive embodiments thereof, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a plan view of an apparatus for feeding a plurality of yarns to a warping machine according to the invention;

Figure 2 is a plan view of a portion of the apparatus of Figure 1;

Figure 3 is a plan view of a further portion of the apparatus of Figure 1;

Figure 4 is a perspective view of the portion of the apparatus of Figure 3;

Figure 5 is a front view of the portion of the apparatus of Figure 3;

Figure 6 is a perspective view of a component of the apparatus according to the invention;

Figure 7 is a lateral view of the component of Figure 6;

Figure 8 is a view, similar to Figure 5, of a first alternative embodiment of the invention;

Figure 9 is a view, similar to Figure 5, of a second alternative embodiment of the invention;

Figure 10 is a view, similar to Figure 5, of a third alternative embodiment of the invention.

[0018] With initial reference to Figure 1, in a manner conventional per se a warping machine 10 receives a plurality of yarns Y from a feeding apparatus which comprises at least one creel but more commonly two creels 12 arranged one in front of the other as in the example shown here.

[0019] Each one of the creels 12 can generally have a modular structure, wherein each one of the modules 12a, 12a' (Figures 2-5) comprises a battery of spools 14 supported by a frame 16 which is extended on a generally vertical plane. In the embodiment described herein by way of example, the spools 14 are arranged with their axes at right angles to the vertical plane of the frame 16, but this aspect is not binding for the purposes of the invention.

[0020] The spools 14 are generally arranged in several horizontal rows, in the example shown here, eight horizontal rows each comprising ten spools, for a total of eighty spools 14 supported by each module 12a, 12a'. The rows of spools 14 are usually, but not necessarily, aligned in a vertical direction.

[0021] Although for the sake of clarity of illustration Figure 1 shows only the two modules 12a, 12a' closest to the warping machine 10, each one of the creels 12 can be composed of a larger number of modules arranged in series, e.g., ten modules, so that each one of them can support eight hundred spools in the example mentioned above.

[0022] The longitudinal extension of the creel 12 is therefore determined by the number of spools 14 that compose each row. In the abovementioned example, a creel composed of rows of one hundred spools can have a length of approximately thirty meters.

[0023] With particular reference now to Figure 2, a series of yarn guiding eyelets 18 anchored to the frame 16 is arranged in order to guide and support the yarns along their path from the respective spools 14 to a longitudinal output end 12c (Figure 1) of the creel 12.

[0024] In a manner conventional per se, the yarn guiding eyelets 18 that engage the yarns of a same row in a certain longitudinal position of the creel 12 are supported side by side to form an array 20 that conventionally can be extended at right angles to the vertical plane of the frame 16. For each row of spools 14, multiple arrays 20 of yarn guiding eyelets 18 can be provided at regular intervals. In this example of embodiment, as shown in detail in Figure 2 with reference to the second to last module before the longitudinal output end 12c of the creel 12, an array 20 of yarn guiding eyelets 18 is arranged at the output of each module 12a, except for the last module 12a'.

[0025] According to the invention, the yarns in output from the respective spools 14 are diverted toward the longitudinal output end 12c of the creel 12 by respective yarn guiding means and are fed to the warping machine 10 by respective yarn feeders 23 (Figures 3-7), each of which comprises a yarn winding reel 24 (Figure 6), which is individually motorized, the yarn feeders 23 associated with a same row of spools 14 being all supported at the longitudinal output end 12c of the creel 12 and being subjected to control means adapted to adjust the rotation rate of the yarn winding reels 24 as a function of the signals received from respective load cells 26 functionally arranged between the yarn winding reels 24 and the warping machine 10, so as to stabilize the tension of the respective yarns fed to the warping machine 10 on a preset fixed or variable level.

[0026] In the preferred embodiment described and illustrated herein, the yarn feeders 23 associated with a same row of spools 14 are arranged so that the axes of the respective yarn winding reels 24 are substantially perpendicular to the longitudinal extension of the creel 12.

[0027] In relation to the control means (not shown), each feeder 23 can incorporate a respective control unit, or all the feeders or groups thereof can be connected to a centralized control unit.

[0028] The provision of the control means is not discussed in depth here, since it is per se part of the normal knowledge of the person skilled in the art and is not part of the aim and objects of the present invention.

[0029] With particular reference to Figure 2, the yarn guiding means can comprise a ring 28 supported by the frame 16 in front of the output end of the respective spool 14.

[0030] As will become apparent in greater detail hereinafter, in a preferred embodiment described and illustrated herein, the load cells 26 are arranged so as to intercept the yarn directly downstream of the respective yarn winding reels 24.

[0031] As an alternative, the load cells 26 might be arranged to intercept the yarn directly upstream of the warping machine 10.

[0032] For the sake of clarity of illustration, Figures 2 and 3 show in dashed lines also some yarns Y that arrive from the previous modules not shown, together with the corresponding yarn guiding eyelets 18 and yarn feeders 23, while Figures 4 and 5 show only the feeders associated with the yarns supported by the last module 12a'.

[0033] Preferably, in order to contain space occupation, the yarn feeders 23 are provided with thin disc-shaped brushless motors (approximately 20 - 30 mm thick, substantially corresponding to the width of a conventional yarn guiding eyelet 18) of the known type provided with an inner stator with windings and a magnetic outer rotor, with the yarn winding reel 24 keyed directly on the rotor.

[0034] Figures 6 and 7 show an example of embodiment of a yarn feeder 23 according to what has been described above.

[0035] The yarn feeder 23 of this example of embodiment comprises a fork-like support 32 which is provided with two parallel plates 32a, 32b between which the yarn winding reel 24 is supported. As mentioned above, the yarn winding reel 24 is keyed directly on the rotor of the motor 34 (shown only schematically in dashed lines in Figure 7).

[0036] The yarn arriving at the yarn feeder 23 passes through an input eyelet 36 fixed to the fork-like support 32, is wound on the yarn winding reel 24, engages the load cell 26, which in this preferred embodiment is incorporated in the yarn feeder 23 and is supported between the two plates 32a, 32b, and finally passes through an output eyelet 38 also fixed to the fork-like support 32 between two protrusions 32'a, 32'b of the plates 32a, 32b, respectively.

[0037] In this manner, multiple yarn feeders 23 can be arranged coaxially side by side, occupying in an axial direction substantially the same space as is occupied by the same number of yarn guiding eyelets 18, as shown in Figure 1.

[0038] In a preferred embodiment, the yarn feeders 23 are arranged with a horizontal axis.

[0039] Advantageously, depending on the space occupations and the available spaces, the yarn feeders 23 of a same row are all coaxial as shown in Figure 5 or, as shown in the alternative embodiment in Figure 8, divided into two or more parallel groups of coaxial yarn feeders 123, the groups being superimposed on a vertical plane substantially at right angles to the direction of arrival of the yarns.

[0040] In another embodiment, shown in Figure 9, the yarn feeders 223 are arranged with the respective yarn winding reels with a vertical axis, and the ones associated with a same row of spools are divided into small groups, for example groups of five feeders arranged one above the other.

[0041] In a further embodiment, shown in Figure 10, the yarn feeders 323 associated with a same row of spools are all coaxial and arranged with an oblique axis.

[0042] It has been found, also in practice, that the method according to the invention fully achieves the intended aim and objects. In particular, by arranging the yarn winding reels at the output end of the creel, the different frictions to which the different yarns are subjected in passing through the yarn guiding eyelets do not affect the actual tension with which the yarn is fed to the warping machine, since the rotation rate of each one of the yarn winding reels is adjusted individually downstream of the creel according to the signal received from the respective load cell, so that the feeding tension is maintained at the desired level, regardless of the tension of the yarn upstream of the feeder.

[0043] Moreover, again according to the intended aim and objects, with the method according to the invention the tension of the yarns can be set at any value, even a relatively low one, since between the yarn winding reels and the warping machine the yarn is no longer subject to frictions that can increase the tension appreciably.

[0044] Some preferred embodiments of the invention have been described herein, but naturally the person skilled in the art may apply various modifications or variations within the scope of the claims.

[0045] In particular, the embodiments described herein may give rise to additional combinations, not shown, all of which are within the scope of the invention. For example, the partition of the yarn winding reels associated with yarns of the same row into groups can also be performed when the yarn winding reels are arranged with oblique axes.

[0046] Moreover, although the method and the apparatus described here are particularly suitable for feeding yarns to warping machines, they might also find application in other areas with similar problems, e.g., for feeding yarns to rectilinear knitting machines.

[0047] Of course, the feeders might be fixed to the frame of the creel as in the example shown here or supported by an independent structure.

[0048] The disclosures in Italian Patent Application No. 102022000007784 from which this application claims priority are incorporated herein by reference.

[0049] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A method for feeding a plurality of yarns to a warping machine from at least one creel (12) which comprises a frame (16) which supports a battery of spools (14) arranged on multiple horizontal rows and a series of yarn guiding eyelets (18) arranged to guide and support the yarns along their path from the respective spools (14) to a longitudinal output end (12c) of the creel (12), each one of said yarns being fed to the warping machine (10) by a respective yarn feeder (23) which comprises a yarn winding reel (24) which is individually motorized, **characterized in that** the yarns from the respective spools (14) are diverted toward said longitudinal output end (12c) by respective yarn guiding means, the yarn feeders (23) associated with a same row of spools (14) being all supported at said longitudinal output end (12c) and being subjected to control means adapted to adjust the rotation rate of the yarn winding reels (24) as a function of the signals received from respective load cells (26) functionally arranged between the respective yarn winding reels (24) and the warping machine (10), so as to stabilize the tension of the respective yarns fed to the warping machine (10) on a fixed or variable preset level.

2. The method according to claim 1, **characterized in that** the yarn feeders (23) associated with a same row of spools (14) are arranged so that the axes of the respective yarn winding reels (24) are substantially perpendicular to the longitudinal extension of the creel (12).

3. The method according to claim 1, **characterized in that** the yarn winding reels (24) of a same row are all coaxial.

4. The method according to claim 1, **characterized in that** the yarn winding reels (24) of a same row are divided into two or more parallel groups of coaxial yarn winding reels (24).

5. The method according to claim 3 or 4, **characterized in that** said yarn winding reels (24) are arranged with horizontal axes.

6. The method according to claim 4, **characterized in that** the yarn winding reels (24) are arranged with vertical axes.

7. The method according to claim 3 or 4, **characterized in that** the yarn winding reels (324) are arranged with oblique axes.

8. The method according to claim 1, **characterized in that** said load cells (26) intercept the yarns directly downstream of the respective yarn winding reels (24).

9. The method according to claim 1, **characterized in that** said load cells (26) intercept the yarns directly upstream of the warping machine (10).

10. An apparatus for feeding a plurality of yarns to a warping machine, comprising at least one creel (12) provided with a frame (16) which supports a battery of spools (14) arranged on multiple horizontal rows and a series of yarn guiding eyelets (18) arranged so as to guide and support the yarns along their path from the respective spools (14) to a longitudinal output end (12c) of the creel (12), each one of said yarns being fed to the warping machine (10) by a respective yarn feeder (23) which comprises a yarn winding reel (24) that is motorized individually, **characterized in that** the yarn feeders (23) associated with a same row of spools (14) are all supported at said longitudinal output end (12c), and **in that** it comprises

    - yarn guiding means arranged so as to divert the yarns from the respective spools (14) toward said longitudinal output end (12c),
    - for each one of said feeders (23), a load cell (26) functionally arranged between the respective yarn winding reel (24) and the warping machine (10),
    - control means adapted to adjust the rotation rate of each one of said yarn winding reels (24) as a function of the signals received from the respective load cell (26), so as to stabilize the tension of the respective yarn fed to the warping machine (10) on a fixed or variable preset level.

11. The apparatus according to claim 10, **characterized in that** the yarn feeders (23) associated with a same row of spools (14) are arranged so that the axes of the respective yarn winding reels (24) are substantially perpendicular to the longitudinal extension of the creel (12).

12. The apparatus according to claim 11, **characterized in that** said yarn guiding means comprise a ring (28) which is supported by said frame (16) in front of the output end of the respective spool (14).

13. The apparatus according to claim 11 or 12, **characterized in that** said load cells (26) are incorporated in the respective yarn feeders (23).

14. The apparatus according to one or more of claims 11-13, **characterized in that** each one of said yarn feeders (23) is provided with a thin disc-shaped brushless motor (34) provided with an inner stator with windings and a magnetic outer rotor, said yarn winding reel (24) being keyed directly on the rotor.

15. The apparatus according to claim 14, **characterized in that** each one of said yarn feeders (23) comprises a fork-like support (32) which is provided with two parallel plates (32a, 32b) between which said winding reel (24) and said load cell (26) are supported, and to which an input eyelet (36) and an output eyelet (38) are fixed respectively upstream of said yarn winding reel (24) and downstream of said load cell (26).

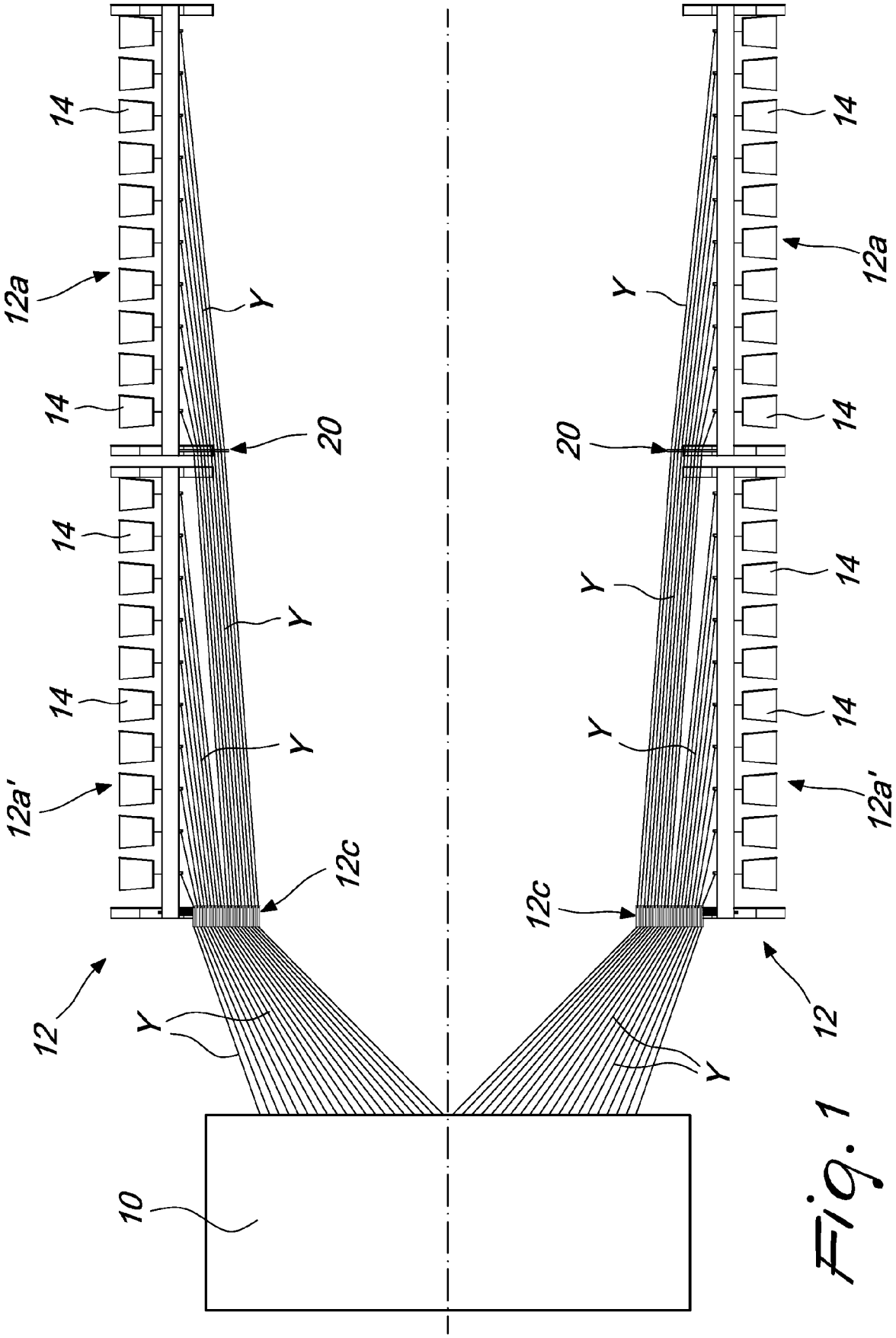

Fig. 1

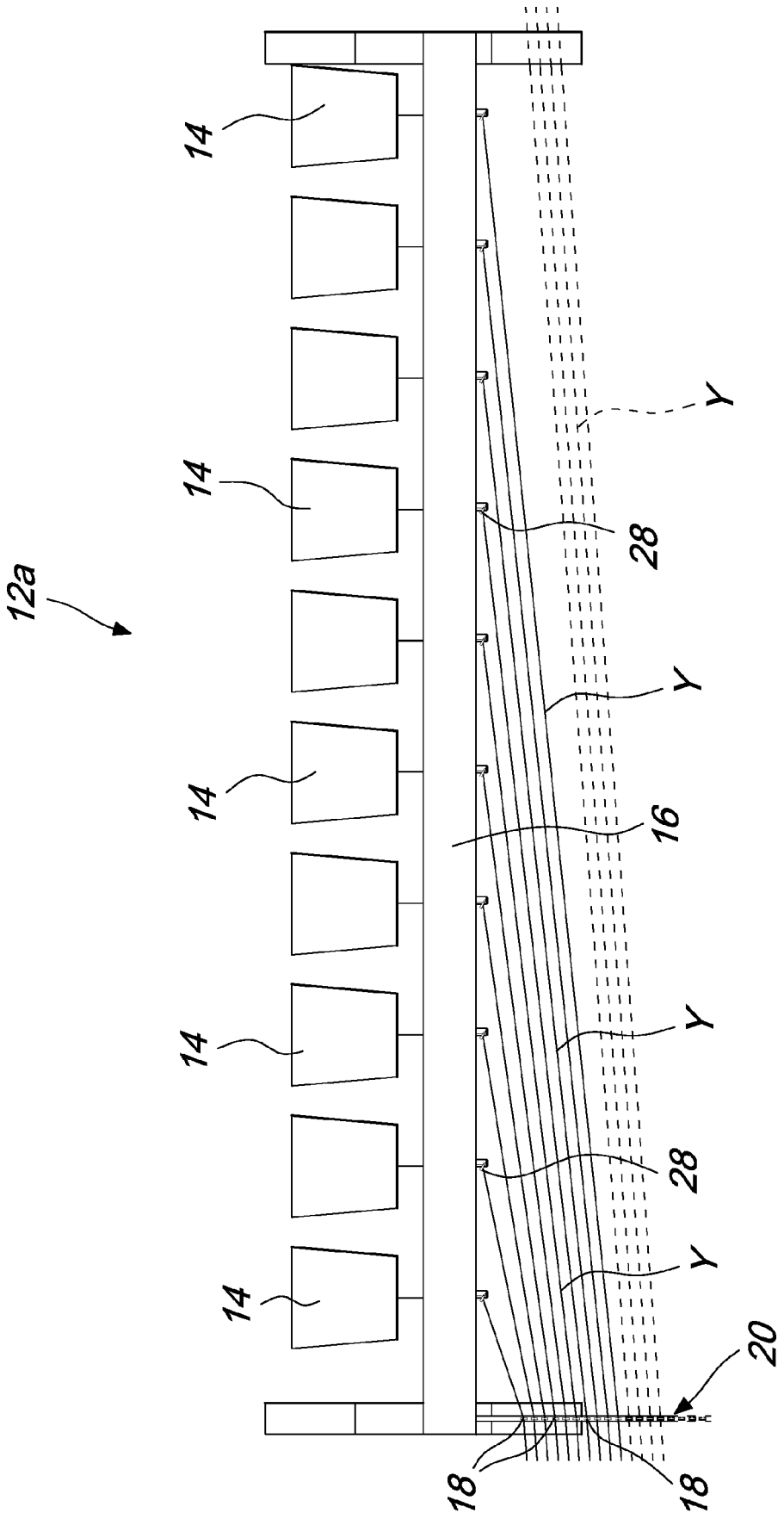

Fig. 2

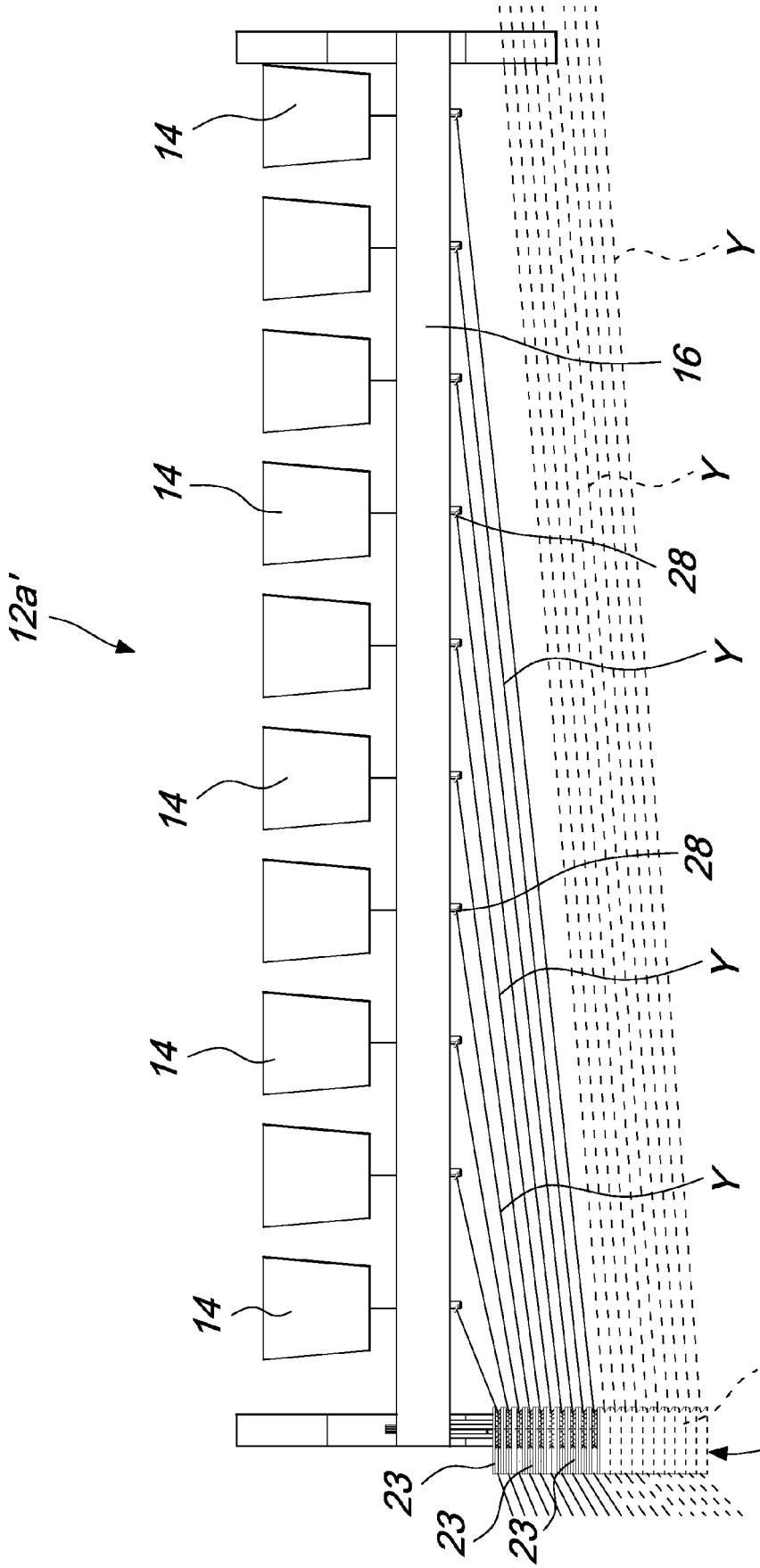

Fig. 3

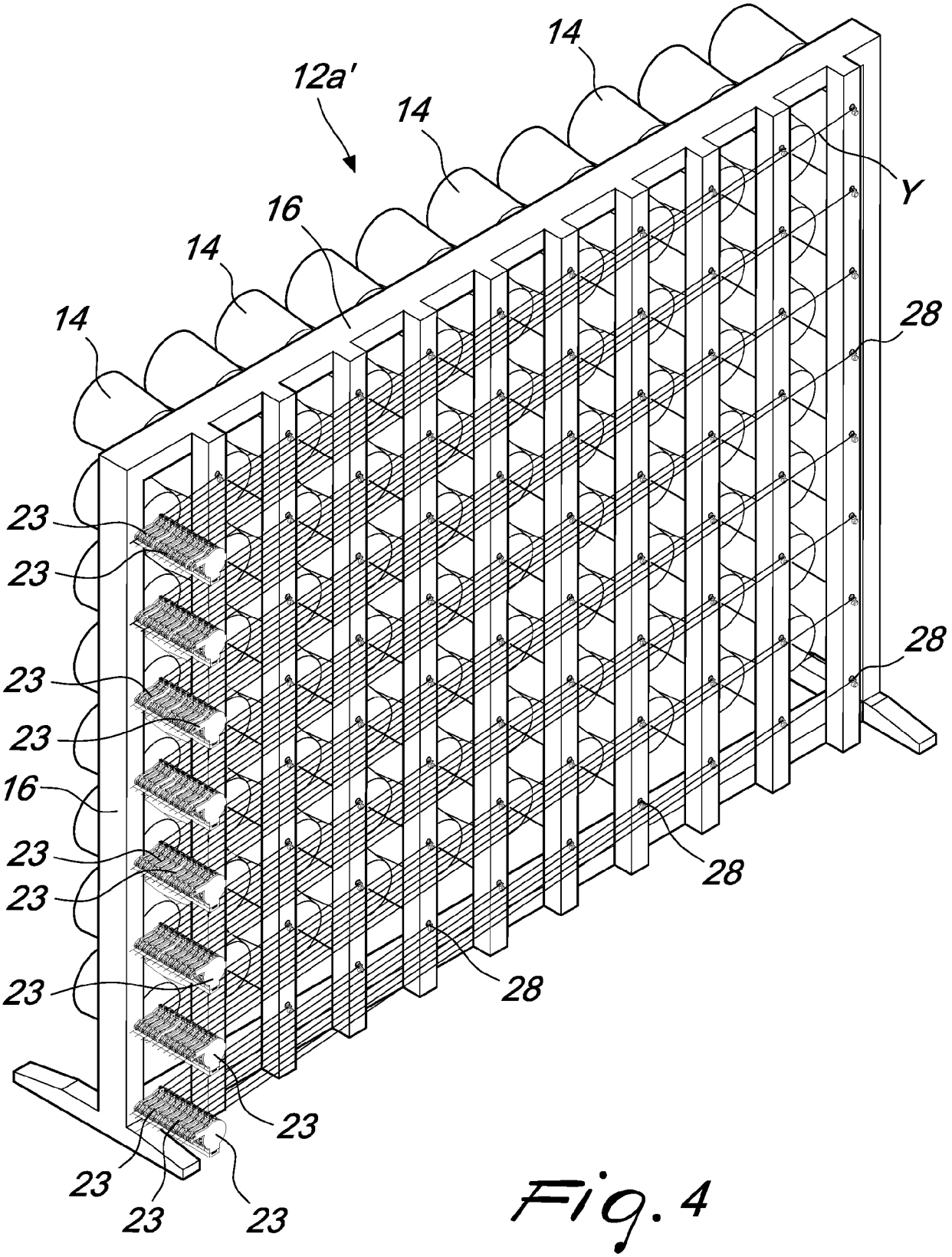

Fig. 4

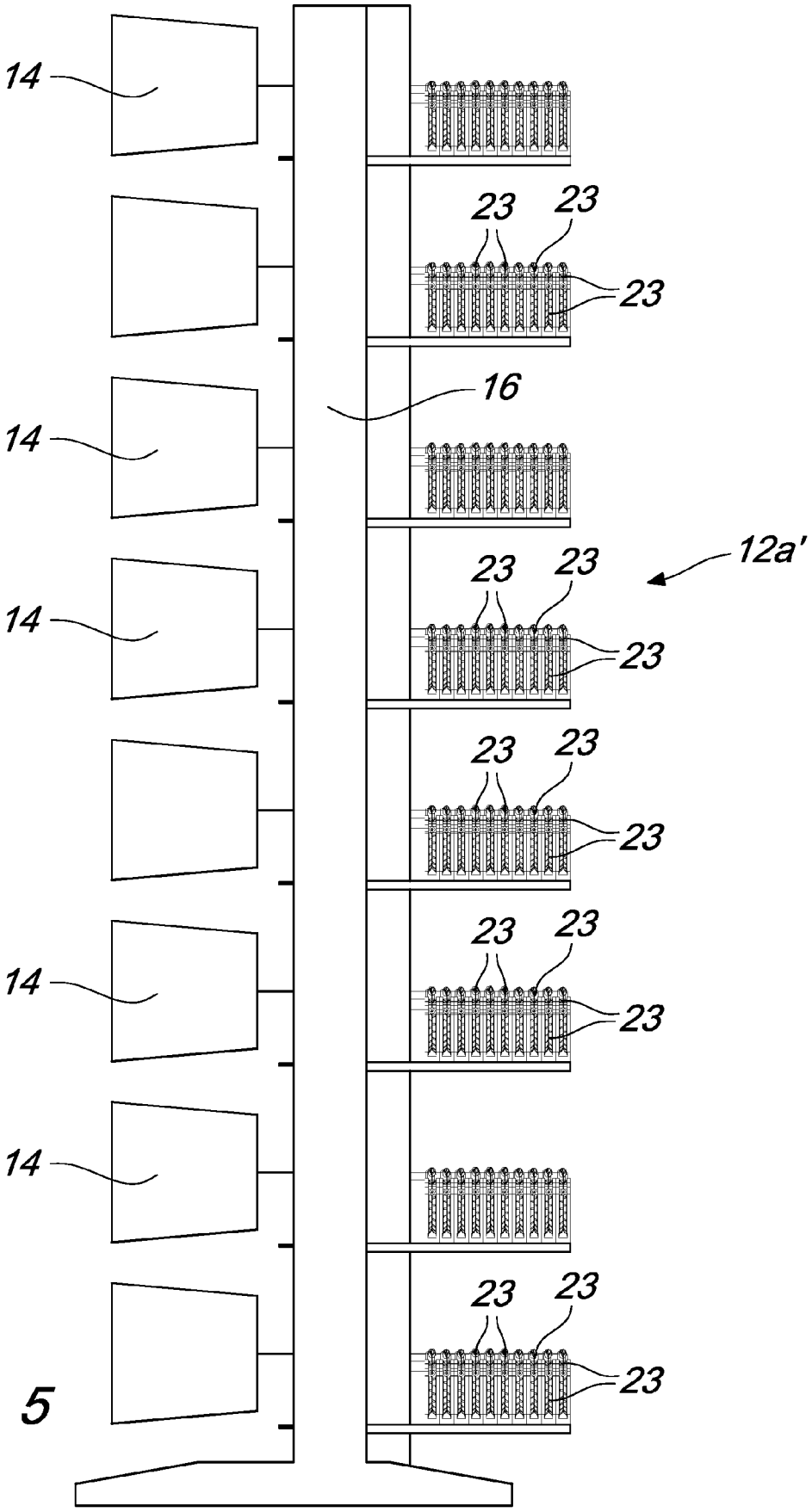

Fig. 5

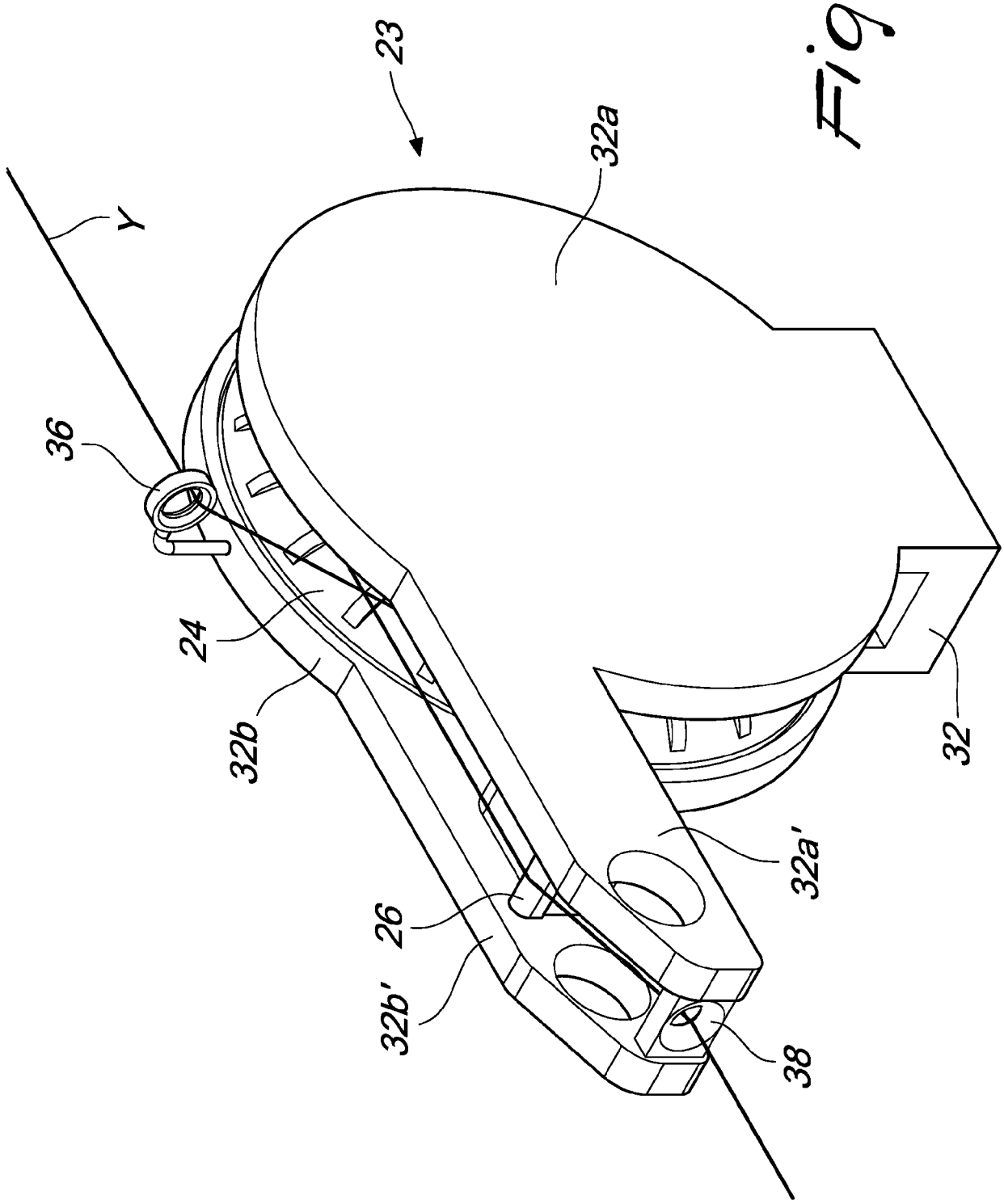

Fig. 6

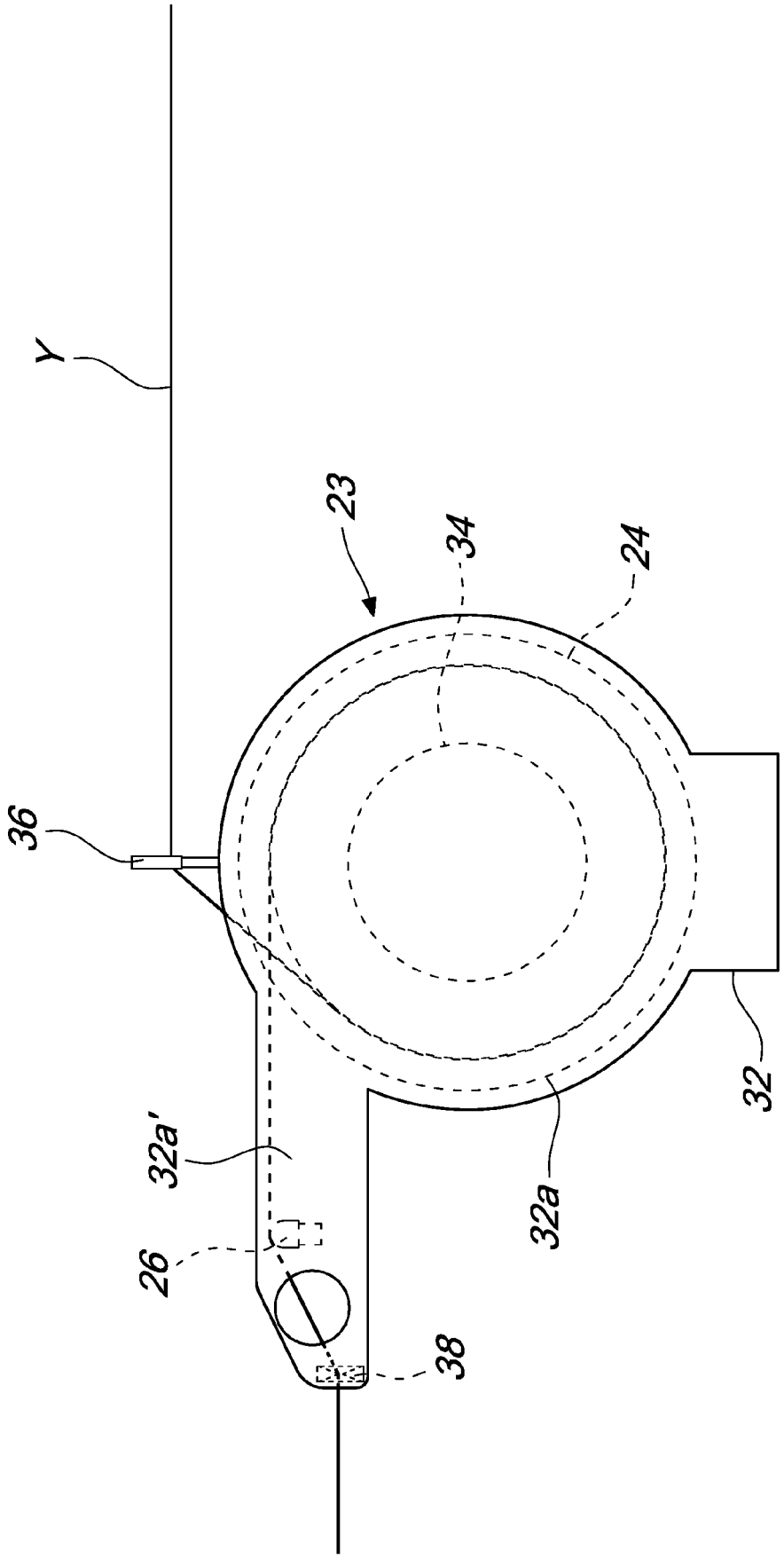

Fig. 7

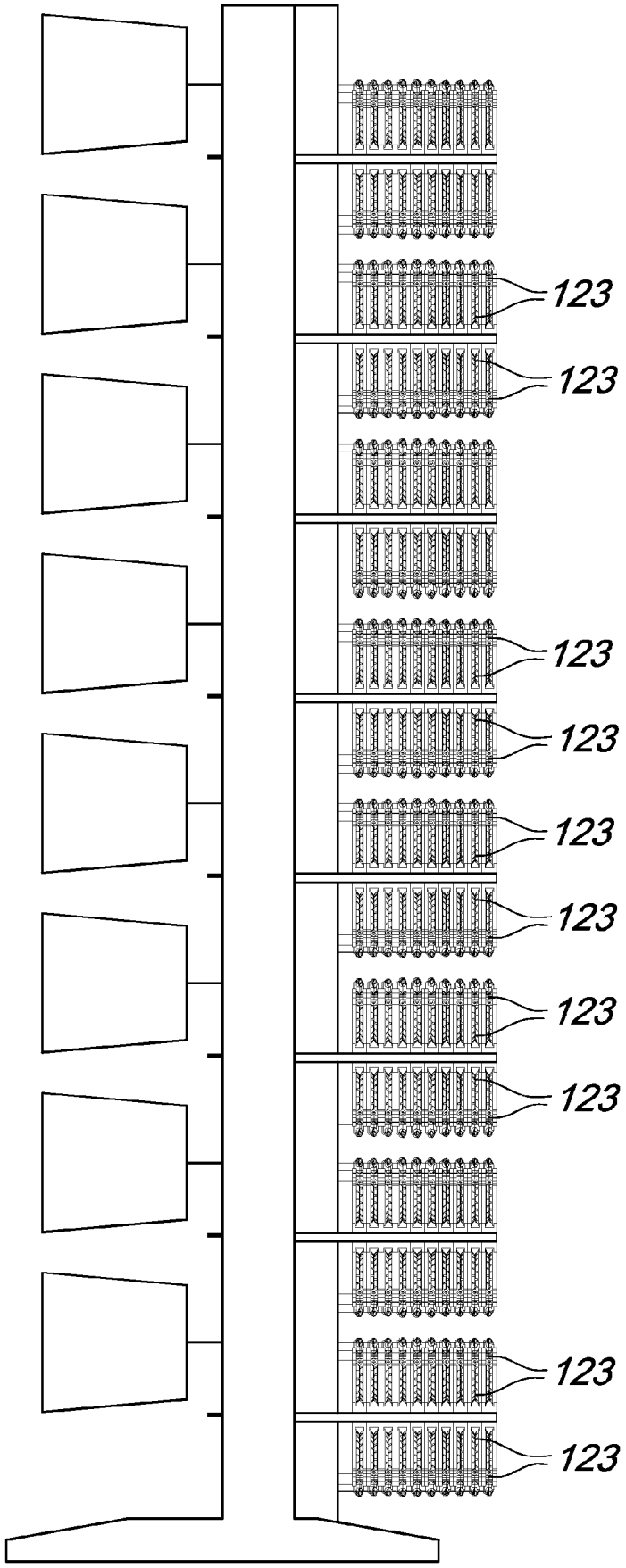

Fig. 8

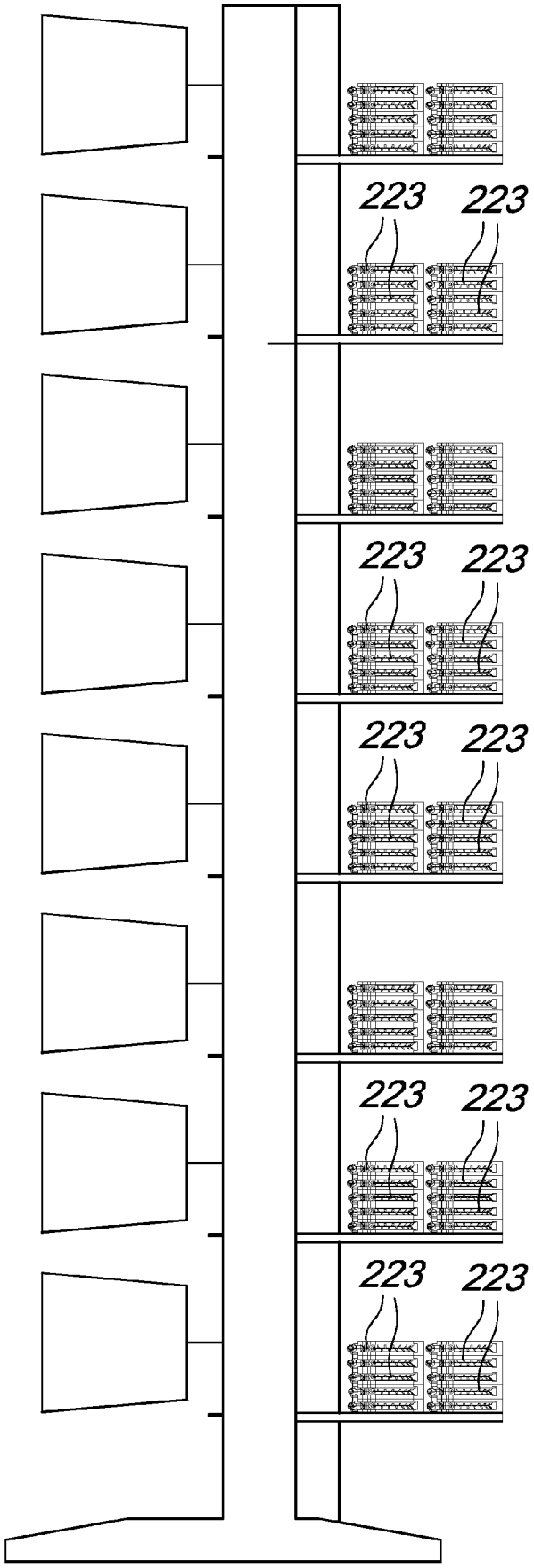

Fig. 9

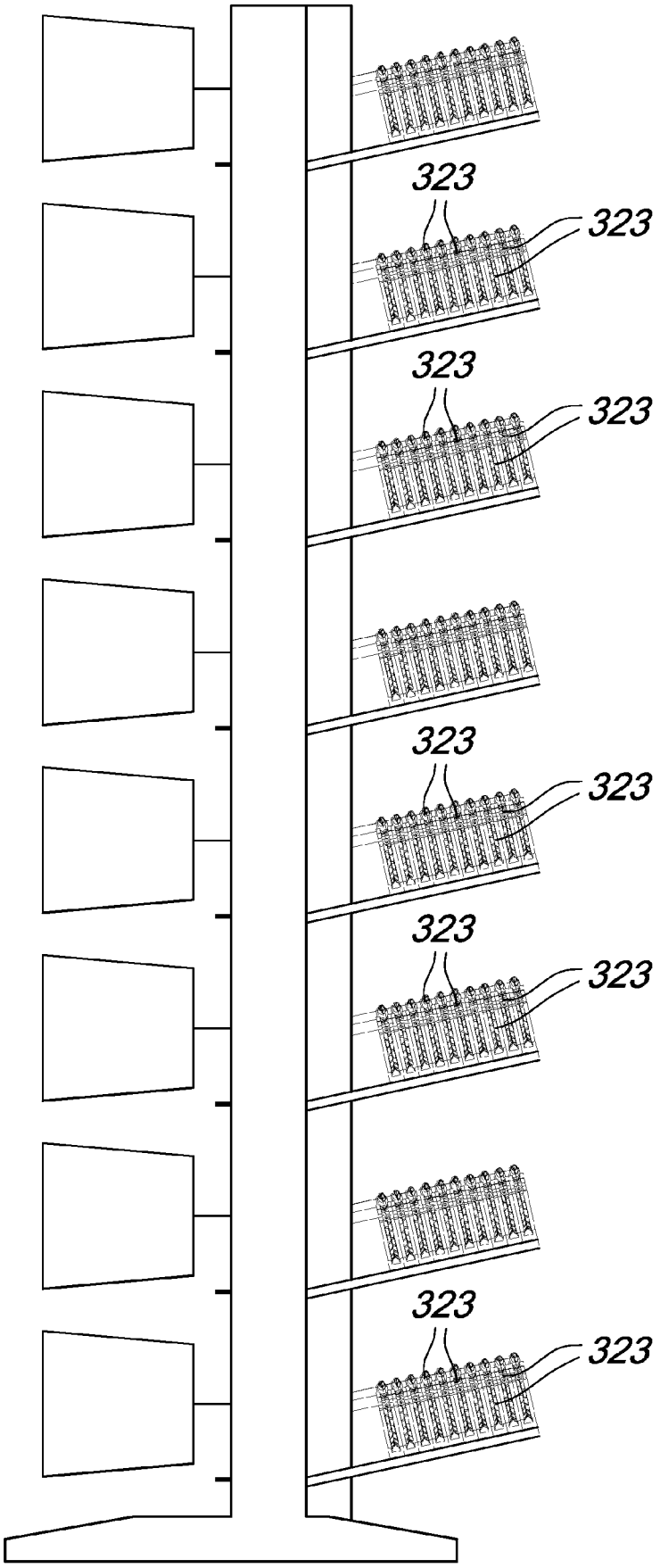

Fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 23 16 5702

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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	29 August 2023	Hausding, Jan

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 16 5702

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