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(54) Self-acting mule

(57) Self-acting mule (10) used to produce yarns in general, and particularly for the production of quality yarns in weaving and knitwear. The self-acting mule (10) consists of at least two sections of machine, respectively left (11) and right (12), independent from each other from

the mechanical point of view, and each comprising at least a relative spool-bearing carriage (19a, 19b), relative spindles (14), relative cylinders (21a, 21b), relative fallers (24a, 24b), relative counter-fallers (26a, 26b), and relative drums for unwinding the spools (23a, 23b).

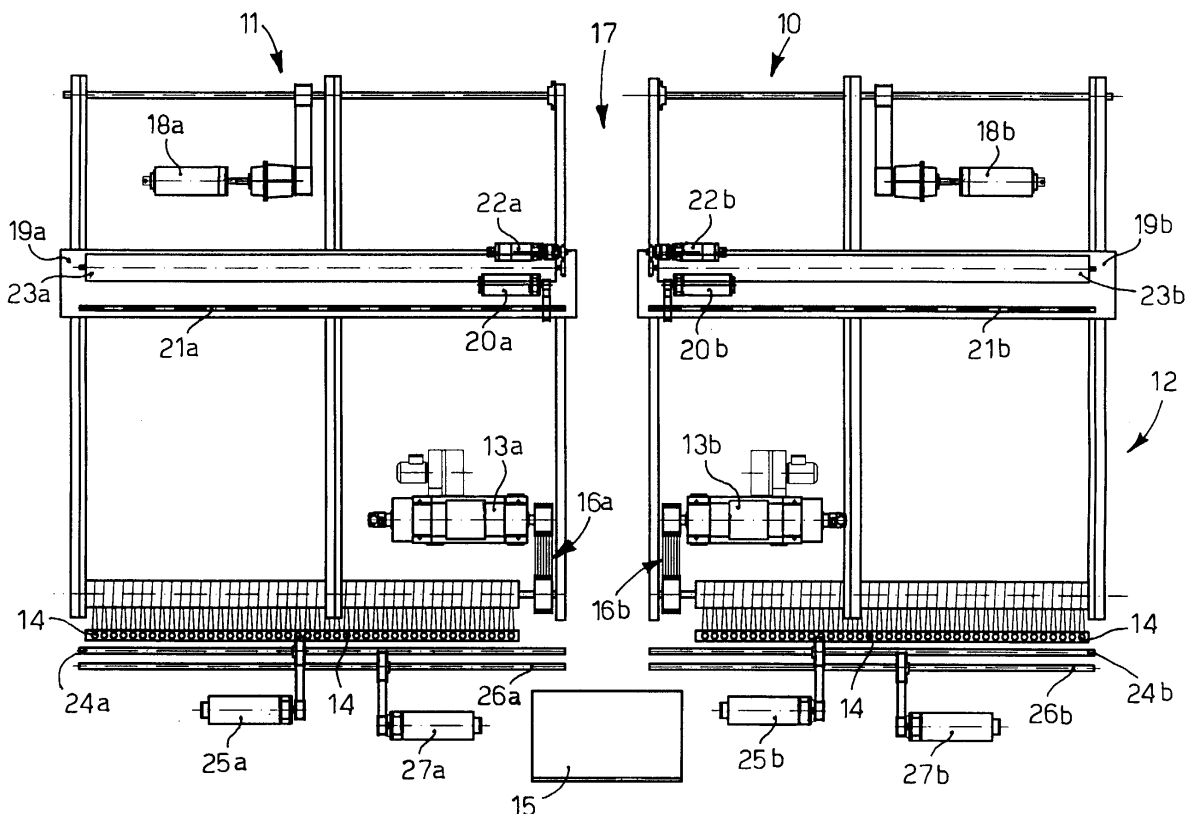


fig. 2

Description

FIELD OF THE INVENTION

[0001] The present invention concerns a self-acting mule used to produce yarns in general, and in particular for the production of quality yarns in weaving and knitwear.

BACKGROUND OF THE INVENTION

[0002] Self-acting mules of a known type, in order to be productive, need some automatisms for loading the product to be worked (roving) and to unload the finished product (yarn). These devices, although they are expensive, make the machine more productive and reduce downtimes. To keep the working and the characteristics of the yarn as constant as possible, normally the tendency is to load a self-acting mule with doffings obtained from the same cardroom line (assortment). For this reason, normally, a self-acting mule is assigned to a single assortment of cards. In order to carry out the production, present day self-acting mules need an electric power of about 100 kW, with peaks of absorption that reach up to 140% of the power involved, while the average consumption remains around 50%. The machine, due to its intrinsic construction, has an intermittent functioning characterized by frequent accelerations and decelerations.

[0003] Self-acting mules of a known type are at present moved by a plurality of motors and commanded, as a single body, by an electronic control unit which manages and guarantees the uniformity of working.

[0004] The system to move the machine consists of the following essential elements:

- carriage motor. The carriage extends the roving to be worked during the opening step and allows to recover the yarn on the spindle in the closing step;
- spindle motor. The spindle imparts the torsions during the opening step and winds the yarn onto the spool during the closing step;
- feed motor. This provides feed to the roving during the opening step, according to the draft set, simultaneously with the torsions imparted (solution with a single motor). In this case the motion of the drums derives mechanically from that of the cylinder;
- cylinder motor and drum motor. Suitably synchronized, they provide feed to the roving during the opening step, according to the draft set, simultaneously with the torsions imparted (solution with two motors);
- counter-faller motor or motors. In the closing step of the self-acting mule, during the winding of the yarn onto the spindle (spooling), they regulate the winding tension responsible for the level of compactness of the spool;
- faller motor or motors. In the closing step of the self-acting mule, during spooling, they position the yarn

according to the laws responsible for the geometry of the spindle.

[0005] In order to achieve the movements described above, a number of motors is therefore used which can vary from a minimum of 5 to a maximum of 8 according to the number of spindles present on the self-acting mule. The solution with 7 motors is normally the one most used.

[0006] Traditional self-acting mules, an example of which is shown in fig. 1, normally comprise a single structure consisting of a central part, and two sections, respectively right and left, which develop from the central part in a substantially symmetrical fashion. In machines with a number of spindles of less than 600, the central part houses the following motors or actuators:

- a first motor, indicated by the reference number 100, for the spool-bearing carriage;
- a second motor 101 for the feed cylinder;
- a third motor 102 for the drums unwinding the roving;
- a fourth motor 103 to command the spindles;
- a fifth motor 104 to move the spooling faller; and
- a sixth motor 105 to move the counter-faller as a member for tensioning the spooling yarn.

[0007] For machines with a larger number of spindles, it is also provided to replace the faller and counter-faller motors 104 and 105 with two pairs of respective motors, positioned substantially at the center of the relative left and right sections.

[0008] All these motors move the self-acting mule, intended as a single body, and are commanded by a single controller 106 which, moment by moment, imparts thereto the movement trajectories so as to guarantee constant working.

[0009] All this is normally obtained by using motors and/or actuators available on the market. According to needs, in fact, both DC, brushless and asynchronous motors are used, and also pneumatic pistons.

[0010] The working cycle of a self-acting mule provides to completely load the machine with the spools and then to head the rovings on the corresponding spindle. This operation requires a time T proportional to the number of spindles, during which the machine does not produce.

[0011] When the preparation is finished, the self-acting mule is started, beginning the production cycle. With every opening and closing a quantity of yarn is spun and collected on the spindle, which depends on the length of the draw. The spindle is ended after a certain number of operations in a time closely connected to the count of the yarn and type of material. During the working there are a number of stops due to the breakage of the yarns which cannot be re-knotted while the machine is in movement. At present, every time the machine stops due to the breaking of the yarns, this involves all the spindles.

[0012] From the energy point of view, the most wasteful shaft is the spindle shaft where a motor of about 100 kW of nominal power is used to accelerate and decelerate

the spindles. During these steps there are energy pick-ups equal to about 140% of the nominal power.

[0013] Two or three doffings are necessary from the terminal part of the carding plant, called divider, in order to load a self-acting mule. The end of batch must be managed so as to load the spinning mill with card bobbins of the same size so as to minimize waste. This operation is difficult to manage for small lots. The possibility of loading and working a single doffing at a time solves the problem of managing the end of batch. For the reasons described above, it is clear that a traditional self-acting mule has intrinsic limits in flexibility, production and energy use which are more considerable in proportion to the higher number of spindles mounted on the machine.

[0014] Purpose of the present invention is to improve the performance of traditional self-acting mules, making said self-acting mule more flexible and more productive, with reduced downtimes.

SUMMARY OF THE INVENTION

[0015] The present invention is set forth and characterized in the main claim, while the dependent claims describe other characteristics of the main inventive idea.

[0016] According to the present invention, the self-acting mule consists of at least two sections of machine with an equal or different number of spindles, respectively right and left, which are completely independent from each other from a mechanical point of view.

[0017] When we refer to the independent sections of the machine the number of two is preferred but not limiting; in fact, the independent sections of the machine could be also three, four or more, with the same characteristics disclosed hereafter with reference to the preferred embodiment.

[0018] According to the present invention, the shafts which, in traditional self-acting mules, move at least the carriage, the spindles, the cylinder and the drums, are divided into two parts, independent of each other, and are moved, for each side of the machine, with its own motor. In this way, each motor can thus be sized with a power proportional to the number of spindles.

[0019] In a preferential solution, the faller and the counter-faller have their own motors disposed substantially at the center of each individual section.

[0020] The self-acting mule according to the invention also uses, in the preferential embodiment having two independent sections:

- two motors, each with a nominal power less than the motor used in traditional self-acting mules, to command the spindles: a first motor for the left section and a second motor for the right section;
- two motors, each with a nominal power less than the motor used in traditional self-acting mules, to command the two sections of the spool-bearing carriage;
- two motors, each with a nominal power less than those used in traditional self-acting mules, to com-

mand the left and right cylinder and drums.

[0021] According to a variant, two motors are used to command the cylinder, respectively left and right, and two motors to command the left and right drums.

[0022] According to the invention, a single control unit may also be present, which manages and coordinates the functioning of the at least two independent units, or, according to a variant, each section is equipped with its own autonomous control unit.

[0023] In this way, the self-acting mule according to the invention no longer consists of a single section, individually commanded, but becomes a machine with at least two sections, completely separate and independent from each other.

[0024] Considerable saving is obtained when the two independent sections share the same control unit and the same electric command panel. In this case, inside the electric panel the power of the right section is managed separately from the power of the left section and the control is performed by a suitable software suitable to manage them as two completely separate entities, while respecting the safety norms currently in force.

[0025] The solution described above gives the following advantages.

[0026] Firstly, there is an increase in production, which derives from the possibility of loading and starting the at least two sections separately, halving the downtime necessary to prepare the machine and rendering the purchase of automatisms superfluous. The stoppages necessary to recover the broken yarns, because they involve only a part of the machine, considerably reduce the losses of production due to this problem. The limited size of the two segments allows to pick up a greater dynamism compared with a traditional self-acting mule, with an increase in acceleration and in speeds.

[0027] Secondly, there is an increase in the quality of the product. This derives from the fact that each of the two sections of the machine can be governed by a divider and hence can be loaded with the rovings of a single doffing, reducing the difficulty in keeping the production parameters constant over time.

[0028] The better quality also derives from a better overall dynamics and a lower torsion on the cross shaft of the carriage, which is due to the better position of the motor in the center of the respective section with respect to the traditional position situated at the center of the entire self-acting mule. In fact, all the advantages found in a short machine are obtained, but with the advantage of also obtaining an extremely high production capacity.

[0029] Another advantage derives from the reduction in the use of energy.

[0030] The self-acting mule with at least two independent sections according to the invention is in fact characterized by:

- lower energy pick-ups, since the peaks of absorption on the right side are not generally simultaneous with

those on the left side;

- less use of power, since the power involved is about 20% less than the consumption of a traditional self-acting mule. As an additional advantage, this allows to sign more advantageous contracts with the power supply company.

[0031] The most obvious advantage of the self-acting mule with at least two independent sections derives from the considerable increase in versatility.

[0032] In fact, the two sections can be supplied with a different number of spindles. For example, a machine having an overall number of 660 spindles can be supplied with the right section having 440 and the left with 220 spindles, so as to load them respectively the right with two doffings of the divider and the left with only one doffing.

[0033] Moreover, the two sections can be used together or separately.

[0034] Furthermore, the two sections can be assembled aligned with each other, one opposite the other or even angled, for example at 90°, for a better use of the spaces according to the specific requirements of adaptation and application.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] The attached drawings are given as a non-restrictive example and show, respectively, fig. 1 a traditional self-acting mule and fig. 2 a self-acting mule according to the present invention.

DETAILED DESCRIPTION OF THE PREFERENTIAL EMBODIMENT

[0036] With reference to fig. 2, a self-acting mule according to the present invention is indicated in its entirety by the number 10. The self-acting mule 10 of the preferential embodiment consists of two sections, respectively left 11 and right 12, independent of each other from the mechanical point of view, which in this case share a control unit 15 with a relative electric panel. It comes within the field of the invention that each section 11 and 12 may dispose of its own autonomous control unit and its own electric panel.

[0037] The two sections 11 and 12 are complete with every component of a normal self-acting mule of the traditional type, such as spindles, cylinders, fallers, counter-fallers, drums for unwinding the spools, spool-bearing carriage, etc, which are driven as described hereafter.

[0038] The two sections 11 and 12 may also have similar sizes and be disposed substantially in line with each other, as in the case shown here, that is, they may have sizes even very different from each other, and may be disposed one opposite the other or angled with respect to each other.

[0039] Each of the two sections 11 and 12 comprises, as main drive elements, a relative motor, respectively

indicated by 13a for the left section 11 and 13b for the right section 12, suitable to command the spindles 14, commanded by a system of belts and pulleys 16a, 16b.

[0040] The motors 13a, 13b are positioned in proximity with the central zone 17 which divides the two sections 11 and 12.

[0041] Each of the two sections 11 and 12 also comprises a relative motor, respectively 18a for the right section 11 and 18b for the left section 12, suitable to command the two sections, respectively left 19a and right 19b, of the spool-bearing carriage.

[0042] Said motors 18a and 18b, in the case shown here, are positioned one substantially half-way along the left section 11 and substantially half-way along the right section 12.

[0043] Each of the two sections 11 and 12 also comprises, in this case, a respective motor 20a, 20b to command the relative cylinder, left 21a and right 21b, and a respective motor 22a, 22b to command the relative left 23a and right 23b drums.

[0044] According to a variant not shown, the drums 23a and 23b are mechanically driven by the motion of the relative cylinder, 21a and 21b respectively.

[0045] The motors 20a, 20b, and 22a, 22b are substantially positioned in the central part 17 of the self-acting mule 10.

[0046] With regard to the drive of the relative fallers 24a, 24b, each of the two sections 11, 12 comprises a relative motor 25a for the left section 11 and 25b for the right section 12, while with regard to the drive of the relative counter-fallers 26a, 26b, each of the two sections 11, 12 comprises a relative motor 27a for the left section 11 and 27b for the right section 12.

[0047] In this case, the motors 25a and 27a are disposed substantially at the center of the respective left section 11 while the motors 25b, 27b are disposed substantially at the center of the respective right section 12.

[0048] The possibility of housing all the above-mentioned motors in different positions from those indicated obviously comes within the field of the invention.

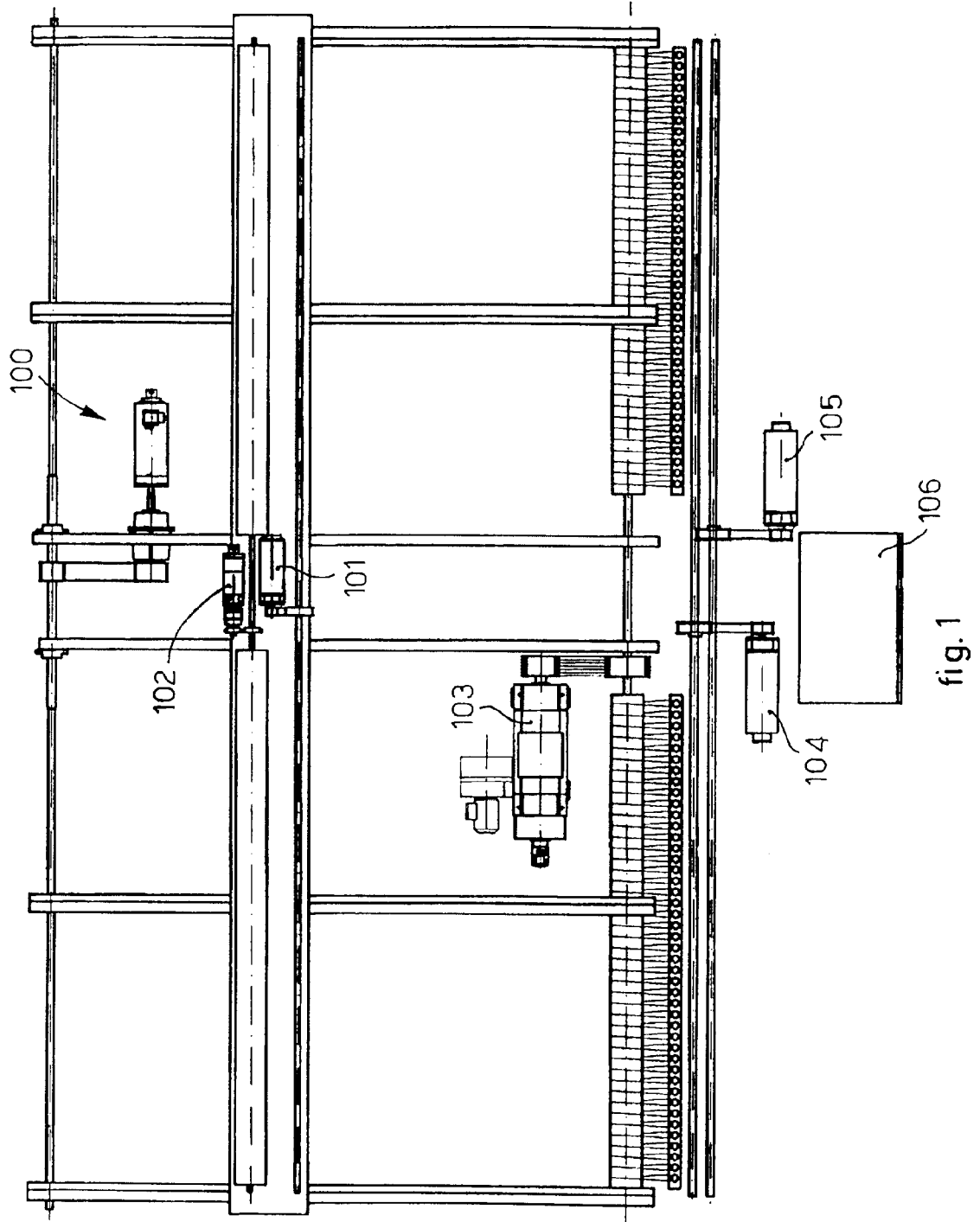
[0049] Modifications and variants may be made to the present invention, which come within the field of protection as defined by the attached claims.

Claims

1. Self-acting mule used to produce yarns in general, and particularly for the production of quality yarns in weaving and knitwear, **characterized in that** said self-acting mule (10) consists of at least two sections of machine, respectively left (11) and right (12), independent from each other from the mechanical point of view, and each comprising at least a relative spool-bearing carriage (19a, 19b), relative spindles (14), relative cylinders (21a, 21b), relative fallers (24a, 24b), relative counter-fallers (26a, 26b), and relative drums for unwinding the spools (23a, 23b).

2. Self-acting mule as in claim 1, **characterized in that** each of said at least two sections (11, 12) comprises a relative motor (13a, 13b) suitable to command the relative spindles (14) commanded by a relative system of belts and pulleys (16a, 16b). 5
3. Self-acting mule as in claim 2, **characterized in that** said motors (13a, 13b) of the spindles (14) are positioned in substantially proximity with the central zone (17) that divides said two sections (11, 12) from each other. 10
4. Self-acting mule as in any claim hereinbefore, **characterized in that** each of said at least two sections (11, 12) comprises a motor (18a, 18b) suitable to command the two sections (11, 12) of the spool-bearing carriage. 15
5. Self-acting mule as in claim 4, **characterized in that** said motors (18a, 18b) of the spool-bearing carriage (19a, 19b) are positioned substantially half-way along the relative sections (11, 12). 20
6. Self-acting mule as in any claim hereinbefore, **characterized in that** each of said at least two sections (11, 12) comprises a motor (20a, 20b) suitable to command the relative cylinder (21a, 21b). 25
7. Self-acting mule as in any claim hereinbefore, **characterized in that** each of said at least two sections (11, 12) comprises a relative motor (22a, 22b) suitable to command the respective drums (23a, 23b) that unwind the spools. 30
8. Self-acting mule as in claims 6 and 7, **characterized in that** said motors (20a, 20b; 22a, 22b) are substantially positioned in the central part (17) of the self-acting mule (10) which separates said sections (11, 12). 35
40
9. Self-acting mule as in claim 1, **characterized in that** the drums (23a, 23b) are each mechanically driven by the motion of the relative cylinders (21a, 21b).
10. Self-acting mule as in any claim hereinbefore, **characterized in that** each of said sections (11, 12) comprises a relative motor (25a, 25b) to drive the relative fallers (24a, 24b). 45
11. Self-acting mule as in any claim hereinbefore, **characterized in that** each of said sections (11, 12) comprises a relative motor (27a, 27b) to drive the relative counter-fallers (26a, 26b). 50
12. Self-acting mule as in claims 10 and 11, **characterized in that** said motors (25a, 27a; 25b, 27b) to drive the relative fallers (24a, 24b) and counter-fallers are disposed substantially at the center of the respective section (11, 12). 55
13. Self-acting mule as in any claim hereinbefore, **characterized in that** it comprises a single control unit (15), and relative command panel, able to manage and coordinate the functioning of said two independent sections (11, 12).
14. Self-acting mule as in any claim from 1 to 12, **characterized in that** each of said two sections (11, 12) comprises a relative control unit (15) and relative control panel.

PRIOR ART



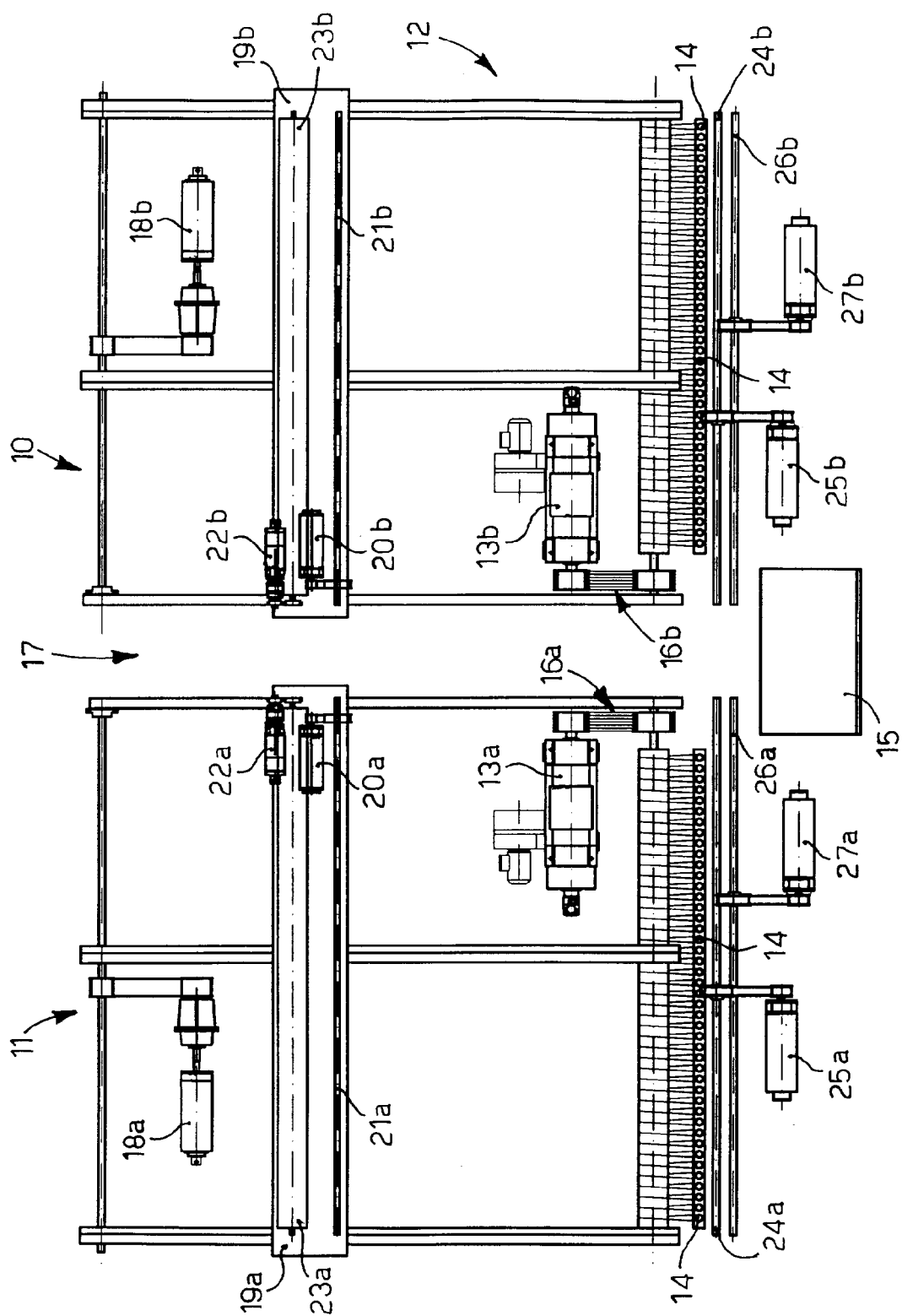


fig. 2