(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 880 963 A2

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.01.2008 Bulletin 2008/04

(51) Int Cl.:
B65H 54/28 *(2006.01)* ***B65H 54/38*** *(2006.01)*

(21) Application number: **07111613.1**

(22) Date of filing: **03.07.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **12.07.2006 IT MI20061353**

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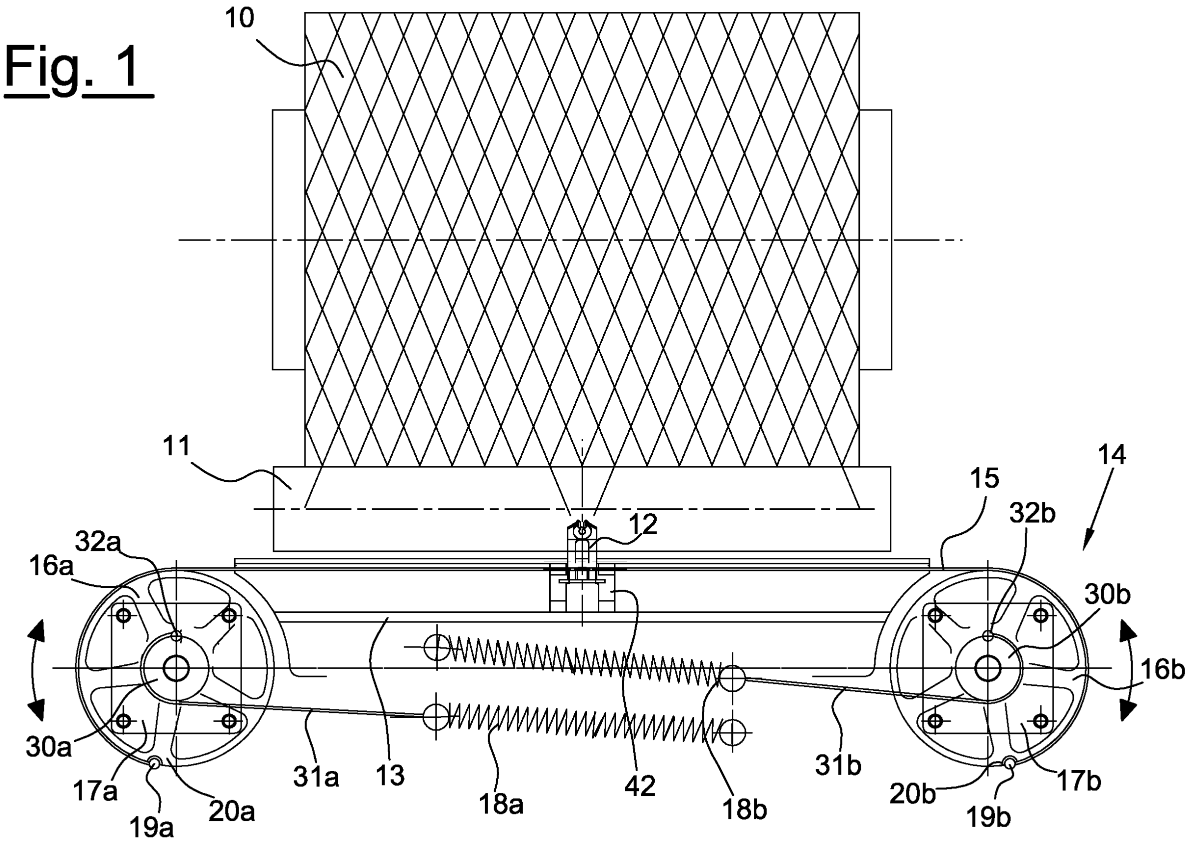
(54) **Thread-guide device for the production of bobbins with traversing modulation**

(57) Thread-guide device with modulated traversing with an individual thread-guide with a back-and-forth movement fixed to a cord open at the two ends and moved between two pulleys in an alternating clockwise/anticlockwise movement, each activated with its own electric motor, both motors being piloted in frequency. The pulleys are connected to springs which pull the thread-guide towards the centre of its run and which alternatingly accumulate and release energy with every run of the thread-guide.

Fig. 1



Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to the collection of the thread produced or processed by textile machines for winding onto bobbins. In industrial practice, thread collection onto a bobbin is effected on tubes supported by a bobbin-holder arm and resting on a rotating roll, by pulling the thread to be wound onto it. The rotating roll can be activated by a motor, transmitting the rotation movement to the tube onto which the thread is wound, or, in an alternative solution, the roll is idle and is entrained by the bobbin in formation which in turn is driven by a motor. In both cases the function of the roll is to ensure the pressure necessary for forming a sufficiently compact bobbin and with a correct shape. The thread is spirally wound onto the rotating bobbin as the collecting unit is equipped with a thread-guide device which distributes the thread onto the outer surface of the bobbin, with an axial back-and-forth movement, according to a predetermined cross angle. In industrial practice, the bobbins can have a conical-truncated or cylindrical shape with substantially flat bases, except in some particular cases in which the bobbins are shaped with a marked flaring in the terminal parts.

[0002] In traditional bobbin-winding, and especially in automatic bobbin-winding, the most widely-used device for distributing the yarn onto the surface of the bobbin with an axial back-and-forth, i.e. transversing, movement consists in a spiral groove situated on the surface of the rotating roll which allows the yarn to effect an axial excursion of a prefixed length, for a pre-established number of revs of the roll itself and with a prefixed trend of the cross angle of the yarn being wound. In other words, the thread winding and yarn distribution organs operate according to a fixed velocity ratio.

[0003] In the present development tendency of yarn processing machines, the thread distribution device on the bobbin must be produced with an autonomous thread-guide device which is independent of the movement of the winding organs.

[0004] The thread-distribution device on the bobbin must therefore be moved by its own activation organ, with which the frequency of the back-and-forth movement, its run, the length of the spiral wound and the winding cross angle, etc. can be modulated each time.

[0005] The patent EP 311,827 describes an individual thread-guide system for a thread collection unit which envisages moving the thread-guide with a closed toothed transmission belt moved with a step-by-step motor controlled by a microprocessor in the transversing movement. The control of the step-by-step motor with a microprocessor allows the desired winding to be effected, with respect to the cross angle, run and transversing frequency. Patent EP 1,209,114 describes belt-tensioner devices for this type of individual thread-guide.

[0006] When the yarn collection on the bobbin is effected under severe conditions with the necessity of high-quality bobbins with respect to shape, density and regular unwinding at high speeds, there are considerable problems, for example especially in the most recently conceived automatic bobbin-winders which operate at extremely high collection rates (even over 2000 m/min), requiring transversing frequencies in the order of 30 Hz and over.

[0007] The main problems under these conditions, with thread-guide devices with an alternating movement, derive from the fact that the overall thread-guide and its activation means in any case have a considerable mass and significant inertia at high frequencies and velocities, even when resorting to all the expedients available for reducing the mass of the organs with alternating movements and also deriving from the fact that the times and spaces for the inversion of the movement must in any case be limited (several milliseconds and a few millimeters), to give the bobbin the quality required by the subsequent use, as far as the structure, form and mechanical stability are concerned.

[0008] In the intermediate part of its transversing run, the thread-guide is easily activated at the desired velocity, whether said velocity be constant, as in the case of cylindrical bobbins, or when said velocity is variable, as in the case of conical bobbins. In the end sections, close to inversion, the inertia of the thread-guide complex makes it necessary to operate with a lower average speed, with respect to the intermediate excursion section.

[0009] As a result of this lower velocity of the thread-guide, the quantity of yarn wound is greater at the two ends of the bobbin. This leads to a greater density at the ends of the bobbin and an irregular profile.

[0010] This is minimum when the thread-guide is halfway through its run and maximum when the thread-guide is at the ends of its run.

[0011] In order to overcome this problem, it would be necessary to give the transversing device additional power in the movement inversion phases, to reduce the times and braking distances and for acceleration in the opposite direction and re-establish the movement at regime velocity.

[0012] In the bobbin-winding of the known art, the greater density at the ends of the bobbin can be reduced by alternating complete transversing runs with shortened transversing runs, or with fixed transversing runs, but with continuous staggering at the two ends.

[0013] Patent EP 311,784 envisages accumulating kinetic energy with mechanical activation systems of the thread-guide during the intermediate part of its run and transferring it to the thread-guide in the movement inversion phases.

[0014] Patent EP 453,622 describes a method and a thread-guide device - again activated with constraint to a flexible ring-closed element and activated with a motor piloted with an alternating movement by a control unit - which controls the position of the thread-guide and applies the step-by-step motor with an overcurrent close to its inversion points, thus increasing the braking and acceleration values. This document also envisages further increasing the power transmitted in the movement inversion phases with an elastic system which is engaged and disengaged during the thread-guide run.

[0015] In patent EP 838,422 a thread-guide is adopted with an oscillating finger which moves according to a circular section around a pin orthogonal to the axis of the bobbin, activated by an electric motor piloted in alternating clockwise/anticlockwise movement. At the two ends of the oscillations of the thread-guide, energy accumulators are positioned consisting of elastic elements which only operate in the brief inversion section, with a repulsing effect.

[0016] Patent application EP 1,498,378 describes an analogous thread-guide with an oscillating finger with an energy accumulator having a repulsing effect obtained by positioning permanent magnets in correspondence with the run-end of the oscillating finger, which repel magnets having the same polarity.

[0017] Patent application EP 1,159,217 describes a thread-guide with an oscillating finger of the previous type, again activated by an electric motor piloted in an alternating clockwise/anticlockwise movement, in which a torsion screw is used as energy accumulator, in particular a propeller screw, or two springs, with opposing winding directions.

[0018] It has been observed that in thread-guides activated with an alternating movement, with a motor rotating alternatingly in a clockwise/anticlockwise direction, of both the closed belt type and oscillating finger type, the torque and inertia of the motor substantially determine the performances of the whole thread-guide system and more specifically the possibility of effecting inversion even at the highest velocities in the necessary times and spaces. It should in fact be taken into account that to obtain the inversion of the movement, in the extremely limited times and spaces available, the motor must brake are restart not only the thread-guide and its kinematic connection chain, but also itself. Consequently, in addition to resorting to all possible expedients for reducing the mass of the alternative movement organs, it is necessary to use motors which can reach the highest acceleration, i.e. the highest ratio between the maximum torque the motor can give in inversion and its own inertia. Generally speaking, in electric motors used for activating alternating movements piloted by a control unit - for example synchronous brushless motors - an increase in the dimensions of the motor, in order to obtain a certain driving torque value produced to give the thread-guide system the required braking and acceleration values, corresponds to a considerable increase in its inertia and a corresponding significant decrease in its acceleration.

[0019] For further clarifications, a group of synchronous brushless motors can be considered and their torque and inertia moment compared. This comparison is provided, for example, in Table 1 below.

Table 1

Type of Motor	Torque (N m)	Inertia (kg cm^2)
Akm 13	0.44	0.045
Akm 22	0.88	0.16
Akm 41	1.88	0.81

[0020] From this it derives that the smaller the motor used for the activation of a thread-guide, the higher the acceleration will be, which can be obtained in the inversion and more specifically in the braking and in the subsequent acceleration for moving in an inverse direction.

[0021] An objective of the present invention is to produce an individual distribution device of the yarn on the winding bobbin which overcomes the restrictions and drawbacks of the thread-guide devices available in the state of the art and allows extremely high accelerations of the thread-guide in correspondence with the inversion points and consequently to obtain the highest-quality bobbins.

[0022] The present invention therefore proposes a thread-guide device for the collection of yarns onto a bobbin, wherein the moving parts are not activated by a single motor which acquires the necessary torque, but by at least two motors having smaller dimensions, arranged to as to assist each other in providing the same torque necessary for the moving parts, with an overall lower inertia. The device is also equipped with elastic means which coadjuvate the motors supplying additional energy in correspondence with the inversion points of the movement.

[0023] The device according to the invention is defined, in its essential components, in the first claim, whereas its variants and preferred embodiments are specified and defined in the dependent claims.

[0024] In order to better illustrate the characteristics and advantages of the present invention, it is described with reference to some of its typical embodiments indicated in the enclosed figures for illustrative and non-limiting purposes.

[0025] In particular, figure 1 illustrates the scheme, in principle, of the present invention for the activation of a high frequency thread-guide in an alternating movement.

[0026] Figure 2 illustrates a preferred embodiment of the principle scheme of figure 1, with torque springs, wherein figure 2A shows its front view, whereas figure 2B shows its side view, partially sectional.

[0027] Figure 3 illustrates actuation in a practical embodiment of the invention, in greater detail.

[0028] Figures 4A and 4B illustrate a preferred embodiment of the activation device of the thread-guide according to the scheme of figure 3.

[0029] Figure 5 shows the trend of the return force exerted by the elastic energy accumulation device on the thread-guide.

[0030] As already specified, the technical solution for the activation of a high frequency thread-guide with an alternating movement according to the present invention is illustrated with reference to figure 1 which shows its principle scheme.

[0031] Figure 2 schematically represents a solution in which the motors and pulleys develop a rotation lower than one rev; it is obviously possible to have rotations greater than a rev, completely similar and completely functioning.

[0032] The bobbin 10 being wound is supported by a bobbin-holder arm for rotating around its axis due to the effect of the contact created by resting on the activation roll 11. The yarn which is wound onto the bobbin 10 is distributed on the surface of the bobbin by the thread-guide 12 which moves with a back-and-forth movement parallel to the axis of the roll 11 and along a guide-rod 13, and as close as possible to the contact point between the roll 11 and the bobbin 10. The thread-guide device 14 according to the invention envisages that the transversing movement of the thread-guide 12 be activated with an open flexible element 15 having an extremely low inertia, which can be a wire or cord, as shown in the figures - or an equivalent known element, for example smooth or toothed belts and so forth, - to which said thread-guide 12 is fixed with a plug 42 which slides along the rod 13.

[0033] In the following description, index "a" indicates the element on the left and index "b" the element on the right, the right and left elements being symmetrical and specularly equal to each other.

[0034] The flexible element 15 is typically moved by two driving pulleys 16a, 16b activated in an alternating clockwise/anticlockwise movement according to the arrows, each with its own electric motor 17a, 17b, both of said motors being piloted in frequency by a control unit, not shown in the figure for the sake of simplicity, which coordinates the movement of the two motors of the device 14, in a known way, to create the desired transversing movement and keep the flexible element 15 tensioned for its whole length. These motors driven in frequency to move with an alternating and coordinated movement with a piloted angular excursion, are known in the art.

[0035] According to a preferred embodiment of the present invention, synchronous motors (17a, 17b) are used, of the so-called brushless or step-by step type, coordinatingly piloted by a control unit of the yarn winding station.

[0036] The ends of the cord 15 are wound onto the two driving pulleys 16a, 16b, to which they are physically constrained by means of the balls 19a, 19b housed in the respective cavities 20a and 20b.

[0037] Two pulleys 30a, 30b are coaxially housed on the driving pulleys 16a, 16b, onto which two flexible transmission elements 31a, 31b, for example cords or belts, are hooked and wound by means of the constraints 32a, 32b to one of their ends. At the other end, the flexible elements 31a, 31b are connected to two elastic spring elements 18a, 18b which are fixed to the structure of the machine. These elastic elements 18a, 18b, which always operate under tension, tend to rotate the pulleys 30a, 30b and with them the pulleys 16a, 16b respectively, in the opposite direction, the latter tending to pull the thread-guide 12 each from its own part, keeping the cord 15 under tension. One of the characteristics of the device 14 lies in the fact that, even without the action of the motors 17a, 17b, the device tends to keep the cord 15 suitably tense and bring the thread-guide 12 back towards the centre of its back-and-forth run, in the point where the forces exerted by the springs 18a, 18b are equal and contrary.

[0038] The functioning of the device 14, referring to a starting position in which the thread-guide 12 is in a central position, is effected as follows. When moving in an anticlockwise direction, the combined movement of the two motors, of which the motor 17a pulls, whereas the motor 17b coordinatingly follows with a slight delay, in order to keep the cord 15 suitably tense, causes the thread-guide 12 to advance towards the left, by means of the respective pulleys 16a and 16b, rigidly fitted onto the driving shafts. As it advances towards the left, the motor 17a increases its driving torque to overcome the gradual increase in the force of the opposite motor 18b, or more specifically the difference in load between the two springs, i.e. between the load of the spring 18b, which increases, and that of the spring 18a, which slowly decreases, with the winding and homologous unwinding of the belts 31b and 31a respectively on the respective pulleys 30b and 30a. Close to the inversion point, the two motors 17a, 17b are contemporaneously stopped and brought back to velocity in the opposite direction with the maximum torque available which, under the maximum winding velocity conditions, can be obtained by giving the motors an overcurrent also equal to 4 or 6 times the nominal value. The braking and restarting action of the motors is coadjuvated by the elastic energy accumulated by the spring 18b, or better by the difference in energy between the two springs 18b and 18a, which forces the thread-guide 12 to brake and restart it in the opposite direction. The invention envisages that the springs 18a, 18b be structured so that in the inversion point they have an energy available which is such as to brake the thread-guide 12 and restart it in the opposite direction with an acceleration close to or higher than the maximum acceleration which every single motor is capable of supplying to the system consisting of the motor, the respective pulley and other parts connected thereto. It should be noted that the thread-guide 12, whose mass or inertia is not indifferent, is the only part not symmetrically positioned and rigidly connected to the two motors. In this way, with each inversion the maximum torque of each motor is available, so that the motor which follows, in the case in question the motor 17a, cannot surpass the opposite motor, consequently slowing down the cord 15. When the inversion has been completed, the thread-guide 12 moves from left to right with the pre-established velocity, up to the centre of the run, under the action of the two motors which coordinatingly cause the thread-guide 12 to advance, controlling the decreasing elastic energy of the springs 18a and 18b. Once the centre of the run has been reached, the cycle restarts symmetrically as described above.

[0039] What is specified above refers to the case in which the thread-guide 12 moves at a constant rate. When the thread-guide 12 moves with an increasing velocity in one direction and a decreasing velocity in the other, the motors 17a, 17b, again suitably coordinated with each other, will supply the torque necessary for accelerating in one direction and braking in the opposite direction.

[0040] The synchronous motors 17a, 17b are controlled by means of respective position detectors, such as encoders for example, which allow the control unit of the winding unit to reveal the position of the motors and consequently the thread-guide 12: on the basis of the position indications, the control unit coordinatingly controls and drives the two motors 17a, 17b with the relative variable frequency current generators, currently called inverters, to ensure the movement of the thread-guide 12 and at the same time to keep the appropriate tensioning of the cord 15, both under regime conditions and during the start-up, rest or stoppage phase of the collection unit.

[0041] Figures 2A and 2B illustrate an alternative embodiment of the technical solution of figure 1, with springs subjected to torsion stress instead of traction.

[0042] Figure 2A synthetically illustrates the connection scheme between motor and torsion elastic elements in a front view, whereas figure 2B shows the side view of the left torsion spring, of index "a": torsion spring 22a with cylindrical winding and with a thread having a round section.

[0043] Between the rear extension of the driving shaft 45a, 45b and the supporting structure of the relative motor 17a, 17b, torsion springs 22a, 22b are inserted, having, as illustrated in the side view on the left of figure 2B, with particular reference to the left-hand elements, index "a", of the thread-guide device 14, one of the ends 23a, 23b constrained to the driving shaft 45a, 45b and the other end 24a, 24b constrained to the structure of the motor itself 17a, 17b. The two ends of the cord 15 are fixed to the throat of the driving pulleys 16a, 16b with the constraint 26a, 26b.

[0044] The torsion springs 22a, 22b operate completely analogously to the scheme of figure 1, referring to the torsion instead of traction stress, and the functioning of the thread-guide device 14 occurs as described for the device represented in the same figure 1, with the only difference that the springs act directly on the driving shafts.

[0045] It should be noted that, if figures 2A and 2B represent the alternative with a torsion spring having a cylindrical winding and with a thread having a round section and a spring applied on the rear side of the motors, completely similar and equally functional alternative solutions are in any case possible, for example with springs with a thread having a rectangular section, and/or with spiral winding, and/or applied on the front side of the respective motor, said alternative forms being completely equivalent to that shown.

[0046] As already mentioned, figure 3 illustrates a variant of the solution schematically represented in figure 1 with a second alternative use of torsion springs.

[0047] The constraint between the cord 15 and driving pulleys 16a, 16b is completely analogous to the scheme of figure 1, whereas the embodiment of the accumulation and elastic energy release device is different. Two pulleys 30a, 30b are coaxially joined to the two driving pulleys 16a, 16b on which two flexible transmission elements 31a, 31bm, for example belts or cords, are hooked, as in the case of the solution represented in figure 1. At the opposite end, the cords 31a, 31b are connected, with the constraints 32a, 32b, to two levers 34a, 34b oscillating around pins 35a, 35b, and preferably oscillating around axes parallel to those of the pulleys 16a, 16b.

[0048] The oscillating levers 34a, 34b are connected to two torsion springs - better shown in the subsequent figure 4B as springs 38a, 38b - which are elastically loaded and accumulate elastic energy increasing their torsion when the homologous pulley 30a, 30b is rotated for winding its cord 31a, 31b for the rotation of its motor 17a, 17b, and which are unloaded by releasing their elastic energy untwisting themselves when the homologous pulley 30a, 30b is rotated to release its cord 31a, 31b, supplying at least the necessary torque for restarting the thread-guide 12 with a higher acceleration than that for each single motor 17a, 17b with the respective pulleys.

[0049] Figures 4A, 4B illustrate a further perfected and preferred embodiment of the thread-guide activation device according to the scheme of figure 3.

[0050] In figure 4A, this perfected embodiment is shown in a front view and corresponds to that of figure 3, with the modification of the winding pulleys of the cords 31a, 31b. Said pulleys 40a, 40b are produced with a substantial eccentricity with respect to the axis of the driving pulleys 16a, 16b, adopting the minimum value of the application arm of the force exerted by the cords 31a, 31b on their pulley 40a, 40b in correspondence with the centre point of the thread-guide run 12 and the maximum value of said arm in correspondence with the end points 41a, 41b of the excursion of the thread-guide 12.

[0051] Figure 4B shows a sectional side view of the device according to the invention with greater details of its functioning. The winding bobbin 10 is sustained by counter-points 43a, 43b of the bobbin-holder arm to rotate in a clockwise direction for contact with the activation roll 11. The yarn F comes from below, diverted by the distancing rod 44, and is wound onto the bobbin 10, distributed on the surface of the bobbin by the thread-guide 12, which moves with a back-and-forth movement parallel to the axis of the roll 11 and along the guiding rod 13.

[0052] The spring 38a, as also the homologous spring 38b, is a torsion spring having an end 39a constrained to rotate with the pass-through pin 35a of the lever 34a, loading and unloading the torsion, whereas the other end 40a is constrained to the structure 41 of the machine.

[0053] Both the embodiment of figure 3 and that of figure 4A, 4B make it possible to operate with limited rotations of the levers 34a, 34b and with springs 38a, 38b with their own very high frequency, which return the elastic energy with the acceleration required for activating the thread-guide, especially of bobbin-winders which operate at the highest velocities.

[0054] Figure 5 illustratively illustrates the trend of the return force exerted by the elastic energy accumulation device on the thread-guide 12 with the cord 15 with a variation of the anticlockwise excursion of the pair of levers 34a, 34b which are tilted towards the left, whereas the thread-guide 12, on the other hand, goes from the centre towards the right, position "0" being the central rest position of the thread-guide and position "10" the extreme movement inversion position. The trend of the return force in the clockwise excursion of the levers 34a, 34b and the return towards the left of the thread-guide is specularly equal to the other part.

[0055] In the lower part of figure 5 the configuration is shown of the elastic energy accumulation system in positions "0"-"10" from the centre to the inversion points and in the upper part, the trend of the diagram of the return force towards the centre of the run of the thread-guide 12 corresponding to said positions of the thread-guide excursion.

[0056] The use of at least two motors, arranged so as to assist each other in supplying torque to the moving parts, for activating the two pulleys to which the flexible element which moves the thread-guide is fixed, offers the advantage of being able to select motors having smaller dimensions with respect to those necessary if the torque required were left to only one motor, with the consequence of being able to exploit the fact that these motors with reduced dimensions have a lower inertia and can therefore provide greater acceleration in correspondence with the inversion of the movement direction. In this way it is possible to optimize the ratio between the torque supplied and the inertia of the system.

[0057] Not only this, but the use of separate motors for the two pulleys also allows the inertia of the parts moved by the motors to be divided, at the same time distributing the points in which the torque is supplied, subjecting the overall system to less stress.

[0058] The overall inertia of the system is lower due to the use of an open flexible element, i.e. a flexible element having reduced dimensions and a smaller mass.

[0059] The action of the elastic means which assist the motors providing their additional energy in correspondence with the inversion points of the movement has the fundamental role of assisting the motors at the moment in which they are most subjected to stress.

[0060] Furthermore, the elastic elements also constantly guarantee the correct tensioning of the flexible element. The possible yielding of the flexible element (which with time tends to elongate and consequently slacken) is contrasted by the fact that the pulleys around which it is wound, each pull the flexible element from their own part, keeping it continually tense.

[0061] The present invention is described for illustrative and non-limiting purposes, according to its preferred embodiments, but variations and/or modifications can obviously be applied by experts in the field, which are all included in the relative protection scope, as defined by the enclosed claims.

[0062] In particular, equivalent solutions are those envisaging torsion springs applied on the back of the respective motors of the thread-guide device, which both operate for only half of the run or a little over, producing a diagram and accumulation not very different from that shown with reference to figure 5.

Claims

1. A thread-guide device (14) for the collection of yarns on a bobbin (10), wherein the yarn (F) is distributed on the surface of the bobbin by a thread-guide (12) which moves with a back-and-forth movement parallel to the axis of the rotating roll (11) in contact with the bobbin (10), and the thread-guide device (14) is driven with a back-and-forth movement by means of a flexible element (15), to which the thread-guide (12) is fixed, the flexible element (15) being moved by two pulleys (16a, 16b) which move with an alternating clockwise/anticlockwise movement by the activation of an electric motor piloted in frequency,
   characterized in that
   the flexible element (15) is an open flexible element;
   both of the pulleys (16a, 16b) are driving pulleys activated by at least one electric motor (17a, 17b) for each pulley, each motor being controlled by means of respective position detectors and piloted by a control unit, which coordinates the piloting of said motors (17a, 17b) to produce the desired transversing movement;
   the ends of the open flexible element (15) are wound onto the two driving pulleys (16a, 16b), to which they are physically fixed with a constraint (26a, 26b); the driving pulleys (16a, 16b) are connected with elastic elements (18a, 18b; 22a, 22b; 38a, 38b), which tend to rotate them in the opposite direction to each other, bringing the thread-guide (12) to its own part and providing, for each run of said thread-guide (12), in addition to the torque exerted by the motors (17a, 17b), also the difference in elastic energy accumulated by the elastic elements (18a, 18b; 22a, 22b; 38a, 38b) in the previous run.

2. The thread-guide device for the collection of yarns on a bobbin according to claim 1, **characterized in that**, in correspondence with the inversion point of the run of said thread-guide (12), both of said motors

(17a, 17b) are contemporaneously stopped and brought to velocity in the opposite direction, with the maximum torque available, the difference in available elastic energy accumulated by the elastic elements (18a, 18b; 22a, 22b; 38a, 38b) in the previous run, being such as to brake and restart the thread-guide (12) in the opposite direction with an acceleration close to or higher than that of the maximum acceleration obtained by each single motor (17a, 17b).

3. The thread-guide device for the collection of yarns on a bobbin according to claim 1, **characterized in that** the elastic elements are spring elastic elements (18a, 18b) which always operate under tension.

4. The thread-guide device for the collection of yarns on a bobbin according to claim 1, **characterized in that** the elastic elements are torsion springs (22a, 22b; 38a, 38b).

5. The thread-guide device for the collection of yarns on a bobbin according to claim 4, **characterized in that** the torsion springs (22a, 22b) are inserted between the rear extension of the driving shaft (45a, 45b) and the supporting structure of the relative motor (17a, 17b), said springs being constrained with one of their ends (23a, 23b) to the driving shafts (45a, 45b) and with the other end (24a, 24b) to the structure of the motor itself (17a, 17b).

6. The thread-guide device for the collection of yarns on a bobbin according to claim 4, **characterized in that** two pulleys (30a, 30b; 40a, 40b) are connected to the driving pulleys (16a, 16b), on which two flexible transmission elements (31a, 31b) are fixed to one of their ends, whereas the elements (31a, 31b) are connected from the other end with two oscillating levers (34a, 34b) and connected to two torsion springs (38a, 38b), said springs accumulating elastic energy when the homologous pulley (30a, 30b; 40a, 40b) rotates and pulls its own cord (31a, 31b) for the rotation of its own homologous motor (17a, 17b), and releasing their elastic energy when said homologous pulley rotates to release its own cord (31a, 31b), thus supplying additional driving torque with respect to that provided by the motors (17a, 17b).

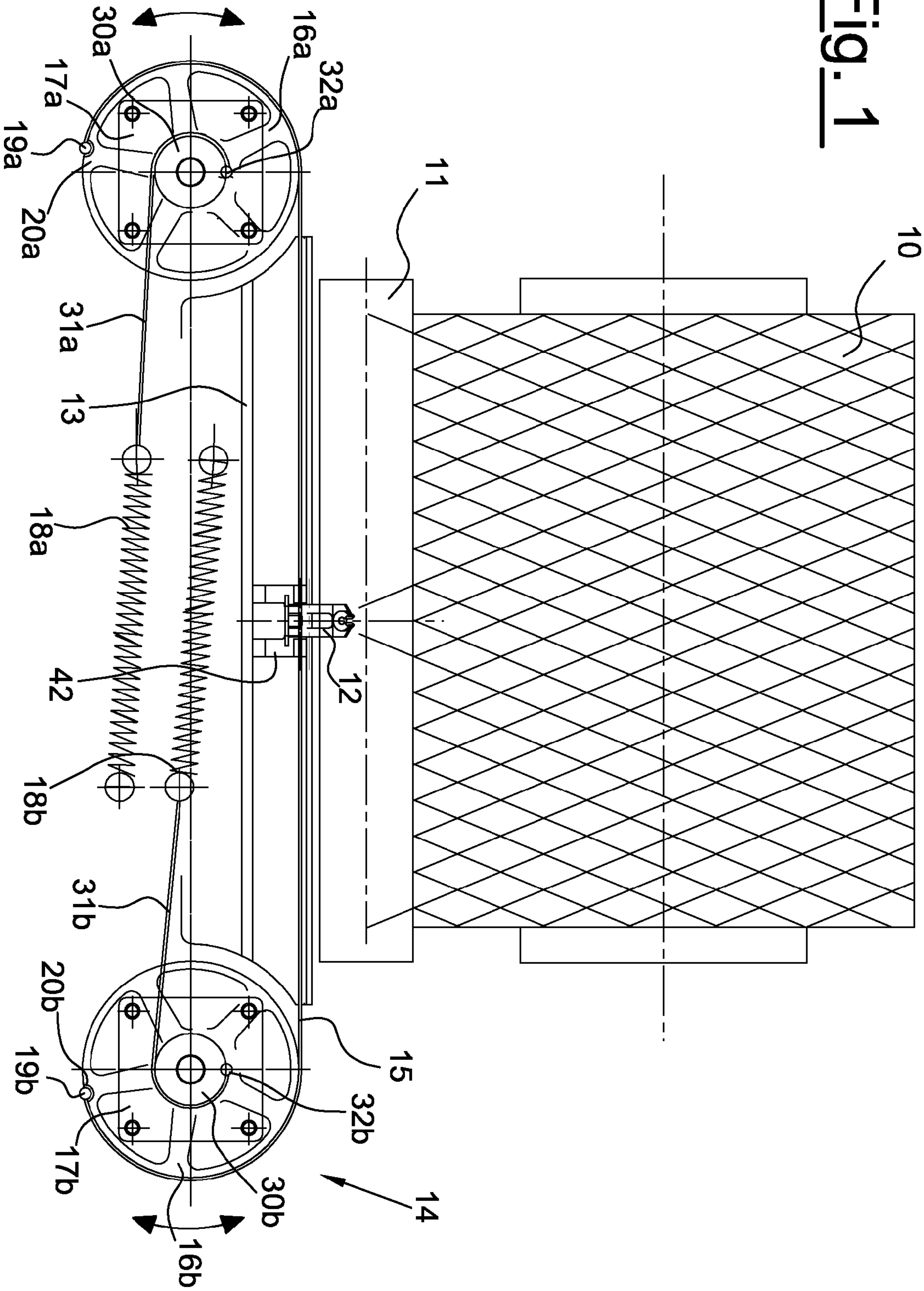
7. The thread-guide device for the collection of yarns on a bobbin according to claim 6, **characterized in that** the two pulleys (30a, 30b) are coaxially assembled with the driving pulleys (16a, 16b).

8. The thread-guide device for the collection of yarns on a bobbin according to claim 6, **characterized in that** the two pulleys (40a, 40b) are produced with a substantial eccentricity with respect to the axis of the driving pulleys (16a, 16b).

9. The thread-guide device for the collection of yarns on a bobbin according to claim 8, **characterized in that** the two pulleys (40a, 40b) are produced with an eccentricity with respect to the axis of the driving pulleys (16a, 16b) which has the minimum value of the application arm of the force exerted by the cords (31a, 31b) on their pulley (40a, 40b) in correspondence with the centre point of the run of the thread-guide (12) and the maximum value of said arm in correspondence with the end points (41a, 41b) of the excursion of the thread-guide (12).

10. The thread-guide device for the collection of yarns on a bobbin according to claim 1, **characterized in that** the motors (17a, 17b) are synchronous brushless or step-by-step motors, coordinatingly piloted by a control unit of the yarn winding station.

Fig. 1


30a
17a
19a
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18b
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17b
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32b
14

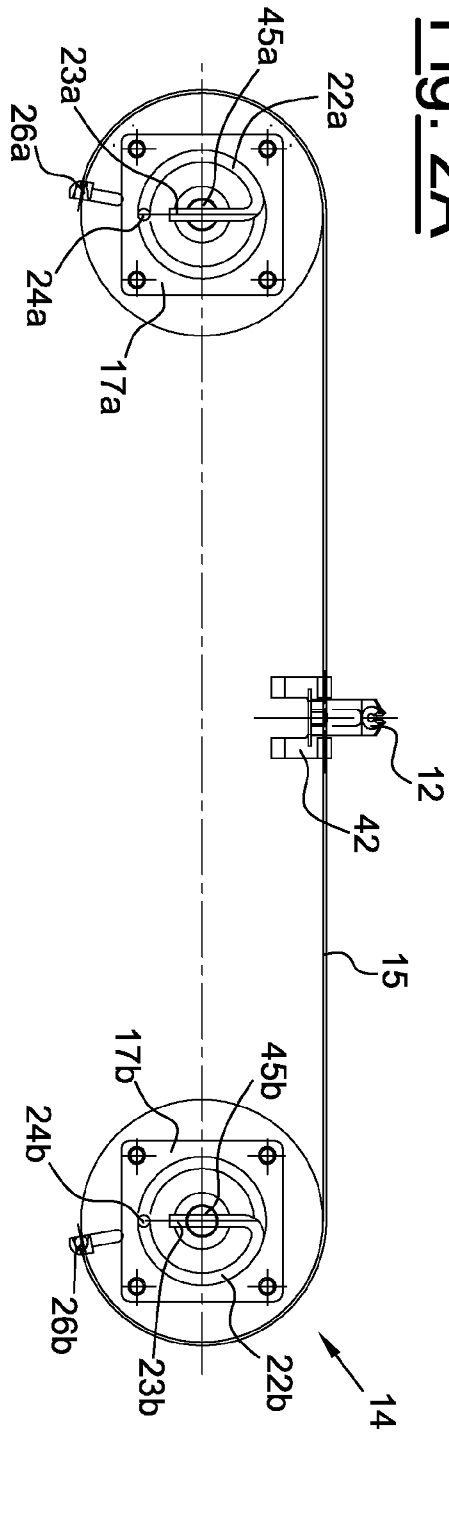

45a
22a
23a
26a
24a
17a
12
42
15
17b
45b
24b
26b
23b
22b
14

Fig. 2A

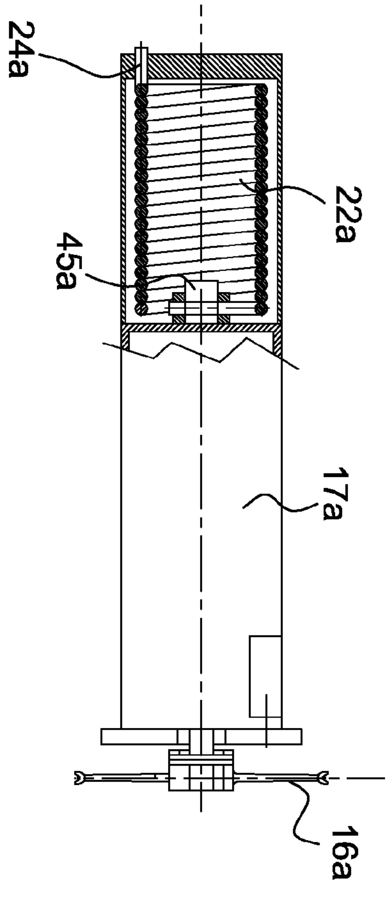

24a
22a
45a
17a
16a

Fig. 2B

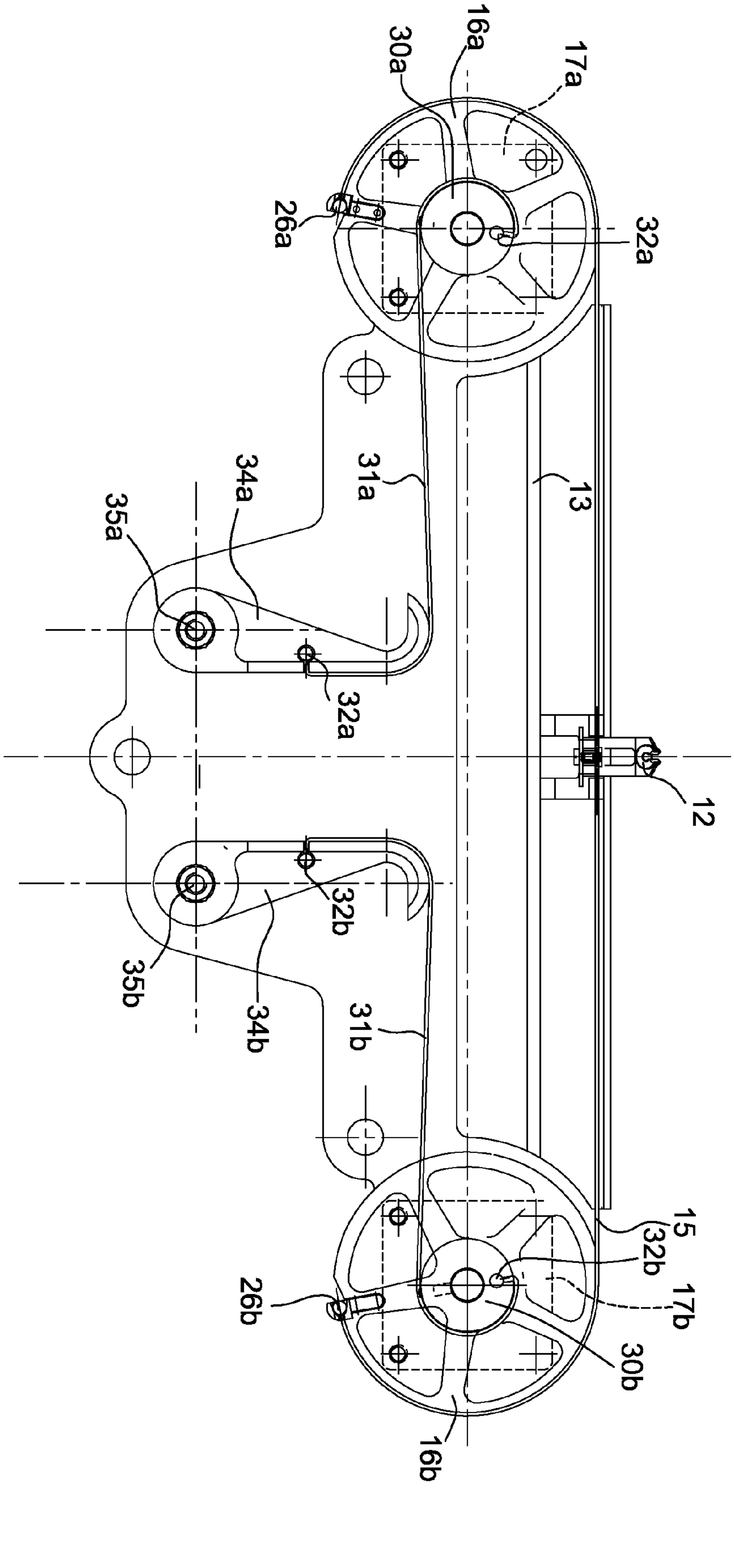

30a
16a
17a
26a
32a
31a
34a
35a
13
32a
12
32b
35b
34b
31b
15
32b
17b
26b
30b
16b

Fig. 3

Fig. 4A

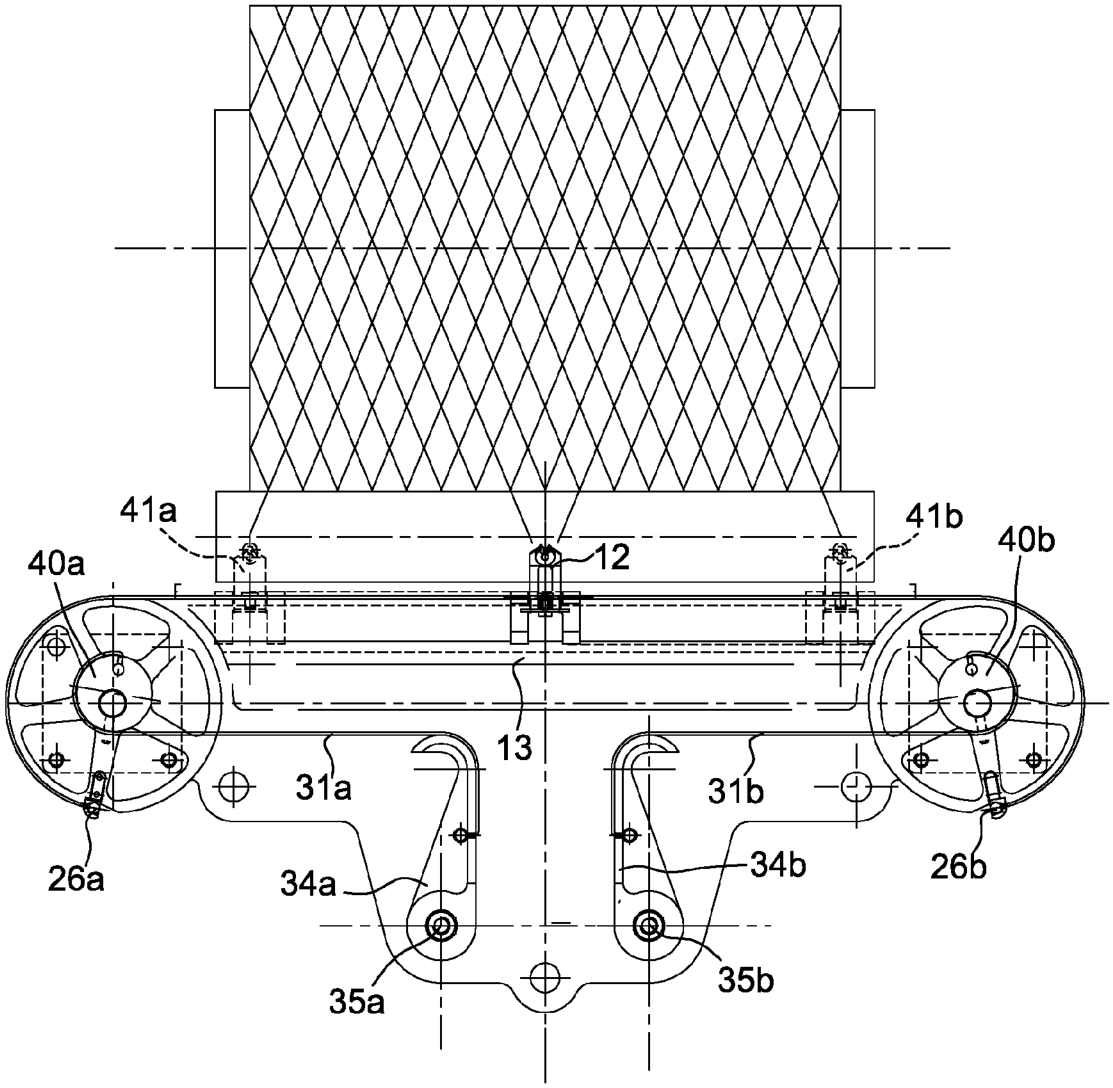
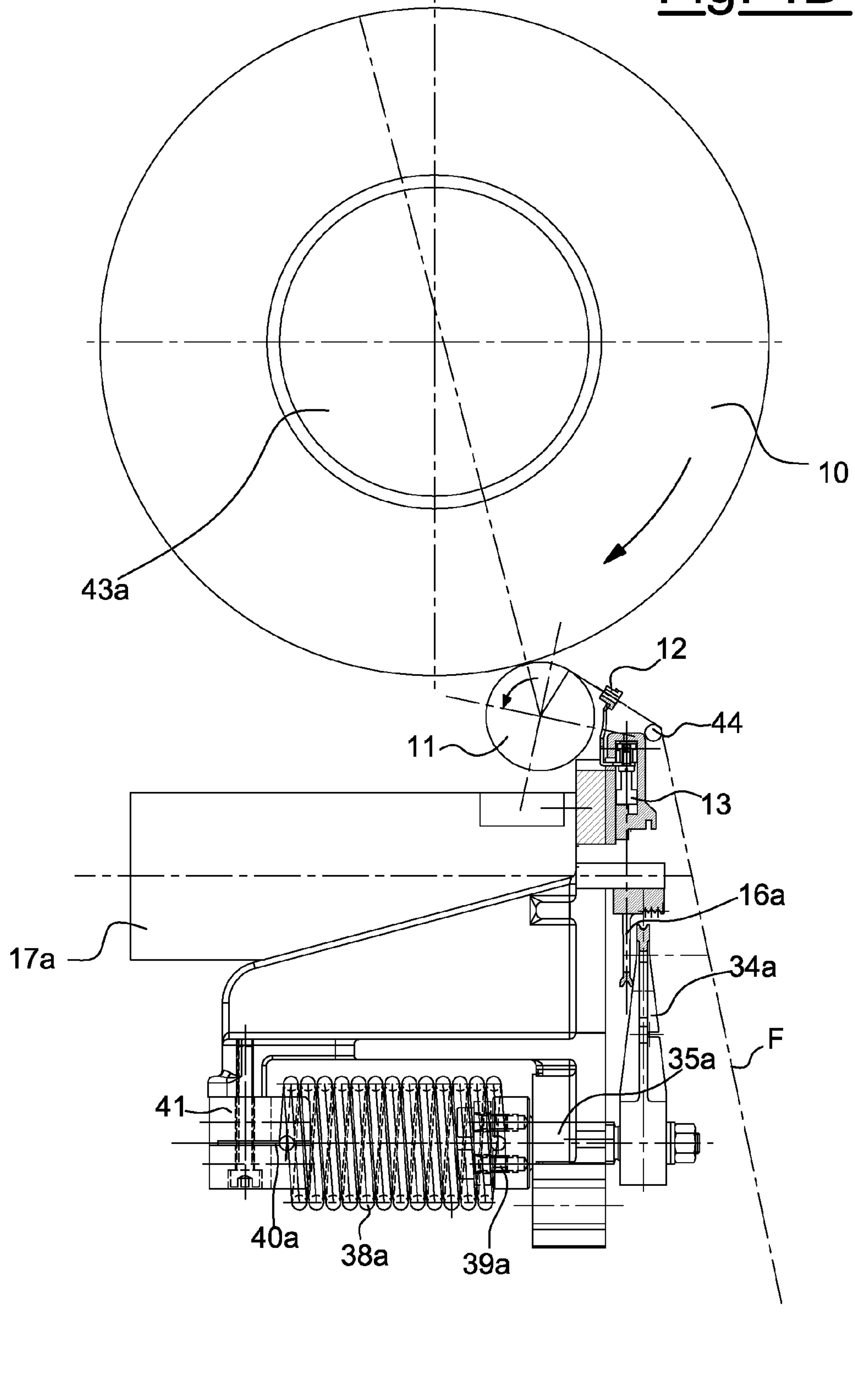


Fig. 4B



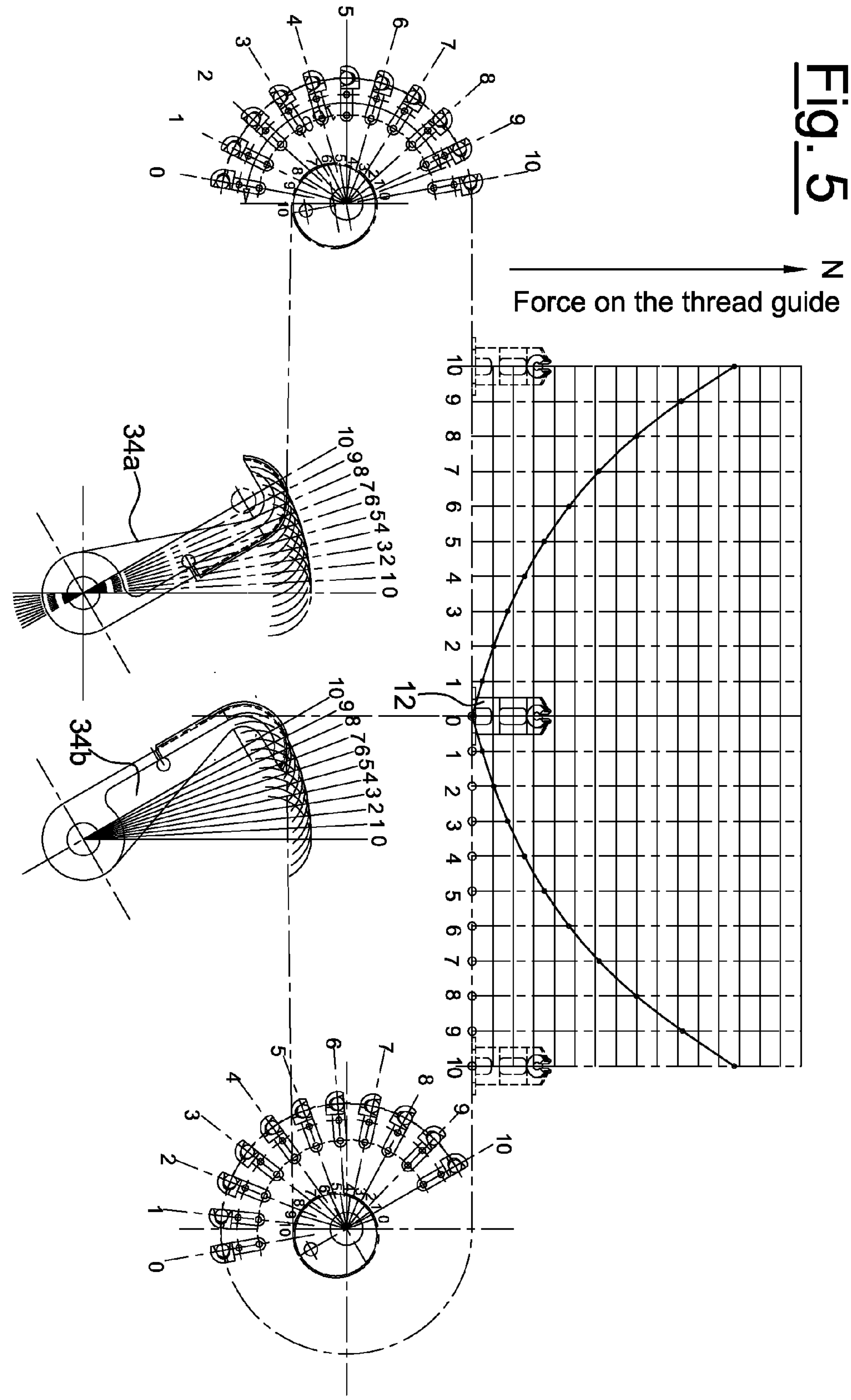


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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