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(54) **High-frequency thread-guide device for the production of bobbins with modulated traversing**

Hochfrequenz Fadenführungsgerät zur Herstellung von Spulen mit moduliertem Durchlauf

Dispositif de guide-fil haute fréquence pour la production de bobines avec déplacement modulé

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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. traversing, 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 preestablished 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 of the yarn 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 and according to necessity.

[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 traversing 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 traversing frequency. Patent EP 1,209,114 describes belt-tensioner devices for this type of individual thread-guide.

[0006] Patent Application DE 199 63 232 A1 describes a thread-guide attached to a reciprocating belt actuated

by two motors driving two pulleys around which the belt is wound.

[0007] 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 2,000 m/min), requiring traversing frequencies in the order of 30 Hz and over.

[0008] 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.

[0009] In the intermediate part of its back-and-forth 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.

[0010] 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.

[0011] This is minimum when the thread-guide is half-way through its run and maximum when the thread-guide is at the ends of its run.

[0012] In order to overcome this problem, it would be necessary to give the traversing device additional power in the movement inversion phases, to reduce the times and distances for braking and acceleration in the opposite direction and re-establish the movement at regime velocity.

[0013] In the bobbin-winding of the known art, the greater density at the ends of the bobbin can be reduced by alternating complete traversing runs with shortened traversing runs, or with fixed traversing runs, but with continuous staggering at the two ends.

[0014] 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.

[0015] Patent EP 453,622 describes a method and a thread-guide device - again activated with constraint to

a flexible ring-closed element and driven by 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, to guarantee the braking and acceleration time 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] It has been observed that in thread-guides activated with an alternating movement, with a motor rotating alternately 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 and 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.

[0020] For further clarifications, a group of synchro-

nous 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

[0021] 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.

[0022] 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.

[0023] 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 provides the necessary torque, but by at least two motors having smaller dimensions, arranged 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.

[0024] 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.

[0025] The figures refer to an embodiment of the thread-guide device according to the invention, suitable for distributing yarn onto the winding bobbin in a yarn collection unit, of which the further fundamental components: yarn, bobbin, driving roll and mandrels of the bobbin-holder arm with respect to the actual thread-guide, are shown in figures 1A and 1B, with the insertion of elastic elements for the energy accumulation to be restored in the inversion points of the movement, whereas figure 1C shows, in the left-side cross section, the relationship between the thread-guide device according to the present invention and the winding station.

[0026] As already specified, the technical solution for activating a thread-guide in a high-frequency alternating movement according to the present invention is illustrated with reference to figures 1A and 1B.

[0027] The bobbin 10 being wound is supported by the

mandrels 11 of a bobbin-holder arm, for rotating around its axis due to the effect of the contact created by resting on its activation roll 12. The yarn F comes from below diverted by the distance rod 14 and is wound onto the bobbin 10, distributed onto the surface of the bobbin by the thread-guide 15 which moves with a back-and-forth movement parallel to the axis of the roll 12 and along two guide-rods 16.

[0028] The thread-guide 15 is shown with a continuous line in its central position and with a dashed line in its end positions in which the traversing movement is inverted.

[0029] The thread-guide device 18 according to the embodiment of the invention shown with reference to figures 1A and 1B, envisages that the back-and-forth movement be activated with a closed flexible element 19, which can have a toothed belt, as shown in the figures - or an equivalent known element, for example smooth belts, cords, chains and so forth - to which the thread-guide 15 is fixed with a fixing organ which runs along the guide-rods 16.

[0030] In the following description the index "a" indicates the element on the left and the index "b" the element on the right, the right and left elements being symmetrical and specularly equal to each other.

[0031] The flexible element 19 is typically moved between two driving pulleys 20a, 20b activated in an alternating clockwise/anticlockwise movement according to the arrows, each with its own electric motor 21a, 21b, both of said motors being piloted by a control unit, not shown in the figure for the sake of simplicity, which coordinates the movement of the two motors 21a, 21b of the device 18, in a known way, to create the desired traversing movement. These motors, driven to move with an alternating movement with a piloted angular excursion, are known in the art.

[0032] According to a preferred embodiment of the present invention, synchronous motors 21a, 21b are used, of the so-called brushless or step-by step type, coordinately piloted by a control unit of the yarn winding station.

[0033] In the embodiment shown in figures 1A and 1B, the flexible element 19 is wound onto two driving pulleys 20a, 20b in a closed circuit and kept tense, with two parallel sections, one upper and the other lower.

[0034] The functioning of the device 18 is effected as follows. In its right-to-left movement, the movement of the thread-guide 15 is determined both by the pulling of the upper part of the flexible element 19 towards the left, exerted by the left driving pulley 20a activated in an anticlockwise direction with respect to the motor 21a, and also by the pulling of the lower part of the flexible element 19 towards the right, exerted by the right driving pulley 20b activated in an anticlockwise direction with respect to the motor 21b.

[0035] The synchronous motors 21a, 21b are controlled by means of position detectors, currently called encoders, which allow the control unit of the winding unit to reveal the angular position of the motor: on the basis of

the indications of the encoder, the control unit controls and drives the two motors 21a, 21b with the relative activations, currently called inverters.

[0036] Figures 1A and 1B represent an embodiment, with a torsion spring with cylindrical winding and with a thread having a round section, applied on the rear side of each motor. Completely similar and equally functional 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.

[0037] Torsion springs 25a, 25b are inserted between the driving pulley 20a, 20b and the fixed structure of the relative motor 21a, 21b, which, as illustrated in the left-side view of figure 1B, have one of the ends 26a, 26b constrained to the rear extension of the driving shaft 28a, 28b and the other end 27a, 27b constrained to the structure of the motor itself 21a, 21b.

[0038] During the alternating runs of the thread-guide 15 and flexible element 19, in its right-to-left movement of the thread-guide 15, the spring 25a untwists unloading its torsion and increasing the leftwards pull of the cord 19 and thus assisting the action of the motors, especially during the inversion of the movement. In the meantime, the system is operating in an anticlockwise direction loading the spring 25b which increases its torsion and accumulates elastic energy which is released in the subsequent run from left to right of the flexible element 19 and thread-guide 15.

[0039] The use, by the activation of the two driving pulleys 20a, 20b to which the flexible element 19 which moves the thread-guide 15 is fixed, of at least two motors, arranged so as to assist each other in providing torque to the moving parts, offers the advantage of being able to select motors having smaller dimensions with respect to those necessary if the necessary torque were assigned to only one motor, with the consequence of being able to exploit the fact that said 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 obtain the optimization of the ratio between the torque supplied and the inertia of the system.

[0040] Furthermore, the use of separate motors for the two driving pulleys also allows the inertia of the parts moved by the motors to be subdivided, and at the same time to distribute the points in which the torque is supplied, subjecting the system as a whole to less stress.

[0041] The action of the elastic means which, when present, assist the motors providing their additional energy in correspondence with the movement inversion points, has the fundamental role of assisting the motors when these are subjected to most stress. The device is consequently able to give the thread-guide greater acceleration, providing the further advantage of obtaining higher production rates.

[0042] The present invention is described for illustra-

tive but non-limiting purposes, according to its preferred embodiments, but variations and/or modifications can obviously be applied by experts in the field, all included in the protection scope, as defined in the enclosed claims.

Claims

1. An individual thread-guide device (18) 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 (15) which moves with a back-and-forth movement parallel to the axis of the supporting roll (12) of the bobbin (10), and the thread-guide device (18) is driven with a back-and-forth movement by means of a flexible element (19), to which the thread-guide (15) is fixed, the flexible element (19) being moved between two driving pulleys (20a, 20b) which move with an alternating clockwise/anticlockwise movement by the activation of an electric motor piloted by a control unit, the flexible elements (19) forming a closed circuit, the pulleys (20a, 20b) being activated by at least two electric motors (21a, 21b) each pulley (20a, 20b) being each activated by its own electric motor (21a, 21b), the motors (21a, 21b) being controlled by at least one position detector and piloted by said control unit, which coordinates the piloting of said motors (21a, 21b) to produce the desired traversing movement, **characterized in that** elastic elements for the accumulation of elastic energy, to be returned in the movement inversion points, are inserted between the fixed structure of each motor (21a, 21b) and the corresponding moving parts of the motor itself, and **in that** said elastic elements are torsion springs (25a, 25b), each of which is constrained with one of its ends (26a, 26b) to the driving shaft (28a, 28b) and with the other end (27a, 27b) to the fixed structure of the motor itself (21a, 21b).
2. The thread-guide device for the collection of yarns on a bobbin according to claim 1, **characterized in that** the motors (21a, 21b) are synchronous motors of the brushless or step-by-step type.
3. The thread-guide device for the collection of yarns on a bobbin according to claim 1, **characterized in that** the pulleys (20a, 20b) are toothed pulleys and the flexible element (19) consists of a closed toothed belt.
4. The thread-guide device for the collection of yarns on a bobbin according to claim 1, **characterized in that** the flexible element (19) consists of a cord, which is wound onto two pulleys (20a, 20b), to which it is physically fixed with constraints.

Patentansprüche

1. Einzelnes Fadenführungsgerät (18) zum Sammeln von Garnen auf einer Spule (10), bei dem das Garn (F) auf der Oberfläche der Spule von einem Fadenführer (15) verteilt wird, der sich mit einer Hin- und Herbewegung parallel zur Achse der Stützrolle (12) der Spule (10) bewegt, und wobei das Fadenführungsgerät (18) mit einer Hin- und Herbewegung durch ein flexibles Element (19) angetrieben wird, an dem der Fadenführer (15) befestigt ist, wobei das flexible Element (19) zwischen zwei Antriebsscheiben (20a, 20b) bewegt wird, die sich durch die Aktivierung eines von einer Steuereinheit gesteuerten Elektromotors mit einer alternierenden Bewegung im und entgegen dem Uhrzeigersinn bewegen, wobei die flexiblen Elemente (19) einen geschlossenen Kreis bilden, wobei die Scheiben (20a, 20b) durch mindestens zwei Elektromotoren (21a, 21b) in Gang gesetzt werden, wobei jede Scheibe (20a, 20b) durch ihren eigenen Elektromotor (21a, 21b) in Gang gesetzt wird, wobei die Motoren (21a, 21b) durch mindestens einen Positionsdetektor überwacht und durch die besagte Steuereinheit gesteuert werden, welche die Steuerung der Motoren (21a, 21b) koordiniert, um die gewünschte Durchlaufbewegung zu erzeugen, **dadurch gekennzeichnet, dass** elastische Elemente für die Speicherung von an den Bewegungsumkehrpunkten zurückzugebender elastischer Energie zwischen das unbewegliche Gehäuse jedes Motors (21a, 21b) und die entsprechenden beweglichen Teile des Motors eingesetzt sind, und dass die besagten elastischen Elemente Torsionsfedern (25a, 25b) sind, von denen jede mit einem ihrer Enden (26a, 26b) in die Antriebswelle (28a, 28b) und mit dem anderen Ende (27a, 27b) in das unbewegliche Gehäuse des Motors (21a, 21b) eingespannt ist.
2. Fadenführungsgerät zum Sammeln von Garnen auf einer Spule nach Anspruch 1, **dadurch gekennzeichnet, dass** die Motoren (21a, 21b) Synchronmotoren vom Typ bürstenloser Motor oder Schrittmotor sind.
3. Fadenführungsgerät zum Sammeln von Garnen auf einer Spule nach Anspruch 1, **dadurch gekennzeichnet, dass** die Scheiben (20a, 20b) Zahnriemenscheiben sind und das flexible Element (19) aus einem geschlossenen Zahnriemen besteht.
4. Fadenführungsgerät zum Sammeln von Garnen auf einer Spule nach Anspruch 1, **dadurch gekennzeichnet, dass** das flexible Element (19) aus einem Seil besteht, das um die zwei Scheiben (20a, 20b) gewunden ist, an denen es mit Einspannungen physisch befestigt ist.

Revendications

1. Dispositif de guide-fil individuel (18) pour collecter des fils sur une bobine (10), dans lequel le fil (F) est distribué sur la surface de la bobine par un guide-fil (15) qui se déplace avec un mouvement d'aller et retour parallèle à l'axe du rouleau de support (12) de la bobine (10) et le dispositif de guide-fil (18) est entraîné avec un mouvement d'aller et retour au moyen d'un élément flexible (19), auquel est fixé le guide-fil (15), l'élément flexible (19) étant déplacé entre deux poulies motrices (20a, 20b) qui se déplacent avec un mouvement alternatif dans le sens horaire/antihoraire par l'activation d'un moteur électrique piloté par une unité de commande, les éléments flexibles (19) formant un circuit fermé, les poulies (20a, 20b) étant actionnées par au moins deux moteurs électriques (21a, 21b), chaque poulie (20a, 20b) étant actionnée chacune par son propre moteur électrique (21a, 21b), les moteurs (21a, 21b) étant commandés par au moins un détecteur de position et pilotés par ladite unité de commande, laquelle coordonne le pilotage desdits moteurs (21a, 21b) pour produire le mouvement transversal désiré, **caractérisé en ce que** des éléments électriques pour l'accumulation d'énergie élastique, destinée à être retournée dans les points d'inversion de mouvement, sont insérés entre la structure fixe de chaque moteur (21a, 21b) et les parties mobiles correspondantes du moteur lui-même, et **en ce que** lesdits éléments élastiques sont des ressorts de torsion (25a, 25b), chacun desquels est sollicité à l'une de ses extrémités (26a, 26b) par l'arbre d'entraînement (28a, 28b) et à l'autre extrémité (27a, 27b) par la structure fixe du moteur lui-même (21a, 21b).
2. Dispositif de guide-fil pour collecter des fils sur une bobine selon la revendication 1, **caractérisé en ce que** les moteurs (21a, 21b) sont des moteurs synchrones du type sans balai ou pas à pas.
3. Dispositif de guide-fil pour collecter des fils sur une bobine selon la revendication 1, **caractérisé en ce que** les poulies (20a, 20b) sont des poulies dentées et l'élément flexible (19) consiste en une courroie dentée en boucle fermée.
4. Dispositif de guide-fil pour collecter des fils sur une bobine selon la revendication 1, **caractérisé en ce que** l'élément flexible (19) consiste en une corde, qui est enroulée sur deux poulies (20a, 20b), auxquelles elle est fixée physiquement avec contraintes.

Fig. A

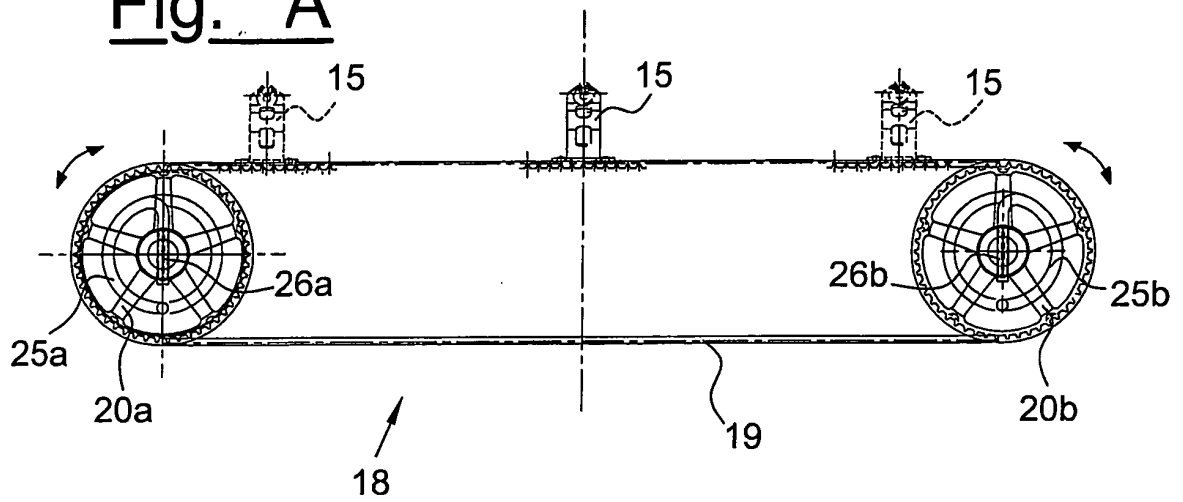


Fig. B

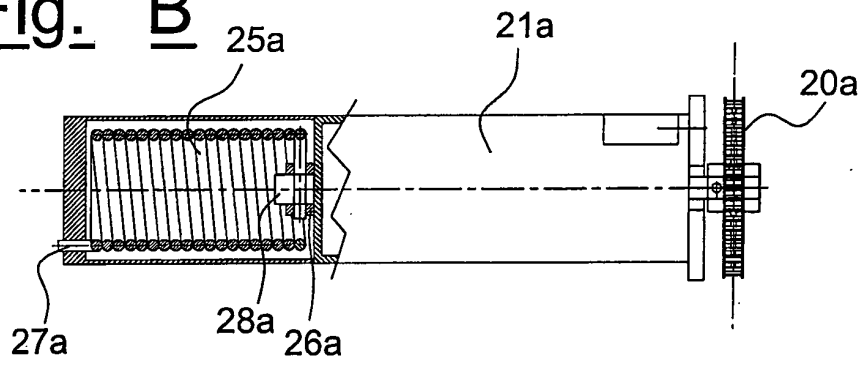
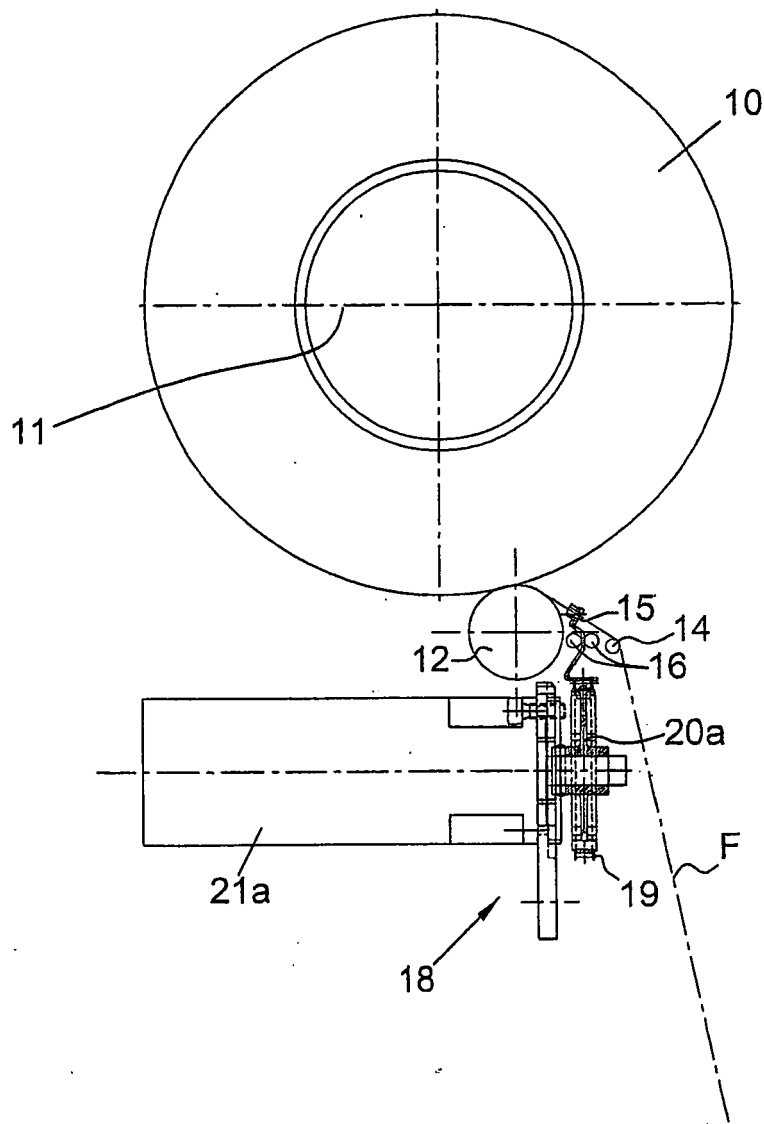


Fig. 1 c



REFERENCES CITED IN THE DESCRIPTION

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