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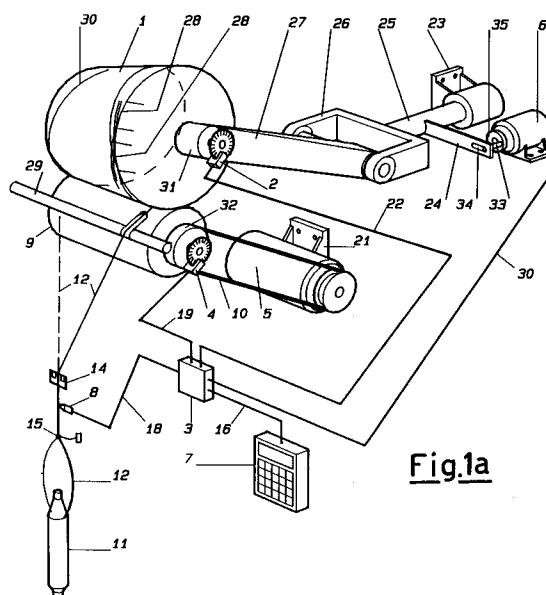
(11) Publication number:

0 630 845 A1

(12)

EUROPEAN PATENT APPLICATION(21) Application number: **94201747.6**(51) Int. Cl.⁵: **B65H 54/38**(22) Date of filing: **18.06.94**(30) Priority: **25.06.93 IT MI931376**
25.06.93 IT MI931377(43) Date of publication of application:
28.12.94 Bulletin 94/52(84) Designated Contracting States:
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I-20121 Milano (IT)(54) **Method and apparatus for distributing wound yarn on a bobbin by means of a drive roller and a yarn guide.**

(57) The invention provides a method for distributing wound yarn (12) on a bobbin (1) by means of the yarn guide (29) and a drive roller (9) in a collection station, in such a manner as to prevent ribbing during the continuous superposing of the various layers of winding, hence rendering the subsequent technical operations to be undergone by the bobbin yarn (12) both possible and simple. The invention also provides an apparatus for implementing the method.

**Fig.1a****EP 0 630 845 A1**

This invention relates to a method and apparatus for distributing wound yarn on a bobbin under formation by means of a yarn guide and a drive roller in a collection station for textile yarns, bobbin and roller having shape different each other.

In other words, this invention relates to a method and apparatus for distributing wound yarn on a conical bobbin driven by a cylindrical roller, or for distributing wound yarn on a cylindrical bobbin driven by a cone.

More specifically, said apparatus comprises a control unit based on a mini-computer into which the operative winding data are fed for processing and comparing with the data arriving from transducer probes or similar means, to provide at the mini-computer output a number of command signals for activating and controlling the motive source which angularly positions the bobbin carrier arm so that the collection station operates in regions not subject to the ribbing effect.

In the ensuing description and claims, the term "yarn" or "filament" indicates any type of filiform material, and the term "bobbin" indicates any package formed from yarn wound in substantially helical turns.

In the state of the art a winding operation is used to form the yarn into a package suitable for subsequent processing.

Winding by dragging is known, in which the bobbin is driven by friction by a roller driven by the drive shaft while a yarn guide moves the yarn reciprocatingly.

According to the above alternative cases, this roller can be a cylindrical roller and then the produced bobbin is conical, or this roller can be a conical or frusto-conical element and then the produced bobbin is cylindrical.

In such a collection unit the yarn is compelled to follow the movements of the bobbin and yarn guide, so that the rotation of the drive roller produces a corresponding rectilinear translation movement by virtue of the yarn guide, which undergoes continuous to-and-fro movement. With reference to this field of the art, the problems strictly related to the principle of distribution of the yarn on the forming bobbin are of considerable importance. The winding units or stations arranged to produce bobbins of wound yarn almost always form deposits of turns concentrated at certain points to form ribbing. This yarn distribution defect arises during the bobbin winding when a wound turn is superposed on and parallel to the previous turns.

This phenomenon occurs if the bobbin circumference is equal to the length of the winding turn, or to a multiple or a sub-multiple thereof. This type of winding in the form of substantially superposed turns results in hard bands within the bobbin.

Said ribbing is known hereinafter as ribbing, taping or "mirror effects", the terms being used interchangeably. These ribbing defects arise during winding if the ratio of the number of revolutions of the bobbin to the number of double beats of the traverser device or the number of complete to-and-fro movements of the yarn per unit of time is a whole number.

Under these conditions, after a complete to-and-fro movement of the yarn the starting point of the turns forming the new layer coincides with that of the previous layer.

This results in hardened superposed yarn layers forming ribbing, i.e. taping of maximum density, which compromises correct subsequent unwinding of the yarn or compromises the uniformity of liquid passage through bobbins during dyeing, resulting in layers not uniformly dyed, leading to periodic variations in yarn colour. To avoid these drawbacks a fractional ratio must be chosen so that the turns are advantageously displaced slightly from the corresponding underlying turn.

It will be assumed that the bobbin rotational speed varies with time by virtue of maintaining its peripheral speed constant as its diameter grows, whereas the drive roller, against which the bobbin rests, rotates at constant speed with the result that the complete to-and-fro movements of the yarn remain constant with time.

Its ratio to the bobbin angular speed W_r varies continuously from a minimum (bobbin commencement) to a maximum (bobbin full), passing through intermediate whole-number values or exact fractional values. Said ratio is defined hereinafter as "winding ratio K " of the forming bobbin.

For each of said whole-number values or exact fractional values ribbing forms, i.e. the superposing of several yarn turns to give rise to the mirror effect.

The aim of any winding system is therefore to deposit layers which do not generate problems during the subsequent use of the bobbin.

For example the density of each layer must not differ from that of the preceding layer by more than a certain amount. Known methods and devices operate in various ways.

The most widely used methods involve discontinuity in the rotation of the bobbin under formation by raising it periodically from its driving contact with the underlying drive roller. The bobbin, which continues to rotate, gradually slows down until it is again brought into contact with the drive roller. It also forms part of the known art to periodically interrupt the rotation of the drive roller by cutting power to its electric drive motor, or by disengaging the roller from the motor by a clutch or the like.

In recent years it has been proposed to periodically vary the speed of the motor which rotates the drive roller. This method has considerable operational drawbacks because, as is well known to the expert of the art, its effect varies with varying diameter of the bobbin under formation. The present applicant is the proprietor of the patent IT 1198214 relating to variation in the transmission of motion between the grooved drive roller and the bobbin for the purpose of varying their point of driving contact by virtue of the taper of the bobbin and/or of its deformability, hence varying the diameter on which it is driven and consequently their transmission ratio.

A different method proposed to prevent wound yarn turns from becoming superposed is described in DE 3521152.0 which describes and claims a method and device which effect a controlled and progressive variation in the rotational speed of the grooved drive element with simultaneous controlled braking of the bobbin, so that its peripheral speed remains constant within tolerance limits.

These and further expedients proposed by the known art to satisfy all the requirements for properly distributing the yarn on the bobbin under formation have always resulted in often precarious operation, giving rise to more or less accentuated ribbing and winding which is not always reproducible from the quality aspect. An object of the present invention is to obviate the aforementioned drawbacks by providing a method and automatic apparatus producing a faultless result which is reliably reproducible in terms of the quality of the winding, embodied essentially by the need to achieve yarn distribution which is uniform both widthwise and depthwise in the formation of bobbins of any size.

A further object of the invention is to form bobbins using continuous control of the peripheral distance between each turn and the next which is able to recognise in advance that ribbing is about to take place and which operates in the sense of varying the transmission ratio in a controlled manner to the extent strictly necessary to maintain a predetermined distance between turns, until conditions arise which indicate that the preceding conditions of potential ribbing no longer exist.

Said control acts by eliminating ribbing of the 1st, 2nd, 3rd, 4th ... order, and can also be extended to ribbing of higher order, even though this is not necessary in that the negative effects induced by ribbing of an order exceeding the 4th are insignificant in the practical use of the bobbin.

A further object of the invention is to wind the yarn in such a manner as to produce well bound bobbins of homogeneous compactness or softness in each point or region of the bobbin under formation, such as to make it perfectly permeable to

dyeing liquids, which are able to lap each side of the wound yarn.

These and further objects are all attained by the method of the present invention which enables the deposition distance between two yarn turns successively deposited on the bobbin under formation to be determined moment by moment; and which on the basis of previously recorded successive variations in the distance between two consecutive turns also determines when said distance falls below a predetermined minimum value, and when said distance again rises above said predetermined minimum value; and further which, before the distance between two consecutive yarn turns falls below the predetermined minimum value, activates a motive source which by means of a lever linkage progressively inclines the bobbin to vary its transmission ratio with the drive element, in order to maintain the distance between consecutive turns about a value slightly greater than the predetermined minimum value and to progressively increase the bobbin inclination each time the distance between said consecutive turns tends to fall, at least until the deposition of consecutive turns at a distance apart less than the predetermined minimum value ceases; and which also enables the initial conditions to be quickly restored by operating the motive source to incline the bobbin in the opposite direction to annul the previously induced inclination and cause a change in the transmission ratio, which at a certain moment assumes a value corresponding to deposition of turns at a distance apart less than the predetermined minimum distance and even zero distance apart, but with a rapidity such as to cause only an insignificant quantity of turns to be deposited very close to or superposed on each other, and which does not damage the quality of the bobbin under formation.

The apparatus used for the implementation of the method of the present invention comprises a control unit based on a mini-computer into which the values relating to the winding parameters, those ribbing orders considered damaging to the quality of the winding underway, and the predetermined minimum distance between two consecutive yarn turns in one complete to-and-fro deposition of the yarn on the surface of the forming bobbin are fed via a keyboard, said values being processed in the computing centre of the mini-computer for the computerised formation of a group of curves each having a constant "winding ratio" of whole number or exact fraction considered dangerous, the mini-computer then receiving electrical pulses generated at each revolution, or submultiple thereof, of the drive roller and bobbin carrier mandrel by known transducer probes applied to them, to unambiguously provide knowledge of the rotational values of said members at each moment, these

latter values being compared with said operational winding parameters within the electronic comparator of the mini-computer, in order to generate a number of command signals in continuous succession to activate and control the motive source which angularly positions the bobbin carrier arm such that the collection station operates in regions not in proximity to the ribbing effect.

According to one embodiment, the apparatus of the present invention is provided in each yarn winding station.

The invention is described in detail hereinafter with reference to the constructional example shown schematically in the figures of the accompanying drawings: the figures with index (a) are referred to a winding machine with a cylindrical drive roller, that produces conical bobbins, whereas the figures with index (b) are referred to a winding machine with a cone drive element, that produces cylindrical bobbins, the figures without index are common to the above alternative cases.

The term "conical" is intended to indicate a frusto-conical element having an inclination which is substantially small but it is sufficient to allow the rotational speed of the driven bobbin to be varied so as to vary the winding of wound yarn turns when the position of the line of contact between the bobbin and the drive element changes.

The figures illustrate the characteristics of the invention in summary form, the accompanying drawings and the description thereof relating to only a preferred embodiment to make its method of implementation more understandable, all constructional modifications to the accompanying drawings being included within its scope of protection:

Figures 1a and 1b are perspective schematic views of a winding station with a bobbin under formation, the figure also showing schematically the lever linkage which inclines the bobbin and the functional electrical connections from the transducers sensing the angular rotation of the roller and bobbin carrier mandrel to the control unit and to the control and activation means for a motive source which sets the correct driving diameter to achieve wound yarn distribution free from damaging ribbing effects;

Figure 2 shows schematically the normal position of the lever linkage for inclining the bobbin; Figures 3a and 3b show schematically the driving contact line between the bobbin and drive roller when in a central position B corresponding to the position of the lever linkage of Figure 2;

Figures 4a, 4b, 5, 6 and 7 show schematically the graphs respectively of the bobbin radius $r(x)$, the substantially uniform contact pressure $n(x)$ along the line on which the bobbin is dragged by the roller, the drag force $f(x)$ which

is partly driving and partly braking in that the no-movement line divides the bobbin into two parts, and the drag moment $m(x)$ which is also divided into a "driving moment" and a "braking moment" because of the taper of coupling between the bobbin and the roller, all as is well known from the state of the art;

Figure 8 schematically shows that lever maximum angular inclination position under which the bobbin is orientated such that it is dragged on a line A close to its left end; Figure 9a shows schematically the line on which the conical bobbin is dragged by the cylindrical roller in a position close to that end of the bobbin corresponding to its minor diameter;

Figure 9b shows schematically the line on which the cylindrical bobbin is dragged by the drive cone in a position close to the major diameter of the cone;

The relative positions shown in figures 9a and 9b correspond respectively to a conical bobbin dragged by the cylindrical roller in a position close to that end of the bobbin corresponding to its minor diameter, and to a cylindrical bobbin dragged by the drive cone in a position close to the major diameter of the cone.

Figures 10a, 10b, 11, 12 and 13 show schematically the graphs respectively of the varying bobbin radius, the contact pressure, the drag force distribution and the drag moment distribution when the no-movement line is in a position close to the left end of the bobbin, as shown schematically in Figure 9;

Figure 14 schematically shows that lever maximum angular inclination position under which the bobbin is orientated such that it is dragged on a line C close to its right end;

Figure 15a shows schematically the line C on which the conical bobbin is dragged by the cylindrical roller in a position close to that end of the bobbin corresponding to its major diameter;

Figure 15b shows schematically the line C on which the bobbin is dragged by the drive cone in a position close to the minor diameter of the cone;

The relative positions shown in figures 15a and 15b correspond respectively to a conical bobbin dragged by the grooved cylindrical roller in a position close to that end of the bobbin corresponding to its major diameter, and to a cylindrical bobbin dragged by the grooved cone in a position close to the minor diameter of the cone.

Figures 16a, 16b, 17, 18 and 19 show schematically the graphs respectively of the varying bobbin radius, the contact pressure, the drag force distribution and the drag moment distribution when the no-movement line is in a position close to the right end of the bobbin, as shown in

Figure 15;

Figure 21 is a diagram showing lines of whole-number or exact fraction constant winding ratio, and also the operative winding line which when in correspondence with a ribbing line comprises horizontal line portions and a vertical line portion representing the instantaneous change in the winding ratio;

Figure 20 is an enlarged view of a region of the diagram of Figure 21, namely that region embracing a ribbing line considered dangerous for the winding underway;

Figure 22 is a block diagram of the operating system representing the method in accordance with the present invention.

In the figures identical parts or parts of identical function carry identical references. Again in the figures, for overall clarity those parts not concerned in the understanding of the invention are omitted or are shown generically because they are of known type.

In said accompanying figures:

9 is the drive roller (respectively cylindrical or conical) on the surface of which there rests with sufficient pressure the bobbin 1 being wound with spun yarn 12 unwound from the feed package 11. The yarn 12 is compelled to undergo reciprocating rectilinear translation movement by a yarn guide element 29, of known type,, so that it becomes collected in turns 30 on the bobbin 1 (respectively conical or cylindrical) under formation, until this latter reaches the required package diameter; 27 is the bobbin carrier arm which supports the package 1 of wound yarn 12 as its diameter increases; 26 is a fork-shaped element which rocks angularly about the pin 25, which possesses a support 23, this latter being rigidly joined to the structure of the machine (not shown); 10 is the belt, preferably toothed to provide positive transmission between the motive source 5, with support 21, and the shaft 32 on which the grooved drive roller 9 is rigidly keyed; 24 is a single lever which at one end is rigid with the pin 25 and at its other end comprises an elongate slot 34 operationally engaging the pin 33.

Said pin 33 is subjected to angular movements by the frontal disc 35, this latter being driven angularly by the motive source 6, which is preferably in the form of a known stepping motor; 4 is the sensor disc which measures moment by moment the rotational speed of the grooved drive element 9 during the entire formation cycle of the bobbin 1; 14 is the known yarn clearer provided for controlling the yarn under cross-winding; 2 is the sensor disc which measures moment by moment the rotational speed of the mandrel 3 which clamps and locks the tube representing the support for the yarn 12 wound in the form of crossed helical turns 30; 8 is a sensor the purpose of which is to sense

the presence or absence of the fed yarn 12, which on unwinding is guided by a yarn guide ring 15; 3 is the control unit, based on a mini-computer or electronic card, for storing the operator instructions introduced via the keyboard 7.

Said control unit 1 is able to convert said instructions arriving via the cable 16 into a program suitable for execution by its calculation and processing centre in order to provide, moment by moment, the signals required during the entire winding process.

The control unit 1 is substantially in the form of a microprocessor using as input the information obtained by the sensor discs 4 and 2 via the cables 19 and 22 and from the sensor 8 via the cable 18, and providing electrical pulses which are transmitted along the cable 30 to cause precise angular movements of the disc 35 via the motive source 6; 28 is the circumferential arc between two points of inversion of the turns of yarn 12 deposited along the side of the bobbin 1 on termination of two successive to-and-fro movements of the yarn 12 being wound; 38 is the line or rather the sufficiently narrow band on which the bobbin 1 is dragged into rotation by the grooved drive roller 9.

K1, K2, K3, K4, K5 ... are those lines of whole-number or exact fraction winding ratio which overall represent the orders of ribbing considered dangerous for the quality of the winding underway in the formation of the bobbin 1; "K" is the winding ratio defined herein as the ratio of the number of revolutions of the grooved drive roller "Wc" to the number of revolutions of the bobbin under formation "Wr" per unit of time.

It is immediately apparent that the constant "K" lines are of increasing value from the commencement of bobbin winding to the termination of winding on reaching the final bobbin diameter; 47 is the line of bobbin formation with constant winding angle, which is predetermined and pre-set from the commencement of the yarn collection process.

The following description of operation, with reference to the stated figures, relates in particular to that which is new and hence examines only the apparatus of the present invention, which governs and controls the means for distributing the yarn on the forming bobbin in such a manner that the winding layers are superposed without any ribbing effects, so producing yarn depositions of uniform compactness, any devices or means of the known art associated therewith within the collection unit not being described.

The operator firstly switches on the apparatus by which the bobbin will be guided to undergo formation with continuous crossed turns of yarn fed from the package 11. The various requests for the operative yarn winding parameters then appear either together or progressively on the window

screen of the keyboard 7. The operator reads these requests and provides the following values:

- reference speed for the collection of the yarn 1 and hence the rotational speed of the drive roller 9, and also the traversing speed of the yarn guide element 29 which by virtue of its to-and-fro movement provides a precise crossing or winding angle for the wound yarn turns;
- distance between consecutive wound yarn turns corresponding to complete to-and-fro movements of yarn collection, one following the other, said distance being predetermined and pre-set with a minimum acceptability limit.

These values are keyed into the control unit 3 by the operator via the keyboard 7, and are processed within its calculation centre in accordance with a previously stored program. In addition to the operative parameters for the winding station, the whole group of lines of whole-number or exact fraction "K" values are determined and memorised, together with the width of the band zone straddling said ribbing lines, this width being determinable in value, and derivable from the minimum acceptable distance between two said consecutive turns.

After this initial setting, the service operator activates the entire winding station and commences the winding process. The motive source 5 rotates the grooved drive roller 9 up to its steady working speed, i.e. to the reference speed for collecting the yarn 12, which deposits on the tube with a constant crossing angle. The yarn guide element 29 is also driven with reciprocating movement by a motive source, not shown. The winding underway then follows the inclined line of Figure 21, said line representing the line 47 of Figure 20 in terms of the progressive winding points. The control unit 3 processes the input data from the sensor discs 2 and 4 in its microprocessor or microprocessor card using its internal program, to calculate moment by moment the winding ratio "K", which represents the ratio of the rotational speed "Wc" of the grooved drive roller 9 to the rotational speed "Wr" of the bobbin 1.

The winding ratio "K" indicates a simple transmission ratio, and the terms "winding" and "transmission" can be used indifferently. The "K" winding ratio values, which gradually increase with the gradual increase in the bobbin diameter (bobbin diameter represented by the horizontal axis of Figure 21), are compared in the electronic comparator of the mini-computer 3 with the whole-number or exact fraction values representing overall those "K" ribbing orders considered dangerous (critical values) for the quality of the winding underway in the formation of the wound yarn bobbin 1. The winding underway operates in a non-critical region and the

bobbin 1 gradually grows with wound yarn 12, all as represented on the block diagram of Figure 22 by the ring positioned to the left, which closes downwards with the deviation block 49.

The diameter of the bobbin 1 increases along a portion of the line 47, said line 47 being characterised by a constant crossing (winding) angle. The winding underway is also represented schematically in its geometrical characteristics by Figures 2, 3 and 4 and in its physical quantities by Figures 5, 6 and 7.

In this respect, the lever linkage 24 and 25 which angularly inclines the bobbin carrier arm is in its normal position, obliging the drag line 38 to assume a central position B (see Figures 3a and 3b), with a substantially constant contact pressure $n(x)$ between the bobbin 1 and the roller 9 and with distribution of the drag force $f(x)$ in accordance with Figure 6.

Said drag force $f(x)$ results in a distribution of the drag moment $m(x)$ as shown in Figure 7, which is easily understandable. The winding ratio "K" varies by increasing with increasing diameter of the bobbin 1, at a certain moment the control unit 3 sensing that the ratio "K" equals the "K" value corresponding to the lower limit of the band zone straddling the first ribbing line K1. The "K" value corresponding to said lower limit 42 (see Figure 20) geometrically corresponds to the predetermined minimum distance between two consecutive turns in the winding underway.

At the moment of operation represented graphically by the point 42 the control unit 3 provides at its output electrical signals which via the cable 30 activate the motive source 6 to induce a progression of small angular rotations of the disc 35, to result in a controlled rotation of the bobbin carrier arm 27 via the pin 33 and lever 24.

The line of contact 38 shifts gradually towards the left end of the bobbin to achieve in the limit the geometrical configuration represented by Figures 8 and 9.

During said gradual shift towards the left end of the bobbin 1, the rate of angular rotation Wr of the bobbin remains substantially constant during the continuous increase in the wound yarn diameter.

The result of this is a constant winding ratio "K" from the point 42 to the point 44 along the line portion 41. The winding underway along the portion 41 is in the critical region with controlled growth.

In the block diagram of Figure 22 said winding with "K" maintained constant is represented by the ring positioned to the left, identified by the term "small bobbin" in the sense that the drag line 38 is gradually shifted towards the left end of the bobbin 1.

This shift action corresponds respectively, according to the above mentioned alternative cases, to

the shift of the drag line 38 towards the minor diameter of the conical bobbin, or to the shift of the drag line 38 towards the major diameter of the drive grooved cone.

The winding corresponding to the geometrical configuration of Figures 8, 9 and 10 is characterised by the variation in contact pressure $n(x)$ shown in Figure 11, the variation in drag force $f(x)$ shown in Figure 1 and the variation in drag moment $m(x)$ shown in Figure 13. Said quantities are the resultant effects along the contact generator between the roller 9 and the overlying bobbin 1.

The controlled-growth winding reaches the point 44.

At that moment of operation represented graphically by said point 44, the control unit 3 provides at its output electrical signals which via the cable 30 activate the motive source 6 to induce an instantaneous angular rotations of the disc 35, to achieve the geometrical configuration shown in Figure 14. Said configuration causes the bobbin carrier arm 27 to incline the bobbin 1 towards the right end, hence shifting the line of contact 38 into the position of Figures 15.

The winding then passes rapidly from the operating point 44 to the operating point 46 along the substantially vertical line portion 43. The winding resulting from the geometrical configuration of Figures 14, 15 and 16 is characterised by the variation in the contact pressure $n(x)$ shown in Figure 17, by the variation in the drag force $f(x)$ shown in Figure 18 and by the variation in the drag moment $m(x)$ shown in Figure 19. Said quantities are the resultant effects along the contact generator between the drive roller 9 and the overlying bobbin 1 when the line of contact 38 is in proximity to the right end of the bobbin 1.

The winding underway deriving from the configuration of Figure 15 corresponds to the operating point 46 of Figure 20.

Controlled-growth winding therefore again commences in that the control unit 3 provides at its output electrical signals which via the cable 30 activate the motive source 6 to induce a progression of small angular rotations of the disc 35, to result in a controlled rotation of the bobbin carrier arm 27 via the pin 33 and lever 24. The line of contact shifts gradually towards the centre of the bobbin 1 into the position of Figure 3.

During said gradual shift towards the centre of the bobbin 1, the rate of angular rotation W_r of the bobbin remains substantially constant during the continuous increase in the wound yarn diameter. The result of this is a constant winding ratio "K" from the point 46 to the point 48 along the line portion 45. The winding underway along the portion 4 is in the critical region with controlled growth, and is also along the upper limit of the band zone

straddling the first ribbing line K1. In the block diagram of Figure 22, said winding at constant "K" is represented by the ring positioned to the right and identified by the term "large bobbin" in the sense that the drag line 38 is shifted gradually towards the centre onto progressively smaller diameters.

The new operational winding point 48 is followed by winding under increasing "K" along the line 47 in accordance with the geometrical configuration of Figures 2 and 3.

At the next ribbing line the control unit 3 operates with a cycle identical to the preceding described cycle, being again repeated identically in proximity to the various ribbing orders considered dangerous for the quality of the winding underway. Using the apparatus of the present invention a method is proposed herein which is able to form wound yarn bobbins with their collected yarn turns perfectly distributed in the sense of being free of ribbing considered damaging for the subsequent processing in the production of a textile article. The description is given only by way of non-limiting example, and modifications are possible without leaving the scope of protection of the invention.

Claims

1. A method for distributing wound yarn on a forming bobbin driven by a drive roller in a collection station of a winding machine, in which bobbin and roller have a different shape each other, and respectively cylindrical or conical, in which in said collection station the drive roller rotates at constant rotational speed and the bobbin, which rests under pressure on the drive roller, is subjected to rotation which aided by the presence of a yarn guide element driven with periodic reciprocating rectilinear movement results in cross-winding of the yarn by unwinding it from the underlying feed package, characterised in that the driving contact line between bobbin and roller is axially shifted, towards the major or the minor diameter of the conical element of the above bobbin-roller coupling, by the variation of inclination of the bobbin with respect to the drive roller in order to avoid the ribbing effect on the bobbin.
2. A winding method for distributing wound yarn as claimed in claim 1 on a forming conical bobbin driven by a cylindrical drive roller in a collection station of a winding machine, for example an automatic winder, in which in said collection station the cylindrical roller rotates at constant rotational speed and the bobbin, which rests under pressure on the cylindrical drive roller, is provided with the necessary

rotation to cross the yarn by unwinding it from the underlying feed package, said method being characterised by:

- determining moment by moment the deposition distance between two yarn turns successively deposited on the surface of the conical bobbin under formation; 5
- on the basis of previously recorded successive variations in distance between two consecutive turns, determining when said distance falls below a predetermined minimum value, and when said distance again rises above said predetermined minimum value; 10
- before the distance between two consecutive yarn turns falls below the predetermined minimum value, activating a motive source which by means of a lever linkage progressively inclines the conical bobbin to vary its transmission ratio with the cylindrical roller, in order to maintain the distance between consecutive turns about a value slightly greater than the predetermined minimum value and to progressively increase the bobbin inclination each time the distance between said consecutive turns tends to fall, at least until the deposition of consecutive turns at a distance apart less than the predetermined minimum value ceases; 15 20 25
- quickly restoring the initial conditions by operating the motive source to incline the bobbin in the opposite direction, to annul the previously induced inclination and cause a change in the transmission ratio, which at a certain moment assumes a value corresponding to deposition of turns at a distance apart less than the predetermined minimum distance and even zero distance apart, but with a rapidity such as to cause only an insignificant quantity of turns to be deposited very close to or superposed on each other, and which does not damage the quality of the bobbin under formation. 30 35 40 45

3. A winding method for distributing wound yarn as claimed in claim 1 on a forming cylindrical bobbin driven by a drive cone in a collection station of a winding machine, for example an automatic winder, in which in said collection station the drive cone rotates at constant rotational speed and the bobbin, which rests under pressure on the drive cone, is provided with the necessary rotation to cross the yarn by unwinding it from the underlying feed package, said method being characterised by: 50 55

- determining moment by moment the deposition distance between two yarn turns successively deposited on the surface of the cylindrical bobbin under formation;
- on the basis of previously recorded successive variations in distance between two consecutive turns, determining when said distance falls below a predetermined minimum value, and when said distance again rises above said predetermined minimum value;
- before the distance between two consecutive yarn turns falls below the predetermined minimum value, activating a motive source which by means of a lever linkage progressively inclines the cylindrical bobbin to vary its transmission ratio with the drive cone, in order to maintain the distance between consecutive turns about a value slightly greater than the predetermined minimum value and to progressively increase the bobbin inclination each time the distance between said consecutive turns tends to fall, at least until the deposition of consecutive turns at a distance apart less than the predetermined minimum value ceases;
- quickly restoring the initial conditions by operating the motive source to incline the cylindrical bobbin in the opposite direction, to annul the previously induced inclination and cause a change in the transmission ratio, which at a certain moment assumes a value corresponding to deposition of turns at a distance apart less than the predetermined minimum distance and even zero distance apart, but with a rapidity such as to cause only an insignificant quantity of turns to be deposited very close to or superposed on each other, and which does not damage the quality of the bobbin under formation.

4. An apparatus for implementing the method claimed in claim 1, characterised by comprising a control unit based on a mini-computer into which the values relating to the winding parameters, those ribbing orders considered damaging to the quality of the winding under-way, and the predetermined minimum distance between two consecutive yarn turns in one complete to-and-fro deposition of the yarn on the surface of the forming bobbin are firstly fed via a keyboard, said values being processed in the computing centre of the mini-computer for the computerised formation of a group of curves each having a constant "winding ratio"

of whole number or exact fraction considered dangerous, the mini-computer then receiving electrical pulses generated at each revolution, or submultiple thereof, of the drive roller and bobbin carrier mandrel by known transducer probes applied to them, to unambiguously provide knowledge of the rotational values of said members at each moment, these latter values being compared with said operational winding parameters within the electronic comparator of the mini-computer, in order to generate a number of command signals in continuous succession to activate and control the motive source which angularly positions the bobbin carrier arm such that the collection station operates in regions not in proximity to the ribbing effect.

5. An apparatus for distributing wound yarn on a forming bobbin as claimed in claim 4, characterised in that one apparatus of the present invention is provided in each yarn winding station.
6. A collection station equipped with an apparatus which enables yarn to be wound by distributing it on the forming bobbin such that this latter is free from damaging ribbing, in accordance with claims 1 to 3.

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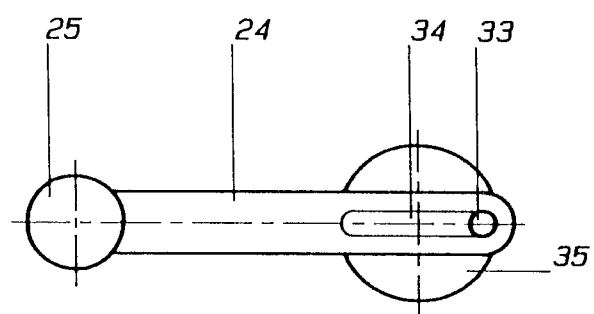
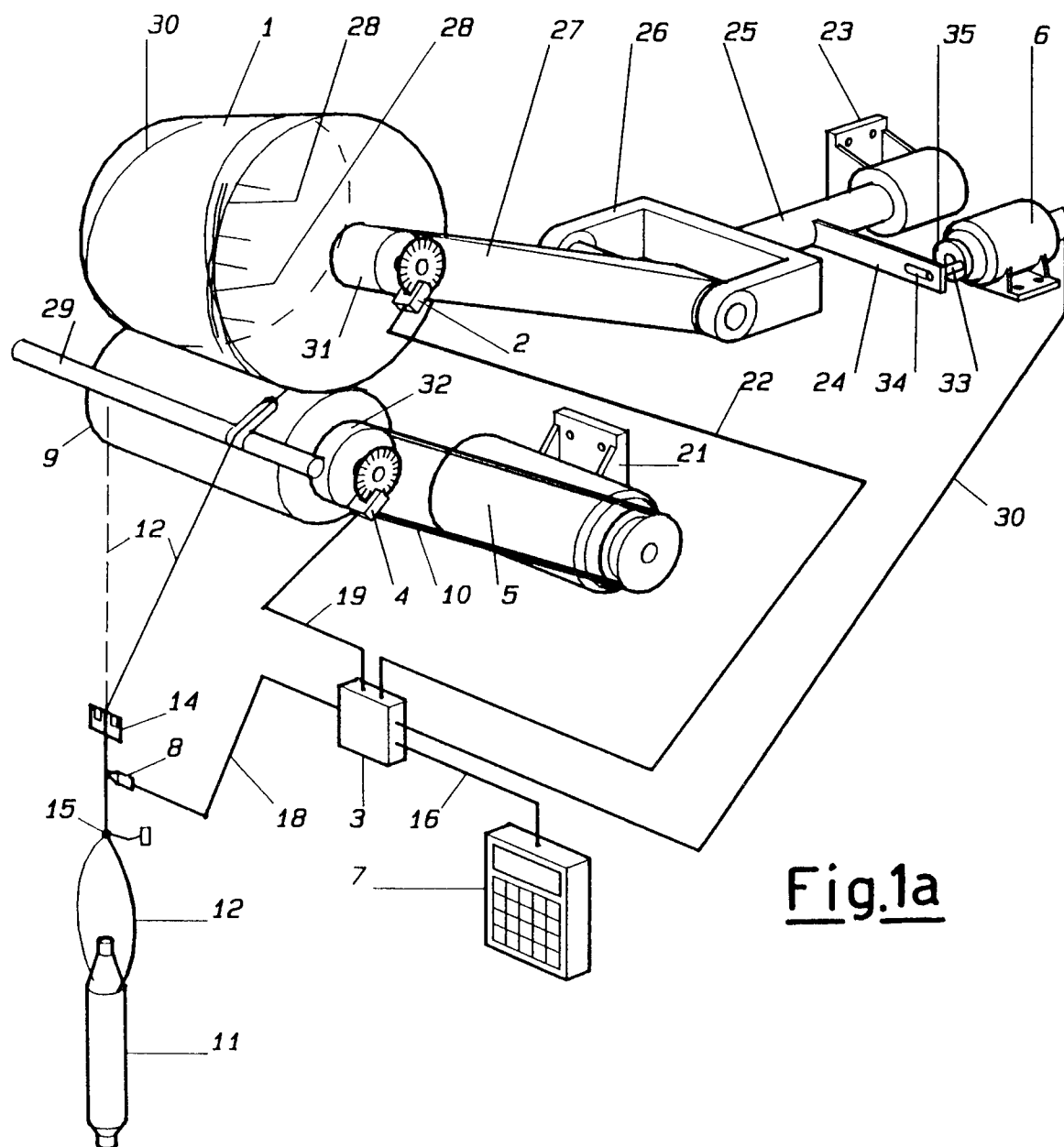
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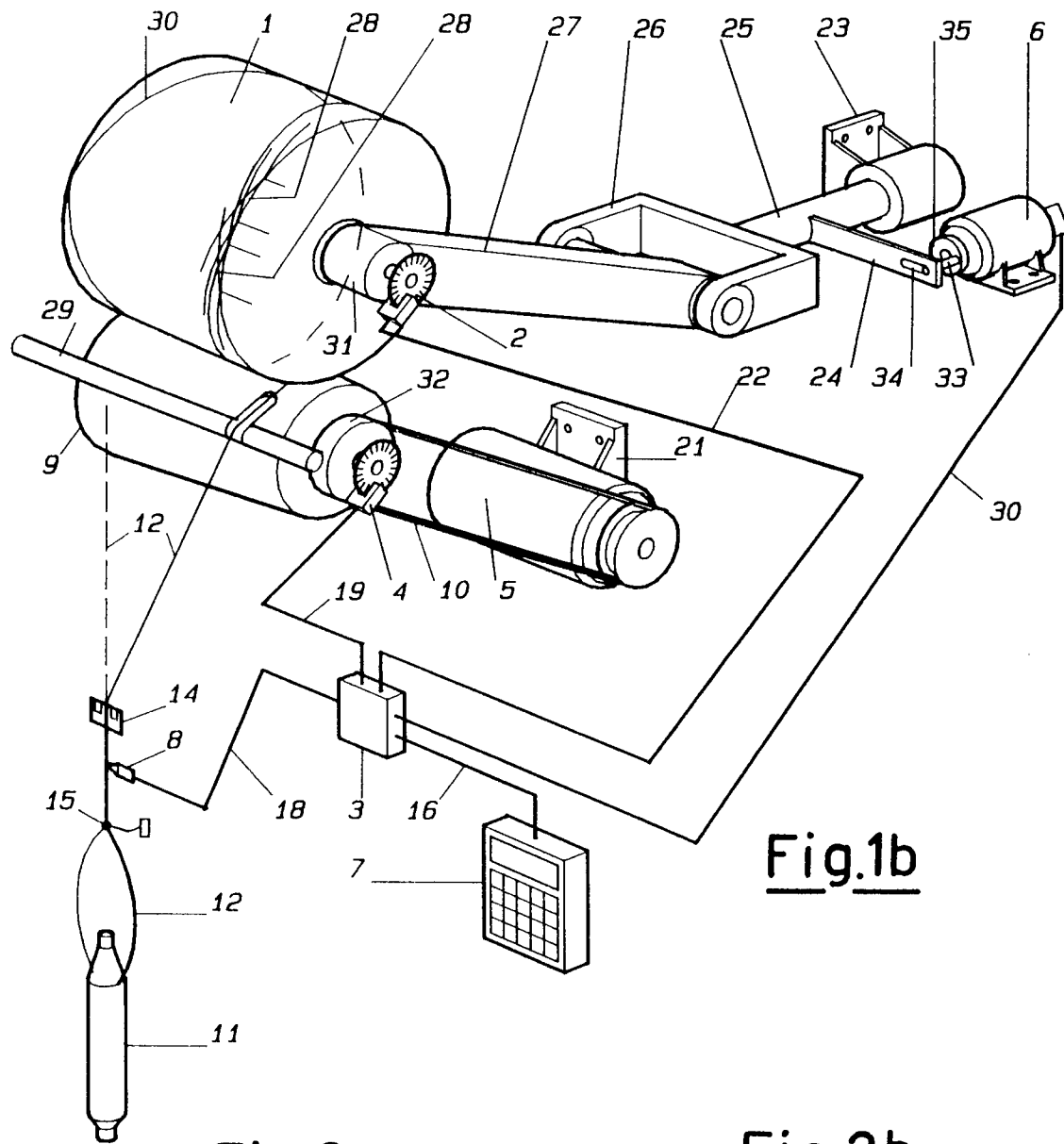
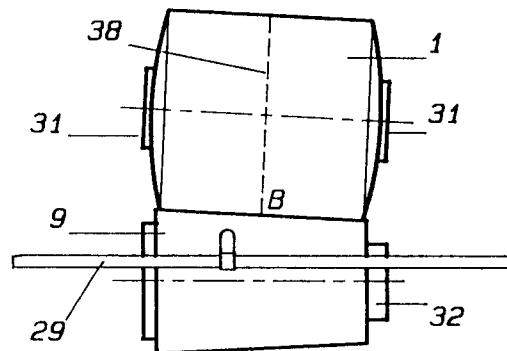
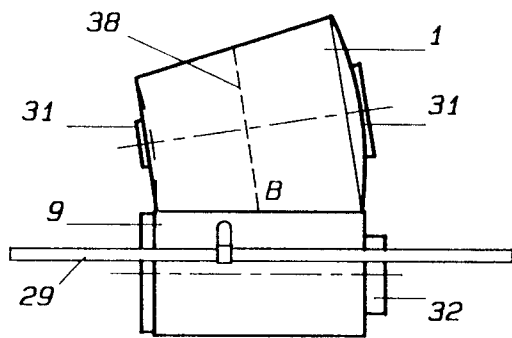


Fig. 3a

Fig. 3b



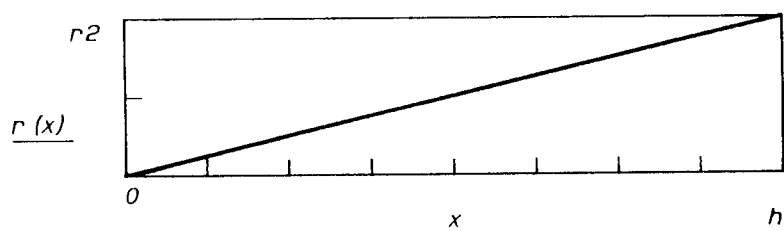


Fig.4a

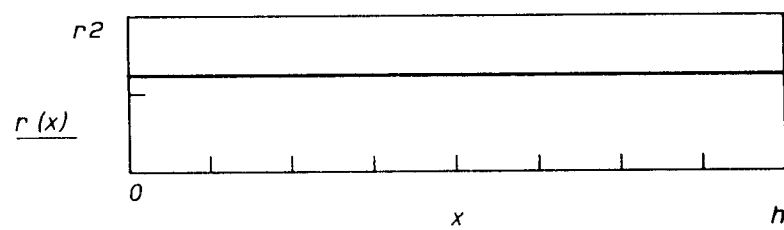


Fig.4b

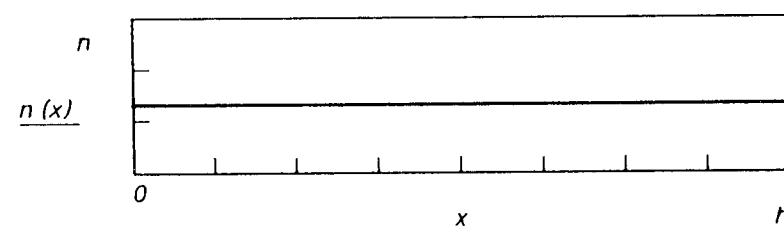


Fig.5

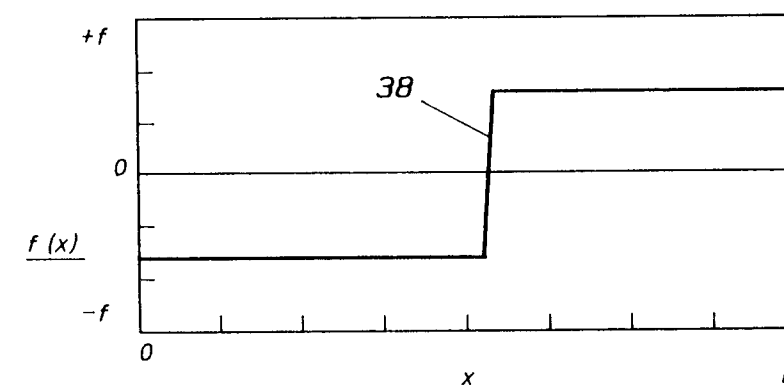


Fig.6

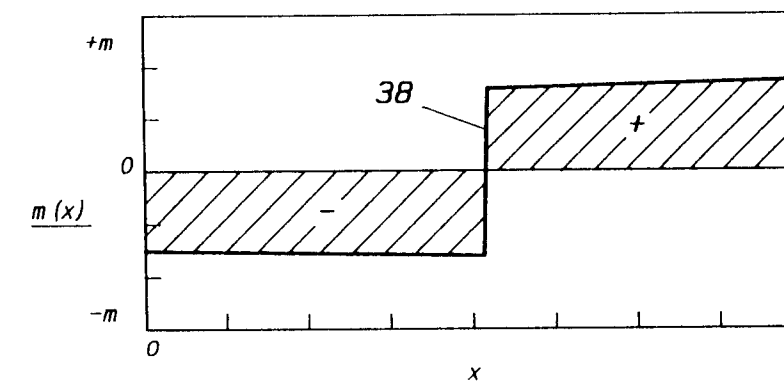


Fig.7

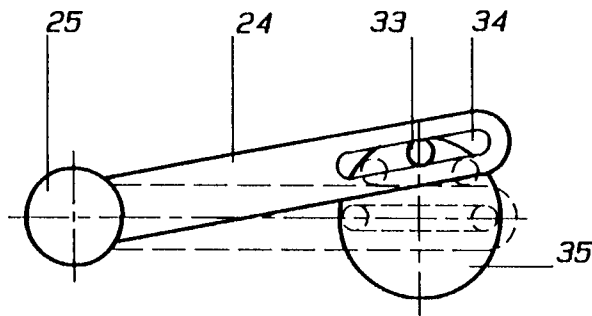


Fig.8

Fig.9a

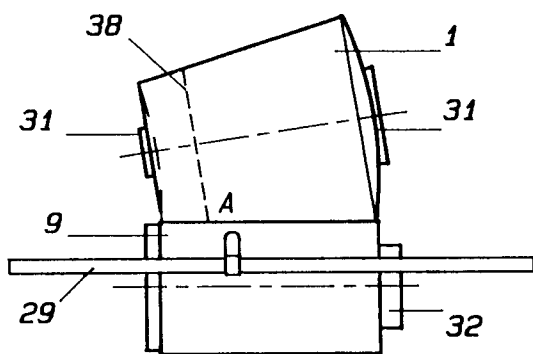


Fig.9b

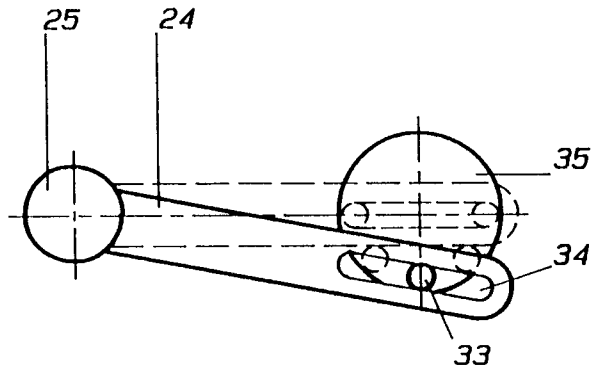
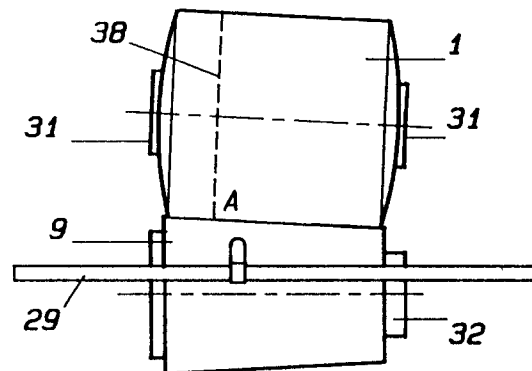


Fig.14

Fig.15a

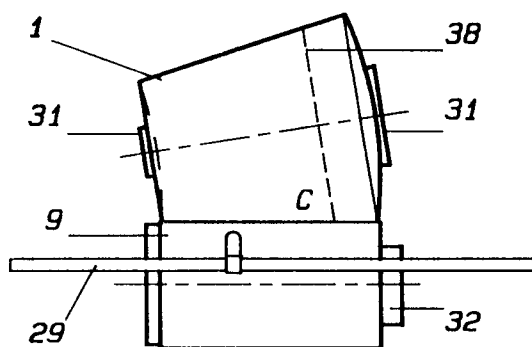
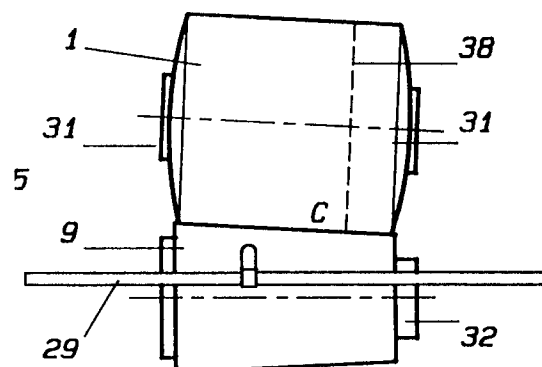


Fig.15b



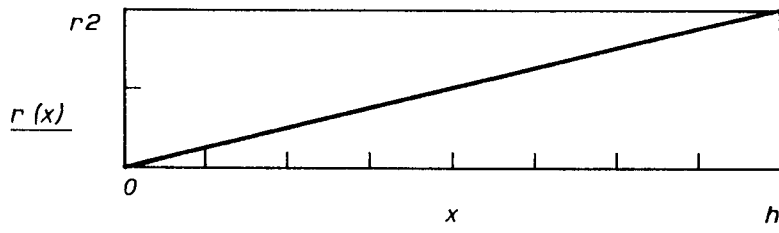


Fig.10a

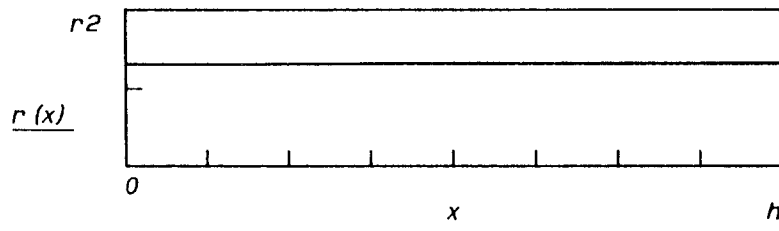


Fig.10b

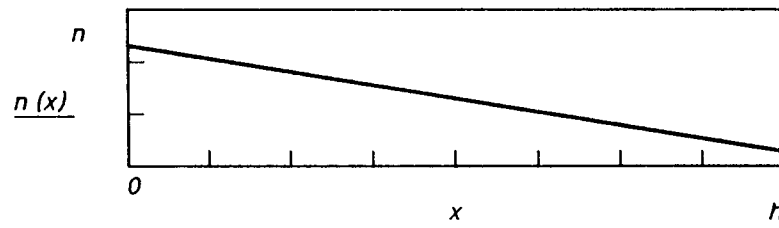


Fig.11

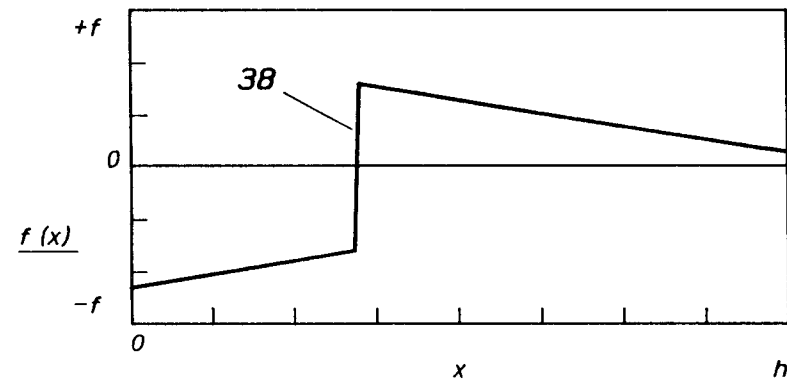


Fig.12

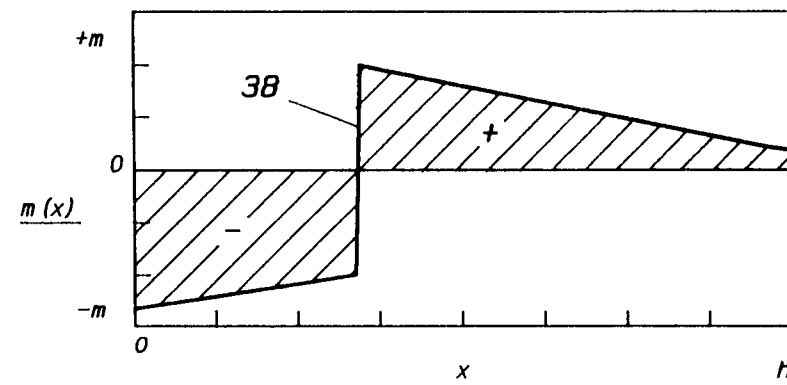


Fig.13

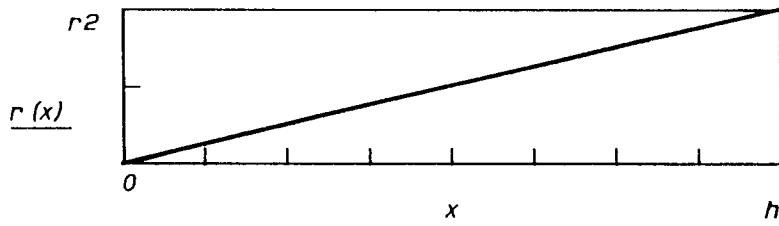


Fig.16a

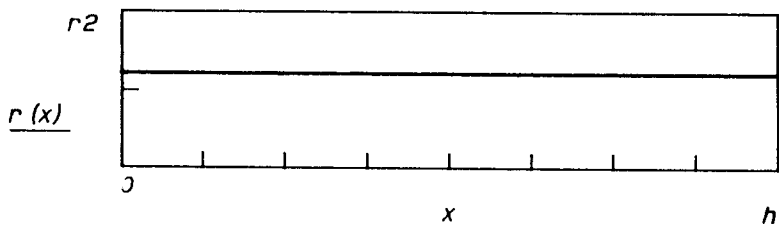


Fig.16b

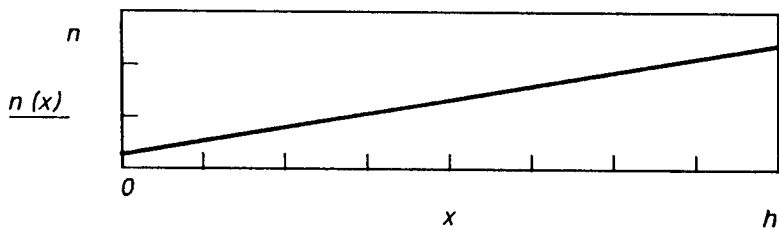


Fig.17

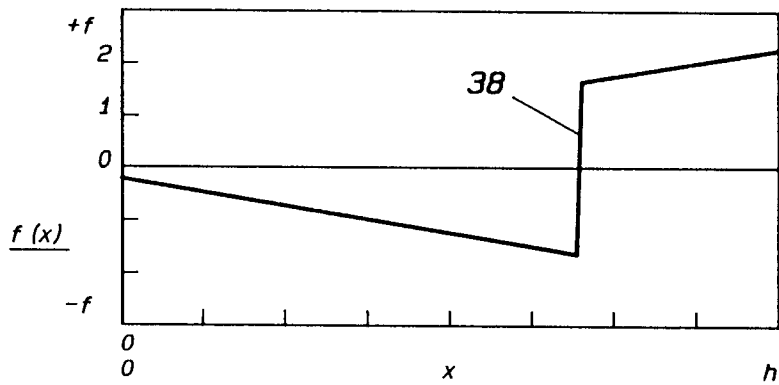


Fig.18

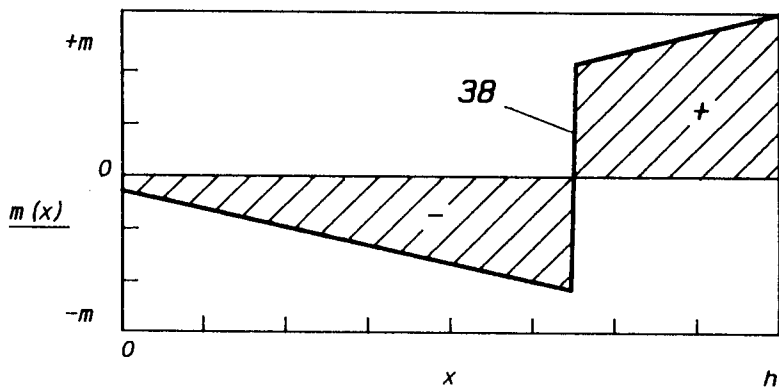
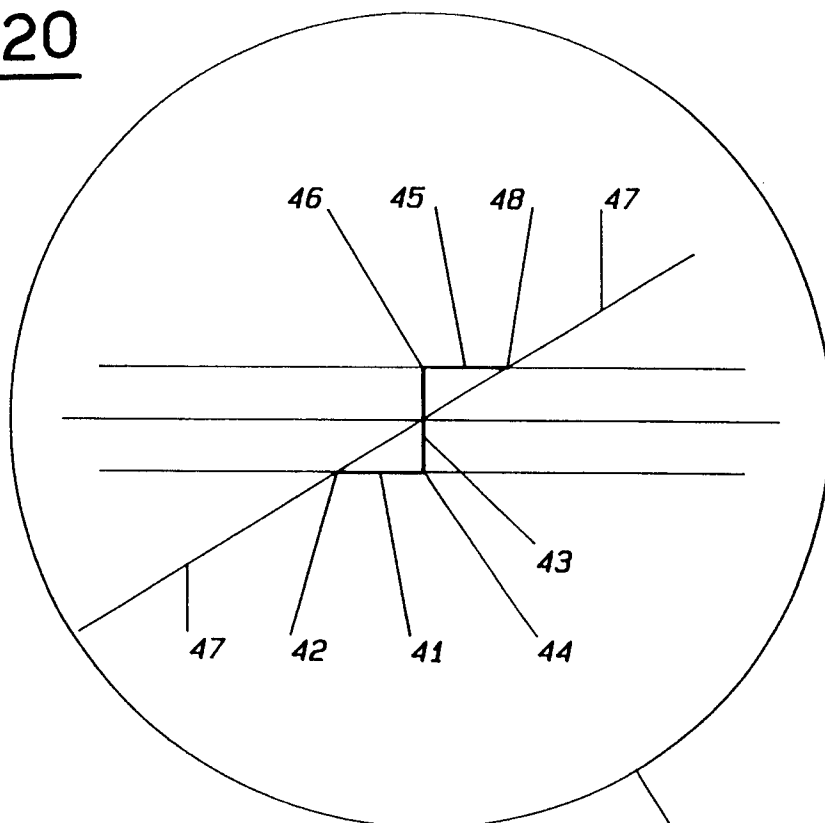


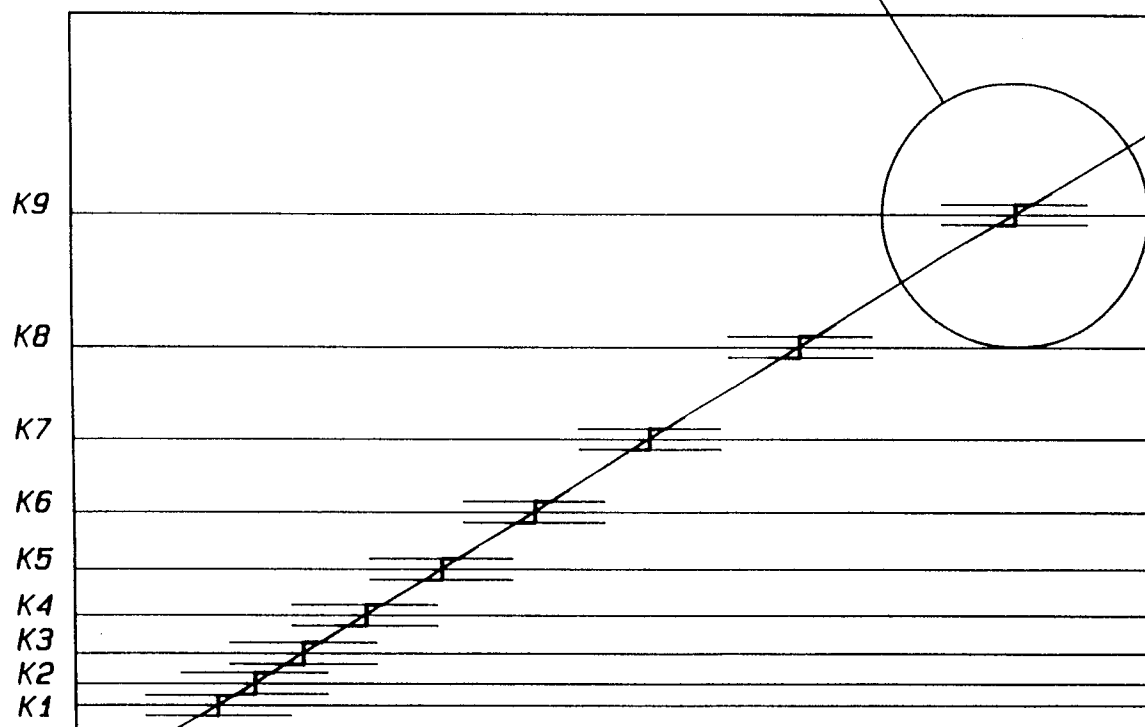
Fig.19

Fig.20



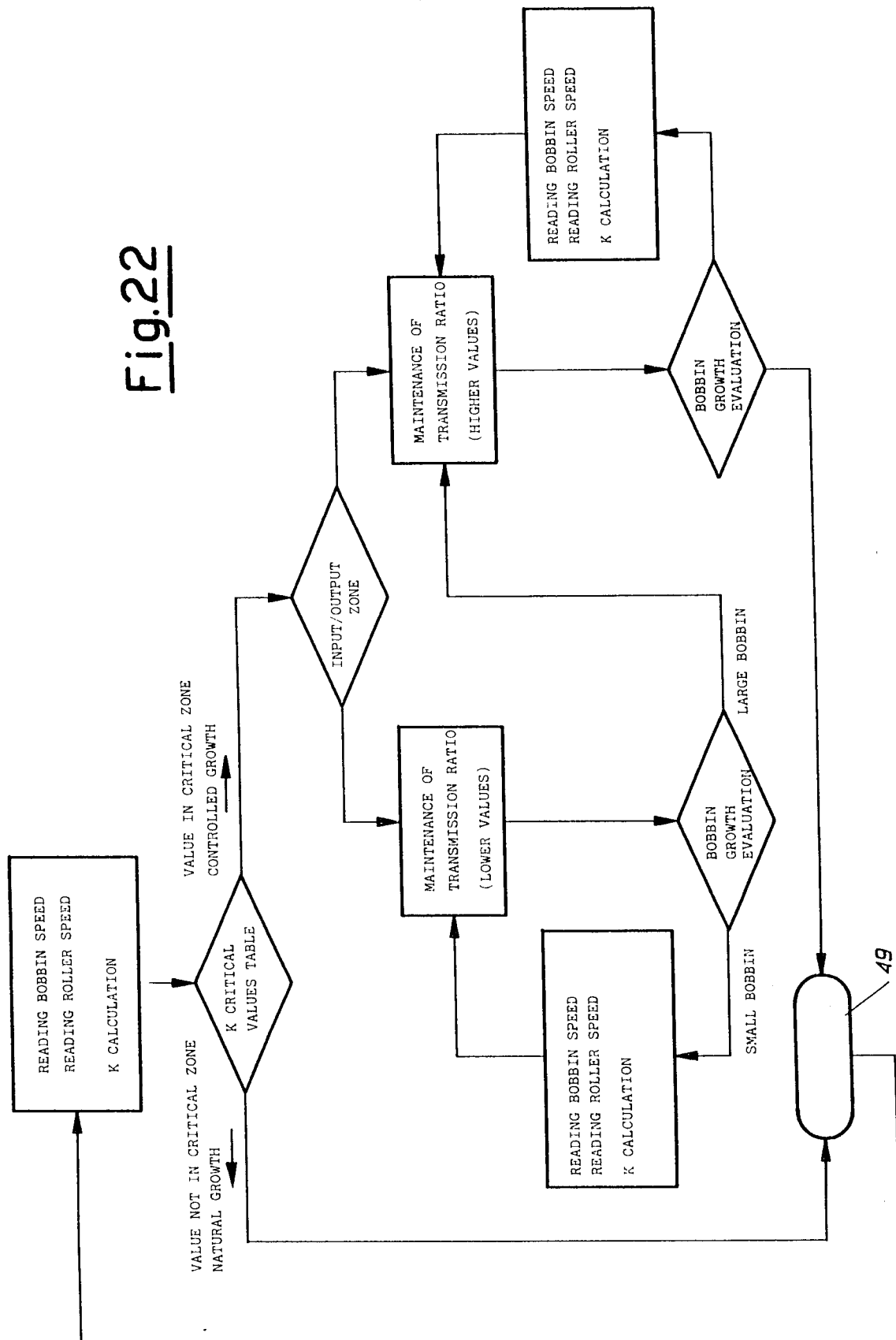
$$K = \frac{WC}{Wr}$$

Fig.21



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Fig.22





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 20 1747

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
Y	GB-A-2 127 443 (SCHWEITER ENGINEERING WORKS LTD.) * page 3, line 50 - line 81 * * page 1, line 4 - page 2, line 40 * * page 2, line 57 - line 105 *	1	B65H54/38
A	---	2,4,6	
Y	DE-A-24 03 341 (W.SCHLAFHORST & CO) * page 4, line 25 - page 5, line 21 *	1	
A	---	6	
A	EP-A-0 272 721 (SAVIO S.P.A.) * column 1, line 1 - column 2, line 19 * * column 3, line 4 - line 44 *	1,2,6	
D	& IT-B-1 198 214 (SAVIO S.P.A.) ---		
A	GB-A-872 608 (JAMES MACKIE & SONS LTD.) * page 1, line 8 - line 41 * * page 2, line 6 - line 107 *	1-3,6	
A	EP-A-0 375 043 (SAVIO S.P.A.) * column 12, line 31 - column 15, line 38 * -----	4,5	TECHNICAL FIELDS SEARCHED (Int.Cl.5) B65H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15 September 1994	Examiner Goodall, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons ----- & : member of the same patent family, corresponding document	