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(54) A METHOD TO POSITION SPINDLE PRECISELY IN TURRET TYPE AUTOMATIC WINDER

VERFAHREN ZUM PRÄZISEN POSITIONIEREN EINER SPINDEL IN EINEM AUTOMATISCHEN WENDEWICKLER

PROCÉDÉ PERMETTANT DE POSITIONNER PRÉCISÉMENT UNE BROCHE DANS UN ENROULEUR AUTOMATIQUE DE TYPE À TOURELLE

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Description

Field of Invention:

[0001] The invention relates to an automatic yarn winding turret type device that can reliably position a spindle for winding after the bobbin changeover.

Background of Invention:

[0002] The automatic turret type winder is used for winding of continuously arriving tapes, threads, or bands onto a bobbin. In general, on the turret type winder, a pair of bobbin holders-also known as spindles-are mounted on the opposite ends of a rotatable turret mounted on suitable machine frame. Each spindle is alternately displaced from the normal winding position to the doffing position by every half rotation of the turret. The turret keeps on rotating in the same direction at required time intervals or when running spindle reaches its maximum length of carrying winding tapes. Each spindle needs precisely controlled rotation around its own axis, so may be driven independently by an electric motor through a suitable mechanism such as a belt and pulley arrangement or with an independent direct driving electrical motor system. Conventionally, the encoders or other suitable devices are mounted on the motor for monitoring the motor revolutions, and the signal is communicated to an electronic controller with the help of a suitable cable. The controller further sends the electrical signals to the inverter/drive of the active motor which determines the power to be given for the motor driving the spindle.

[0003] The conventional winders of the above type are disclosed in the US Patent Nos. 5228630, 4765552 and European Patent 861800A2, and WO 2017/093950.

[0004] Automatic turret type winders were introduced for providing bobbins of polyolefin flat/fibrillated yarns and to improve efficiency, reduce wastages. Automatic changeover process replaces spindle carrying yarn bobbin with empty spindle.

[0005] In these conventional automatic winders, the turret is rotated by using a clutch and a pulley in synchronicity. Turret rotation is performed by releasing clutch and transferring the driving force to the pulley for rotation. After the turret rotation, correct positioning of empty bobbin is done by drifting bobbin in reverse direction towards the CAM box pressure roller. Ideally, spindle is positioned such that pressure roller should exert pressure uniformly on spindle present for winding. Reverse movement of turret carrying spindle is controlled according to the pre-set time and speed parameters in the control system. Practically, in conventional systems, turret movement is not uniform, and therefore as spindle position after changeover is not precise and motion smooth as required, due to change in mechanical condition. Machines of the type being discussed here are generally not operated under entirely dust-free environment. Therefore, as time progresses, accumulation of foreign particles on the mechanical components of the machinery increases even after taking abundant precaution to clean and maintain the machine. Accumulation of particulate matter provides hindrance to smooth motion of moving elements over a period of time. In other words, the system's resistance to smooth movement of components increases due to general wear and tear and accumulation of particulate matter.

[0006] For instance, the turret could get jammed due to accumulation of dust particles or may be extra tightened or loosen during maintenance cycle - any of which could affect the turret rotation by making it fast/slow and/or jerky in nature. This jerky behavior is generally known as 'Mechanical glitches'. Conventional winders are known to unavoidably suffer from improper spindle positioning in respect to CAM pressure roller on account of said mechanical glitches.

[0007] Improper spindle positioning causes a gap between the spindle bobbin which is ready to be wound and the pressure roller, which in turn produces uneven winding tension and therefore non-uniform package density. Second, some of the existing systems lead to imprecise spindle positioning when the turret motion pushes the CAM roller extra in reverse direction. This is because of the lower sensitivity achieved in these spindle positioning methods, for example, as mentioned in patent WO 2017/093950.

[0008] Therefore, there is a need to provide a method to position spindle precisely and with greater precision than the conventional methods in turret type automatic winder automatic method, especially a method to identify correct stationing position of turret and spindle after reverse movement post doffing.

[0009] There is also a need to provide a system that reduces possibility of turret positioning itself at an intermediate location, thereby leaving a gap between the spindle and the pressure roller, or positioning itself past its desired location, thereby exerting extra pressure on the roller.

Objects of the invention:

[0010] Accordingly, it is an object of the present invention to provide improved automated method which can identify correct spindle stationing position more accurately and in lesser response time of motor current of the spindle motor as spindle touches the pressure roller.

[0011] Another object of the present invention is to provide a system with higher accuracy of reaching correct turret position, which reduces possibility of pushing extra on pressure roller due to lower sensitivity in earlier positioning methods.

List of parts:

[0012]

Turret (1)	Tape/yarn (3)
Spindle (2A)	CAM box (4)
Spindle (2B)	Pressure Roller (5)
Tape Guide (6)	Close-by positional line (9')
First and second bobbins (7, 7A)	First control system (10)
Tensioning Bow (8)	Second control system (11)
Winding position line (9)	Master Control system (12)

Summary Of Invention

[0013] The invention relates to an automatic turret type yarn winding device. The automatic bobbin changeover process involves winding of slit film tape/yarn on a bobbin, followed by rotation of the turret to bring an empty bobbin into the winding position. Pressure rollers are provided to ensure consistent and accurate winding. The accurate relative positioning of the bobbins and pressure rollers is important. Wear and tear and particulate dust may cause malfunctioning of winder systems which may affect accuracy of turret rotations and relative positioning of the bobbins and pressure rollers, especially when the turret rotation during bobbin changeover stage is done in a single rotation. The invention provides a system and a method to position spindle more precisely in turret type automatic winder, especially to identify correct stationing position of turret spindle after reverse movement post doffing. It involves, during the bobbin changeover process, the step of rotating the turret in at least two discrete rotational movements carried out at controlled speeds, whereby the empty bobbin assumes its accurate winding position. In an important inventive aspect of the invention, the turret rotation is controlled by sensing the current in the motors controlling the spindles.

Brief description of figures:

[0014]

The objects and advantages of the invention may be understood by making reference to the following description, taken with the accompanying drawings:

Figure 1 shows a schematic of a turret with two spindles;
Figure 2 shows a schematic where the pre-set tape length is reached;
Figure 3 shows a schematic of the turret under the bobbin changeover process;
Figure 4 shows a schematic representing completion of the automatic changeover process and the drifting of spindle in respect to the pressure roller
Figure 5 shows a schematic of positioning of the turret and the spindle at correct position
Figure 6 shows the comparative change in the currents of the spindle and the turret motor as a percentage of the rated values
Figure 7 shows relationship between the control systems of the invention

Detailed Description of the invention:

[0015] The present invention discloses an improved procedure for precise Turret positioning after the bobbin changeover. The terms 'precise', 'precisely' or 'accurate' used in this specification in the context of positioning or the spindle or the turret are meant to convey that a good or close to good position of turret or spindle is achieved whereby the best possible quality bobbin is produced.

[0016] Figure 1 shows the present invention in an operational state. It shows a turret with spindles, with one spindle in a position to start winding. Each spindle is driven by an associated spindle motor. There is also a motor that drives the turret. Motors are not shown in figure.

[0017] Figure 1 shows the present invention in an operational state. It shows a turret (1) at the start of a winding operation. It has empty first and second bobbins (7, 7A) mounted on two spindles (2A and 2B) with their centres respectively termed as points A and A', which fall on what is termed as a winding-position-line (9) or a bobbin positional axis/line, and where one of the two spindles (2A) is in a winding position to start winding. The position of the winding positioning line (9), which is an imaginary axis, is a position that is suitable for winding of yarn and will be known to a person skilled in the art. When the turret (1) is in this position, centres (A and A') of both bobbins (7, 7A) (presently empty) fall on the winding positional line (9) and one of the empty winding bobbins (7 or 7A) which is mounted on the spindles (2A or 2B) optimally touches the pressure roller (5). In this position, the pressure exerted by the first bobbin (7) which is in the winding position and the pressure roller (5) on each other is the optimal pressure for a given yarn (3), something a person skilled in the art would readily know.

[0018] The yarn/tape (3) is delivered after cutting and conditioning from tape line machine from direction 'a' (as indicated in Fig1) after passing through a dancing arm which regulates tape tension. The tape line speed of discharging tapes varies from 200 to 800 meters per minute; the density of the tape material varies from 400 to 3000 denier.

[0019] Each spindle is driven by an associated spindle motor. There is a motor that drives the turret.

[0020] Tape/yarn (3) winding starts on the presently empty first bobbin (7) after a CAM box (4) bows down by an angle 'θ' (measured from the vertical) in the direction 'b' (indicated by a counter-clockwise arrow in Figure 1). The magnitude of the angle is dependent on the turret geometry/design and would be known to a person skilled in the art. As the tape (3) winding progresses, the first bobbin (7) package diameter grows to a predetermined value. At this stage, a bobbin changeover is expected whereupon the common controller for the winder head instructs the motor of turret driving system (not shown in figures) to rotate for the bobbin changeover, such that the now empty second bobbin (7A) assumes the winding position.

[0021] Figure 2 shows a position of the CAM box (4) where the preset first bobbin (7) diameter after winding of yarn has been achieved. As a part of the bobbin changeover process, the CAM box now rotates in a clockwise direction (i. e. a direction opposite to b) and the pressure roller (5) retracts from the wound first bobbin (7). A device that carries out the aforementioned rotation of the CAM box (4) may be an electromechanical, or a pneumatic or hydraulic system. Following the retractive rotation of the CAM box, the turret (1) begins to rotate in a direction indicated by arrow 'c' in Figure 3, which shows the turret in a state of transitional movement.

[0022] At the end of the transitional movement, according to the invention, the turret reaches a position such that the now empty second bobbin (7A) which is mounted on the spindle (2B) reaches a position close to the winding position (Figure 4). At the actual winding position, the centre (A') of the second bobbin (7A) should precisely be at the position previously occupied by the centre (A) of the now-filled first bobbin (7) at the start of its winding. However, according to the present invention, at the end of the transitional movement, the line joining the bobbin centres (A-A') achieved at the end of the transitional movement is not coincidental with the final position for winding represented by the winding positional line (9); actual position of the line joining centres of both bobbins (A-A') at the end of the transitional movement is deliberately drifted by an angle 'ϕ' (see Figure 4), termed as the displacement angle, with respect to required winding positional line (9). In one aspect of the invention, the displacement angle (ϕ) may be up to 45°. The actual positional line joining the centres (A, A') of two bobbins (7, 7A) at the end of first rotational movement is termed as a close-by positional line (9'). If, as is the conventional manner, after winding of the operational first bobbin (7) is complete, turret (1) at the end of its transitional movement is rotated from its original winding position to its final position (so that the empty second bobbin (7A) is in a winding position) in a single continuous movement (as indicated by rotational direction arrow 'c'), then there is a strong possibility that the spindle needing to be wound would stop before or after the pressure roller location - but not at the precise desired location.

[0023] The final position of the second bobbin (7A) is arrived at as a result of at least two discrete rotational movements. In the case where there are only two discrete rotational movements, the total rotational movement comprises a first and a second rotational movement. At the end of the transitional movement also termed as first rotational movement (indicated by arrow c in Figure 3) for the purpose of this description, the empty second bobbin (7A) is intentionally stopped at the close-by position (9'). At the final intended winding position (9), the pressure roller leans on the empty second bobbin (7A) and exerts a gentle pressure on it before the winding can begin. The rotational speed of the first rotational movement depends on various parameters such as the yarn type and denier, line speed, winder designs in general, and would be known to a person skilled in the art.

[0024] The first rotational movement is followed by a second rotational movement (indicated by direction d in Figure 4) in the direction required for the second bobbin (7A) to attain the final intended position, which takes place at a speed slower than the first rotational speed. As the second rotational movement continues and the second bobbin (7A) approaches its final winding position, and at some point touches the pressure roller (5) which may have already reached its predetermine location or in process of reaching it. At this point in time, the current in the spindle motor starts to rise. The second rotational movement is stopped when the current in the spindle motor reaches a predetermined value, indicating that the pressure roller (5) and the second bobbin (7A) are in the required final relative positions where the winding can begin. In some winding systems, the winding of the second bobbin (7A) may have already started before the pressure roller (5) and the second bobbin (7A) assume their required final relative positions.

[0025] The rotational speed (measured in RPM) of the second rotational movement may be up to 25% of the first rotational speed. This is done because controlling the movement at slow speeds to attain accurate final positioning of the second bobbin (7A) is far more feasible or achievable than trying to do so at high speed carried out in a single rotational movement. It is preferable, but not necessary, that the position of the second bobbin (7A) at the end of the first rotational movement is past the intended final position such that the directions c and d may be opposite to each other.

[0026] The position achieved by the second bobbin (7A) at the end of the first rotational movement may optionally be before its final intended position. In this situation, the second rotational movement takes places in the same direction as the first rotational movement, i.e. the directions c and d may be same (i.e. both may be clockwise).

[0027] The final winding position of the second bobbin (7A) (see Figure 5), is such that the second bobbin (7A) touches the pressure roller (5) at a position where tape tension does not vary much during winding process. In the preferred embodiment, the second bobbin (7A) reaches required position by rotating slightly in reverse direction 'd' (see Figure 4). Typically, this reverse motion (d) is controlled by set parameters, however, sometimes due to the problems related to the mechanical adjustment of the parts facilitating the motion, the spindle does not reach the correct position. There is therefore a need to provide a procedure that will identify the exact position of the spindle.

[0028] The present invention also discloses a system to control motions of the turret and the spindles (see Figure 7). It comprises a first control system (10) to control the rotational motion of the turret and a second control system (11) to control the rotational motion of the spindle. It also comprises a master control system (12) which controls both systems (10, 11) and receives signal/information from and sends command to the two control systems (10, 11). In other words, at the start of the winding operation, the master control system (12) sends a command to the first control system (10) to start the first rotational motion and stop it upon meeting the criteria outlined in this disclosure. Similarly, the master control also sends a command to the first control system (10) to start the second rotational motion at an appropriate time. In a key aspect of the present invention, the master control system (12) receives information from the second control system (11) regarding the upsurge in the spindle current and upon the said spindle current reaching its set threshold value, the master control system (12) instructs the first control system (10) to stop the second rotational motion of the turret and lock it such that the second bobbin (7A) remains in the optimum position.

[0029] The development of the upsurge in the currents in the motors of the turret and the spindle are illustrated in the comparative graph shown Figure 6 wherein data points 'X' and 'Y' represent, respectively, the points at which the spindle motor current and the turret motor current start increasing as a result of the spindle touching the pressure roller (5) during turret positioning.

[0030] Upon critical observation, the inventor noticed that the spindle motor current reaches its threshold value much earlier than the turret current reaches its own threshold value. This is a very important discovery which allows control of the turret movement on the basis of sensing the spindle current. Time difference between data points 'X' and 'Y' clearly shows delay of approximately 400ms in one of the captured instances for turret motor current to change significantly in comparison to spindle motor current on load increase due to resistance applied by pressure roller (5) to turret movement. In a conventional apparatus where the turret current controls the turret movement, this additional time would mean that the turret keeps rotating for that extra period even after the spindle has touched the pressure roller. This can have damaging effect on the working of the apparatus and consequently affect the quality of the wound bobbin (i.e. the final product).

[0031] A key aspect of the present invention is that the current in the motor that drives the spindle is used to control the stoppage of rotational movement of the turret once the spindle touches the pressure roller.

[0032] A key aspect of the present invention is that the current in the motor that drives the spindle is used to control the stoppage of rotational movement of the turret once the spindle touches the pressure roller.

[0033] The present invention further improves accuracy and responsiveness of the turret movement in regard specified position by sensing the spindle motor current such that when the spindle touches the pressure roller (5), the current of the active spindle motor surges to a definite value more sharply and in a short period up to a threshold value. The threshold value can be pre-set below or higher than or equal to motor rated value for releasing command as current reaches set level for specified time duration; when trigger value of spindle motor current reaches to specific value, the master control system (12) sends a command to the first control system (10) to stop at the initial winding position.

[0034] It is evident that the invention has a number of embodiments.

[0035] In the first embodiment, a method to position spindle precisely in turret type automatic winder is disclosed, said winder incorporating a rotatable turret (1) driven by a turret motor, said motor being controlled by a turret driving system and said spindle being driven by a spindle motor controlled by a spindle driving system, on which turret (1) at least a first and a second bobbins (7, 7A) are mounted on respective spindles (2A, 2B) in a diametrically opposite position along a winding-positional-line (9), and wherein the first bobbin (7) is positioned in a position of winding a tape/yarn(3) on it whereby, at the start of the tape winding process, said first bobbin (7) touches a pressure roller (5) provided on said winder, said method comprises the step of, upon said first bobbin (7) reaching its predetermined package size, rotating the turret (1) in at least two discrete rotational movements carried out at controlled speeds, preferably two discrete rotational movements, wherein a first rotational movement is carried out at a controlled first rotational speed up to a point where the centres (A, A') of said bobbins (7, 7A) fall on a close-by positional line (9'), whereby said close-by positional line (9') and said winding positional line (9) are at a finite displacement angle (ϕ) with each other, followed by rotating said turret in a required direction at a controlled second rotational speed to carry out a second rotational movement, up to a point where said second bobbin (7A) touches said pressure roller (5), followed by triggering a stop-and-lock action to stop the rotation of said turret (1), wherein said second controlled speed is less than or equal to first controlled speed, and wherein said stop-and-lock action comprises the steps of

- monitoring the change current in said spindle motor up to the predetermined/pre-set threshold value,
- sending a command through a second control system (11) controlling said spindle rotation to a master control system (12) that controls said second control system (11) informing it that said spindle current has reached its threshold value
- sending a command through said master control system (12) to a first control system (10) that controls turret rotation, instructing said first control system (10) to stop the second rotational movement of said turret (1) and then to lock said turret (1) at the position reached at the end of said second rotational movement.

[0036] In a next embodiment the first movement is carried out so that said centre (A') of said second bobbin (7A) crosses over said winding-positional-line (9).

[0037] In a further embodiment, the direction of rotation of said second rotational movement is opposite to the direction of rotation of said first rotational movement.

[0038] In a still further embodiment, the direction of rotation of said second rotational movement is same as the direction of rotation of said first rotational movement.

[0039] The invention also discloses a system to position spindle precisely in turret type automatic winder using the method disclosed in earlier embodiments. The system (see Figure 7) comprises:

- a first control system (10) to carry out said two discrete rotational movements of said turret,
- a second control system (11) to carry out said rotation of said spindles,
- a master control system (12) to receive information from and send instructions to either or both of said first and second control systems (10, 11), wherein

said master control system (12), upon receiving information from said second control system (11) that the increase in said spindle current has reached its pre-set threshold, sends a command to said first control system (10) to stop said second rotational motion of said turret and lock said turret in that position.

Claims

1. A method to position spindle precisely in turret type automatic winder, said winder incorporating a rotatable turret (1) driven by a turret motor, said motor being controlled by a turret driving system and said spindle being driven by a spindle motor controlled by a spindle driving system, on which turret (1) at least a first and a second bobbins (7, 7A) are mounted on respective spindles (2A, 2B) in a diametrically opposite position along a winding-positional-line (9), and wherein the first bobbin (7) is positioned in a position of winding a tape on it whereby, at the start of the tape winding process, said first bobbin (7) touches a pressure roller (5) provided on said winder, said method comprises the step of, upon said first bobbin (7) reaching its predetermined package size, rotating the turret (1) in at least two discrete rotational movements carried out at controlled speeds, preferably two discrete rotational movements, wherein a first rotational movement is carried out at a controlled first rotational speed up to a point where the centres (A, A') of said bobbins (7, 7A) fall on a close-by positional line (9'), whereby said close-by positional line (9') and said winding positional line (9) are at a finite displacement angle (ϕ) with each other, followed by rotating said turret in a required direction at a controlled second rotational speed to carry out a second rotational movement, up to a point where the empty said second bobbin (7A) touches said pressure roller (5), followed by triggering a stop-and-lock action to stop the rotation of said turret (1), wherein said second controlled speed is less than or equal to first controlled speed, **characterised in that** said stop-and-lock action comprises the steps of:

   - monitoring the increase in the current in said spindle motor up to the predetermined threshold value, said increase in current taking place upon the empty bobbin touching said pressure roller (5),
   - sending a command through a second control system (11) provided to control said spindle rotation to a master control system (12) provided to control said second control system (11) informing it that said spindle current has reached its threshold value,
   - sending a command through said master control system (12) to a first control system (10) provided to control the turret rotation, instructing said first control system (10) to stop the second rotational movement of said turret

(1) and then to lock said turret (1) at the position reached at the end of said second rotational movement.

2. A method as claimed in claim 1, wherein said first movement is carried out so that said centre (A') of said second bobbin (7A) crosses over said winding-positional-line (9).

3. A method as claimed in claim 2, wherein the direction of rotation of said second rotational movement is opposite to the direction of rotation of said first rotational movement.

4. A method as claimed in claim 2, wherein the direction of rotation of said second rotational movement is same as the direction of rotation of said first rotational movement.

5. A method as claimed in claim 4, wherein the threshold value of said spindle current is pre-set below or higher than the rated value of said spindle motor.

6. A system to position spindle precisely in turret type automatic winder using the method as claimed in claim 1, **characterized in that** said system comprises:

- a first control system (10) to carry out said two discrete rotational movements of said turret,
- a second control system (11) to carry out said rotation of said spindles,
- a master control system (12) to receive information from and send instructions to either or both of said first and second control systems (10, 11), wherein

said master control system (12), upon receiving information from said second control system(11) that the increase in said spindle current has reached its pre-set threshold, sends a command to said first control system (10) to stop said second rotational motion of said turret (1) and lock said turret **in that** position.

7. The system as claimed in claim 6, wherein the threshold value of spindle current is set below or higher than the rated value of said spindle motor.

Patentansprüche

1. Verfahren zur präzisen Positionierung einer Spindel in einem automatischen Wickler vom Revolvertyp, wobei der Wickler einen drehbaren Revolver (1) aufweist, der durch einen Revolvermotor angetrieben wird, wobei der Motor durch ein Revolverantriebssystem gesteuert wird und die Spindel durch einen Spindelmotor angetrieben wird, der durch ein Spindelantriebssystem gesteuert wird, wobei auf dem Revolver (1) zumindest eine erste und eine zweite Spule (7, 7A) auf jeweiligen Spindeln (2A, 2B) in einer diametral gegenüberliegenden Position entlang einer Wickelpositionslinie (9) montiert sind, und wobei die erste Spule (7) in einer Position des Aufwickelns eines Bands darauf positioniert ist, wodurch bei dem Start des Bandwickelprozesses die erste Spule (7) eine Druckrolle (5) berührt, die an dem Wickler bereitgestellt ist, wobei das Verfahren umfasst den Schritt des, sobald die erste Spule (7) ihre vorbestimmte Packungsgröße erreicht, Drehens des Revolvers (1) in mindestens zwei separaten Drehbewegungen, die mit gesteuerten Geschwindigkeiten ausgeführt werden, vorzugsweise zwei separaten Drehbewegungen, wobei eine erste Drehbewegung mit einer gesteuerten ersten Drehgeschwindigkeit bis zu einem Punkt ausgeführt wird, an dem die Mitten (A, A') der Spulen (7, 7A) auf eine Nahpositionslinie (9') fallen, wodurch die Nahpositionslinie (9') und die Wickelpositionslinie (9) in einem endlichen Verlagerungswinkel (Φ) zueinander liegen, gefolgt von Drehen des Revolvers in einer erforderlichen Richtung mit einer gesteuerten zweiten Drehgeschwindigkeit, um eine zweite Drehbewegung auszuführen, bis zu einem Punkt, an dem die leere zweite Spule (7A) die Druckrolle (5) berührt, gefolgt von Auslösen einer Stopp- und Verriegelungsaktion, um die Drehung des Revolvers (1) zu stoppen, wobei die zweite gesteuerte Geschwindigkeit kleiner als oder gleich der ersten gesteuerten Geschwindigkeit ist, **dadurch gekennzeichnet, dass** die Stopp- und Verriegelungsaktion umfasst die Schritte des:

- Überwachens der Zunahme des Stroms in dem Spindelmotor bis zu dem vorbestimmten Schwellenwert, wobei die Zunahme des Stroms stattfindet, sobald die leere Spule die Druckrolle (5) berührt,
- Sendens eines Befehls durch ein zweites Steuersystem (11), das bereitgestellt ist, um die Spindeldrehung zu steuern, an ein Mastersteuersystem (12), das bereitgestellt ist, um das zweite Steuersystem (11) zu steuern, der es darüber informiert, dass der Spindelstrom seinen Schwellenwert erreicht hat,
- Sendens eines Befehls durch das Mastersteuersystem (12) an ein erstes Steuersystem (10), das bereitgestellt ist, um die Revolverdrehung zu steuern, der das erste Steuersystem (10) anweist, die zweite Drehbewegung

des Revolvers (1) zu stoppen und dann den Revolver (1) an der am Ende der zweiten Drehbewegung erreichten Position zu verriegeln.

2. Verfahren nach Anspruch 1, wobei die erste Bewegung so ausgeführt wird, dass die Mitte (A') der zweiten Spule (7A) die Wickelpositionslinie (9) überquert.

3. Verfahren nach Anspruch 2, wobei die Drehrichtung der zweiten Drehbewegung entgegengesetzt zu der Drehrichtung der ersten Drehbewegung verläuft.

4. Verfahren nach Anspruch 2, wobei die Drehrichtung der zweiten Drehbewegung dieselbe ist wie die Drehrichtung der ersten Drehbewegung.

5. Verfahren nach Anspruch 4, wobei der Schwellenwert des Spindelstroms unter oder über dem Nennwert des Spindelmotors voreingestellt ist.

6. System zur präzisen Positionierung einer Spindel in einem automatischen Wickler vom Revolvertyp unter Verwendung des Verfahrens nach Anspruch 1, **dadurch gekennzeichnet, dass** das System aufweist:

- ein erstes Steuersystem (10) zum Ausführen der zwei separaten Drehbewegungen des Revolvers,
- ein zweites Steuersystem (11) zum Ausführen der Drehung der Spindeln,
- ein Mastersteuersystem (12) zum Empfangen von Informationen von einem oder beiden des ersten und des zweiten Steuersystems (10, 11) und zum Senden von Anweisungen an diese/s, wobei

das Mastersteuersystem (12) bei Empfangen von Informationen von dem zweiten Steuersystem (11), dass die Zunahme des Spindelstroms seinen voreingestellten Schwellenwert erreicht hat, einen Befehl an das erste Steuersystem (10) sendet, um die zweite Drehbewegung des Revolvers (1) zu stoppen und den Revolver in dieser Position zu verriegeln.

7. System nach Anspruch 6, wobei der Schwellenwert des Spindelstroms unter oder über dem Nennwert des Spindelmotors eingestellt ist.

Revendications

1. Procédé permettant de positionner une broche avec précision dans un enrouleur automatique de type à tourelle, ledit enrouleur intégrant une tourelle (1) pouvant être tournée entraînée par un moteur de tourelle, ledit moteur étant commandé par un système d'entraînement de tourelle et ladite broche étant entraînée par un moteur de broche commandé par un système d'entraînement de broche, sur la tourelle (1) duquel au moins une première et une deuxième bobine (7, 7A) sont montées sur des broches (2A, 2B) respectives sur une position diamétralement opposée le long d'une ligne de positionnement d'enroulement (9), et dans lequel la première bobine (7) est positionnée sur une position d'enroulement d'une bande sur celle-ci, où, au début du processus d'enroulement de bande, ladite première bobine (7) touche ainsi un rouleau de pression (5) prévu sur ledit enrouleur, ledit procédé comprend, une fois que ladite première bobine (7) a atteint sa taille d'emballage prédéterminée, l'étape de rotation de la tourelle (1) selon au moins deux mouvements de rotation discrets réalisés à des vitesses commandées, de préférence deux mouvements de rotation discrets, dans lequel un premier mouvement de rotation est réalisé à une première vitesse de rotation commandée jusqu'à un point où les centres (A, A') desdites bobines (7, 7A) se retrouvent sur une ligne de positionnement rapprochée (9'), où ladite ligne de positionnement rapprochée (9') et ladite ligne de positionnement d'enroulement (9) se situent ainsi l'une par rapport à l'autre selon un angle de déplacement fini (Φ), suivi par la rotation de ladite tourelle dans une direction requise à une deuxième vitesse de rotation commandée pour réaliser un deuxième mouvement de rotation jusqu'à un point où ladite deuxième bobine (7A) vide touche ledit rouleau de pression (5), suivi par le déclenchement d'une action d'arrêt et de verrouillage pour arrêter la rotation de ladite tourelle (1), dans lequel ladite deuxième vitesse commandée est inférieure ou égale à la première vitesse commandée, **caractérisé en ce que** ladite action d'arrêt et de verrouillage comprend les étapes :

de surveillance de l'augmentation du courant dans ledit moteur de broche jusqu'à la valeur de seuil prédéterminée, ladite augmentation de courant ayant lieu une fois que la bobine vide touche ledit rouleau de pression (5), d'envoi d'une instruction par un deuxième système de commande (11) fourni pour commander ladite rotation de broche à un système de commande maître (12) fourni pour commander ledit deuxième système de commande

(11) l'informant que ledit courant de broche a atteint sa valeur de seuil, d'envoi d'une instruction par ledit système de commande maître (12) à un premier système de commande (10) fourni pour commander la rotation de tourelle, ordonnant ledit premier système de commande (10) d'arrêter le deuxième mouvement de rotation de ladite tourelle (1) puis de verrouiller ladite tourelle (1) sur la position atteinte à la fin dudit deuxième mouvement de rotation.

2. Procédé selon la revendication 1, dans lequel ledit premier mouvement est réalisé de telle sorte que ledit centre (A') de ladite deuxième bobine (7A) croise ladite ligne de positionnement d'enroulement (9).

3. Procédé selon la revendication 2, dans lequel la direction de rotation dudit deuxième mouvement de rotation est opposée à la direction de rotation dudit premier mouvement de rotation.

4. Procédé selon la revendication 2, dans lequel la direction de rotation dudit deuxième mouvement de rotation est la même que la direction de rotation dudit premier mouvement de rotation.

5. Procédé selon la revendication 4, dans lequel la valeur de seuil dudit courant de broche est préréglée en dessous ou au-dessus de la valeur nominale dudit moteur de broche.

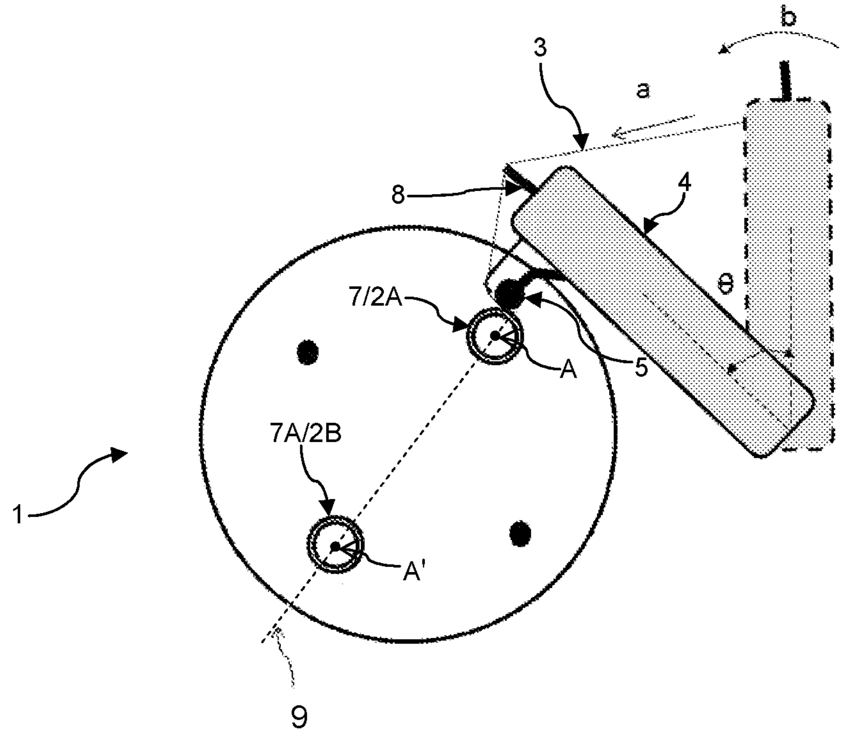
6. Système permettant de positionner une broche avec précision dans un enrouleur automatique type à tourelle en utilisant le procédé selon la revendication 1, caractérisé en ce ledit système comprend :

- un premier système de commande (10) pour réaliser lesdits deux mouvements de rotation discrets de ladite tourelle,
- un deuxième système de commande (11) pour réaliser ladite rotation desdites broches,
- un système de commande maître (12) pour recevoir des informations de et envoyer des consignes à chacun ou aux deux desdits premier et deuxième systèmes de commande (10, 11), dans lequel

ledit système de commande maître (12) envoie, à réception dudit deuxième système de commande (11) de l'information que l'augmentation du courant de ladite broche a atteint son seuil préréglé, une instruction audit premier système de commande (10) pour arrêter ledit deuxième mouvement de rotation de ladite tourelle (1) et pour verrouiller ladite tourelle dans cette position.

7. Système selon la revendication 6, dans lequel la valeur de seuil dudit courant de broche est réglée en dessous ou au-dessus de la valeur nominale dudit moteur de broche.

Figure 1



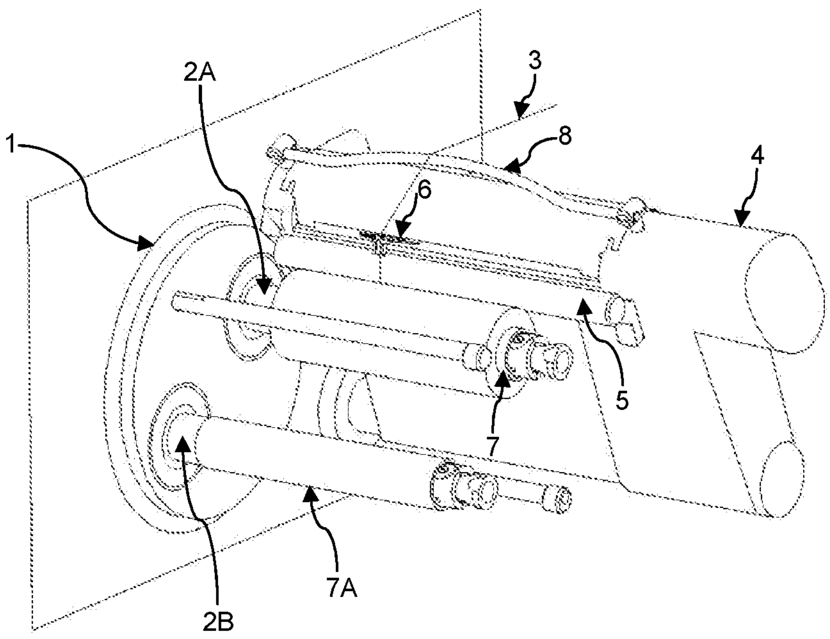
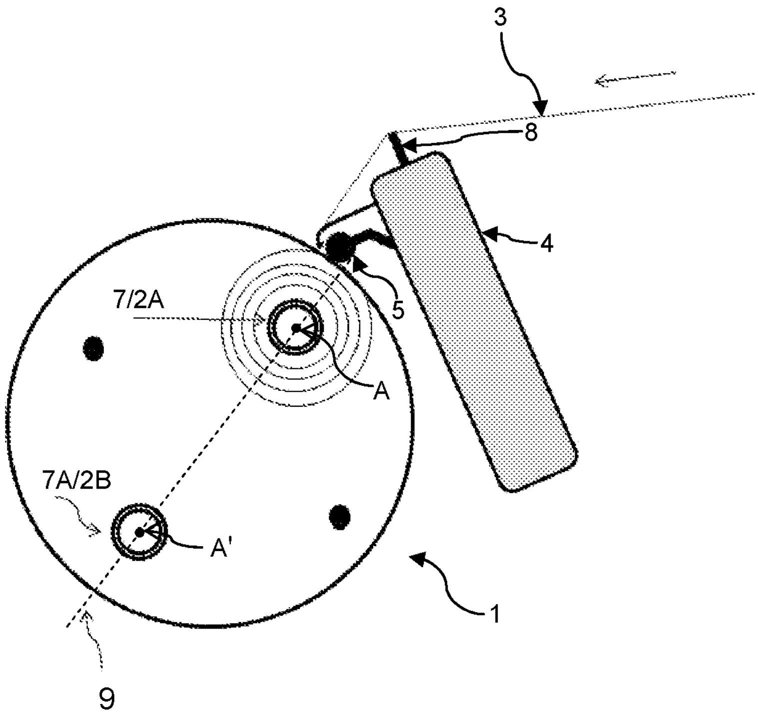


Figure 1A

Figure 2



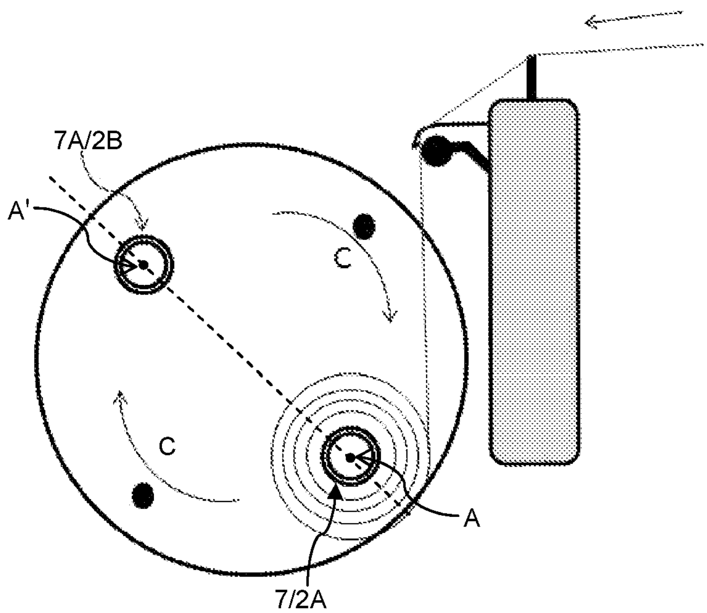
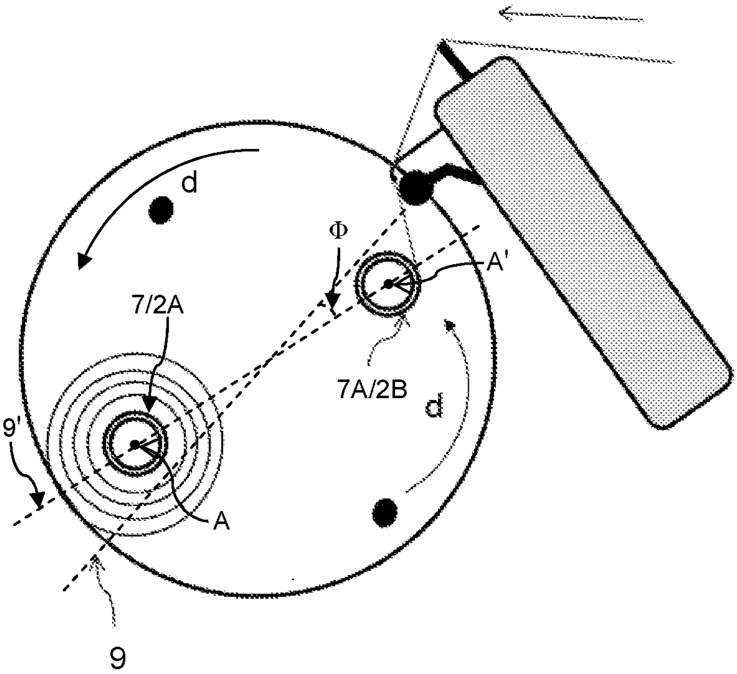


Figure 3

Figure 4



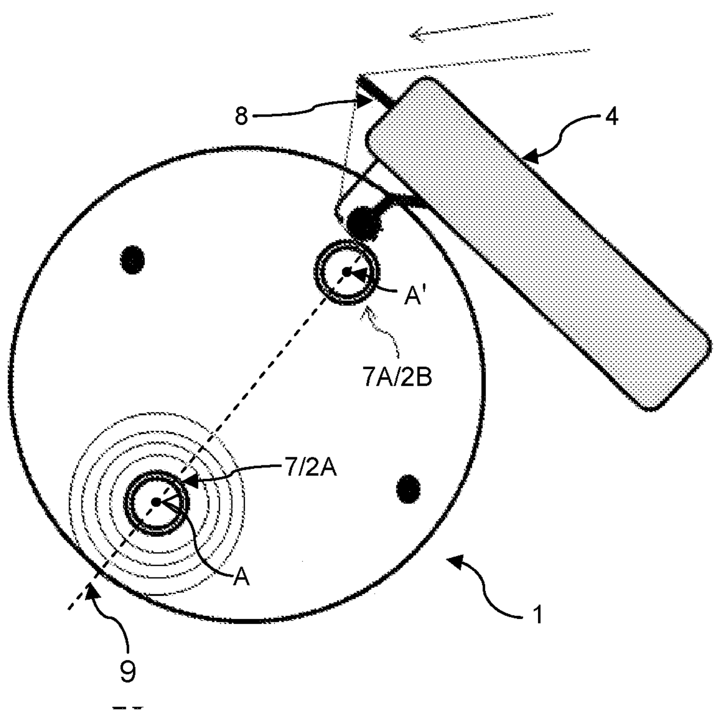


Figure 5

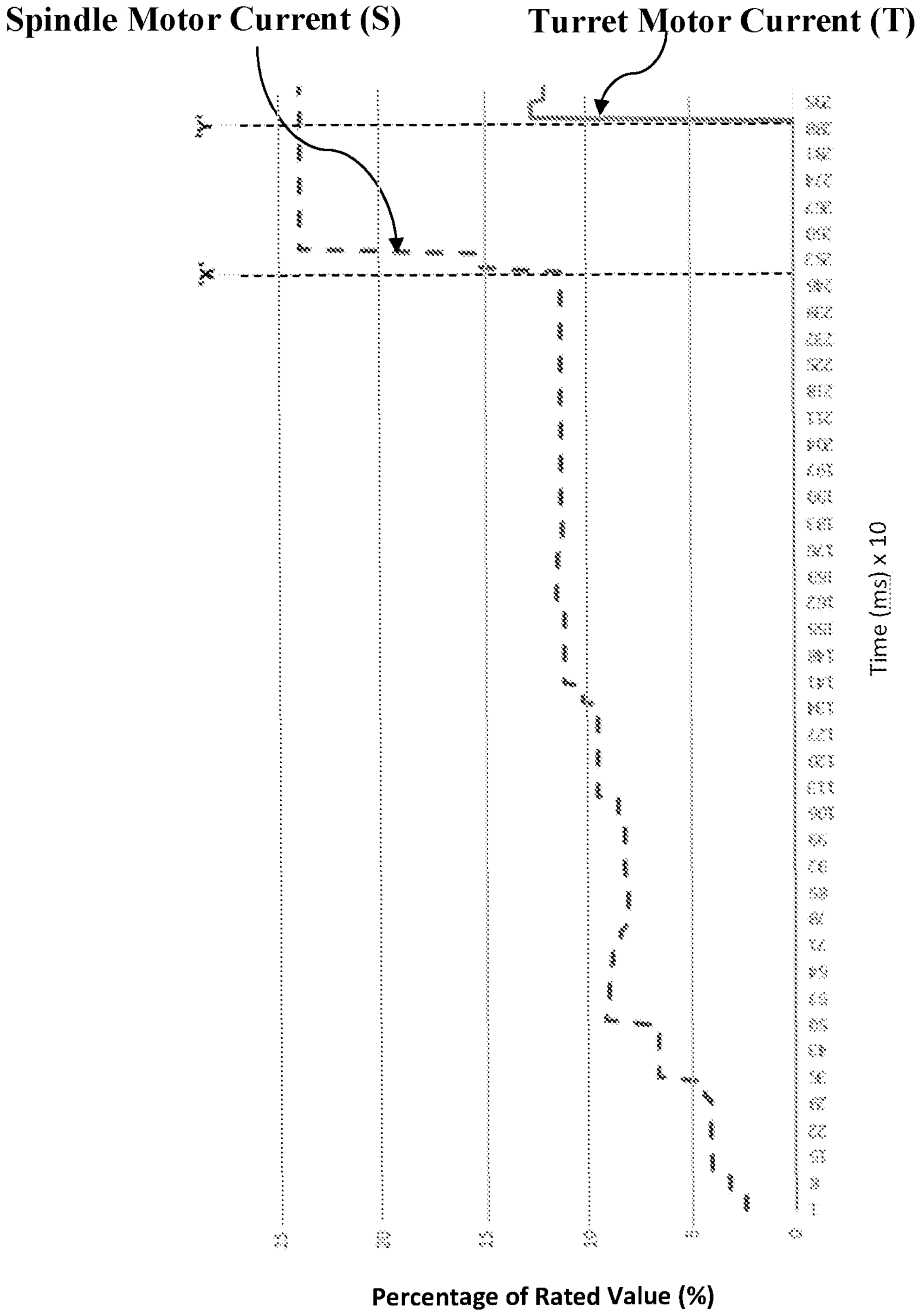

Spindle Motor Current (S)
Turret Motor Current (T)
Y
X
Time (ms) x 10
Percentage of Rated Value (%)

Figure 6

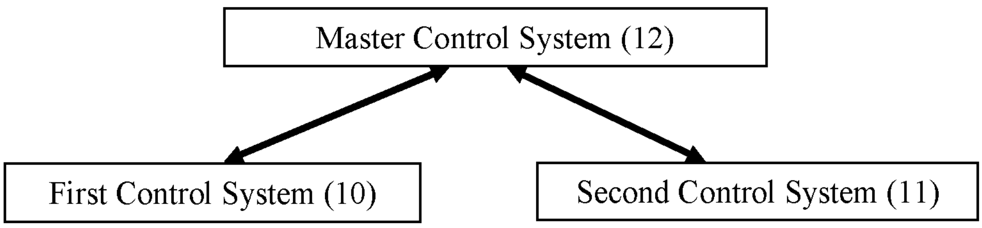

Master Control System (12)
First Control System (10)
Second Control System (11)

Figure 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- US 4765552 A **[0003]**
- EP 861800 A2 **[0003]**
- WO 2017093950 A **[0003] [0007]**