

EUROPEAN PATENT SPECIFICATION

- (45) Date of publication of patent specification: **07.10.87** (51) Int. Cl.⁴: **B 65 H 61/00**
(21) Application number: **82303742.9**
(22) Date of filing: **16.07.82**

(54) **Apparatus for copying a reference winding for making a production winding of similar dimensions.**

(30) Priority: **31.07.81 GB 8123567**

(43) Date of publication of application:
09.02.83 Bulletin 83/06

(45) Publication of the grant of the patent:
07.10.87 Bulletin 87/41

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(58) References cited:
DE-A-2 433 786
DE-B-1 774 229

(73) Proprietor: **GÜTERMANN & CO.,**
AKTIENGESELLSCHAFT
Postfach 8023 Claridenstrasse 25
CH-8023 Zürich (CH)

(72) Inventor: **Häusler, Werner**
i Fa-Gütermann & Co.
D-7809 Gutach-Breisgau (DE)

(74) Representative: **Riebling, Peter, Dr.-Ing. et al**
Patentanwälte Dr.-Ing., Dipl.-Ing., Ing.(grad.)
Günter Riebling Dr.-Ing., Dipl.-Ing. Peter Riebling
Rennerle 10 Postfach 3160
D-8990 Lindau (DE)

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European patent convention).

Description

This invention relates to a winding device for the winding of predetermined lengths of thread and tape materials in which the material is wound on to a spool, to a pre-determined maximum diameter of winding, said winding device having a first measuring device having a measuring wheel to determine the length of material, a second measuring device to determine the number of revolutions of the spool, a register for the digital registration of the values given during production of a reference spool, and a comparator device which compares the stored values with the values arising during the manufacture of a production spool and which, when discrepancies arise, controls a thread brake through which the material runs, which thread brake has two opposing brake plates of which the pressure of one brake plate in the direction of the opposing brake plate is controlled in relation to the measured discrepancy determined by the comparator device.

Such a winding device is already known from DE—AS 17 74 229. There, information carriers are used for the measuring of the length and the diameter of the winding material, said information carriers are driven by rolls of the winding device. Here it is of disadvantage that the rolls themselves may have a slip which may lead to discrepancies. Furthermore, at the known winding device the thread brake is operated by means of rods setting out from a differential gear which due to mechanical backlash may lead to discrepancies. The thread brake is operated furthermore by a spring loaded brake shoe which may also lead to discrepancies because the spring force does not proceed in proportion to the brake stroke of the rods which operate the thread brake. The purpose of the invention is to form a winding device in the prior described manner as such that an essential and cost-saving working method will be achieved.

The solution of the task is achieved in that the determination of the values is achieved without contact with the measuring wheel and spool by transducers each of which transmit a digital signal to the respective digital register which provide an input to a microprocessor whose output acts on the thread brake which is electro-magnetically controlled by the control signal formed by the microprocessor, in which the movable brake plate is directly coupled to the anchor, of the electromagnet.

By the means the measurement results are registered free from backlash and contact and act over a digital signal processing directly on the thread brake. The moveable brake shoe of the thread brake is directly coupled with the armature of the electromagnet and, in this manner, causes a brake reaction which is always reproducible and which, to a large extent, proceeds proportionally with regard to the measurement results. By means of this simple designed device, the winding material may be processed more precisely and economically.

Preferably, the apparatus of the invention

includes a microprocessor system for storing the reference data, for processing the production data, and for comparing the production data with the reference data in order to provide the output signal for regulating the tensioning means. In this case, the reference data is stored in the memory of the microprocessor system when the reference winding is made on the winding machine. For example, for each ten revolutions of the winding drive, the output of a transducer associated with either the measuring wheel, or the thread guide which contacts the winding, is stored. When the production winding is made, the output of the transducer is compared with the stored values, for each ten revolutions of the winding drive, in order to determine if there is any difference or error. If there is, an error signal is produced and this is supplied to the adjustable tensioning means in order to regulate the tension so as to compensate for the difference. For example, if an insufficient length of material is present on the production winding after a given number of revolutions of the winding drive, the control signal causes the tensioning means to reduce the tension on the material. With a reduced tension, the material is not so tightly wound and hence more material is drawn onto the production winding for each revolution of the winding drive. Conversely, the tension is increased in order to produce a tighter winding if too much material has been wound after a given number of revolutions of the winding drive. The situation is checked at intervals (e.g. on every 10th revolutions of the winding drive) to see if the error has been corrected. If not, the tension is regulated until the correct amount of materials has been fed to the production winding. Thus, the winding process is periodically checked throughout the complete winding cycle so as to ensure that, at the end of the cycle, the production winding has the required length and cross-section, or the required cross-section.

Clearly, the intervals at which the situation is checked can be made so short that the tension of the material is regulated in an almost continuous manner.

In the case of using a microprocessor control system, characteristic reference data may be placed in store for reference windings of different shapes. In the case of spools of sewing threads, this data may be stored with reference to a serial number which represents the length of thread on a spool of a given shape. Thus, the apparatus can be programmed so that the serial number is entered into the microprocessor system whereupon the correct reference data characteristics are available from the store so as to provide the correct form of control for making production spools of a specific type.

Examples of the invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 diagrammatically illustrates different characteristic curves which relate to the number of turns and to either the length, or the cross-section of a reference winding.

Fig. 2 shows one example of the invention, in schematic form, which uses a measuring wheel.

Fig. 3 is a cross-sectional view of a preferred form of thread brake for use in the arrangements of Fig. 2.

Embodiments of the invention will now be described with reference to winding sewing thread on a spool to make a production winding having a similar length and diameter. However it will be understood that the arrangement described can be modified or used as a basis for winding other material either with, or without a core (such as a spool).

Fig. 1 is a graph illustrating typical characteristic curves (a) and (b) which relate a measured length (L) of thread to the number of revolutions (n) of a spool on which the thread is wound. The meaning of the graph will become apparent with regard to the following description of the arrangement shown in Fig. 2.

Fig. 2 schematically illustrates one form of a winding machine which embodies the invention. Thread 10 passes through an adjustable thread brake 1 to a measuring wheel 11. The thread 10 passes once around the periphery of the measuring wheel 11 and then it passes down towards and through a thread guide 12. The thread passes from the guide 12 onto a spool 13 which is rotated at high speed by a drive (not shown). The measuring wheel and the spool 13 both rotate in the direction of the arrows shown on the drawing.

A transducer 14 provides a pulsed output signal representing the number of revolution of the measuring wheel 11. The transducer 14 may be of the type which responds, for example, to the passage of a small magnet 15 attached the periphery of the measuring wheel 11. Alternatively, it may be of a photoelectric type wherein a beam of light is periodically interrupted by the passage of a shutter as the wheel 11 rotates. A similar transducer 16 senses the passage of a permanent magnet 17 which is attached to the drive (not shown) of the spool 13. Transducer 16 also provides a pulse output signal representing the number of revolutions of the spool 13. The outputs from transducers 14, 16 are converted from analog to digital form (by an A/D converter not shown) and the corresponding digital signals are supplied to respective registers 18, 19. Registers 18, 19 are both connected to, or are part of a microprocessing system 20 which includes a microprocessing unit together with a suitable memory. An output from the microprocessor system 20 is connected to the adjustable thread brake 1 for supplying a control signal to adjust the clamping pressure of the brake, and hence to regulate the tension of the thread 10 passes to the measuring wheel 11 and hence to the spool 13.

The thread brake 1 is preferably of the type described in our Copending European Patent Application No. 0045643. This type of thread brake is generally illustrated in Fig. 3. It employs a pair of circular braking discs 2, 3 which are freely and rotatably mounted on a sleeve 8 adjacent an end face of an electromagnet 4. The electro-

magnet 4 has a cylindrical body, the longitudinal axis of which is coaxial with the braking discs 2, 3. Both discs 2, 3 have a central aperture to receive the sleeve 8, the sleeve being made of wear-resistant material and being mounted on a pin 8a passing through the cylindrical magnet. A retaining ring 9 is fitted to the end of the sleeve 8 to retain the discs 2, 3 whilst allowing them to move axially on the sleeve 8. The central aperture in disc 3 is countersunk. As the bearing face of each disc 2, 3 on sleeve 8 is small, both discs can tilt with respect to the longitudinal axis of the sleeve 8. Disc 2, which is nearest to the end face of the electromagnet 4, is generally plain, but disc 3 has a series of countersunk apertures extending radially around its central aperture, the countersunk side of the apertures facing outwardly away from the electromagnet 4. The other side of disc 3, which faces the opposite side of disc 2, is also slightly concave. The thread passes between the opposed major faces of the braking discs 2, 3 and around a part of the circumference of sleeve 8. The thread thereby makes an angle with the sleeve 8 (preferably between 110 to 160 degrees) and this prevents the disc 3 from tilting round the thread (e.g. where the thread acts as a tilt bearing). The angle of the thread also serves to avoid direct contact between the two discs 2, 3. The thread is thereby clamped between the discs when the electromagnet 4 is energised. The outermost disc 3, with the radial apertures, is made of ferromagnetic material, but the other disc is made of nonferromagnetic material. The radial apertures 7, in the ferromagnetic disc 3 provide an exist for material abraded from the thread, due to friction between the thread and the thread brake. The electromagnet 4 is controlled by varying a supply of direct current thereto whereby the braking pressure is adjusted and hence the tension of the thread is regulated.

The mode of operation of the arrangement shown in Fig. 2 will now be described. It will be assumed that the same thread and winding machine is used for winding thread on a reference spool as well as on a production spool.

Thread is first wound onto the reference spool 13 so that the reference spool contains a predetermined length of thread and so that the thread windings have a predetermined outer diameter. This may be achieved by winding thread on reference spools with different tension, in order to select the reference spool with the optimum thread winding diameter. Conventional means are employed, such as a reciprocating thread guide (not shown), so as to feed the thread helically onto the spool 13 in order to build up a cylindrical winding. During this process, the registers 18, 19 are indexed in accordance with the number of revolutions of the measuring wheel 11 and the spool 13 respectively. Instantaneous values of register 18 are entered, at regular intervals into the memory of the microprocessor system 20. For example, each time that the register 18 counts ten revolution of the spool 13, the contents of register 18 are gated into the

memory of the microprocessor system 20. The gating circuitry, which may be conventional, is not shown but its construction and operation will be clear to those skilled in the art. The contents of register 18, i.e. the instantaneous values of the number of revolutions of the measuring wheel 1 for every tenth revolution of the spool 13, are stored in the memory of the microprocessor 20 so that they can be retrieved in the sequence in which they were recorded.

The diameter of the measuring wheel 11 is constant, whereby a predetermined length of thread is passed to the spool 13 for each revolution of wheel 11. However, the diameter of the windings on the spool 13 will gradually increase from a small to a large diameter as the winding proceeds. If the diameter of the measuring wheel 11 was somewhere between the small and large diameters of the thread windings on spool 13, the counting rate of register 18 will initially be lower than that of register 19. The counting rates will then become similar, when the winding diameter on spool 13 is similar to the diameter of wheel 11. Then, the counting rate of register 18 will exceed that of register 19, i.e. When the winding diameter in spool 13 exceeds the diameter of wheel 11. If the instantaneous values of register 18 are plotted on a graph against every ten revolutions of the spool 13, a characteristic curve of the ratio of a measured length of thread to the number of revolutions of the spool 13 is obtained as shown in Fig. 1. In practice, the diameter of the measuring wheel 11, with respect to the minimum and the maximum diameters of the thread windings on the spool 5, is such that the characteristic curve is approximately linear, at least over its initial length. If thread having a different thickness is used, or if the thread is wound onto a spool having a different diameter, the characteristic curve will be different and this is indicated by the broken line (b) in Fig. 1.

After the memory of the microprocessor system 20 has been loaded with the instantaneous values derived from register 18, the reference spool is replaced by a production spool. Thread 10 is then wound onto the production spool 13 and, during the winding process, similar instantaneous values of register 18 are periodically supplied to the microprocessor system 20. For example for every ten revolutions of the production spool 13, the contents of register 18 are entered into the system 20. The system 20 then compares the production data with the reference data (by conventional means, not shown in detail), in order to provide a control signal for adjusting the clamping pressure on the thread brake 1. For example, assuming that the production spool 13 has made fifty revolutions, the corresponding instantaneous value of register 18 stored in the memory whilst winding the reference spool is compared with the same instantaneous value of register 18 which is obtained during the winding of the production spool. If the readings differ, an error signal is generated and this is converted, by the system 20, into the

control signal which is supplied to the thread brake 1. This control signal regulates the amount of direct current supported to the electromagnet and hence it adjusts the clamping pressure applied by the braking disc 2, 3 whereby the thread tension is regulated during the winding process. For example, if the reading on register 18 when winding thread on the production spool is less than it was when winding the thread on the reference spool, this will mean that the thread is being wound too tightly on the production spool.

Hence, the braking pressure is relieved so that the thread is more loosely wound on spool 13. Relieving the braking pressure will reduce the thread tension hence resulting in a looser winding. Therefore, more thread will be wound on spool 13, for each revolution, and hence the counting rate of register 18 will increase until it "catches up" with the "correct" value stored in the memory of the microprocessor system 20. The clamping pressure of the thread brake 1 is adjusted until the instantaneous values of the production data and reference data coincide whereupon the error signal is zero and the correct thread tension is applied for winding the thread on the production spool. Conversely, the braking pressure is increased to increase the tension if the thread is wound too loosely on the spool 13. The operation is such that, at the end of the winding cycle, a predetermined amount of thread is wound onto the spool 13 and that the diameter of the thread windings is same as that on the reference spool.

The construction and mode of operation of the transducer 14, 16 the registers 18, 19 and the microprocessor system 20 are generally conventional and hence known to those skilled in the art. Therefore, no detailed description will be given in order to facilitate the description of the novel features of the arrangement which embody the invention.

A change in the nominal thickness of the thread, i.e. a distinct change in thickness of the material which is wound, will provide a different characteristic curve in Fig. 1. However, by using the same characteristic curve, it is possible to compensate for small changes in nominal thread thickness. Despite the usual quality control which is exercised when manufacturing thread, there are bound to be slight differences in nominal thread thickness due to the nature of the thread and the manufacturing process. Whereas such variations gave rise to problems in the prior art, the present invention can be applied to compensate for slight differences in nominal thread thickness. For example, if the thread is slightly thicker than it should be, the thread can be wound more tightly onto the spool 13 so as to end up with windings of the predetermined diameter. Conversely, if the thread is slightly thinner than usual, it is wound more loosely to provide windings having the required diameter.

The arrangement according to the invention will also compensate for variations in the coefficient of friction between the thread 16 and

the thread brake 1. Thread is normally coated with oil so that it runs smoothly through thread guides without too much friction. However, despite quality control, the coating may be patchy or thin, or even missing entirely in some places. Clearly, there will be greater friction between the thread brake 1 and the thread 10 when the coating is missing. This has the result of increasing the thread tension and hence causing the thread to be wound more tightly onto the spool 13. However, the arrangement shown in Fig. 2 will detect and compensate for this problem, because the control signal from the microprocessor system 20 would cause the braking pressure to be relieved, to reduce the thread tension, whereby the thread is wound more loosely on the spool 13.

A further advantage is that the winding speed does not effect the mode of operation of an arrangement which embodies the invention. An increase in winding speed merely results in increasing the rate at which the production data is supplied to the microprocessor system 20 for comparison with the reference data which is already in the memory. Thus operation is generally independent of winding speed.

The invention may be applied to single spool or multispool winding machines. With regard to the arrangements described above, the microprocessor system 20 may be supplied with multiplexed inputs and conditioned to provide respective error signals to the corresponding thread brakes on a multispool winding machine. The arrangement may also be such that the microprocessor system stores reference data which can be retrieved in response to a serial number which is entered by means of a keyboard. The serial number represents a certain type of spool carrying a predetermined length of a particular type of thread.

Thus, it can be seen that the arrangement which embody the invention operate in accordance with direct digital control in order to manufacture production windings which are "copies" of a reference winding.

Claim

Winding device for the winding of pre-determined lengths of thread and tape materials is wound on to a spool (13) to a pre-determined maximum diameter of winding, said winding device having a first measuring device having a measuring wheel (15) to determine the length of material, a second measuring device to determine the number of revolutions of the spool (13), a register (18, 19) for the digital registration of the values given during production of a reference spool, and a comparator device (20) which compares the stored values with the values arising during the manufacture of a production spool and which, when discrepancies arise, controls a thread brake (1) through which the material runs, which thread brake has two opposing brake plates of which the pressure of one brake plate in the direction of the opposing brake plate is con-

trolled in relation to the measured discrepancy determined by the comparator device, characterized in that the determination of the values is achieved without contact with the measuring wheel and spool by transducers (14, 16) each of which transmit a digital signal to the respective digital register (18, 19) which provide an input to a microprocessor (20) whose output acts on the thread brake (1) which is electro-magnetically controlled by the control signal formed by the microprocessor, in which the movable brake plate (3) is directly coupled to the anchor (8, 8a), of the electromagnet.

Patentanspruch

Aufwicklungsvorrichtung zur Aufwicklung einer vorher festgelegten Länge von Faden- und Bandmaterial, wobei das Material auf eine Spule (13) aufgewickelt wird bis zu einem vorher festgelegten, maximalen Aufwicklungsdurchmesser, wobei besagte Aufwicklungsvorrichtung eine erste Meßvorrichtung mit einem Meßrad (15) aufweist, um die Länge des Materials festzustellen, mit einer zweiten Meßvorrichtung, um die Anzahl der Umdrehungen der Spule (13) festzustellen, einer Registriervorrichtung (18, 19) für die digitale Registrierung der gegebenen Werte während des Betriebes einer entsprechenden Spule, und einer Vergleichsvorrichtung (20), die die aufgewickelten Werte mit den Werten vergleicht, die während des Betriebes einer Betriebsspule anfallen, und die, wenn Abweichungen auftreten, eine Fadenbremse (1) steuert, durch die das Material läuft, wobei die Fadenbremse zwei sich gegenüberliegende Bremsplatten aufweist, von denen der Druck der einen Bremsplatte in Richtung auf die gegenüberliegende Bremsplatte im Verhältnis zu der gemessenen Abweichung gesteuert wird, die von der Vergleichsvorrichtung festgestellt wird, dadurch gekennzeichnet, daß die Feststellung der Werte ohne Kontakt mit dem Meßrad und der Spule durch Umformer (14, 16) erreicht wird, wobei jeder Umformer ein digitales Signal an die entsprechende Digitalregistrierung (18, 19) übermittelt, die einen Eingangsimpuls an einen Mikroprozessor (20) abgibt, dessen Ausgangsimpuls auf die Fadenbremse (1) wirkt, die elektro-magnetisch von dem vom Mikroprozessor erteilten Steuersignal gesteuert wird, in dem die bewegliche Bremsplatte (3) direkt mit dem Anker (8, 8a) des Elektromagnets gekuppelt wird.

Revendication

Dispositif enrouleur pour le bobinage de longueurs pré-déterminées de matériaux en forme de fils et de rubans, dans lequel le matériau est enroulé sur une bobine (13) jusqu'à ce que l'enroulement atteigne un diamètre prédéterminé maximum, ledit dispositif enrouler comportant un premier dispositif de mesure muni d'une roue de mesure (15) pour déterminer la longueur du matériau, un second dispositif de mesure, pour déterminer le nombre de révolutions de la bobine

(13), un registre (18, 19) pour l'enregistrement numérique des valeurs données au cours de la formation d'une bobine de référence, et un dispositif comparateur (20) qui compare les valeurs mémorisées aux valeurs apparaissant lors de la production d'une bobine de fabrication et qui lorsque des perturbations se manifestent, commande un frein de fil (1) à travers lequel le matériau défile, ce frein de fil possédant deux plaques de frein en vis-à-vis, la pression de l'une des plaques de frein exercée dans la direction de la plaque de frein en vis-à-vis étant ajustée en fonction de la perturbation mesurée qui est déter-

minée par le comparateur, caractérisé en ce que la détermination des valeurs est réalisée, sans aucun contact avec la roue de mesure et la bobine, par des transducteurs (14, 16), chacun de ceux-ci transmettant un signal numérique au registre numérique correspondant (18, 19) lequel délivre un signal d'entrée à un micro-processeur (20) dont la sortie agit sur le frein de fil (1) qui est commandé électromagnétiquement par le signal de commande formé par le micro-processeur, dans lequel la plaque de frein mobile (3) est directement accouplée, à l'induit (8, 8a) de l'électroaimant.

15

20

25

30

35

40

45

50

55

60

65



