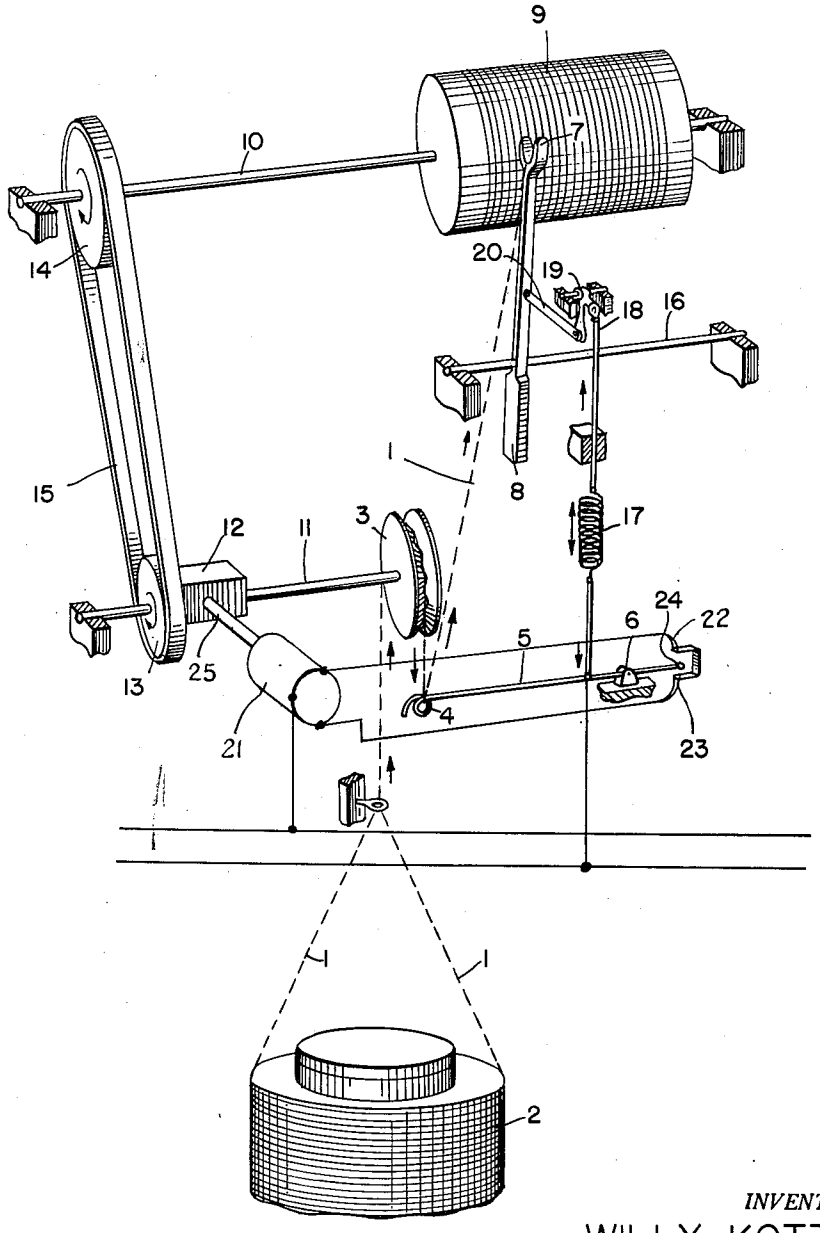
July 31, 1962 W. KOTTE 3,047,247

APPARATUS FOR PRODUCING WOUND BOBBINS WITH CONTROLLED THREAD TENSION

Filed Feb. 17, 1956 3 Sheets-Sheet 1

FIG. 1



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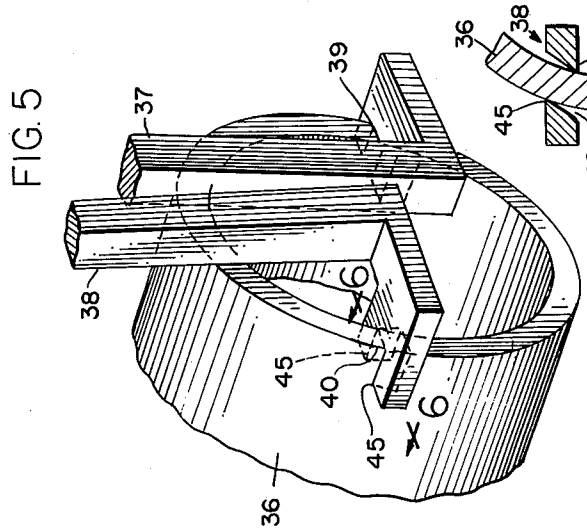

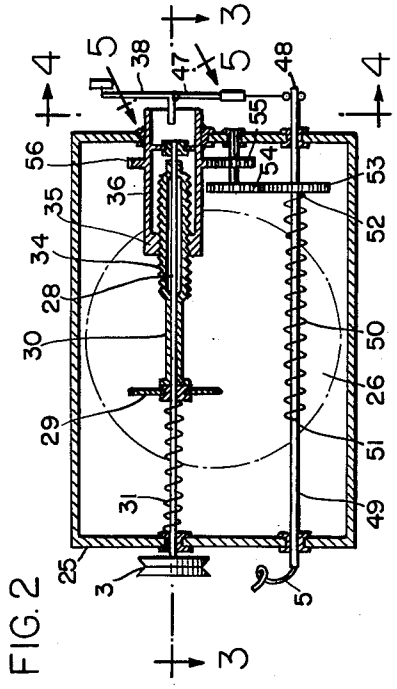

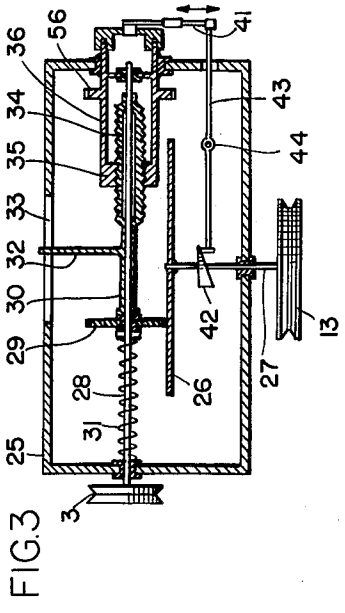

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FIG. 4

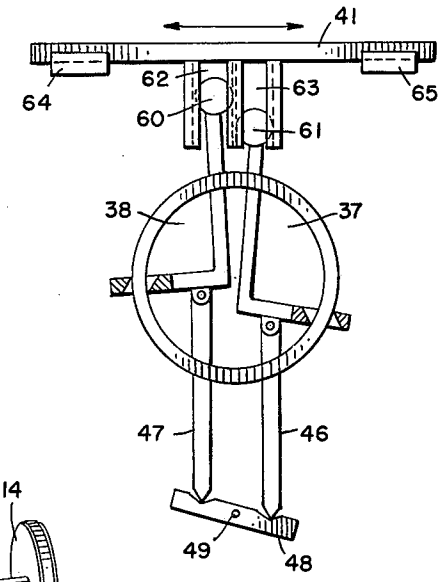
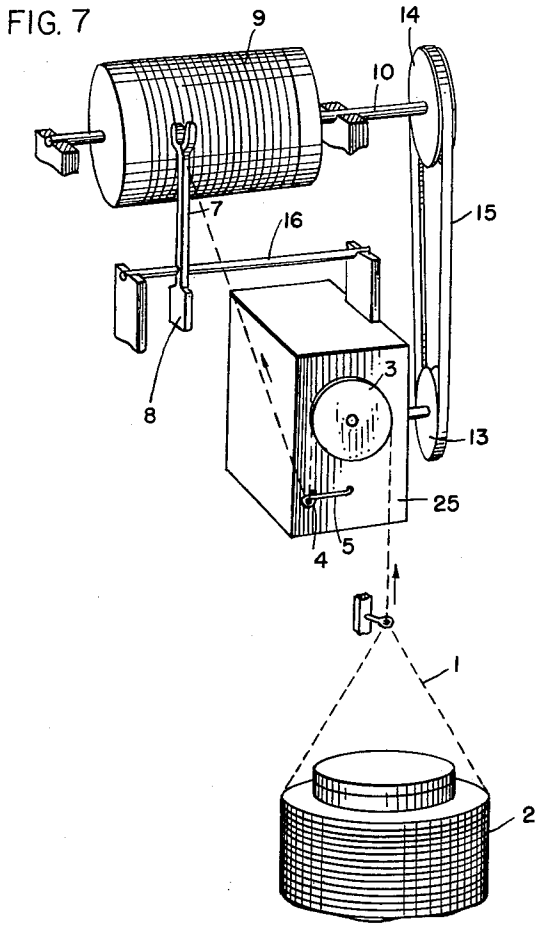


FIG. 7



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3,047,247

APPARATUS FOR PRODUCING WOUND BOBBINS WITH CONTROLLED THREAD TENSION

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This invention relates to an apparatus for producing wound bobbins with a controlled thread tension.

In the production of wound bobbins for industries, such as weaving and the like, it is desirable that the tension of the thread being wound be controlled at all times. Attempts to control thread tension during the winding have included the use of thread brakes which keep the thread under tension and the braking action of which is adjusted with increases in the time of winding or with increases in the diameter of the winding bobbin, thus generally reducing the thread tension. A thread feeler may be employed between the thread brake and the winding bobbin which is responsive to changes in thread tension and in the case of an increase in thread tension will cause a reduction in the braking effect of the thread brake. If the thread tension decreases, the thread feeler will cause an increase in the braking effect.

The employment of a thread brake to control thread tension has the disadvantage that it has only a decelerating function. When the thread tension becomes great enough the thread brake fails to function since it can not accelerate feeding of the thread and thus reduces the tension. Furthermore, since winding machines customarily have a constant bobbin rotation speed, very fine threads could not be wound with sufficiently low tension since the use of a thread brake plus other devices, such as cleaning discs, loop knives and guide rollers, produces a tension which exceeds the desired maximum, particularly in the topmost layers on the bobbin.

Attempts have been made to control the tension on the thread by adjustment of the winding speed of the bobbin. Variations in the thread tension are picked up by a thread feeler which actuates a speed regulator on the bobbin driving means. This method has the disadvantage that there is a considerable time lag in correcting certain tension variations such as that caused by the increasing diameter of the winding bobbin. Furthermore, the method lacks precision in correcting tension variations at remote points such as the thread supply cop.

It is an object of the invention to provide an apparatus for winding thread in which the thread tension may be efficiently controlled with fine as well as coarse threads and regardless of the amount or source of the tension variations.

Another object of the invention is to provide an apparatus for winding thread in which the thread tension may be controlled whether the winding speed be constant or varied.

A further object of the invention is to provide an apparatus for winding thread in which the tension variations may be corrected with a minimum time lag.

Various other objects and advantages of the invention will become apparent from the following description and drawing. The latter illustrates a preferred embodiment of the invention in which like numbers are used to indicate like parts, and wherein:

FIG. 1 is a perspective view of one embodiment of the invention with parts therein shown schematically;

FIG. 2 is a sectioned elevational view of a specific embodiment of another speed adjusting means for the take-off device of the invention;

FIG. 3 is a sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is an enlarged sectional view taken on line 4—4 of FIG. 2;

FIG. 5 is an enlarged detailed perspective view of parts shown in FIG. 4;

FIG. 6 is a fragmentary sectional view taken on line 6—6 of FIG. 5, and

FIG. 7 is a perspective view of the speed-adjusting means of FIGS. 2–6 in a thread-winding apparatus with parts therein shown schematically.

The invention is accomplished by an apparatus comprising a take-off device engaging and feeding the thread from a supply cop to the winding bobbin, thread tensioning means contacting and guiding the thread between the take-off device and the bobbin, adjustable-speed driving means drivingly associated with the take-off device, and speed-adjusting means for the driving means. The tensioning means is responsive to changes in the thread hoard by the guide loop and is operatively associated with the speed-adjusting means so that the speed of the driving means is adjusted with changes in the thread hoard. It is preferable that the speed-adjusting means for the driving means become operatively associated with the thread-tensioning pivot arm only when a given change occurs in the thread hoard so that the thread hoard will be maintained within given limits.

In a preferred embodiment of the invention, illustrated in FIG. 1, the thread **1** is drawn from a supply cop **2** by a take-off roller **3**, passes through a guide loop **4** on a tensioning arm **5** having a pivotal mounting **6**, changes its direction to pass through a thread guide **7** on a thread layer **8** at the locus of winding and is wound on a winding bobbin **9** mounted on a drive shaft **10** which is rotated conventionally by a driving means (not shown). The take-off roller **3** has a wavy groove therein to frictionally engage the thread and is mounted on a drive shaft **11** which is rotated at a controlled speed by a variable-output-speed friction drive transmission **12** which is coupled to the rotating shaft **10** by means of pulleys **13** and **14** and belt **15**.

The thread layer **8** is mounted on a shaft **16** so as to be pivotable outwardly from the bobbin **9** and has conventional means (not shown) for a reciprocating movement parallel to the shaft **10** between the ends of the bobbin **9**.

A compressed spring **17** mounted on a movable support rod **18** is coupled to the pivot arm **5** so as to supply a controlled tension to the thread at the loop **4**. The movable support rod **18** is coupled to the thread layer **8** by means of a bell crank **19** and a swivel rod **20** so as to decompress spring **17** and supply reduced tension to the thread at loop **4** as the thread layer **8** is pivoted outwardly from the bobbin **9** with increasing layers of thread.

The transmission **12** is connected by an electrical circuit to an electrical regulating means which is a reversible electric motor **21** having its field coil wired to brush contacts **22** and **23**. The contacts **22** and **23** are spaced on opposing sides of the free-swinging end **24** of the pivot arm **5** so as to be contacted when a change in thread hoard occurs greater than the normal periodic fluctuation caused by the reciprocating movement of the thread layer **8**.

When an increase in hoard occurs in the thread **1** greater than that due to the reciprocating movement of the thread layer, the free-swinging end **24** of the pivot arm **5** contacts the contact means **22**, causing the motor **21** to be driven in one direction so that it rotates the shaft **25** connected to the transmission **12** to decrease its output speed and decelerate the take-off roller **3** thus restoring the original thread hoard.

Similarly, when a decrease in thread hoard occurs greater than that caused by the thread layer, the end **24**

contacts the contact 23. In this case, the current flowing from the power source through the pivot arm or dancer arm 5 causes the reversible motor 21 to rotate in the direction opposite from which it rotates when contact 22 is touched. This, in turn, causes the transmission 12 to accelerate the take-off roller 3 thus increasing the thread hoard the original amount.

As increasing layers of thread are wound upon the bobbin 9, the thread layer 8 moves outwardly from the bobbin, by which simultaneously decompresses the spring 17 by means of swivel rod 20, bell crank 19 and spring support rod 18 to effect a further upward deflection of arm 5 and diminish the original thread tension.

The reciprocating movement of the thread layer 8 causes a periodic fluctuation in the thread hoard. However, since these fluctuations are small they do not actuate the regulator 21 because of the free space for action between end 24 and contact means 22 and 23.

Various modifications may be made in the above-described embodiment within the scope of the invention. For example, an electric or magnetic field may be employed instead of the spring 17 providing the tensioning arm 5 is light enough to follow the fluctuations caused by the thread layer without actuating the regulator 21. The belt-pulley arrangement 13, 14 and 15 may be dispensed with and a separate motor may be employed for driving the take-off roller 3. The transmission 12 may be a continuously adjustable friction wheel transmission or any other continuously adjustable transmission. The electrical regulating motor 21 may also be replaced by any known mechanical pneumatic, hydraulic, electrical or mechanical device which can transform the contacting declinations of the arm 24 into controlling impulses for adjusting the transmission 12.

If the thread tension in the wound bobbin is to remain unchanged during the winding, the support rod 18 of the spring 17 may be fixed; or its position may be made dependent on other influences than the diameter of the winding bobbin. For example, the position of the rod 18 may be made dependent on the adjustment of the transmission 12 or on the winding speed. In any case, by these means, the thread tension on and immediately preceding the bobbin may be adjusted with a high degree of precision and with any desired amount of variation throughout the winding period without any detrimental effect on the thread tension.

FIGS. 2 to 7 illustrate a further embodiment of the invention in which the entire apparatus for controllably varying the speed of rotation of the take-off roller 3 according to the tension on the thread is housed in a box 25. The apparatus includes a continuously rotatable drive disc 26 coupled to the pulley 13 by a drive shaft 27, the pulley 13 being driven continuously by drive means previously described. Speed-adjusting coupling means for drivingly coupling the disc 26 to the take-off roller 3 are provided by a rotatable shaft 28 fixed to the roller 3 and a friction wheel 29 mounted on a part of the shaft 28 which is splined or otherwise constructed so that the wheel 29 is rotatable with the shaft 28 and slidable therealong. The wheel 29 frictionally engages a flat side of the disc 26 at various radial positions thereon, the particular position of engagement being varied by control means operatively coupled to the wheel 29 so as to slide the wheel on the shaft 28 responsive to the tension of the thread.

The control means for controllably moving the wheel 29 with respect to the disc 26 includes a threaded means comprising a sleeve 30 surrounding the shaft 28 and movable therealong. A spring 31 on the shaft 28 urges the wheel 29 against one end of the sleeve 30, the bearing surface on both sides of the wheel 29 avoiding friction with the spring on one side and the sleeve on the other side. The sleeve 30 has an indicator appendage 32 extending into a slot 33 in the housing 25 to prevent rotation of the sleeve and to indicate its longitudinal position on the shaft 28. The sleeve 30 has a male threaded end 34 coupled into a female threaded collar 35 on one end of a control cylinder or tube-nut 36 rotatably mounted in the housing 25.

Means for rotating the cylinder are provided which include a pair of dogs or angle levers 37 and 38, each of which has a slot 39 and 40 for engaging opposite sides of an end of the control cylinder 36 extending from the housing 25. Continuously oscillating drive means for the dogs 37 and 38 are provided by a connecting rod 41, one end of which is coupled to the upper ends of the dogs and the other end of which is coupled to a cam 42 on the drive shaft 27 by means of a cam follower 43 having a pivotal mounting 44. An independent drive means may also be used to provide the oscillatory motion. The slots 39 and 40 in the dogs 37 and 38 have sharp angled edges 45 which engage the cylinder 36 when the dogs are offset with respect to each more than a given amount so as to rotate the cylinder by increments as the dogs oscillate, the rotatable direction and incremental amount corresponding to the amount of offsetting of the dogs. The angling of the sharp edges 45 is such that when the dogs are set evenly with respect to each other or offset less than the aforementioned given amount, the dogs oscillate freely without torque on the cylinder 36.

Means responsive to the thread tensioning for offsetting the dogs 37 and 38 include a pair of push-pull links 46 and 47 each of which contact or are coupled to the lower end of one of the dogs at one pair of ends, and each of the other ends of which are pivotally connected to one arm of a double armed lever 48. The lever 48 is fixed at its center to one end of a shaft 49 rotatably mounted in the housing 25. A thread engaging tensioning arm 5 is fixed to the other end of the shaft 49 so as to rotate the shaft as the arm swings in engagement with the thread.

The aforementioned given amount of offsetting of the dogs 37 and 38 which causes the sharp angled edges 45 to engage and rotate the cylinder 36 is sufficient to permit changes in tensioning of the thread due to the reciprocating movement of the previously described thread laying means without the dogs becoming operative to rotate the control cylinder. The tensioning variations due to the reciprocating movement of the thread layer are absorbed by a torsion spring 50 torsionally associated with the rotatable shaft 49. One end 51 of the spring is fixed to the shaft 49 and the other end 52 may be fixed to the housing 25 (not shown). However, if it is desired to vary the tensioning of the thread as the winding operation proceeds, a gear means is provided which is operatively associated with the rotatable cylinder 36 and with the torsion spring 50 whereby a rotation of the cylinder 36 effects an adjustment of the torsion spring. This is illustrated in FIG. 2 wherein the spring end 52 is fixed to a gear wheel 53 rotatably mounted on the shaft 49, the wheel 53 being adjustably coupled by intermediate gears 54 and 55 to a gear wheel 56 fixed to the cylinder 36.

The dogs 37 and 38 have at their upper ends ball heads 60, 61 slidably mounted inside of slide tracks 62 and 63 secured on the rod 41, which is supported for sliding movement in bearing members 64 and 65. The ball heads are free to slide and pivot in their respective tracks during the reciprocation of arm 41 until the sharp edges 45 of their respective dogs engage the control cylinder 36, at which point during reciprocal movement in one direction the connection through the dog between the control cylinder 36 and the reciprocating arm becomes rigid. As the arm 41 moves further in its linear travel, the control cylinder 36 is rotated by pivotal movement of the dog and the speed of the take-off device 3 is adjusted to restore the thread hoard by the mechanism previously described. The rate of speed adjustment in this embodiment is variable, depending upon the amount of change in the thread hoard, because, the greater the

change in the thread hoard, the greater is the offsetting of the dogs 37, 38.

For example, with the dogs positioned as shown in FIG. 4, the dog 37 in a lowered position will clamp the control cylinder 36 when the arm 41 moves to the left and thus rotate the cylinder in a counterclockwise direction. The dog 37 releases when the arm 41 reverses direction. The dog 38 in the raised position does not clamp the cylinder 36 during the reciprocal cycle of arm 41. The amount of rotation of the control cylinder 36 per reciprocal cycle of the arm 41 and hence the rate of speed adjustment of the drive for the take-off device 3, varies with the degree of change in the thread hoard of the running thread. The greater the change in the thread hoard, the greater is the offsetting of the dogs. As the degree of displacement of the lower operable dog increases, it engages the control cylinder at an earlier point in the reciprocal travel of arm 41, and hence the control cylinder 36 is rotated a greater amount during a reciprocal cycle. The combination thus provides a variable rate of speed adjustment of the take-off device, which rate is responsive to the amount of change in the thread hoard.

When a change in tensioning of the thread occurs which is greater than that due to the reciprocating movement of the thread layer, the arm 5 is pivoted in a direction dependent on whether the change is an increase or decrease in tensioning, causing the lever 48 on the shaft 49 to rotate correspondingly. This causes the dogs 37 and 38 to become offset so as to engage the cylinder 36. The oscillatory motion supplied continuously to the dogs through the connecting rod 41 then causes the dogs to rotate the cylinder 36 which moves the sleeve 30 and wheel 29 in a longitudinal direction along the shaft 28. The change in the radial position of the wheel 29 on the continuously rotating disc 26 causes a corresponding change in the speed of rotation of the wheel 29 and the roller 3 fixed thereto. As a result the roller accelerates or decelerates the feeding of the thread to the winding bobbin so as to restore the thread tension to the original amount.

The invention makes possible the production of wound bobbins with a controlled thread tension regardless of the winding speed. Furthermore, the resulting wound bobbin has uniformly wound layers of thread whether the thread be coarse or fine or of natural or synthetic origin. The invention is particularly effective in controlling the thread tension, since the control means employed serve equally well as accelerators or decelerators for the thread.

The invention is hereby claimed as follows:

1. In a machine for winding thread having a rotating take-off roller engaging and feeding the thread to a winding bobbin and having a reciprocating thread laying means guiding the thread winding on the bobbin, apparatus for controllably varying the speed of rotation of the roller according to the hoard on the thread, said apparatus comprising a continuously rotatable drive disc; a friction wheel frictionally engaging the disc, said wheel being movable to engage the disc at various radial positions thereon; means drivingly coupling the wheel to the roller; control means for controllably moving the wheel with respect to the disc, said control means including a rotatably mounted control cylinder and threaded means operatively associated with the cylinder and coupled to the wheel for moving the wheel radially on the disc as the cylinder is rotated; continuously oscillating drive means; a pair of dogs coupled to the oscillating drive means, each of said dogs engaging an opposite side of the control cylinder; means responsive to the thread hoard for offsetting the dogs with respect to each other, said dogs when offset more than a given amount being operative to rotate the control cylinder by increments as the dogs oscillate, the rotatable direction and incremental amount corresponding to the offsetting of the dogs, said given amount of offsetting being sufficient to permit changes in hoard of the thread due to the reciprocating movement of said thread laying means without the dogs becoming operative to rotate the control cylinder.

2. An apparatus according to claim 1 wherein the means responsive to the thread hoard for offsetting the dogs comprises an arm engageable with the thread, a rotatably mounted shaft connected to the arm and rotatable as the arm swings in engagement with the thread, a double armed lever fixed to the shaft, and a pair of push-pull links each being pivotally connected to one of the arms of the lever, each of said links being coupled to one of the dogs whereby pivotal movement of the thread engaging arm will cause offsetting of the dogs.

3. An apparatus according to claim 1 wherein the means responsive to the thread hoard comprises an arm engageable with the thread, a rotatably mounted shaft connected to the arm and rotatable as the arm swings in engagement with the thread, an adjustable torsion spring torsionally associated with the rotatably mounted shaft, and gear means operatively associated with the rotatably mounted control cylinder and with the torsion spring whereby a rotation of the control cylinder effects an adjustment of the torsion spring.

4. In a machine for winding thread at controlled thread tension, a rotatable take-off device for engaging and feeding thread from a supply cop to a winding package, thread feeler means for forming a thread hoard between said device and said package, said feeler means being displaceable from its normal operative position in response to changes in said thread hoard, drive means connected with said take-off device for rotatably driving said take-off device, said drive means including means for accelerating and decelerating, at variable rates of acceleration and deceleration, the rate of rotation at which said take-off device is rotatably driven by said drive means, and means operatively connecting said feeler means and said means for accelerating and decelerating to give a rate of acceleration or deceleration of said take-off device correlated with the amount of displacement of said feeler means from its normal operative position in a relationship wherein the rate of acceleration or deceleration increases with the amount of displacement of said thread feeler means from its normal operative position.

5. In a machine for winding thread at controlled thread tension, a rotatable take-off device for engaging and feeding thread from a supply cop to a winding package, thread feeler means for forming a thread hoard between said device and said package, said feeler means being displaceable from its normal operative position in response to changes in the thread hoard, drive means connected with said take-off device for rotatably driving said take-off device, said drive means including a variable-output-speed mechanical drive, and means for accelerating and decelerating at variable rates of acceleration and deceleration the output speed of said mechanical drive, and means operatively connecting said feeler means and said means for accelerating and decelerating the output speed of said mechanical drive to give a rate of acceleration or deceleration of said take-off device correlating with the amount of displacement of said feeler means from its normal operative position in a relationship wherein the rate of acceleration or deceleration of the output speed of said drive increases wtih the amount of displacement of said feeler means from its normal operative position.

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