United States Patent

Furst

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[54] **UNWINDING DEVICE FOR FILAMENTARY MATERIAL**

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[73] Assignee: **Walter Reiners,** Monchengladbach, Germany

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[52] **U.S. Cl.** .....**242/36,** 242/54 R, 242/78.6, 66/86 A

[51] **Int. Cl.** **B65h 49/18,** B65h 63/00

[58] **Field of Search**.....242/36, 37, 39, 57, 35.6, 45, 242/54, 78.6; 66/82 S, 86 A, 125

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[57] **ABSTRACT**

Unwinding device for filamentary material includes means for determining the extent of fullness of the thread winding on a bobbin being unwound, and means for automatically controlling, in accordance with the extent of fullness of the thread winding on the bobbin, the speed at which the thread is being withdrawn from the bobbin.

3 Claims, 3 Drawing Figures

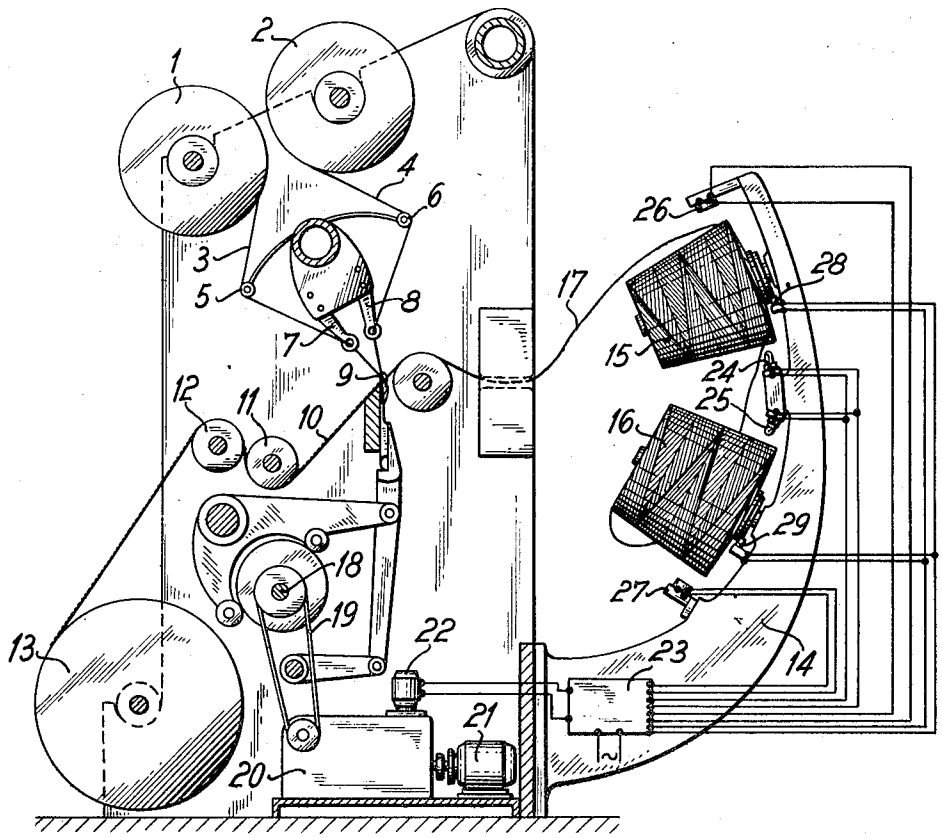

FIG. 2

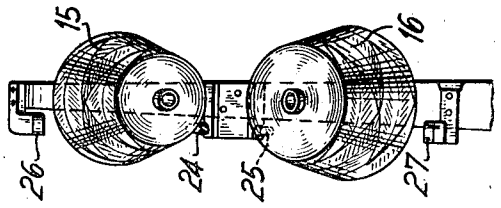
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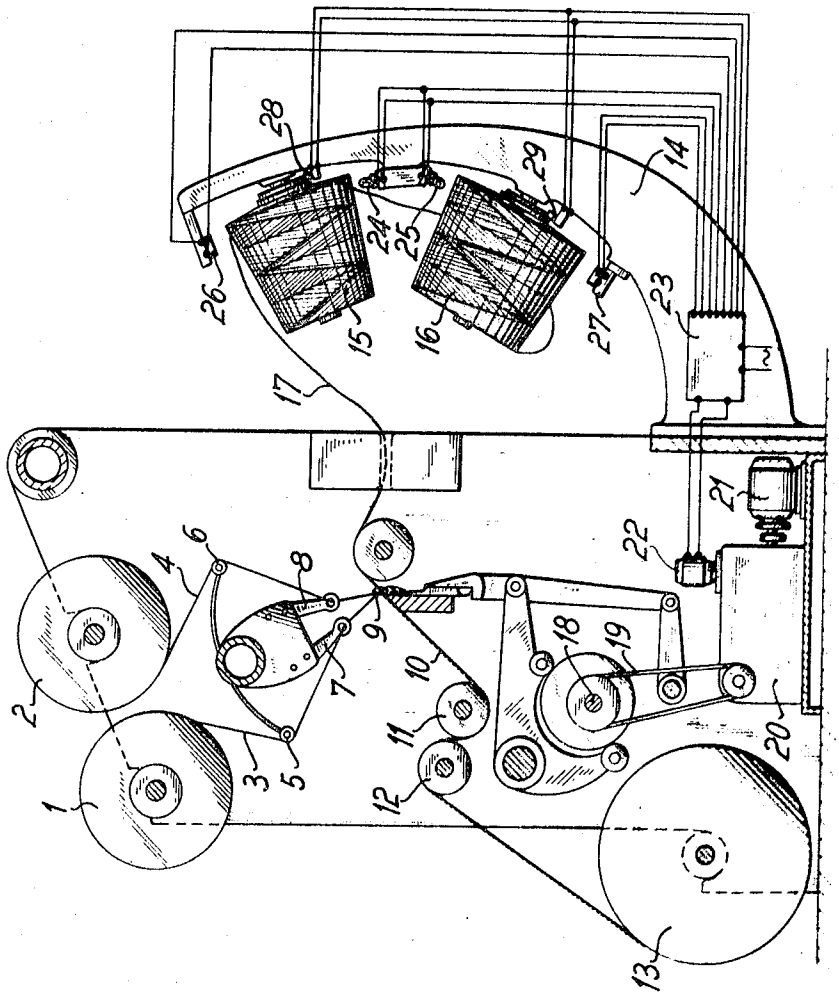
FIG. 1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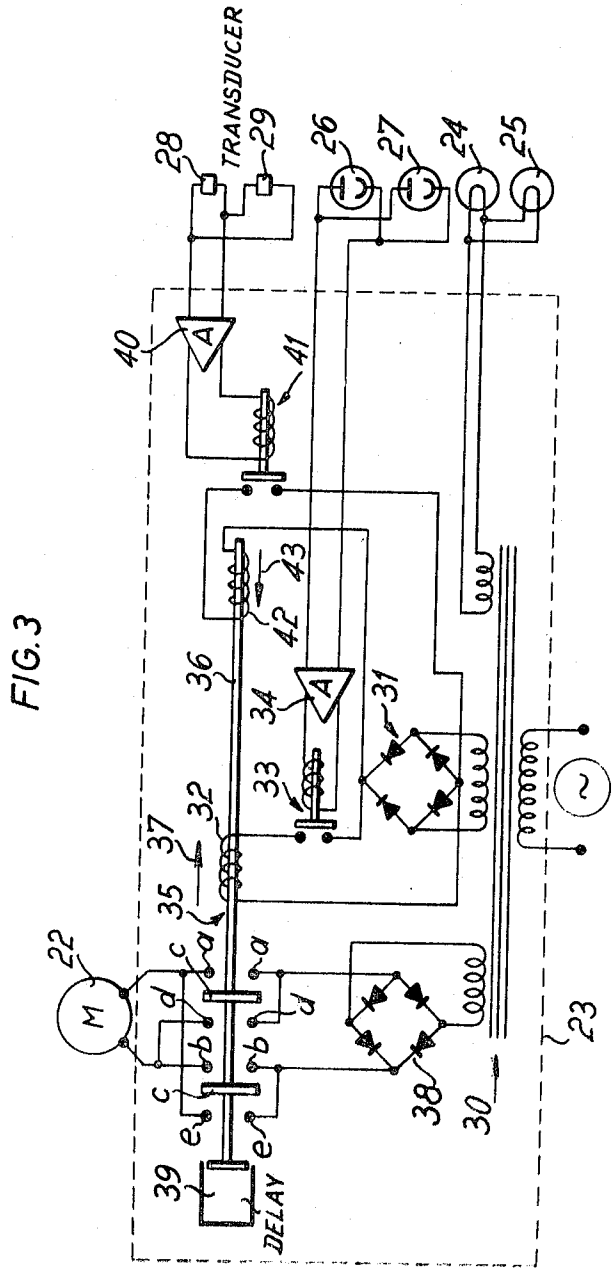
TRANSDUCER
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DELAY

FIG. 3

UNWINDING DEVICE FOR FILAMENTARY MATERIAL

My invention relates to unwinding device for filamentary material. Such unwinding devices are employed, for example in apparatus wherein a thread is unwound from a supply coil, such as a spinning cop, and wound onto a takeup coil such as a bobbin or cheese, or in machines wherein a thread that is being unwound is to be treated or processed as, for example, in the case of filling or feeding a weft in a Raschel knitting machine.

It is generally known that the tension in a thread during the course of a coil unwinding operation is subjected to deviations for various reasons. If a given maximum tension should be exceeded, the thread may either break or permanent structural changes may be produced therein which will become noticeable afterwards when processing the thread into webs or fabric. Since the maximum tensions that are produced in the thread in the course of the tension deviations are greater, the higher the feed or unwinding velocity of the thread, it has heretofore been mandatory in the case of winding machines to maintain the unwinding velocity of the thread so low that the maximum tensions produced in the thread do not cause any excessive stress in the thread. In order to attain higher thread unwinding speeds, attempts have been made to reduce the maximum tensions in the thread as much as possible by whatever measures that are most suitable for this purpose. For example, in this regard, attention is directed to the so-called balloon breaker which disrupts the thread ballooning action that occurs when a thread is unwound vertically from a coil and thereby reduces the tension of the unwinding thread. Although numerous measures have become known for keeping as low as possible the maximum thread tensions occurring during an unwinding operation, complete elimination of varying thread tensions during the unwinding operation is not entirely possible so that the highest possible thread unwinding speed is limited by the maximum tensions which are produced in the thread.

It is accordingly an object of my invention to provide unwinding device for filamentary material wherein the unwinding speed of the filamentary material is increased over that in conventional unwinding devices of this general type, thereby increasing the efficiency of the novel unwinding device over that of the conventional devices.

With the foregoing and other objects in view, I provide in accordance with my invention, unwinding device for filamentary material comprising means for determining the extent of fullness of the thread winding on a bobbin being unwound and means for automatically controlling, in accordance with the extent of fullness of the thread winding on the bobbin, the speed at which the thread is being withdrawn from the bobbin. My invention makes use of the knowledge that especially high thread tensions are generally produced only within specific, relatively limited stages of the unwinding process, respectively according to the extent of fullness of the thread winding on the coil being unwound. It is consequently possible, by means of my invention, to increase markedly the unwinding speed of the thread over the predominantly greatest interval of the unwinding process and to reduce the thread unwinding speed only at those intervals wherein the extent of fullness of the thread winding on the coil is such as to produce very high unwinding tensions so that the permissible limits of thread tension are not exceeded.

As aforementioned, especially high tensions are produced in the unwinding thread generally at specific locations of the unwinding coil. When the thread of the coils, such as cross wound bobbins or cops, is unwound vertically, the highest thread tensions occur when the coil is almost completely unwound. When unwinding devices are supplied with such coils, a marked simplification is effected according to my invention by providing means for automatically reducing the speed at which the filamentary material or thread is being unwound whenever the extent of fullness of the thread winding on the coil falls short of a predetermined value so that the unwinding device virtually operates at two speeds, namely a high speed, which is considerably higher than the speed at which the heretofore known conventional unwinding devices of this general type have been operated, and a lower speed to which it is automatically adjusted when the extent of fullness of the thread winding on the coil falls short of the aforementioned predetermined value, that lower speed corresponding actually to the conventional speed of the heretofore known devices.

To permit a longest possible uninterrupted operation of the unwinding device, it has been known to provide several coils that are to be unwound, the terminating end of one of the coils being connected to the starting end of another of the coils before the one coil has been unwound. When transposing the thread unwinding operation from the thus unwound first coil to the fully wound succeeding coil a considerably increased danger of thread breakage arises, however, because markedly increased tensions are produced in the thread due to the transition from one ballooning configuration of the thread to another and due to the more difficult unwinding of the last thread layers of the coasting virtually totally unwound coil. Since these thread tensions could hardly be eliminated even by the aforementioned heretofore known device for reducing the thread tension, the conventional unwinding device had to be driven with such low thread unwinding speeds that it barely exhibited any advantages over other unwinding devices wherein the respective unwinding coil being unwound respectively would be replaced by a new fully wound coil after the unwinding operation performed thereon is completed. My invention permits even such unwinding devices wherein several coils are provided having the terminating thread end of a respective coil connected to the starting thread end of a successive coil to operate with higher thread unwinding speeds. In an especially simplified embodiment of my invention, I provide unwinding device for filamentary material with means for sensing the changeover of the unwinding operation from one coil to another, and means for automatically reducing the speed at which the filamentary material is being unwound during the changeover in accordance with the extent of the fullness of the winding of the filamentary material on the coil. A conventional delay device is provided in accordance with my invention to ensure the fact that the reduced unwinding speed will be maintained for a predetermined period also at the beginning of the unwinding of the new and fully wound succeeding coil, in order to eliminate by means of the reduced unwinding speed the difficulties that occur at the start of the unwinding operation.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in unwinding device for filamentary material, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a diagrammatic view partly in section of a Raschel knitting machine constructed in accordance with my invention;

FIG. 2 is a view of the thread coils mounted on the projecting arm of the machine as seen from the left-hand side thereof in FIG. 1; and

FIG. 3 is a schematic view of the switching device of FIG. 1 showing the various details and components thereof.

Referring now to the drawings, there is shown a Raschel knitting machine provided with partial warp beams 1 and 2 rotatably mounted on the upper part of a frame sidewall. Warp threads 3 and 4 lead from the beams 1 and 2, respectively, through spring seesaws or rocker arms 5 and 6, respectively, and through respective eye needles 7 and 8 to latch needles 9. Material 10 which has been knitted in the machine is withdrawn from the needles 9 by rotatably mounted feed rol-

lers 11 and 12 suitably driven, for example, through nonillustrated transmission mechanism from a main drive shaft 18 of the machine, and is wound on a beam 13. A projecting arm 14 is secured by a connecting member or crosspiece to the frame sidewall of the machine. A pair of cross wound bobbins or cheeses 15 and 16 are rotatably mounted on the projecting arm, the threads wound thereon being connected in a conventional manner for the purpose of affording continuous unwinding of a weft 17 therefrom. In order to keep the figures as clear as possible, various conventional structural elements of the Raschel knitting machine, which are of no importance to the invention of this application, have been omitted. All of the movements of the Raschel knitting machine are derived in a known manner from the main shaft 18 which is in turn connected through a drive system 19, such as a belt or chain drive, to a variable transmission 20 that is driven by a motor 21. A variable motor 22 serves for varying or adjusting the transmission 20. The motor 22 is coordinated in a conventional manner with the adjusting or varying shaft of the variable transmission 20 and is electrically connected to a switching device or control system 23. Current is supplied from the control system 23 to electric lamps 24 and 25, suitably mounted on the projecting arm 14. The lamps 24 and 25 are located at positions displaced a given distance from a line passing through the axes of the holders for the bobbins 15 and 16, as seen more clearly in FIG. 2, so as to cast a light beam therefrom onto respective photoelectric cells 26 and 27, also suitably mounted on the projecting arm 14 at a given offset from the line passing through the axes of the bobbin holders, when the thread wound on the respective bobbins 15 and 16 has become depleted to such an extent that the radius of the thus depleted bobbins is less than the offset distance of the respective lamps 24 and 25 and photoelectric cells 26 and 27 from the line passing through the axes of the holders of the bobbins 15 and 16. If the bobbin 15, for example, has become reduced in diameter beyond a given nominal diameter, the light beam from the lamp 24 then impinges on the photoelectric cell 26 which then emits an electric pulse through the control system or switch box 23 to adjust the variable motor 22 of the transmission 20 so as to reduce the rotary speed of the main shaft 18 to a desired lower value. By means of conventional electric switch members or components that are provided in the switching device 23, the variable motor 22 is adjusted to the originally selected rotary speed in response to a signal pulse from a suitable transducer 29 responsive to the inception of rotation of the bobbin 16, when the bobbin 15 has been depleted of the thread originally wound thereon, the feed has shifted to the thread of the bobbin 16 and the bobbin 16 is duly running down. This cycle is repeated in a similar manner through a transducer 28 when the bobbin 16 becomes depleted and, in the interim a new, fully wound bobbin has been substituted for the depleted bobbin 15 and the thread starting end of the new bobbin has been connected to the terminating thread end of the bobbin 16.

Since the rotary speed of the main drive shaft 18 determines the speed of all the moving members of the Raschel knitting machine, the speed of the weft 17 running from the bobbins 15 and 16 is necessarily dependent or contingent upon the speed of the main shaft 18. On the other hand, since the rotary speed of the main drive shaft 18, as aforedescribed, during the exchange of depleted bobbins i.e., during the transition of the weft feed from the depleted bobbin 15 to the full bobbin 16, is reduced automatically in accordance with the degree of fullness of the thread winding on the bobbin 15, while, after subsequent transition of weft feed from depleted bobbin to full bobbin, it is readjusted automatically to the increased operating speed, a higher average speed of the Raschel knitting machine can actually be attained with the aid of the novel device of my invention.

My invention is not limited to the illustrated embodiment. Many other means may be employed, for example, to determine the extent of fullness of the thread winding on the bobbins. Thus, for example, instead of electro-optical sensing with the aid of the photoelectric cells 26 and 27, mechanical sensing of the bobbin diameter by a suitable mechanical feeler element or a determination of the weight of the bobbin may be employed to the same purpose. Moreover, the scope of my invention is not limited to Raschel knitting machines as shown in the illustrated embodiment and whose use is especially advantageous, but rather is applicable to all unwinding devices for filamentary materials wherein the problems solved by the invention can occur. Furthermore, my invention is to be used not only in those situations wherein the speed of the drawn-off thread or weft is reduced after a bobbin has been depleted beyond a predetermined degree of fullness of the thread wound thereon or a transition of weft feed has taken place from a depleted bobbin to a full bobbin, but can also be used in all other cases wherein disturbances in the running off of the thread can occur in accordance with the extent to which the bobbin is wound.

Details of the switching device or control system 23 are shown schematically in FIG. 3. A transformer 30 is energized by a conventional electric supply line to provide lighting current for the lamps 24 and 25. The transformer also supplies current rectified by the full wave rectifier 31 for energizing an induction coil 32 connected in a circuit which is closed by a relay 33 whenever either of the photoelectric cells emits a pulse when subjected to a light beam from the lamps 24 and 25 respectively. The pulse from either of the photoelectric cells 26 and 27 is amplified by the amplifier 34. The induction coil 32 forms part of a two-way relay 35 whose armature 36 is accordingly shifted in the direction of the arrow 37 to complete a circuit to the motor 22 energized from the transformer 30 and including a fullwave rectifier 38 and contacts *a,a* and *b,b*. A suitable delay mechanism 39 permits the switch arms *c,c* of the relay armature 36 to engage the respective contacts *a,a* and *b,b* long enough to rotate the armature of the motor 22 through a predetermined rotary angle so as to adjust the transmission 20 to a reduced ratio, and then restore the armature 36 and the switch arms *c,c* to the noncontacting position shown in FIG. 3. When the respective bobbin has finally become totally depleted so that feed of the weft 17 has shifted to the adjacent full bobbin which then begins to rotate as the weft 17 is unwound therefrom, a respective transducer 28 or 29 emits a pulse which is amplified by an amplifier 40 to energize a relay 41 which closes a circuit that includes the rectifier 31 and an induction coil 42. The coil 42 is suitably energized to shift the armature 36 in the direction of the arrow 43 so that the switch arms *c,c* thereof engage the contacts *d,d* and *e,e* of the motor circuit, thereby causing the armature of the motor 22 to rotate in opposite rotary direction to the previous rotation thereof when the contacts *a,a* and *b,b* were engaged by the switch arms *c,c*. The delay mechanism 39 permits the armature of the motor 22 to turn back to its starting position and then disengages the switch arms *c,c* from the contacts *d,d* and *e,e*. The adjusting shaft of the transmission 20 has accordingly adjusted the transmission to a ratio which provides a predetermined rotary speed of the main drive shaft 18 to operate the Raschel knitting machine at its highest operating speed for a fully wound bobbin.

I claim:

1. Unwinding device for filamentary material wound in coils comprising means for withdrawing from a coil, at speeds varying from a maximum value to a minimum value greater than zero, filamentary material wound on the coil, means for determining the extent of fullness of the filamentary material winding in the coil being unwound, and means for automatically regulating, in accordance with the extent of fullness of the filamentary material winding in the coil, the speed of said withdrawing means between said maximum and minimum values.

2. Unwinding device according to claim 1, wherein said fullness-determining means comprises a device for detecting the reduction of fullness in the winding of the coil below a predetermined fullness value, and said speed regulating means is operatively connected to said device and responsive to a

signal therefrom for automatically reducing the speed at which the filamentary material is being withdrawn from the coil by said withdrawing means.

3. Unwinding device according to claim 1, including means for mounting a plurality of coils wound with filamentary material, the terminating end of the filamentary material on a preceding coil being connectable to the starting end of the filamentary material on the next succeeding coil, said withdrawing means including means for continuing the withdrawal of the filamentary material during a changeover from the preceding coil to the next succeeding coil as the winding in the preceding coil is depleted, said speed regulating means being operatively connected to the fullness-determining means and responsive thereto during said changeover for automatically reducing the speed at which the filamentary material is being withdrawn from the coil by said withdrawing means.

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