ABSTRACT

A web, such as the warp in a loom, is wound up on a warp beam after passing over a transporting roller which is driven at a constant speed, and a control roller mounted on a support which turns about the axis of the transporting roller. When the speed of the wound up web varies, the tension in the web changes and the support of the control roller is angularly displaced by the web and operates adjusting means of a variable transmission by which the warp beam is driven so that a desired constant tension can be maintained in the warp.

12 Claims, 3 Drawing Figures
REGULATED WINDUP APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a regulated windup apparatus which is particularly suitable for winding up a warp on a warp beam of a loom. It is an important requirement that, when the warp threads are wound up on the warp beam of a loom, before the weaving operation is started, that the tension in the warp is maintained substantially constant. This requires a reduction of the rotary speed of the warp beam, as the diameter of the warp wound up on the warp beam increases. Accordingly, regulating apparatus has been proposed for obtaining constant tension in the warp by means of a variable friction transmission acting on the warp beam. However, apparatus of this type has not been fully successful at high operational speeds.

In a known apparatus for winding up the warp on a warp beam, the warp is guided over movable feeder rollers which required additional rollers deflecting the warp, and moreover there is a certain danger of crossing and entanglement of the warp threads.

SUMMARY OF THE INVENTION

It is one object of the invention to provide a regulated winding apparatus avoiding the disadvantages of prior-art constructions and obtaining substantially constant tension in a wound up web, irrespective of the diameter of the wound up web package.

Another object of the invention is to provide a regulated winding apparatus which is particularly suitable for winding a warp onto the warp beam of a loom.

With these objects in view, the present invention provides between a transporting roller and a windup roller, a control roller which is mounted for movement along a circle having its center in the axis of a transport roller. When the control roller is angularly displaced due to a varying tension in the wound up web or warp, adjusting means are actuated by which the rotary speed of the windup roller, such as the warp beam, is adjusted to obtain substantially constant tension in the wound up web.

In accordance with the invention, a reversing roller, which is frequently provided in winding apparatus of this type, can be used in accordance with the invention for adjusting the tension in the wound up web.

One embodiment of the invention comprises transporting roller means; a control device including a control roller cooperating with the transporting roller means, and support means mounting the control roller for movement about the axis of the transporting roller means along the periphery of the same; a web being supplied to said supporting roller means and passing between the same and said control roller, and in a loop over the control roller to a windup roller; drive means for rotating the transporting roller means so that the web is transported; and variable transmission means connecting said drive means with the windup roller, and including adjusting means operated by the control device during angular movement of the control roller about the axis of the transporting roller means.

In this manner, the speed of the windup means is adjusted when the control device angularly displaced due to a speed variation of the web wound up on the windup roller and a corresponding tension variation in the web.

In the preferred embodiment of the invention, the support means of the control roller, which are mounted for angular movement about the axis of the transporting roller, include radial slots in which the control roller is mounted for radial movement, biased by spring means to move toward the radially inner ends of the slots so that the control roller is resiliently pressed against the transporting roller, with the web located between the two rollers.

Due to the fact that the control roller is pressed against the transporting roller by springs, it is possible to adjust the pressure of the control roller on the transporting roller by means of adjusting screws for the springs. The resilient abutment of the control roller has the advantage, that webs consisting of a material having low friction, do not slip on the transporting roller. Particularly for low friction webs, the combination of a control roller which is spring biased and movable over the periphery of the transporting roller along a particular path, is particularly advantageous since the angular displacement of the control roller obtains the desired regulation of the web tension since a slipping of the web upon varying web tension is avoided by pressing the control roller against the transporting roller with a suitable resilient force. Therefore, the mounting of a spring biased control roller for movement along the periphery of the transporting roller, is considered an important feature of the invention.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, 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 drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary side view illustrating an embodiment of the invention;

FIG. 2 is a fragmentary schematic plan view, partially in section, of the embodiment of FIG. 1; and

FIG. 3 is a fragmentary horizontal section illustrating a detail of FIG. 2 on a larger scale.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A winding apparatus B transports a warp, hereinafter referred to as "web" to a warp beam 24, hereinafter referred to as "windup roller" so that a wound up body 24a of increasing diameter is formed on the windup roller 24. The web W passes first over the pressure roller 7 which is mounted on a pair of arms 5 and 6 for angular movement, then over a major portion of the peripheral surface of transporting roller 1 between transporting roller 1 and a control roller 11, in a loop over control roller 11 to a guide roller 25, and from there to the windup roller 24.

Transporting roller 1 is hollow, and has hollow journal portions 4a at the ends, which are mounted in bearings in support walls 2 and 3. At the outer ends of the tubular journals 4a, bearings are provided for a control shaft 8 which passes through the transporting roller 1 and projects at both ends thereof. One of the journals 4a carries a fixed pulley 4 driven through a belt 42 from a pulley on a shaft 41 driven from a drive shaft 40 through a pair of bevel gears 40a.
A control roller 11 has journal portions at the ends which are mounted in bearings 11a in a slide block 26, 27, respectively, as best seen in FIGS. 2 and 3. Slide blocks 26, 27 are located in guide slots 26a provided at the outer ends of a pair of support arms 9, 10 which are respectively fixedly secured to the ends of control shaft 8. Control roller 11a project in radial direction from the hubs of support arms 9 and 10 substantially in a diametrical position to the support arms 9 and 10, and counter balancing weights 12 and 13 are mounted on the guide rods 12a for adjustment so that the weight of the supporting arms 9, 10 with control roller 11 can be balanced so that gravity does not influence the movement of control roller 11 which can turn, together with the support arms 9, 10, and shaft 8 about the axis of transporting roller 1 so that control roller 11 moves along a part-circular path along the periphery of transporting roller 1, whereby the loop of the web W is increased or decreased in size. Depending on the tension in the web caused by speed variations on windup roller 24, control roller 11 performs an angular movement in the direction of the double arrow P/2 between two end positions in which the supporting arms 9, 10 are stopped by stops 9a.

In order to obtain suitable pressure between the control roller 11 and transporting roller 1, control roller 11 is mounted in slide blocks 26, 27 which are biased in radial inward direction by springs 28 and 29, as best seen in FIG. 3. Adjusting screws 31 are provided which are threaded into the respective support arm 9 or 10, and permit an adjustment of the force of springs 28 and 29 which urge the control roller 11 in radial inward direction in slots 26a. The threaded adjusting means 31 has an inner recess in which the spring 28 or 29 is guided. A bolt 32 is secured to slide block 26, 27, and has a threaded end portion onto which a nut 33 is screwed to secure the adjusted position of adjusting means 31 and springs 28, 29.

Upon adjustment, the slide blocks 26, 27 with bearings 11a and control roller 11, are pressed inward in radial direction so that the control roller 11 abuts with an adjusted resilient force on the periphery of transporting roller 1 which preferably has a rubber surface.

By use of nut 33, a fixed distance or gap between transporting roller 1 and control roller 11 may be obtained whose thickness is selected in accordance with the web between control roller 11 and transporting roller 1. When a thicker portion such as a knot, in the web W passes between rollers 11 and 11, control roller 11 can resiliently yield against the action of springs 28 and 29 so that a thicker web portion can pass through the gap.

At the ends of control shaft 8, two wheels 14 and 15 are fixed which turn together with support arms 9 and 10. Links 14a and 15a have ends respectively connected to wheels 14 and 15 at points eccentric to the axis of shaft 8 and transporting roller 1, and are connected with control pistons 16a and 17a in pressure cylinders 16 and 17. A pressure fluid is supplied through an inlet conduit 18a to an adjustable valve 18 and flows through conduit means 18b into the cylinders 16 and 17. By adjustment of the pressure in the conduit means by control valve 18, a selected pressure, indicated by the manometer 19, is obtained in cylinders 16 and 17, acting on pistons 16a and 17a so that the wheels 14 and 15 are turned with a corresponding torque together with the support arms 9 and 10 until support arms 9 and 10 with control roller 11 are in a desired angular position obtained against the torque produced by the pull of the web on the control roller 11. Due to the counter balancing weights 12 and 13, the weight of control roller 11 does not influence the balancing of the opposing torques.

It is apparent from FIG. 1 that if a pull is exerted on one of the links 14a, 15a toward the respective cylinders 16 or 17, a torque acting on roller 1 is produced which acts in the opposite direction that when control roller 11 is moved downward as indicated by the end Sp of a double arrow P/2. This counter torque can be selected and set by admitting pressure fluid to the cylinders 16 and 17 in accordance with the prevailing operational conditions. Angular displacement of the control device 9, 10, 11 by the tension in the web, is counter acted by a selected resilient force exerted by pistons 16a, 17a.

A gear segment 20 is secured to one end of control shaft 8 and meshes with a pinion 21 connected with a potentiometer 22 which is connected by a line 22a with electric operating means 23a controlling adjusting means 23 which is connected by a first pulley and belt transmission 44 with shaft 41, and by a second pulley and belt transmission 43 with the windup roller 24, as shown in FIG. 2. The ratio of the transmission 43, 44, 23 is variable, and adjusted by turning gear segment 20 and the movable part of the potentiometer 22 so that the speed of the windup roller 24 is varied when the angular position of the control device 9, 10, 11 changes due to a variation of the tension in the web. For example, as the speed of the web toward the windup roller 24 increases due to an increase of the diameter of the wound up body 24a, the control roller 11 is moved in clockwise direction about the axis of shaft 8 and of transporting roller 1 out of the normal position selected by operation of valve 18. The displacement of the control device 9, 10, 11 causes operation of potentiometer 22 and corresponding adjustment of the transmission ratio of transmission 44, 23, 43 by adjusting means 23 actuated by the potentiometer-controlled electric operating means 23a, until the rotary speed of the windup roller 24 is sufficiently reduced so that the reduced tension in the web permits control roller 11 to return to its normal position.

The adjusting means 23 of the variable transmission 43, 44, 23 effects a continuous adjustment of the transmission ratio and of the rotary speed of windup roller 24. The speed of the transporting roller 1, which is driven by the transmission 41, 42 directly from the input drive shaft 40, is constant.

FIG. 1 shows the guide roller 25 in a position for deflecting the web W between the control roller 11 and the outer periphery of the wound up body 24a on windup roller 24. The position of guide roller 25 is selected so that only a small part of its peripheral surface is in contact with the web W, and so that the portion of the web between guide roller 25 and control roller 11 extends substantially in tangential direction in relation to the parts-circular path along which control roller 11 moves with supporting arms 9, 10 about the axis of shaft 8 and transporting roller 1. This position of the web facilitates the passage of the web about control roller 11, and is independent of the diameter of the wound up body 24a so that the response of the control device
The apparatus of the invention permits a very exact adjustment of the web tension within a wide range. Furthermore, if webs having a low friction coefficient are used, a slipping of the web on the transporting roller is prevented due to the fact that the control roller 11 is inwardly biased by springs 28, 29 into resilient abutment with the web and transporting roller 1.

The construction of the constant ratio transmission driving transporting roller 1, and the variable ratio transmission driving windup roller 24, is not an object of the invention, and any adjusting means 23 for continuously varying the ratio of the transmission 43, 44, 23 may be used, but the adjusting means 23 is controlled by the angular position of the control roller 11 in accordance with the invention. The adjusting means 23 of the variable transmission obtain a variation of the rotary speed of windup roller 24 for the purpose of maintaining the same constant selected tension in the wound up web, irrespective of variations of the speed of the web which may be caused by the increase, or decrease, of the diameter of the wound up web 24a. The term "web" is used in the present application to include any flexible elongated element, such as a thread or wire.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of regulated windup apparatus differing from the types described above.

While the invention has been illustrated and described as embodied in an windup apparatus in which the speed of the windup roller is varied by displacement of a control roller due to the varying web tension, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. Regulated windup apparatus for an elongated web, comprising a windup roller; transporting roller means having an axis of rotation; a control device including a control roller cooperating with said transporting roller means, and support means mounting said control roller for turning movement about said axis and along the periphery of said transporting roller means; said transporting roller means transporting said web between said transporting roller means and said control roller, and in a loop over said control roller to said windup roller; drive means for rotating said transporting roller means so that said web is transported toward said windup roller; and variable transmission means connecting said drive means with said windup control roller, and including adjusting means operated by said control device during turning movement of said control roller about said axis, to adjust the speed of said windup means when said control device is angularly displaced due to a speed variation of the web wound up on said windup roller and a corresponding tension variation in said web.

2. Regulated windup apparatus as claimed in claim 1 wherein said control device includes weight means for counter balancing the weight of said support means and of said control roller so that said control device is balanced for movement about said shaft irrespective of the force of gravity.

3. Regulated windup apparatus as claimed in claim 1 wherein said control device includes control means for adjusting the angular position of said control device to a normal position corresponding to the desired speed of the web being wound up and to the desired tension in said web.

4. Regulated windup apparatus as claimed in claim 1 wherein said support means of said control device include a control shaft coaxial with said transporting roller means and passing therethrough, said transporting roller means being hollow and having bearings for said control shaft, and two supporting arm means secured to said control shaft at the ends of said transporting roller means and having free ends rotatably supporting said control roller.

5. Regulated windup apparatus as claimed in claim 4 wherein said control device includes manual control means for adjusting the angular position of said control device to a normal position corresponding to the desired speed of said windup roller and to the desired tension in the web, said manual control means including a pair of links having first ends secured to said supporting arm means eccentric to said axis, a pair of control cylinders, a pair of control pistons in said control cylinders connected with the other ends of said links, and manual means for varying the pressure in said control cylinders.

6. Regulated windup apparatus as claimed in claim 1 wherein said adjusting means of said variable transmission includes a potentiometer operated by said support means during angular displacement of said control device, and electric operating means controlled by said potentiometer to vary the ratio of said variable transmission so that turning of said potentiometer in one direction caused by increased tension in said web acting on said control device effects a transmission ratio adjustment and a reduction of the speed of said windup roller by said electric operating means.

7. Regulated windup apparatus as claimed in claim 1 wherein said adjusting means of said variable transmission includes means for continuously adjusting the output speed of said variable transmission so that the speed of said windup means is gradually adjusted.

8. Regulated windup apparatus as claimed in claim 1 wherein said control device have radial slots for mounting said control roller for radial movement; and wherein said control device includes spring means for biasing said control roller toward the radially inner ends of said slots so that said control roller resiliently abuts the web and said transporting roller means.

9. Regulated windup apparatus as claimed in claim 8 wherein said control device includes threaded adjusting means for adjusting the force with which said spring means act on said control roller.

10. Regulated windup apparatus as claimed in claim 1 and including stop means for limiting angular movement of said control device.
11. Regulated windup apparatus as claimed in claim 1 further comprising a guide roller located between said control roller and said windup roller for guiding the web portion adjacent said control roller along a path tangential to the circular path along which said control roller moves during angular movement of said support means, irrespective of the varying diameter of the web wound up on said windup roller.

12. Regulated windup apparatus as claimed in claim 1 wherein said windup roller is the warp beam of a loom; and wherein said web is a warp formed by parallel warp threads.

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