LOOM WARP LETTING-OFF MECHANISM
Thomas Hindle, Blackburn, England, assignor to Hindle, Son & Co. Limited, Blackburn, England
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ABSTRACT OF THE DISCLOSURE

An automatic let-off mechanism for a weaving loom in which the backrest of the loom has a part thereof which is movably sensitive to the tension in the warp threads, the part being arranged to control the feed of yarn threads according to its movement.

This invention relates to automatic warp letting-off mechanism for weaving looms, and has particular, although not exclusive, application to heavy looms of relatively wide reed space, such as those required for weaving papermakers' felts and the like.

In such various known mechanisms, it is common practice to mount the entire backrest so as to be sensitive to the tension and/or length of the warp yarn bearing on it. In the case of medium and wide looms, however, such provision is unnecessarily cumbersome and costly, and is also inconvenient in use.

According to the present invention part only of the backrest is movably sensitive to the tension in the warp threads and the let-off mechanism includes means whereby the feed of warp threads is altered depending upon said movement of said part of the backrest.

The preferred moving part is a comparatively short section of the loom's backrest, such short section being conveniently referred to hereinafter as "the sampling backrest," which is sensitive to the length and tension of a representative part or sample of the full-width warp. The sampling backrest is flexibly and sensitively mounted on the loom structure near to or at the middle of the loom's weaving width, whereas the remainder of the backrest is rigidly and immovably fixed to that structure.

The warp yarn unwinding from the beam preferably first laps partly around a tension bar T (FIG. 1), then reverses to lap around the backrest tube to the extent of 180° or more, and thence extends horizontally through the healds to the fell of the cloth. The said tension bar may however be omitted, if desired, when weaving relatively light fabrics.

The warp yarn extending between the temporarily stationary beam and the cloth fell attains its maximum tension as the weft is beaten-up into the fell of the cloth by the reed, and the sampling backrest must sustain such peak tension without significant displacement or deflection. For this reason, during that part of the weaving cycle in which the weft is beaten-up, the sampling backrest is positively forced back and rigidly supported in close alignment with the fixed remainder of the backrest by the action of a cam fixed on and rotating with the loom crankshaft. This provision ensures, at the moment of beat-up, that the length and therefore the tension of the warp yarn bearing respectively on the sampling backrest and on the fixed remainder of the backrest are substantially equal, this being a prerequisite for the weaving of uniform cloth across the full reed width of the loom.

Apart from a narrow angle of dwell coincident with the beat-up, the cam profile is of a constant, smaller radius, thereby withdrawing its positive support from the sampling backrest throughout the remainder of the weaving cycle, i.e. crankshaft revolution.

The sampling backrest is subject to a predetermine constant force exerted by a compressed air cylinder (of either piston or diaphragm type) which force tends to displace the sampling backrest towards the rear, in opposition to the resistance of the warp yarn, which as it is absorbed in the woven cloth, displaces the sampling backrest towards the front of the loom. After the beat-up, when the positive support of the cam has been withdrawn, the sampling backrest is free to assume a position of equilibrium in which the tension of the warp yarn bearing on the sampling backrest exactly balances the constant force with which the sampling backrest is urged to the rear. At such time, therefore, the backrest readily assumes an intermediate position within its permitted range of movement according to the length of warp yarn extending between the fell and the beam, such length being sensed while the sampling warp is tensioned by the constant force applied to it by the sampling backrest.

In the particular position assumed by the sampling backrest, or a part of the mechanism linked to it, in relation to the loom structure as a whole, is the criterion which decides the automatic action of the let-off mechanism.

The warp beam is preferably arranged to be rotated by an electric motor fitted with a friction brake of known construction, such brake being released electromagnetically when the motor is energised, and subsequently spring-applied when the motor and brake are dis-energised.

The said electric motor is arranged to rotate the warp beam through a train of reduction gears. The required overall reduction ratio, other things being equal, is dependent upon the speed of the loom crankshaft in revolutions per minute, and the rate of let-off appropriate to the specified pick density in the woven cloth. The said train of gears includes one or two pairs of change gears which are selected to suit the required picks per inch in the woven cloth.

While the principal duty of the electric motor is the intermittent letting-off of warp from the beam, it is also utilised in certain circumstances, later described herein, to wind back on to the beam any surplus or slack warp which may develop, for example, in the course of unwinding in order to eliminate a weaving fault from the cloth.

If, immediately after the beat-up, the sampling backrest, then being free to assume a position of equilibrium, is displaced in the forward direction due to temporary loss of the normal length of yarn extending between the fall and the beam, then the motor will start up to let-off warp from the beam, and will stop as soon as the normal length of yarn has been restored, which is indicated by the sampling backrest moving back to its normal position, i.e. in the neutral zone, as a consequence of the constant force exerted by the air cylinder.

If, however, the sampling backrest is not sufficiently displaced in the forward direction to start the motor to let-off will occur during that weaving cycle, and this state of affairs may result in the motor starting-up to let-off only every two or more weaving cycles. This effect is
an indication that the particular change gears in use are not appropriate to the specified picks per inch in the woven cloth, and the fitting of the correct change gears to increase the overall ratio will provide regular letting-off action.

If, for any reason the warp yarn extending between the fell and the beam becomes unduly slack, the constant force exerted by the air cylinder displaces the sampling backrest to the rear, where it or a part of the mechanism linked to it ultimately abuts against a fixed stop. Such backward displacement exerts tension due to the cam at beat-up, and in the described circumstances the electric motor is caused to start running in the reverse direction so as to wind back the slack yarn on to the beam. As the warp yarn tightens up and attains the tension required to displace the sampling backrest, this is moved forward into the neutral zone, whereupon the motor is switched off, leaving the mechanism in readiness for letting-off warp as and when normal weaving is resumed.

The above described reversing provision is a convenient means of attaining the desired weaving tension when fitting a fresh beam in the loom, as it avoids the customary necessity of barring round the beam. It is especially useful, however, in combination with a cloth take-up mechanism of the continuous positive type which can be reversed when it becomes temporarily necessary to unweave cloth at the fell in order to eliminate a weaving fault. As the loom is turned over one crankshaft revolution at a time for removal of the weft yarns, the reversing take-up rolls let-back the cloth at the appropriate rate. During this operation, the warp yarn tends to slacken off even though the letting-off process is suspended. This slackness of the warp allows the compressed air cylinder to displace the sampling backrest further to the rear thereby causing the electric motor to start-up in the reverse direction and wind back the surplus warp on to the beam, so maintaining a substantially constant warp tension during such unwinding operation, and enabling normal weaving to proceed without the usual necessity of manipulating the beam and its frictional or other devices to restore correct weaving tension.

In an application to wide looms, the warp beam may be in two, or even more, sections, each controlled in the manner described by its own sampling backrest, and driven by its own electric motor. In such cases, in order to secure equal loading of the two, or more, sampling backrests, which are made of equal width, the air cylinders loading each of them are all connected in parallel and are all controlled by one pressure reducing valve.

The reducing valve for regulating the air pressure acting on the air cylinder or cylinders is preferably mounted, accompanied by a pressure gauge, at the front of the loom in a position convenient for the weaver's inspection.

It will be apparent that once the air pressure has been regulated to suit the particular cloth being woven, no further adjustment is required throughout the weaving down of the beam. Furthermore, that since the width of the sampling backrest remains constant in any particular loom, it is not necessary to alter the air pressure for the purpose of weaving cloth of identical construction but of different reed width. When regularly weaving cloths of various standardised constructions the air pressure found most suitable for each may be noted and the same adjustment of the regulating valve readily repeated, thus ensuring a high degree of uniformity in the woven products.

Instead of furnishing the warp yarn in the form of a beam on the beam, the warp may alternatively be drawn directly from a multiple bobbin creed located behind the loom. In such case, the beam is replaced by two or more measuring rolls, mounted in suitable bearings at the rear of the loom, the rolls driving the yarn by frictional contact. The warp yarn is arranged to pass in a wide sheet from the creel to a gang of friction bars, including at least one faller-bar capable of absorbing slack yarn, and then around the said measuring rolls and thence to the loom backrest.

The automatic warp let-off mechanism as hereto described may be used with particular advantage to control the delivery of warp yarn from creel to loom. A single centrally located sampling backrest is provided, and the electric motor is arranged to rotate the measuring rolls, so serving to draw yarn from the creel and deliver it to the loom under controlled tension dependent upon the air pressure applied to the sampling backrest. As in the case of beam loom, the let-off mechanism may be duplicated for very wide looms.

When unweaving, the electric motor reverses the measuring rolls so as to maintain the length and tension of the warp between the fell and the measuring rolls, while the faller-bar, above referred to, temporarily absorbs the slack yarn between the rolls and the creel. Upon resumption of normal weaving, the surplus yarn previously absorbed by the faller-bar is first drawn forward by the rolls, and when the faller-bar has been raised to its topmost position, yarn is again drawn from the creel by the measuring rolls as they are intermittently rotated by the electric motor under control of the sampling backrest.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings; in which

FIG. 1 is a diagrammatic side view, partly in section, of a loom warp letting-off mechanism according to the invention;

FIG. 2 is an end view of the mechanism shown in FIG. 1;

FIG. 3 is an enlarged plan view of part of the mechanism shown in FIGS. 1 and 2;

FIG. 4 is a sectional view of the mechanism shown in FIG. 3;

FIG. 5 is a diagram showing the various zones of movement of the movable part of the mechanism shown in detail in FIGS. 3 and 4; and

FIG. 6 is a perspective view showing the relation of the sampling backrest to the backrest lever.

Referring to the drawings, a loom warp letting-off mechanism includes a sampling backrest 10 which is here shown (FIG. 6) as interposed between the axially aligned spaced sections 10a and 10b of the backrest proper, this sampling backrest may conveniently be of 40 to 80 inches wide or thereof, pivoted about a vertical axis 11 in a manner enabling it to move freely forwards and backwards. At each end, the said backrest is connected by a link 12 to relatively short vertical arms on a torsionally-stiff rocker shaft 13 rotateably mounted in two and anti-friction bearings fixed to the loom frame between the backrest 10 and the head frames 15.

Secured to the said rocker shaft 13 is a forward projecting and approximately horizontally disposed control lever 16, such lever magnifying the forward and backward displacement of the sampling backrest 10. At a convenient radius from its fulcrum (i.e. from the said rocker shaft) control lever 16 is provided with an anti-friction roller 17 which bears continually on the upper end of the vertical piston-rod 18 of a single-acting compressed air cylinder 19, which is of the diaphragm type in the example, in order to minimise friction effects; but may be of the piston type. The upward stroke of the piston rod 18, and therefore, of the horizontal control lever 16, is limited by an upper stop 20 the position of which may be adjustable.

At another convenient radius, the control lever 16 is adapted to be raised by a vertical tappet or push-rod 21, the lower end of which is pivotally attached to the end portion of a lever K provided with a roller cam-follower 22 running in continuous contact with a cam 23. The cam 23 lifts the push-rod 21 during the narrow angle θ covering the beat-up period, but normally the push-rod 21 engages the control lever 16 so as to hold the sampling
The gear train through which the electric motor 25 rotates the beam B, or the measuring rolls in the case of creel-weighing, may conveniently be replaced by a worm-gear 28, the ratio of which is chosen to suit the running speed of the loom; one or two pairs of spur-gears 29 used as change-gears to cover the required range of pick density in the woven cloth, and an open worm-gear 30 of fixed ratio, the worm-wheel being secured to the beam B or to one of the measuring rolls.

Further, to achieve the stated object of minimizing friction effects, the piston-rod 21 of the diaphragm cylinder may be guided in a linear ball bearing 31. All linkage pins may be provided with self-aligning spherical bushings.

In a modification (FIG. 6), two forwardly projecting horizontal levers 16 may be used instead of one. The first may be controlled by the air cylinder 19 and the second by the cam 23 and vertical push-rod 21. Both such levers are, of course, securely attached to the rocker shaft 13, and either lever 16 may actuate the control switches 26, 27.

What I claim is:

1. In a textile loom of the kind wherein the warp yarns pass over a stationary backrest on their way from a supply to the shed-forming harness, in combination, automatic let-off mechanism operative to feed the warp yarns according to the demand of the weaving process, a sampling means comprising a minor portion, only, of the backrest, which is movable relatively to the backrest proper and means responsive to variations in the position of said minor portion or "sampling backrest" to determine the rate of yarn feed.

2. A mechanism as claimed in claim 1 further characterized in that the sampling backrest is positioned approximately centrally of the effective width of the loom.

3. The combination according to claim 1, further characterized in that the let-off mechanism comprises a reversible electric motor and switches operative, respectively, to determine whether the motor shall turn forwardly or reversely.

4. A mechanism as claimed in claim 1 further characterized in having means operative positively to locate the sampling backrest in alignment with the remainder of the backrest during loom "beating-up."

5. A mechanism as claimed in claim 1 further characterized in that said let-off mechanism includes a cam mounted on the loom crankshaft and rotatable therewith and a cam follower in contact with such cam, the said cam follower being operative, at each loom cycle, to actuate a linkage thus to move the sampling backrest into alignment with the remainder of such backrest and to maintain such sampling backrest in such position against the tension in the warp at "beating-up."

6. A mechanism as claimed in claim 5 wherein said cam follower is mounted on a pivoted lever, which controls the said linkage through a push-rod member.

7. Apparatus according to claim 3, further characterized in having a fluid pressure motor which is operative, in response to abnormally low yarn tension, positively to move the sampling backrest in a direction such as to reverse the let-off motor thereby to take up the slack in the yarn.

8. A mechanism as claimed in claim 1 characterized in that the sampling backrest is mounted on the loom structure for pivotal motion about a fixed axis.

9. Let-off mechanism according to claim 3, further characterized in having a linkage which is sensitive to the position of the sampling backrest and which is operative, in accordance with its position, selectively to actuate electrical switches in the circuit of the electrical let-off motor thereby alternatively to feed yarn or to wind back yarn.

10. A mechanism as claimed in claim 9 wherein the said linkage comprises a bellcrank lever mounted for pivotal motion about a fixed axis transversely thereof, and a link arm pivotally connected to the said bellcrank lever and to the sampling backrest, the said bellcrank lever being displaced during the beat-up and in alignment with the remainder of the backrest.

The displacement of the sampling backrest 10 is reproduced, in magnified form at the forward end of the control lever, the said end carrying a transverse bar R (FIG. 4) which is utilized to actuate control switches 24 and 24' (FIGS. 3 and 4) to provide the control direction, starting and stopping of a let-off motor 25 (FIG. 2). The sampling backrest control lever 16 (and therefore of the sampling backrest 10) is limited by top and bottom stops. As already explained, the lever 16 is forced up against the top stop 20 by the air cylinder 19 when the yarn tension is unduly low, or is absent altogether. The bottom stop is defined by the upper end of the vertical push-rod 21 when the latter is supported on the minimum radius portion of the cam 23, the push-rod 21, in such circumstances, being in its lowest position. The horizontal control lever 16 rests on the push-rod 21 when the latter is in its lowest position, only then, as the air pressure is unduly low or is absent altogether, or the tension in the warp threads W is unduly high.

Assuming, by way of example, the total range of vertical movement of the forward end of the horizontal control lever 16 between its top and bottom stops to be one inch in depth, then the lever 16 is forced up so that the stop 16 to a position some ½ inch high for the beat-up. The position of final equilibrium when the cam is out of action and the motor has just stopped letting-off warp yarn, is about ⅛ inch up in the one inch movement. There are thus three zones of which the lowestmost is about ⅛ inch deep and is the zone in which let-off control switch 26 alone is closed. The intermediate or neutral zone is about ⅛ inch deep, and is the zone in which the let-off switch and a wind-back control switch 27 are both open. The top zone is about ⅛ inch deep and is the zone in which the wind-back control switch 27 alone is closed.

As normal weaving proceeds, the action of the cloth take-up device draws the warp forward so that the length of yarn extending between fell and beam is reduced. In consequence (after the beat-up), the sampling backrest 10 is displaced towards the front of the loom thereby, by way of the linkage provided, depressing the forward end of the horizontal control lever 16 sufficiently to move it down into the bottom zone to close the let-off control switch 26 and cause the motor 25 to start up and let-off warp. This promptly restores the horizontal control lever 16 to the neutral zone, whereupon the motor 25 ceases.

If, on the other hand, the warp yarn becomes slack, because of its excessive length extending between fell and beam, the control lever 16 is raised by the air cylinder into the top zone, and even into abutment with the top stop. In such event, the wind-back control switch 27 is closed with the result that the electric motor 25 is started in the reverse direction, so as to rotate the beam B backwards. As the warp yarn between fell and beam B tightens up, the control lever is returned to the neutral zone whereby the wind-back control switch 27 is opened, so stopping the motor 25.

It will be apparent that when the motor 25 is letting-off warp due to the control lever 16 being depressed into the bottom zone, such letting-off process will in any case be suspended during the narrow beat-up angle ⁴ where the cam 23 raises the push-rod 21 which in turn raises the control lever 16 into the neutral zone, so opening the let-off control switch 26. This is a valuable feature, as it is undesirable to let-off warp during the beat-up operation when the warp tension attained is usually appreciably higher than the tension existing during the remainder of the weaving cycle.

On the other hand, when the motor 25 is winding back slack warp onto the beam B, such process will not be interrupted for the beat-up angle ⁴ because the control lever 16 is then already above the neutral zone, and therefore beyond the reach of the push-rod 21.
ing selectively co-operatable with the said switches according to its position angularly of its pivot axis.

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JAMES KEE CHI, Primary Examiner

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