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Hosono et al.

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[54] **LET-OFF MOTION IN LOOM**

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[52] **U.S. Cl.** **139/110**

[51] **Int. Cl.** **D03d 49/06**

[58] **Field of Search** ..... 139/110, 109, 99, 139/115; 66/86 A

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[57] **ABSTRACT**

A warp let-off mechanism for a loom having a warp beam driven through a variable speed transmission and a backrest over which the warp runs, the backrest being movable in a direction for increasing and decreasing warp tension and being resiliently urged against warp tension in the tension increasing direction, the variable speed transmission having means for varying the speed thereof. The warp let-off mechanism is comprised of a first adjustment means comprising backrest coupling means coupled between the backrest and the means for varying the speed of the variable speed transmission and responsive to an increase or decrease in tension in the warp as the removal of the warp from the warp beam progresses for adjusting the position of the varying means to increase or decrease, respectively, the speed of the warp beam for reducing or increasing, respectively, the tension. A second adjustment means is coupled to the first adjustment means and is responsive to adjusting movement of the first adjusting means for adjusting the coupling between the coupling means and the varying means to return the backrest to its initial position while maintaining the varying means in its adjusted position.

6 Claims, 6 Drawing Figures

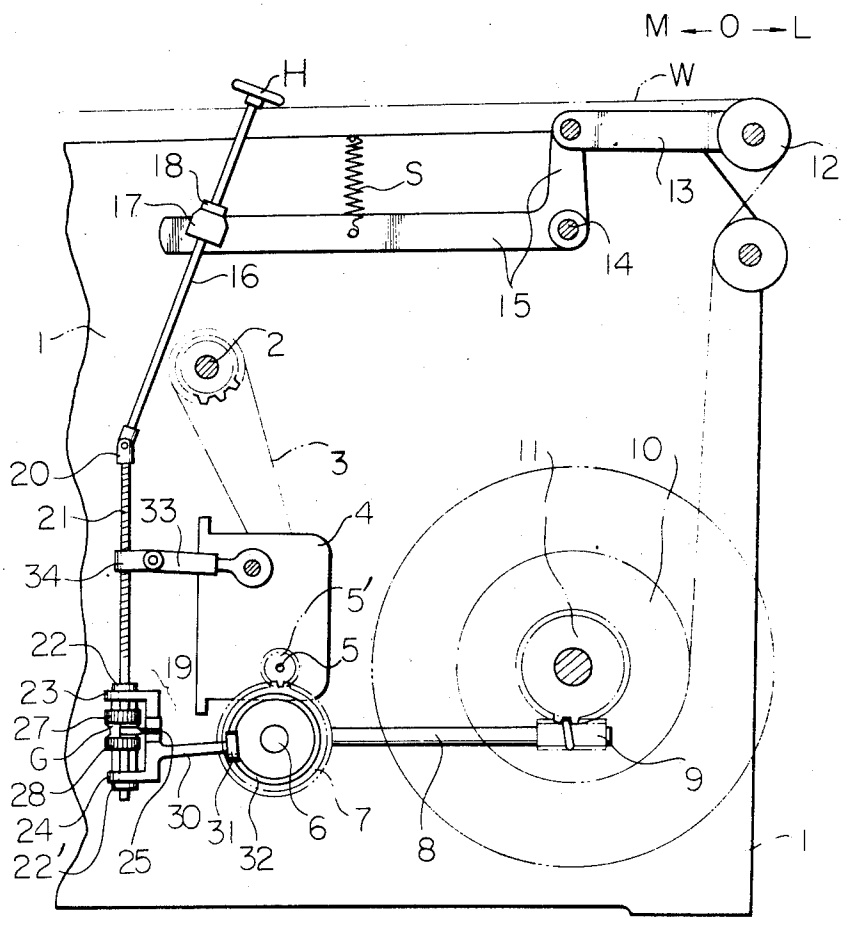
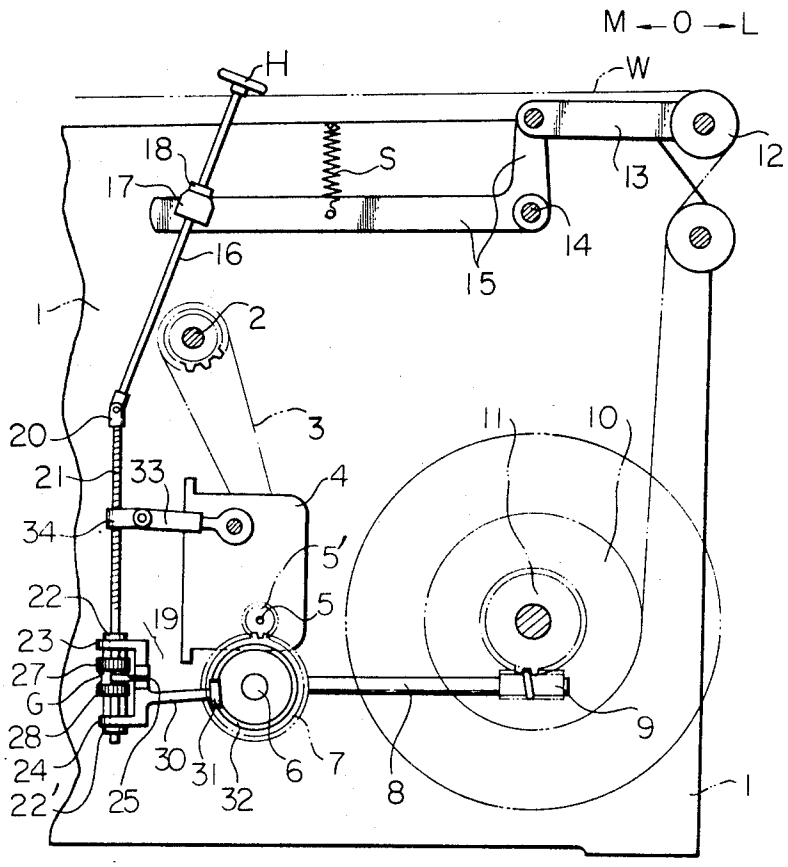


Fig. 1

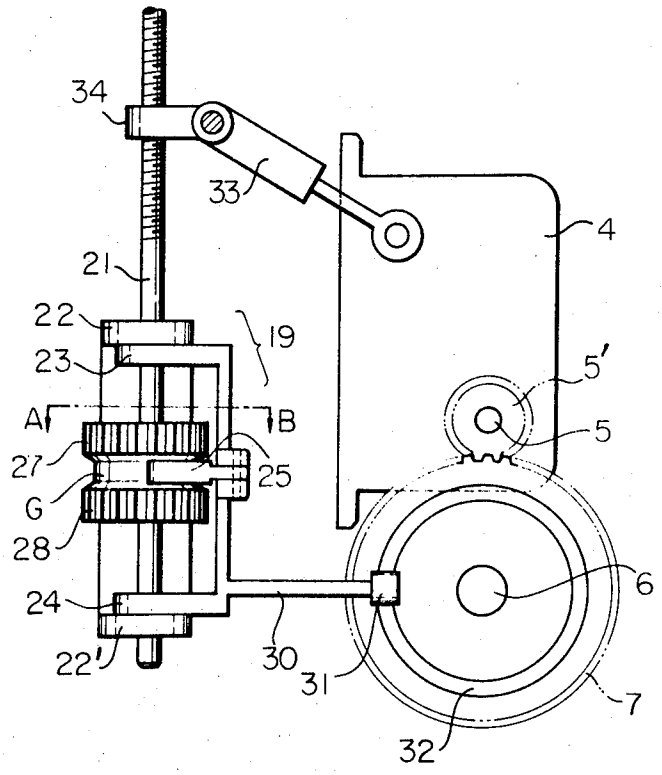


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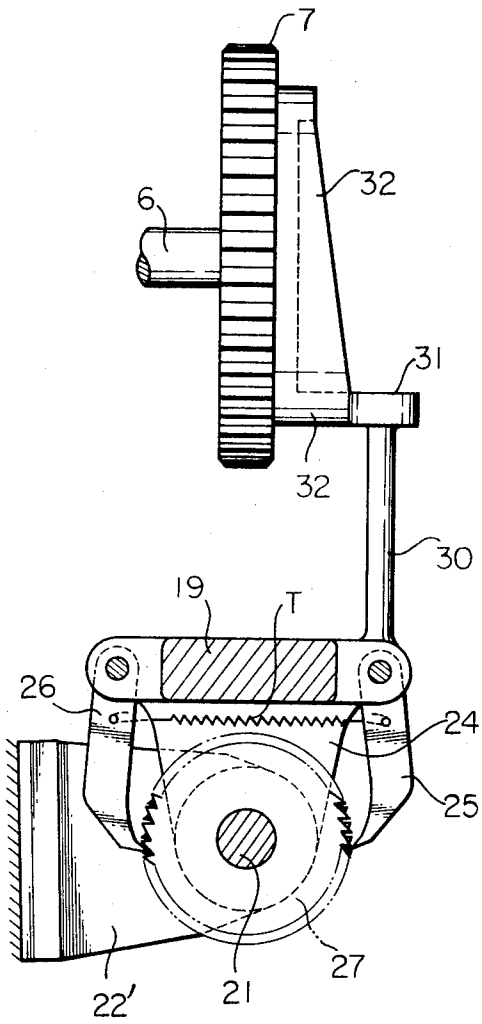
Fig. 2



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Fig. 3

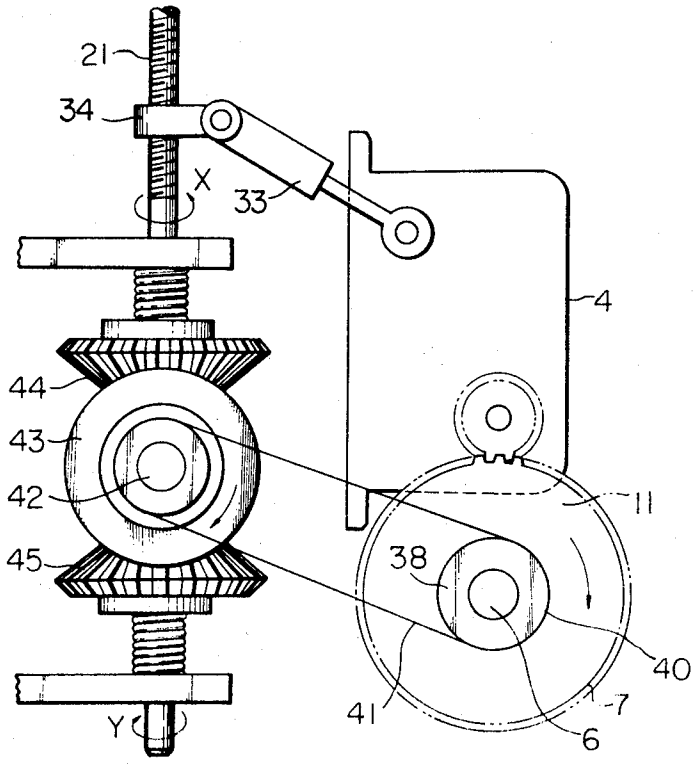


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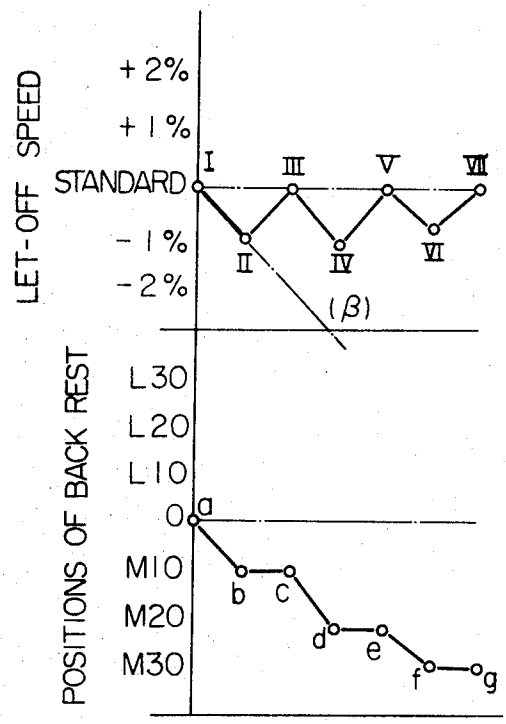
Fig. 4



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Fig. 5

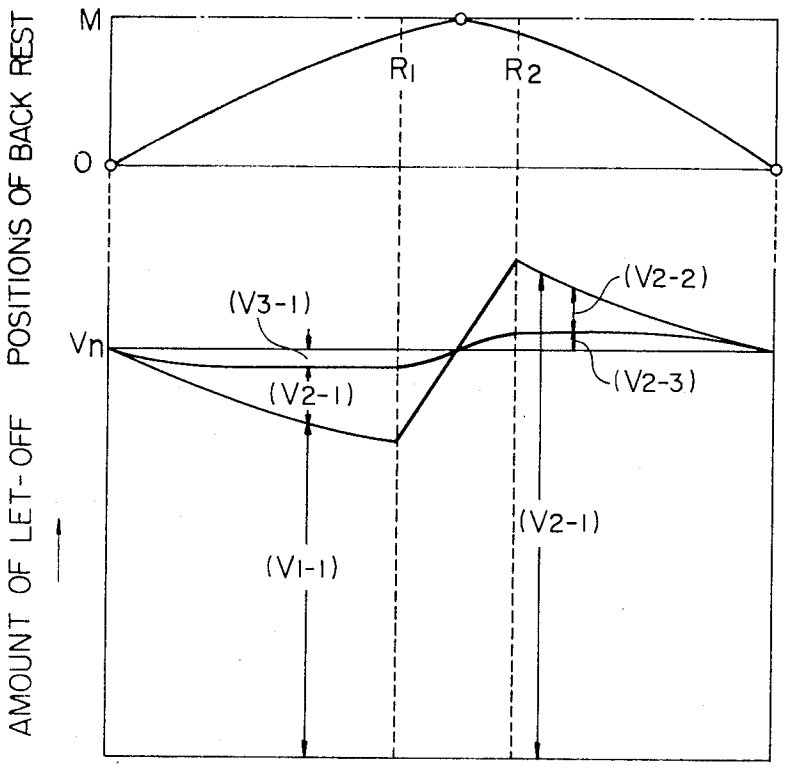
DIAGRAM CLARIFYING DISPLACEMENT OF BACK REST



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Fig. 6



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LET-OFF MOTION IN LOOM

The present invention relates to let-off device in a loom wherein a warp beam and a back rest are jointly used.

A back rest has so far been in use in a loom to regulate warp tension. The back rest is displaced according to warp tension variations to alleviate them. The normal position of the back rest is point O at which warp tension is regular. A spring or a counter weight is attached to the back rest and consequently the back rest is not stationary but movable. When warp tension increases, the back rest is assumed to be displaced in the direction O → M and when it decreases, it is assumed to be displaced in the direction O → M and when it decreases, it is assumed to be displaced in the direction O → L. The back rest can move back and forth on line M − L.

The causes of changes in warp tension are two-fold. A first cause is nonuniformity of warp package building or nonuniformity of the course of weaving. A second cause is that the winding diameter of a warp beam gradually becomes smaller. The first cause is mostly temporary; for instance, warp tension fluctuates temporarily owing to non-uniformity of the course of weaving. In the case of increase in warp tension, the back rest moves in the direction O → M to alleviate instantly an increase in warp tension. In contrast, when warp tension decreases, the back rest moves in the direction O L to alleviate instantly decreases in warp tension. With respect to the first cause, the back rest moves by itself in response to the increase or decrease of warp tension to regulate it. Hence when warp tension variations occur only due to the first cause, the back rest moves back and forth in the direction O → M or O → L as the case may be.

As a matter of fact the second cause inevitably combines with the first cause to cause a greater movement of the back rest.

As described before, the winding diameter of the warp package gradually decreases with the progress of weaving. If the rotation of a warp beam is constant (in fact, constant rotation of a warp beam is the prevailing practice), the consumption of warp yarn on the weaving side is constant, and the shortage of warp supply appears first as an increase of warp tension. This phenomenon is inevitable and continuous. When there are no counter-measures against warp tension variations, the back rest is continuously pushed in the direction O → M and let-off motion will come to a standstill. One countermeasure has been the displacement of the back rest used to control the rotation of the warp beam. The above-mentioned two types of causes combine to generate warp tension variations and the back rest is caused to respond to the generated warp tension variations. The displacement of the back rest is then transmitted to a variable speed transmission, which is connected with the shaft of the warp beam. Thus the number of rotations of the warp beam is controlled by the displacement of the back rest responsive to the tension variations of warp yarn via a connecting member or a variable speed transmission to keep warp tension normal.

In short, the back rest displaces itself in response to warp tension variations and serves as an alleviator of tension variations and with the use of the displacement, the back rest controls the number of rotations of the warp beam and keeps the warp tension at normal conditions.

Such a technological idea is well known in the art and various improvements or devices have so far been provided.

The present invention relates to such improvements in the art.

A conventional back rest is usually provided with a spring or a counter weight such that it is balanced with warp tension. It is found, however, that the counter weight is not satisfactory because it is difficult for the weight to follow vibrations due to the high pitch of warp tension due to high speed weaving.

Although a spring acts more favorably than a counter weight, it has still a drawback. One end of the spring is secured to the frame and the other to a lever. The lever extends in a direction opposite to the spring via a pivot, and on the other end of the lever is mounted the back rest. The spring applies to the back rest a bearing force to cause it to be well-balanced with the warp tension. As described before, as the diameter of the warp package decreases, the back rest moves from point O toward point M.

The displacement progressively increases, and the back rest will not return to point O. If the back rest has moved to point M the bearing force applied to the back rest by the spring at this time could be greater than that at point O. With the progressive displacement of the back rest from point O to point M, the bearing force gradually increases, resulting in the increase of warp tension. This drawback is always present as long as the back rest is provided with a spring. In order that the drawback may be minimal, it is essential that the length O → M be appropriately small and that when the back rest reaches point M, it can automatically return to point O.

The above-described improvement is also necessary for another reason. In the special case of a back rest which uses a spring as well as in general cases, the total length which the back rest moves from a full warp beam to an empty warp beam depends on the winding diameter of the warp package. When the winding diameter of the warp package is small, the length of displacement is comparatively small. However with the recent trend to a larger warp package, the length of displacement of the back rest becomes great, and it has to be returned to point O frequently. It is troublesome to manually return the back rest to the normal point frequently and automation is thus required.

After long research on this point, the inventors have come to the following conclusion.

When the back rest is displaced to point M on account of warp tension variations, the temporary loosening of warp tension will suffice. At that time the back rest will immediately return in the direction M − O, because the spring is working on the back rest. And if the warp tension acting on the back rest which has returned to point O can be kept as in the normal condition, the desired object ought to be attained.

For this reason, the inventors have carefully studied various means of loosening warp tension and finally found that it is very effective to alter the length of connecting means between the back rest and the transmission lever.

An inevitable drawback due to the fact that the length of the connecting means is constant in conventional back rests will be described below.

In order to compensate for a decrease in the diameter of the warp package, which occurs without fail due to the above-described second cause, it is necessary to continue to increase the warp beam rotating speed. In doing so, the transmission lever should be kept on increasing speed. That is, in keeping the amount of let off constant, the transmission lever always should be displaced in a direction of speed increase. Hence when the back rest is connected with the transmission lever with connecting means of constant length, the back rest has to be kept on being displaced in the O → M direction according to the progressive displacement of the transmission lever. The progressive displacement of the back rest causes an increase in warp tension by the action of a spring. As long as the length of means for connecting the back rest with the transmission lever is kept constant, weaving is compelled to proceed with progressively increasing warp tension responsive to the gradual decrease of the diameter of the warp beam. This is a very undesirable drawback.

In the present invention, the displacement of the back rest is transmitted to a speed transmission via a lever to control the rotation of the warp beam. Hereinafter this adjustment is referred to as a first adjustment and the subsequent adjustment as a second adjustment. The second adjustment occurs when the back rest comes to point M, the rotation of the warp beam is temporarily increased to lower warp tension. As a result the back rest automatically returns to its normal position O. By the second adjustment (later discussed in detail), the warp tension is restored to its normal condition.

At the end of the first adjustment, the back rest reaches point M; the lever, the shaft, etc., connected to the back rest and to each other move in each direction, and as these connecting means are nonretractable, they move as a whole in a series relationship. The sum of the lengths of each portion extending up to the joint (connecting point of the transmission lever), which is the end of the connecting means with the cardinal point at the back rest is constant. However in the second adjustment of the present invention, lengths of connecting means are supplemented in the neighborhood of the joint to increase the rotation of the transmission lever. In short, in the present invention, the tip of the connecting means advanced in the first adjustment is caused to advance farther to restore the position of the back rest and regain the normal warp tension.

As described above, it is most essential to return the back rest to its normal position, and the conventional methods have thus been improved.

The present invention comprises a yarn tension device to adjust the rotation of the warp beam by making use of the displacement of a back rest and means to restore the displaced back rest to its normal position, and it is the object of this invention to effectively combine these means and to maintain a constant warp tension regardless of the diameter of the warp package wound on the warp beam for producing good fabric.

One embodiment will be described below with reference to the accompanying drawings.

FIG. 1 is a front view illustrating one embodiment of the present invention.

FIG. 2 is an enlarged view of a control assembly shown in FIG. 1.

FIG. 3 is a cross sectional view on line A-B of FIG. 2.

FIG. 4 is a front view of a modified rotational device.

FIG. 5 is a graph showing the relation between the displacement of a speed back rest and let-off.

FIG. 6 is a graph showing variations in the rate of let-off in the displacement restoration of a back rest.

Referring to FIG. 1 a warp beam **10** and back rest **12** are mounted on loom frame **1.** Warp threads W wound on warp beam **10** are led to the loom by passing over the periphery of back rest **12.** It is well known that a back rest is used for governing tension control motion, that the rotation of a warp beam is controlled to govern warp tension and that the rotation of the warp beam is governed by utilizing the displacement of a back rest. In such tension device, backrest **12** is rotatably mounted on the end of rod **13.** Rod **13** is rotatably connected to the end of L-shaped lever **15** having shaft **14** as its fulcrum. Spring S is secured to L-shaped lever **15** halfway between its free end and its fulcrum **14.** The other end of spring S is secured to loom frame **1.** To the free end of lever **15** is attached rod **16** by means of bracket **17.** The up-and-down motions of rod **16** are prevented with collar **18** mounted to bracket **17.** To the lower end of rod **16** is attached threaded shaft **21** by means of universal joint **20.** The other end of threaded shaft **21** is held in supporting metal arms **22** and **22'** mounted on frame **1.** Joint **34** is threaded on threaded shaft **21** and retractably connected to variable speed transmission **4** by means of transmission lever **33** on transmission speed ratio adjusting shaft **33'.** The rod **13,** lever **15,** rod **16,** shaft **21** and joint **34** are first adjusting means. The variable speed transmission can be a conventional V-pulley disc type, cone pulley type or one having a similar function. The one shown in FIG. **1** is a type in which a transmission is disposed in a box and has an input and an output shaft, and by rotating the shaft **33',** the speed ratio is adjusted. Now, power is received at the input shaft (not shown) of variable speed transmission **4** through rotary chain **3,** etc. from rotary shaft **2** and is speed varied by variable speed transmission **4.** Warp beam **10** is rotated by means of output shaft **5,** gear **5'** on the shaft **5,** gear **7** on the other transmission shaft **6,** a set of bevel gears (not shown) on shaft **6** and the other shaft **8,** worm **9** on shaft **8,** and gear **11** on the shaft of warp beam **10.** The train of elements from gear **5'** to gear **11** is referred to as the rotational means for the warp beam.

With such mechanism, back rest **12** moves with changes in warp tension. That is, when tension is high, back rest **12** moves in the direction to reduce tension, the direction O → M, and stops moving at a point of displacement where the balance of force between it and spring S attached to L-shaped lever **15** connected to back rest **12** is attained. The oblique force of spring S bears always on back rest **12** and keeps in balance with the warp tension. Thus, as the position of the back rest changes between M-O-L, the force of the spring bearing on the back rest varies and subsequently warp tension varies too. As previously described, such is a drawback of the conventional control system.

In order that the above-mentioned function may be understood more clearly, an embodiment will be described below with reference to FIG. **5.** In FIG. **5** the time elapsed is plotted as the abscissa, and let-off speed as the upper ordinate. Let standard let-off speed be α. α is illustrated in plus and minus percentage above and below said standard line (α). As the lower ordinate there is plotted the position of the back rest. Above O,

the central position of the back rest, is given O → L and below O is given O → M. At the time of start-up, let-off speed is on I, that is, standard line α, back rest **12** on a, that is, O. The let-off speed (β) of warp threads gradually falls and reaches II as time goes on. The back rest moves toward M and reaches b. By the displacement of $a \rightarrow b$, threaded shaft **21** is pushed downward, and let-off speed (β) of the warp beam increases by the rotational means of transmission **4**, etc., through joint **34** and transmission lever **33** to correspond to standard let-off speed (α). That is, speed (β) changes form (II) → (III), during which time the back rest occupies a position of displacement which does not change ($b \rightarrow c$). However, the let-off speed of warp threads which have returned to standard speed (α) continues to decrease afterwards [(III) → (IV)]. Again the backrest moves to decrease warp tension (c d), and thereafter the same as above, the yarn speed (β) is controlled to change IV → V while the backrest remains in position ($d - e$); again as yarn speed (β) changes V → VI and VI → VII, the back rest moves $e \rightarrow f$ and $f \rightarrow g$. As the back rest changes its position between O and M, the bearing force of the back rest on the warp varies at each position of displacement, because this bearing force originates from spring S. As described above, by the first control, yarn speed (β) is adjusted, but the bearing force on the warp producing warp tension varies.

When back rest **12** moves toward M with increase in warp tension, the free end of L-shaped lever **15** pivoted at shaft **14** rotates downwards and threaded shaft **21** moves down. Consequently joint **34** threaded on threaded shaft **21** moves down to cause shaft **33'** of transmission **4** to rotate through transmission lever **33.** The interior of the transmission is actuated by the rotation of shaft **33'** to accelerate the rotation of shaft **5.** When joint **34** moves upward, the transmission direction is reversed to decelerate shaft **5.** As described above, when the back rest is displaced, transmission lever **33** is caused to rotate directly correspondingly to the displacement of the back rest to decelerate or accelerate warp beam **10** for regulating the rate of let-off on the loom. At this time, the back rest is stationed at a point of displacement. Such means required for this function from rod **13,** lever **15,** rod **16,** threaded shaft **21,** and joint **34** to transmission lever **33** is referred to as the tension device. Any means may be used if the displacement of back rest **12** can be converted into that of transmission lever **33.** The mechanism of the transmission is also optional. Such is the summary of the first regulation.

In such a warp tension device back rest **12** cannot return to its original position. In the present invention the return of back rest **12** to its normal position can be accomplished by various second adjustment means. A specific device will be described below.

In FIGS. **1, 2** and **3,** the lower end of threaded shaft **21** runs through supporting metal arms **22** and **22',** and halfway between the arms, ratchet wheels **27** and **28** are secured to threaded shaft **21,** with a space G between them and with the direction of teeth of the ratchet wheels opposite to each other. The teeth of either said ratchet wheels can be actuated by an outside force to cause threaded shaft **21** to rotate. The outside force is applied by a U-shaped lever **19** comprising two legs **23** and **24** pivoted on shaft **21,** ratchets **25** and **26** pivotally attached to the middle point of a connecting member connecting said legs, arm **30** extending from the connecting member in a direction opposite to the direction said ratchets and legs extend and a cam ball **31** at the end of said arm **30.** Said lever **19** is rotatably mounted on threaded shaft **21** so that it can rotate with shaft **21** with the center at the shaft when the cam ball **17** is oscillated. As a means of oscillating cam ball **31** cam wheel **32** is provided in front of gear **7** and is attached to intermediate shaft **6** driving the warp beam. The cam wheel is circular and has an inclined annular cam surface thereon. When the annular cam surface rotates, cam ball **31** in contact with the wheel is subjected to oscillations back and forth while being guided by the cam surface. Thus cam ball **31** makes reciprocating, arcuate motions together with lever **19,** with the center at shaft **21.** This is, cam ball **31,** while sliding along the surface of cam wheel **32** makes reciprocating motions perpendicular to the surface of the cam wheel to permit lever **19** connected to said cam ball **31** to make reciprocating, arcuate motions with the center at screw shaft **21.** In such mechanism, if either of ratchets **25** and **26** engages either of ratchet wheels **27** and **28,** it causes the ratchet wheel to rotate in a predetermined rotational direction and accordingly shaft **21** rotates. As shown in FIG. **2,** when ratchets **25** and **26** are positioned in space G, the rotation of shaft **21** does not take place. When shaft **21** makes up-and-down motions, the ratchets begin engaging the ratchet wheels. For instance, when shaft **21** descends, ratchets **25** and **26** mesh with ratchet wheel **27,** and shaft **21** rotates in a predetermined direction.

When shaft **21** descends, the ratchets are engaged with ratchet wheel **28** and the shaft rotates in the opposite direction. When the ratchets mesh with the upper wheel **27** for rotating the shaft, the direction of rotation is such that joint **34** is threaded down the shaft and transmission lever **33** is pushed down, and when the lever wheel **28** meshes with the ratchets, the direction of rotation is such that transmission lever **33** is pushed up in the reverse manner. The above is the second adjustment, the most essential part, in the present invention.

Now the relationships between the first and second adjustments will be described below.

At the start of the weaving operations, the back rest is positioned at O and ratchets **25** and **26** are arranged to be located in space G. Handle H is manually manipulated so that the warp beam is in good order, and joint **34** is moved to a predetermined position for starting the loom.

During the weaving, when warp tension is too high, back rest **12** is caused to move in the direction to reduce tension (O → M). The free end of L-shaped lever **15** is rotated in the counterclockwise direction to push down rod **16** and threaded shaft **21** connected thereto. As joint **34** is threaded on threaded shaft **21,** it descends together with the shaft and causes shaft **33'** of variable speed transmission **4** to rotate. This action permits the warp beam to accelerate via rotary means of the warp beam. Accordingly warp tension is reduced to a desirable tension.

Nevertheless back rest **12** remains displaced. Such is the first adjustment, but at this time the second adjustment has already begun. As seen in FIGS. **1** and **2,** during the first adjustment threaded shaft **21** descends. Prior to this time lever **19** and ratchets **25** and **26** are positioned as shown in the Figs. But ratchet wheels **27**

and 28 secured to shaft 21 descend together with shaft 21 to make ratchets 25 and 26 engage ratchet wheel 27. Thus the second adjustment begins to follow the first adjustment slowly. That is, the ratchets of lever 19 make shaft 21 slowly rotate through the ratchet wheel 27 to gradually push down joint 34.

Threaded shaft 21 has moved downward in the first adjustment and accelerated the rotation of the warp beam. Successively to this control, the second adjustment makes joint 34 descend and the warp beam further accelerates. Warp tension thus becomes lower. Taking advantage of this low tension, back rest 21 starts moving from M to O, by means of the force of spring S, secured to L-shaped lever 15. The spring returns back rest 12 to position O, rotates clockwise the free end of L-shaped lever 15 to pull up rod 16 and shaft 21. Ratchet wheel 27 is thereby pulled up and released from between the ratchets, and ratchets 25 and 26 are returned to space G. As described above, when shaft 21 is pulled up and returned to the position of the first adjustment, this results in the removal of the second adjustment; consequently, warp beam 10 and warp tension return to the state of the beginning of the first adjustment, and back rest 12 occupies O. This displacement is most desirable. Such is an example of too high warp tension, and in the case of too low warp tension, the second adjustment follows the first adjustment and after the restoration of back rest 12 the second adjustment is removed with the exception that the movements of levers, etc. is opposite to those in the case of high warp tension.

Said second adjustment is the essential part of this invention, always following the first adjustment and the main object is to permit back rest 12 displaced in the first adjustment to return to position O. The means required for this object, that is, cam ball 31, cam 32, arm 30, lever 19, ratchets 25, 26, ratchet wheels 27 and 28, threaded shaft 21, transmission lever 33, etc. (shown in the drawings) are the rotary assembly for back rest restoration.

Another modified embodiment is shown in FIG. 4. Bevel gear 43 is rotated by pulley 38 attached to shaft 6 of gear 11 and belt 41. In a vertical plane meeting at right angles with shaft 42 of said bevel gear 43 is threaded shaft 21 to which upper bevel gear 44 and lower bevel gear 45 are secured at appropriate intervals. When threaded shaft 21 descends, upper bevel gear 44 meshes with bevel gear 43 positioned in the center to cause shaft 21 to rotate in the direction of arrow X, and when shaft 21 ascends, lower gear 45 meshes with bevel gear 43 in the center to cause shaft 21 to rotate in the opposite direction, that is, the direction of arrow Y. Together with the rotation of shaft 21, as described above, joint 34 threaded on threaded shaft 21 moves up and down to control the warp beam.

Restoration means for the back rest is not limited to the embodiments shown in the drawings, and any means whereby the back rest which has been displaced so that the supply and demand of warp threads are balanced is returned to its original position while warp tension is being maintained as desired and whereby the threaded shaft is caused to rotate in the restoration direction only when the back rest is its normal position, may be employed.

In the present invention, the position of joint 34 threaded on shaft 21 moves at every adjustment and the range of its movement can experimentally be determined beforehand. Hence, the length corresponding to the range may be given to threaded shaft 21. Further the movement of joint 34 is possible by the manual rotation of shaft 21. Such is an explanation of one working example. Other working examples follow:

EXAMPLE 1

In FIG. 1, after the first adjustment has occurred by the displacement of back rest 12, threaded shaft 21 is caused to rotate in a given direction to generate the second adjustment. This shaft may be rotated by a different power source. In order that the displacement may be transmitted to said power source, an electric switch or a photoelectric cell in an electric circuit is set in the back rest 12 system to carry out the on-off control for the circuit, by making use of the displacement of back rest 12.

EXAMPLE 2

When an electric switch or a photoelectric cell is set in back rest system in Example 1, a magnet or an electric rotator may be set in the circuit to promote the speed control of transmission 4 additionally. In this case -shaped lever 19 is not in use. Hence a non-screwed bar in place of screw shaft 21 may be used.

EXAMPLE 3

A hydraulic cylinder is attached to any of back rest 12, rod 13 connected thereto, and lever 15 to introduce pressure liquid generated in the hydraulic cylinder by making use of the displacement of said back rest 12 system into the main part of transmission 4 through a conduit for adjusting the speed of said transmission 4.

In order that the function of the present invention may be more fully understood, referring to the graph in FIG. 6, the relation between the first and second adjustments for the amount of let-off will be explained below. The upper diagram shows the displacement of the back rest and the lower diagram said displacement vs. the amount of let-off. The time of progress is plotted as the abscissa and the displacement of the back rest (upper diagram) and the amount of warp let-off (lower diagram) as ordinates.

When the back rest is displaced in O → M, then M → O, the first adjustment takes place mainly between O and M and the amount of let-off is maintained at a standard amount (Vn), whereas mainly the second adjustment takes place and the standard amount of let-off (Vn) is kept between M and O. In short, the warp is maintained at the standard amount of let-off (Vn) through the whole course. The state in O → M is first described.

When the back rest is positioned at point O, the diameter of warp package wound on the warp beam is in an appropriate size, and so the amount of let-off (V_{1-1}) unwound from the constantly rotating warp beam agrees with standard amount of let-off (Vn). However as time goes on, warp threads are consumed, and the diameter of the warp package decreases. Therefore the amount of let-off (V_{1-1}) unwound from the constantly rotating warp beam decreases as shown in the diagram and becomes insufficient compared to the standard amount.

In order that this shortage may be made up for, amount of let-off (V_{2-1}) caused by the acceleration of the warp beam due to the displacement of the back rest and the transmission lever and amount of let-off (V_{3-1})

caused by decrease of the length of the warp from the warp beam to the cloth fell due to the displacement of the back rest are added to said amount (V_{1-1}). As a result, in this stage the amount of let-off is maintained at the standard amount of let-off (Vn). Then when the back rest reaches R_1, the second adjustment starts. For instance, in examples **1** and **2**, the additional displacement of the transmission lever begins on account of the rotation of the threaded shaft. And in example **3**, the electric circuit turns on and magnet, etc. start additional adjustment. The above-mentioned adjustment is continued until the back rest is displaced to R_2 the same phrase as R_1. The amount of let-off (V_{1-1}) turns into (V_{1-2}), exceeding the standard amount (Vn), and excessive warp is let-off to loosen warp tension. Through the looseness of the warp tension, the back rest is displaced in a direction of (O → M), reaching R_2 and by stopping the rotation of the screw shaft and by the electric circuit being off, the warp beam is slightly adjusted in the deceleration direction. Even at this point, the warp beam is rotating in overfeed. And even if it rotates at equal speeds after-wards, the amount of let-off (V_{1-2}) decreases as shown in the diagram on account of decrease in the diameter of the warp package and the surplus over standard amount of let-off (Vn) continues to decrease as time goes on. Negative amount of let-off (V_{2-2}) generated by the deceleration of the warp beam due to the displacement of the back rest and the transmission lever and negative amount of let-off (V_{3-2}) generated by increase of the length of warp between the warp beam and the cloth fell due to the displacement of the back rest are deducted from the amount of let-off (V_{1-2}). As a result, even in this stage, the amount of let-off is maintained at the standard amount of let-off (Vn).

Further, in the present invention, the back rest is not only restored to the normal position under the standard amount of let-off but also the velocity of restoration is appropriately slow and freely adjustable. That is, if the oscillation length and number of rotations of ratchets **25** and **26**, the number of teeth of ratchet wheels **27** and **28**, etc. are properly adjusted, the restoration velocity of the back rest M → O or L → O can be such that the degradation of appearance and quality of fabric due to warp tension variations at the time of restoration is a minimum. As described above, since when the back rest is displaced, it is accurately restored to the normal position at a predetermined slow speed while the actual warp tension is being maintained as near the standard conditions as possible, warp tension can be maintained in the normal state throughout the weaving operation.

We claim:

1. In a loom having a warp beam driven through a variable speed transmission and a backrest over which the warp runs, the backrest being movable in a direction for increasing and decreasing warp tension and being resiliently urged against warp tension in the tension increasing direction, the variable speed transmission having means for varying the speed thereof, a warp let-off mechanism comprised of a first adjustment means comprising backrest coupling means coupled between said backrest and said means for varying the speed of said variable speed transmission and responsive to an increase or decrease in tension in the warp as the removal of the warp from the warp beam progresses for adjusting the position of said varying means to increase or decrease, respectively, the speed of the warp beam for reducing or increasing, respectively, the tension, and a second adjustment means coupled to said first adjustment means and responsive to adjusting movement of said first adjusting means for adjusting the coupling between said coupling means and said varying means to return the backrest to its initial position while maintaining said varying means in its adjusted position.

2. In a loom having a warp beam driven through a variable speed transmission and a backrest over which the warp runs, the backrest being movable in a direction for increasing and decreasing the warp tension and being resiliently urged against warp tension in the tension increasing direction, the variable speed transmission having a lever for varying the speed thereof, a warp let-off mechanism comprised of a first adjustment means comprising a lever and rod means and a threaded shaft coupled to the backrest and a joint on said threaded shaft connected to said variable speed transmission lever, the variable speed transmission lever being moved to an adjusted position to increase or decrease the speed of the warp beam for reducing or increasing, respectfully, the warp tension in response to an increase or decrease, respectively, of warp tension as the removal of the warp from the warp beam progresses, and a second adjustment means comprising a shaft rotating means positioned adjacent said threaded shaft and coupled to said threaded shaft only when said threaded shaft moves in response to changed warp tension, and driving means coupled to said shaft rotating means for driving said shaft rotating means, said shaft rotating means rotating said threaded shaft in a direction to move said shaft relative to said joint to return the backrest to its initial position while maintaining said joint and said transmission lever at the adjusted position.

3. A warp let-off mechanism as claimed in claim **2** in which said second adjustment means comprises ratchet wheel means on said threaded shaft and ratchet means positioned adjacent said shaft and spaced from said ratchet wheel means when the backrest is in the normal position and engaged with said ratchet wheel means when said backrest is displaced from the normal position due to a change in the warp tension.

4. A warp let-off mechanism as claimed in claim **3** in which said driving means coupled to said shaft rotating means comprises a lever means on which said ratchet means is mounted, and cam means driven by said transmission engaged with said lever means for oscillating said lever means.

5. A warp let-off mechanism as claimed in claim **2** in which said second adjustment means comprises bevel gear means on said threaded shaft and further bevel gear means positioned adjacent said shaft and spaced from said firstmentioned bevel gear means when the backrest is in the normal position and engaged with said firstmentioned bevel gear means when said backrest is displaced from the normal position due to a change in the warp tension.

6. A warp let-off mechanism as claimed in claim **5** in which said driving means coupled to said shaft rotating means comprises a drive shaft coupled to said further bevel gear and driven by said transmission.

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