The well-known needle loom stop motion devices are only suitable for weaving looms on which single one-ply fabrics are woven. Devices of this kind cannot be used for the manufacture of multiple-ply fabrics (particularly of fabrics with a great many plies) as it is not possible to make the weft-feeler needles to pass surely the single warp-thread groups (plies) at each movement of the lay; as is necessary for the sensing of the inserted weft thread. Further, when weaving multiple-ply fabrics, the feeler needles would be submitted to such a heavy strain that they would not have a long span of life.

The present invention which concerns an instantaneous-ly acting loom stop motion control arrangement for weaving looms, is particularly suitable for the manufacture of multiple-ply fabrics, especially of fabrics with a great many plies.

A feature of the invention is that a terminal switch, which is actuated by a cam on the crank shaft, prepares at each forward movement of the lay, the circuit of the stop motion. If a correct insertion of the weft thread is made, the prepared circuit of the loom becomes ineffective by the opening of a switch controlled by the weft thread to be inserted. This terminal switch is operated by the inserted weft thread by means of a feeler needle. The instantaneous stopping of the loom only takes place when the weft thread breaks or runs out and when in this case also the terminal switch on the entrance side of the warp shed is closed or not operated at all.

For this purpose, the weft stop motion is fitted with feeler needles, placed horizontally and parallel with the selvages, movable in the weft direction for operating the terminal switches. To increase the sensibility of these terminal switches, they are fitted with an additional spring adjustable in its power, and countereacting a standard spring provided in the terminal switches. In an example, the feeler needles of the loom stop motion are operable between a sensing position and a position in which the needles are withdrawn from the weft loop. The latter is done, when the lay cap engages control rollers, by the difference between the sectional view taken counteracting adjustable springs, or by means of a sliding member mounted on the lay cap and operative during the forward movement of the lay. In this manner, the feeler means is withdrawn from the path of movement of the lay or of the reed, respectively. At the succeeding backward movement of the lay, the before mentioned weft stop motion returns to the sensing position.

A further feature of the invention is that the moment for withdrawing the weft-stopping motion with its feeler needles from the path of the lay or the reed, and the moment for bringing it back to the feeling position, can be precisely adjusted i.e. by the variation of the effective length of a rod, by the variation of the position of one or more springs, or by a rod of suitable shape operated by a sliding guide on the lay cap.

Finally provisions are made to adjust exactly in every direction, the feeler needles of the weft stop motion or feeling needles respectively, and to adjust the position of rest of the weft stop motion or the feeler needles respectively.

The invention will be best understood with reference to the accompanying drawing in which:

FIG. 1 is a cross-sectional view taken on line 1—1 in FIG. 7 and illustrating a weft sensing device according to one embodiment of the invention in its inactive position;

FIG. 2 is a cross section corresponding to FIG. 1 and illustrating the device in a sensing position;

FIG. 3 is a side view, partially in cross section and illustrating another embodiment of the weft sensing device in an inactive position;

FIG. 4 is a side view, partially in section, illustrating the device of FIG. 3 in a sensing position;

FIG. 5 is a side view, partially in cross section, illustrating a further embodiment of the weft sensing device in an inactive position;

FIG. 6 is a side view, partially in cross section, illustrating the embodiment of FIG. 5 in a sensing position;

FIG. 7 is a fragmentary elevation, partially in section taken on line 7—7 in FIG. 1 illustrating the embodiment of FIG. 1 as viewed in the direction of the arrow A in FIG. 1;

FIG. 8 is a fragmentary elevation illustrating the embodiment of FIG. 3 viewed in the direction of the arrow B in FIG. 3;

FIG. 9 is a fragmentary elevation illustrating the embodiment of FIG. 5 as viewed in the direction of the arrow C in FIG. 5; and

FIG. 10 is a circuit diagram showing the electric circuit of the weft sensing device according to the invention.

In the FIGS. 1—6, 1 denotes the warp threads coming from the warp beam or from a creel (not shown), and 2 the woven fabric, held under tension by the temples 3. The lay or lay 4, which at each cycle moves forward and backward, has a guide way 5 over which at each cycle a shuttle 99 (FIG. 10) is picked through the shed 6, formed by the warp threads 1—see FIGS. 2, 4, and 6—whereupon a weft thread inserted by the shuttle, is beaten up at the forward movement of the lay 4 by means of the reed 7 against the fell of the cloth 2—see FIGS. 1, 3, and 5. The reed 7 is fixed at its bottom part in the lay 4; at its top part, it is held by the lay cap 8. Referring to the first embodiment, shown in FIGS. 1, 2 and 7, on the breast beam 9 with the breastbeam plate 10 is fitted a prismatic guide 11 on which slides a slide member 12 which is adjustable in its direction and which can be locked by means of the screws 13—see FIG. 7. The slide member 12—see FIGS. 1 and 2—has a guide way slidably supporting another slide member 14 movable in warp direction. Slide member 12 carries the pressure spring 17 whose spring power is adjustable by means of adjusting screw 15 with counter nut 16. The other end of the pressure spring 17 is carried by abutment 18, on the slide member 14. Slide member 12 has an arm 19 which serves to carry temple 3, by means of the vertical arm 20.

Further, a bracket 22 of a switch box 23 is pivotally mounted on slide member 14 on a pivot 21, and there is also a pressure spring 24 biasing switch box 23 to turn about pivot 21 in a direction toward the reed. In the front wall and in the back wall of the switch box 23 are ball bearings 25 for a horizontal shaft 26 which supports the feeler needle 27 and extends parallel to the selvages and warps. Within the switch box 23, the shaft 26 carries the lever 28 acting on the terminal switch 29, and a further lever 30 on whose extremity the draw spring or tension spring 31 acts, see FIG. 7. Spring 31 counteracts the spring force of the standard contact spring within the terminal switch 29. The force of spring 31 can be adjusted by an adjusting screw 32 locked by two nuts 33. Fitted to the top of the switch box 23, by means of the two screws 34, is the control rod 35 which, at its front end, carries a control roller 36.

The embodiment illustrated FIGS. 1, 2 and 7 is operated as follows:

When the lay moves to the left as viewed in FIG. 1, control roller 36 remains first in contact with the top
beam 8 of the slay 4 due to the action of spring 17, with member 14 and housing 23 sliding along guide way 12. During further movement of slay 4, roller means 36 is still in contact with member 8, but now under the action of spring 24 so that the switch housing 23 turns about pivot 14 as the point of the pivot screw means 27 assumes its sensing position, as shown in FIG. 2. During the remaining portion of the rearward stroke of the slay, member 8 releases roller means 36, so that all parts assume a sensing position.

During the following forward stroke of the slay, member 8 engages roller means 36 so that first housing 23 turns about shaft 21 compressing spring 24 and pulling feeler needle means 27 out of the weft thread loop, whereupon member 14 is urged rearward to move along slide 12 so that the feeler needle means, and all other parts of the device, are moved out of the region in which the beating of the weft thread by the reed 7 into the felt takes place.

The exact moment in which the feeler needle means 27 is pulled out of the weft thread loop, can be adjusted by displacing shifting rod member 35, which is accomplished by screws 34 passing through slots in the shifting member 35. The effective force of compression spring 17 can be adjusted by the adjusting screw 15. Control switch 29, which is controlled by the feeler needle means, and opens when the feeler needle means 27 is turned by a weft loop together with shaft 26 and lever 30, can be very accurately adjusted by the adjusting screw 32 by which the tension of a tension spring 31 is regulated, the tension spring 31 counteracting the spring of control switch 29. The adjustable force of spring 31 is directed to the left as viewed in FIG. 7 and is smaller than the force of the contact spring which acts to the right. Consequently, the resulting adjusted force which has to be overcome by the feeler needle, is smaller than the force of the contact spring.

The parts 11-36 are provided on the loom at each side thereof and for each selvedge. Referring to the embodiment shown in FIGS. 3, 4 and 8, on the breast beam 37 is fixed, by means of the screws 38, a bracket 39 which carries a flat rod 40, adjustable fixed by bolts 42 passing through slots 41. At the points 43 and 44, the flat rod 40 carries the pivoted links 47 and 48 to a flat rod 49, at whose rear end is fitted, by means of the pivot screw 50, the needle holder 51 which carries the feeler needle 52, allowing its angular adjustment.

The flat rod 40 carries the adjustable stop 53, and the link 45 carries the lever arm 54. At point 55 of the lever arm 54, a draw spring 56 whose opposite end is secured by the flat rod 40. The necessary tensile force of the draw spring 56 can be adjusted by attaching the same to different points 57 of the flat rod 40. On the other side, at the point 55 of the lever arm 54 the power of the draw spring 62 acts through an eye 58, fitted to the rod 60 by means of the nut 59. One end of spring 62 abuts a double nut 61; the other end of the draw spring 62 abuts a slide 63 sliding on the rod 60. The slide 63 is pivoted in a fork 64 which is fixed to the lay cap 8 by means of the U-shaped strap 65.

The terminal switch 66—see FIG. 8—is fixed to the flat rod 49 which is also pivoted the needle holder 51 with the feeler needle 52. The top end of the needle holder 51 and the terminal switch 66 are connected by a small draw spring 67 whose force can be adjusted by means of the screw 68 and which acts upon the terminal switch 66. The needle holder can be exactly adjusted by means of a further screw 69. Two counter nuts 70 and 71 serve to lock the screws 68 and 69.

The parts 56-71 are also twice on the loom, placed at the selvedges on opposite sides of the loom.

The embodiment shown in FIGS. 3, 4 and 8 operates in the following manner:

During the rearward movement of the slay 4 to the left as viewed in FIG. 3, the slide means 63 will slide along shifting rod 60, and during further movement of slay 4 in this direction, spring 62 is compressed. When the force of the compression spring 62 acting at the point 55 exceeds the power of the tension spring 56, which acts on point 55 in the opposite direction, pivots 47 and 48 on rod 49 are moved in circular paths due to the parallel motion of links 45 and 46 about pivots 43 and 44 on rod 49. Since the feeler needle means is secured to rod 49 by the holder 51, it moves along a circular path to the sensing position shown in FIG. 4.

During the forwardmost stroke of the slay 4, these operations take place in the reverse sequence. The nut means 61 permit an exact adjustment of the moment in which the feeler needle means 51, 52 moves out of the path of movement of the reed 7 or slay 4. In this manner, the spring forces of springs 56 and 62 can be adjusted so that the desired cooperation of the springs is obtained.

The position of rod 40 can be adjusted by displacing the same along bolts 42 which is possible due to slots 41. The position of the needle holder 51 is adjusted by swinging about pivot 50. In this manner, the feeler needle 52 can be placed in a desired position relative to warp and weft threads.

Referring to the third embodiment shown in FIGS. 5, 6 and 9, on the breast beam 72 is fitted, by means of the bolts 73, the bracket 74 which carries the temple arm 81, held by screw 75. The temple arm 81 carries the two temples 40, and its arm 81a has a bore in which bolt 84 is turnable.

The bolt has at one end the collar 84a which carries the bent control rod 85. The axial position of the bolts 84 in the hole of the downwards extending arm 81a of the temple arm 81 is fixed by the ring 86. The free end of the bent control rod 85, swivelling with bolt 84, is guided in slide 88, which is turnable in the fork 89. The fork 89 is fitted to the lay cap 8 by means of the strap 90. The bent control rod 8 carries a connecting piece 91 whose position can be adjusted by means of the two adjusting screws 92 with locking nuts 93. The connecting piece 91 further carries the movable bearing rod 94 (see also FIG. 9) whose position can be fixed by means of the adjusting screw 95 and counter nut 96.

To the bent end 94a of the bearing rod 94 are fitted the terminal switch 66, the needle holder 51 with feeler needle 52 and the parts 67-71, designed and arranged as shown in FIG. 8.

The weft-control motion parts 51, 52, 66-71, and 74-96 shown in FIGS. 5 and 6, are arranged twice on the loom, at both the selvedges.

The embodiment of FIGS. 5, 6 and 9 is operated as follows. During the forward movement of the slay 4, the slide 88 is displaced along the shifting rod by the motion of slay 4, 8. As best seen in FIG. 5, shifting rod 85 turns clockwise about pivot bolt 84 during displacement of slide 88 of shifting rod 85 whereby the feeler needle means 51 and 52 connected with shifting rod 85 by parts 91 to 96, are operated. First feeler needle means 52 is pulled out of the weft thread loop, and then the entire device is moved out of the path of oscillation of slay 4 with reed 7.

By suitably shaping shifting rod 85, the exact moment in which the feeler needle means is pulled out of the loop of the weft thread can be determined. The particular shape of the shifting rod 85, will also influence the speed of the movement of the feeler needle means between the sensing position shown in FIG. 6 and the retracted position shown in FIG. 5.

During the rearward movement of the slay 4, the same operations take place in reversed sequence, until the feeler needle means 51 and 52 are again in the sensing position. The exact sensing position of the feeler needles 52 can be adjusted by displacing the same in the holder 51. Further adjustment is possible by operation of the adjusting screw 92 by which the position of the member 91 on shift-
The electric circuit of all three embodiments shown in the FIGS. 1–9, can be seen on the wiring diagram of FIG. 10 which shows the electric circuit of the apparatus. A cam 102 rotates in synchronism with the loom operations, and is adjusted in such a manner that a circuit-preparing switch 101 is closed by cam 102 during the passage of the shuttle 99 with a weft thread 100 through a warp shed. Control switches, for example, the control switches 29, 29' of the embodiment of FIG. 1, or the control switches 66, 66' of the embodiment of FIG. 3 are located on opposite sides of the warp threads in the region of the warp shed. The control switches are normally closed, but when a weft is inserted, it loops about the feeder needle means 27, 27', or 52, 52' and turns the feeder needle means to an actuating position in which the respective control switch 29 or 29' is open. Control switches 29, 29' are connected in series, and also connected in series with the cam-operated switch 101 and with the electric operating means 106. Consequently, electromagnetic operating means 106 will only be energized when all three switches are closed, and in this event, electromagnetic means 105 will operate a weft stop motion by which the operation is instantaneously stopped. When a weft is properly picked, the electromagnetic means 105 will be without current, since the weft thread 100, looped about feeder needle means 27', for instance, will open switch 29' and interrupt the circuit. When the shuttle 99 arrives at the other side of it, the feeder needle means 27' is moved to a retracted position, and turns to its normal position in which switch 29' is closed. However, at this moment, switch 101 has been interrupted by operation of cam 102. The same operation takes place when the weft thread is looped about feeder needle means 27 on the under side of the warps. As explained above, while the shuttle does not cross the warp shed, and at the time while the weft thread 100 is not yet pulled out of the shuttle 99, circuit-preparing switch 101 is permitted to open by cam 102.

The manually operated switch 104 is always closed during operation of the loom, and is opened only when the apparatus does not operate.

When a weft breaks, or if the supply of the weft thread is exhausted, no weft thread can be looped about a feeder needle means 27, 27', and consequently all switches are closed, and the electromagnetic means 105 is energized, and the loom is stopped.

The devices herein described and illustrated by the enclosed figures are only examples of preferred embodiments of the present invention. As a matter of fact, the described parts and arrangements can be varied without departing from the invention. For instance, it will be possible to actuate weft-control devices as shown in the FIGS. 3–6 and 8 and 9, by means of control means arranged below the lay 4; the loom could be stopped f.i. by means of a three phase alternator in which case the electromagnet 105 shown in FIG. 10, could be considered as relay coil of a three-phase relay current.

1. Weft stop motion control apparatus for a loom having a reciprocating sley, comprising, in combination, actuating means moving in synchronism with the sley; a circuit-preparing switch operated by said actuating means to assume an operative position during the passage of a shuttle through a warp shed; control switch means including a spring and having an operative position; said control switch means being connected with said circuit-preparing switch; electric operating means operable for instantaneously actuating a loom stop motion and being connected with said circuit-preparing switch and said control switch means to be actuated when said circuit-preparing switch and said control switch means assume the operative positions thereof; feeder means movable between a sensing position close to the seldge warp threads and a retracted position, and also movable in said sensing position in the direction of a normal position; and an actuating position, and being connected to said control switch means to move the same out of said operative position when moving to said actuated position; adjustable spring means acting on feeder means for varying and adjusting the force required by said feeder means to move said control switch means out of said actuated position; and shifting means connected to said feeder means and being operable in timed relation with said sley and actuating means to hold said feeder means in said sensing position only during the passage of the shuttle with a weft thread through a warp shed so that the weft thread engages said feeder means in said sensing position and moves the same to said actuated position so that said electric operating means is not operated whereas said loom stop motion is actuated by said operating means if said feeder means is not engaged by a weft thread.

2. Weft stop motion control apparatus for a loom having a reciprocating sley, comprising, in combination, actuating means moving in synchronism with the sley; a circuit-preparing switch operated by said actuating means to assume an operative position during the passage of a shuttle through a warp shed; control switch means including a spring and having an operative position, said control switch means being connected with said circuit-preparing switch; electric operating means operable for instantaneously actuating a loom stop motion and being connected with said circuit-preparing switch and said control switch means to be actuated when said circuit-preparing switch and said control switch means assume the operative positions thereof; feeder means movable between a sensing position close to the seldge warp threads and a retracted position, and also movable in said sensing position in a weftwise direction between a normal position and an actuating position, and being connected to said control switch means to move the same out of said operative position when moving to said actuated position; and shifting means connected to said feeder means and being operable in timed relation with said sley and actuating means to hold said feeder means in said sensing position only during the passage of the shuttle with a weft thread through a warp shed so that the weft thread engages said feeder means in said sensing position and moves the same to said actuated position so that said electric operating means is not operated whereas said loom stop motion is actuated by said preyfeet means if said feeder means is not engaged by a weft thread, said shifting means including first and second counteracting springs, and means for adjusting said springs for timing the motion of said feeder means with the reciprocating motion of the sley.
a circuit-preparing switch operated by said actuating means to close only during the passage of a shuttle through a warp shed; control switch means connected in series with said circuit-preparing switch; electric operating means operable for instantaneously actuating a warpshed means being connected in series with said circuit-preparing switch and said control switch means to be actuated when said circuit-preparing switch and said control switch means are closed; feeler means movable between a sensing position close to the selvedge warp threads and a retracted position, and also movable in a weftwise direction between a normal position and an actuated position, and being connected to said control switch means to open the same when moving to said actuated position; adjustable spring means counteracting feeler means for variably reducing the force required by said feeler means to move said control switch means to said operative position; and shifting means connected to said feeler means and being operated by said slay to hold said feeler means in said sensing position only during the passage of the shuttle with a weft thread through a warp shed so that the weft thread engages said feeler means and moves the same to said actuated position so that said electric operating means is not operated, whereas said loom stop motion is actuated by said operating means if said feeler means is not engaged by a weft thread, said shifting means including first and second counteracting springs, and means for adjusting the position of said springs for timing the motion of said feeler means with the reciprocating motion of said slay.

4. Weft stop motion control apparatus for a loom having a reciprocating slay, comprising, in combination, actuating means moving in synchronism with the slay; a circuit-preparing switch operated by said actuating means to close only during the passage of a shuttle through a warp shed; control switch means including two control switches connected in series with said circuit-preparing switch and with each other; electric operating means for instantaneously actuating a weft stop motion when energized to stop the loom, and being connected in series with said circuit-preparing switch and with said control switches; two feeler needle means located on opposite sides of the warp threads and movable between a sensing position to the selvedge warp threads and a retracted position, and also turnable in said sensing position about a horizontal axis extending transverse to the weft direction to move in weftwise direction between a normal position and an actuated position, and being connected to said control switch means, respectively, to open the same only in said actuated position; adjustable spring means opposing movement of said feeler needle means to said actuated position; shifting means connected to said feeler needle means and being operated by the slay to hold said feeler needle means in said sensing position only during the passage of a shuttle with a weft thread through a warp shed so that the weft thread is looped about said feeler needle means in said sensing position and moves the same to said actuated position whereby said electric operating means is de-energized, while release of said feeler needle means by the weft thread causes actuating of the weft stop motion by said operating means including a manner of said shifting means connected to said housing to a position in which said feeler needle means are in said sensing position and counteracting the movement of said housing after said roller means has been engaged by the slay and said feeler needle means have moved to said retracted position together with said hous-
circuit-preparing switch operated by said actuating means to close only during the passage of a shuttle through a warp shed; control switch means including two control switches connected in series with said circuit-preparing switch and with each other; electric operating means for instantaneously actuating a weft stop motion when energized to stop the loom, and being connected in series with said circuit-preparing switch and with said control switches; two feeler needle means located on opposite sides of the warp threads and movable between a sensing position close to the selvedge warp threads and a retracted position, and also turnable in said sensing position about a horizontal axis extending transverse to the weft direction to move in weftwise direction between a normal position and in actuated position, and being connected to said control switch means, respectively, to open the same only in said actuated position; adjustable spring means opposing movement of said feeler needle means to said actuated position; shifting means connected to said feeler needle means and being operated by the slay to hold said feeler needle means in said sensing position only during the passage of a shuttle with a weft thread through a warp shed so that the weft thread is looped about said feeler needle means in said sensing position and moves the same to said actuated position whereby said electric operating means is de-energized, while release of said feeler needle means by the weft thread causes actuation of the weft stop motion by said operating means, said shifting means including a pivotally mounted rod, a slide member turnably mounted on the slay and sliding on said rod, and adjustable means connecting said feeler needle means with said rod so that said feeler needle means smoothly move between said sensing and retracted positions.

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