Displacement of the selvage of the fabric on shuttless looms as a factor in optimizing the silk fabric production process

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Abstract. One of the main weaving defects that reduces the quality of solid fabrics is streaks that appear after stopping the machine. These bands differ from shortcuts in that they only form when the machine is put into operation. The reason for the formation of boot bands can be due to the characteristics of both the elastic feeding system and the design of the main machine parts involved in the fabric formation process: batons, waste, feeding devices material for the machine with the base. and discard the finished fabric. On textile machines, for ease of maintenance, the machines are stopped and started in a stagnant position, and with each subsequent start of the machine, the baton and together with the reed do not have time to gain inertial force that they have when the machine is running. As a result, the strength of the reed waves may not be enough, leading to the formation of shear lines (release strips). The main controller of a non-closing loom does not control the tension of the sole after stopping the machine. Warp tension due to warp yarn slackening and fabric changes, resulting in a change in tension at the first pass. On a weaving machine, the elastic fabric forming system (ESFF) consists of two heterogeneous warp and fabric systems, with different stretch characteristics, and when the weaving machine is stopped, the relative lengths of the warp and fabric as well as the total The tension of the elastic system changes the formation of the fabric. In this case, the total length of the elastic tissue formation system does not change.

1 Introduction

Fabric formation in the unstable operating mode of the weaving machine, that is, during the period of trial operation, is significantly different from the fabric formation conditions in the established operating mode of the weaving machine[1]. This leads to obtaining a fabric with a weft density different from the specified weft density [2], i.e. a defect appears on the fabric - stripes. Issues about the appearance and study of launch paths have been

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mentioned in works [3; 4; 5; 8]. The work [3] was the first attempt to provide a theoretical analysis of the nature of the phenomena that occur on a machine when it starts up after a long stop, analyzing the causes of interruptions during the process. The usual weaving process follows. stop the machine.

Pay special attention to studying the position of the fabric edge and the influence of the edge position on the weft density of the fabric. According to the author, moving the fabric edge from the correct position when stopping the machine is the cause of uneven fabric density after starting the machine. The main reason why the fabric edge moves is due to uneven stretching of the base and fabric. The value of the work is relatively diminished because the experimental studies were carried out on mechanical machines and used a device that was not accurate enough to measure the movement of the fabric edges. Additionally, the edge motion is only taken into account from elastic deformation, which does not allow the authors to plan for dealing with the ejection range. In the study [5], the change in size of the release strips on the fabric that appears after starting the weaving machine depending on the tension of the sole, the stopping time of the weaving machine and other parameters was studied.

Research has shown that longer machine downtime causes visible diagonal stripes. It has been proven that in the fabric production process, the amount of “undercut” increases fastest in the first few seconds when the machine stops working. During machine downtime, the fuel system provides stress release, stress release, and back stress release. If we take into account the fact that these processes can occur simultaneously in separate fibers and, moreover, differently in the main fibers and in the fabric, the complexity of studying the stretching properties of The “basic fabric” elastic system becomes clear. Maxwell's viscoelastic model is used to study matrix and tissue expansion [8-12]. It has been shown that the degree of displacement of the selvedge depends on the free length of the base and fabric in the machine filler layer. The resulting expression for the displacement of the fabric edge as a function of load, base and fabric relaxation time, corresponding to the elastic modulus, adequately describes the relaxation processes in the electroelastic system. recovery during short machine downtime.

In the work [4], Boltzmann's genetic environment equation was used to qualitatively analyze the studied phenomena, making it possible to monitor changes in tension and edge displacement over time. With different combinations of base and fabric properties, different types of movement of the fabric edge were obtained. The amplitude of these movements is proportional to the tension at which the loom stops. Theoretically, the obtained equation perfectly describes the nature of the movement of the fabric selvedge, based on the physical and mechanical properties of the base and fabric. In practice, it is difficult to determine some factors included in this equation, such as the hysteresis elasticity of the matrix and fabric, and the viscosity coefficient of the matrix and fabric. Several recommendations are made to reduce the ejection belt: reduce tension in the intake system during shutdown periods; technological measures - stopping the machine in the spade position and working with low filling tension, accompanied by a large sized glide strip, less sensitive to edge movements; Design and development of a mechanism to automatically drain the fuel system at the moment the machine stops at most of the available voltage and automatically restore it at the moment the machine is put into operation after shutdown; The precise selection of existing elements and the introduction of new special elements in different areas of the machine, allows changing the pattern of movement of the fabric edges during the stay of the machine; modify the filling patterns of special machines by reducing the length of the fabric in the filling; modification of fiber properties towards reducing rheological properties by correct selection of weaving preparation operations; the creation of electrical and electromechanical devices to monitor the position of the fabric during downtime and return it to its original position at the time of machine operation while maintaining the initial level of charging voltage. It is difficult to agree with the author about the work of a machine with an increased gliding strip, since this leads to an increase in the tension of the base fibers at the time of gliding and their greater friction against the eye of the user. smooth and toothy. of the reed, this will increase the chance of the string breaking. It is also a mistake to assume that the starting line of the machine is reduced compared to the starting position.

An analysis of works on the emergence and study of launching strips showed: the magnitude and nature of the movement of the selvage of the fabric depends on the downtime of the loom, on the tension in the elastic filling system and on the physical and mechanical properties of the base and fabric; the existing experimental methods do not allow to reveal more precisely the magnitude and nature of the movement of the fabric selvage and to obtain data for the design and correct choice of mechanisms that prevent the appearance of launching strips; there are no studies on the movements of the fabric selvage on shuttleless looms filled with natural silk fabric; A drawback of the studies is that the authors did not consider the temperature and humidity of the weaving mill when determining the movement of the fabric end. In addition, no specific measures have been taken to combat the launching strips. On a loom, the elastic threading system consists of two heterogeneous systems, basic threads and fabric, with different relaxation patterns, and during the shutdown of the loom, the relative length of the base and fabric, and the total tension of the elastic threading system change. In this case, the total length of the elastic filling system remains unchanged. Consequently, the fabric selvage (the border of the transition of the base threads into the fabric) moves either to the chest or to the shafts [11].

2 Materials and Methods

The purpose of the work is to investigate the movement of the fabric selvage in viscoelastic systems on shutterless looms. For this purpose, it is planned: theoretically and experimentally to study the movement of the fabric selvage; to study the influence of the method of laying the weft thread on the starting strips. As a research method, a mechanical model of relaxation oscillations of the viscoelastic system of threading a loom was used. The material of the study was fabrics made of natural and artificial silk made under production conditions at a weaving enterprise, as well as the fabric selvage. At the same time, the temperature and humidity conditions in the workshop were maintained at two levels, the specified values for the throat height and the warp thread tension. Let's solve the problem of moving the edge of the fabric during the standing time of the loom due to the relaxation of the elastic system of filling the loom. As is known from the physics of macromolecular compounds, the most convenient methods for studying deformations and the nature of their superposition in textile materials are analogues in the form of mechanical models consisting of a combination of simple elements with elastic and viscous properties. Analogues are possible in the form of mechanical models with a serial connection of elastic and viscous elements, that is, according to the Maxwell model, and a parallel connection of elastic and viscous elements, that is, according to the Kelvin-Voigt model. The advantage of the parallel connection of elastic and viscous elements is the accuracy of the description of the relaxation processes taking place at the edge of the fabric of the elastic system of filling the loom.

3 Results

3.1 Theoretical analysis of movement of the cloth-fell

Let us solve the problem of movement of the cloth-fell during machine downtime due to relaxation of the elastic system of fabric formation of weaving loom. As is known from physics of high-molecular compounds, the most convenient methods for studying deformations and the nature of their superposition in textile materials are analogues in the form of mechanical models consisting of a combination of simple elements with elastic and viscous properties (Figure 1).

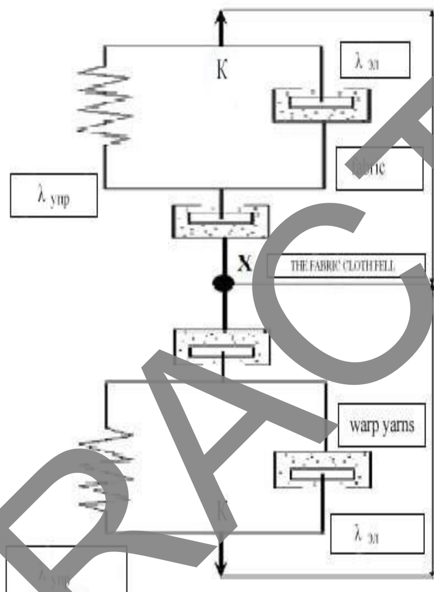

Fig. 1. Mechanical model of viscoelastic filling system of loom [10].

Usually, the total deformation of such a polymer consists of three types of deformation:

$$\lambda = \lambda_y + \lambda_e + \lambda_p \tag{1}$$

However, by the time of machine stop in the problem under our consideration, both the base and the fabric have had time to undergo several thousand load cycles each, which allows us to discard the last term (1) with some approximation, considering the plastic part of the deformation as selected [10].

To describe the course of high elastic deformation process, we assume the value $\lambda_e(t)$ instead of the finite equilibrium value λ_e in equation (1), i.e., high elastic deformation develops as a function of time (machine standstill). Its dependence on time $\lambda_e(t)=f(t)$, obtained experimentally, is very complex and in particular, depends on the history of the sample. Therefore, the mathematical description of high-elastic deformation can be carried out using functionals, which, however, leads to a very complicated calculation and does not contribute to revealing the physical picture of the phenomenon.

For a clearer description of the physical scheme of the process, it can be approximated that the relaxation process in establishing a high elastic deformation under a constant force follows an exponential law [1] (2):

$$\lambda_e(t) = \lambda_e\left(1 - exp\left\{-\frac{t}{\tau}\right\}\right) \tag{2}$$

where: t - time of load application to the material; τ - time of relaxation of the material.
For complete deformation (3):

$$\lambda(t) = \lambda_y + \lambda_e(t) = \lambda_y + \lambda_e\left(1 - exp\left\{-\frac{t}{\tau}\right\}\right) \tag{3}$$

According to [8], the deformation of the elastic system of the loom piecing depends on the tension and stiffness of the system

$$\lambda = \frac{K}{C} \tag{4}$$

Substituting this expression into (3), we obtain:

$$\lambda(t) = \frac{K}{C} + \frac{K}{C}\left(1 - exp\left\{-\frac{t}{\tau}\right\}\right) \tag{5}$$

Consequently, the strain for the warp threads in the elastic system of fabric formation will be (6):

$$\lambda_o = \frac{K_o}{C_o} + \frac{K_o}{C_o}\left(1 - exp\left\{-\frac{t}{\tau}\right\}\right) \tag{6}$$

Deformation for the fabric in the elastic system of fabric formation (7):

$$\lambda_T = \frac{K_T}{C_T} + \frac{K_T}{C_T}\left(1 - exp\left\{-\frac{t}{\tau}\right\}\right) \tag{7}$$

Where: $K_O, K_T -$ warp and fabric tension in the elastic system of fabric formation;
$C_O, C_T -$ stiffness coefficient of warp and fabric in the elastic system;
$\tau_O, \tau_T -$ relaxation time of warp and fabric in the elastic system;
t – downtime of the loom.

Let us determine the movement of the cloth-fell, given that the difference of warp and fabric deformation will be the value of movement of the cloth-fell (8):

$$X = \lambda_o(t) - \lambda_T(t) = \left[\frac{K_o}{C_o} + \frac{K_o}{C_o}\left(1 - exp\left\{-\frac{t}{\tau_o}\right\}\right) - \left(\frac{K_T}{C_T} + \frac{K_T}{C_T}\left(1 - exp\left\{-\frac{t}{\tau_T}\right\}\right)\right)\right] \tag{8}$$

or

$$X = \left[\frac{K_o}{C_o} - \frac{K_T}{C_T}\right] + \left[\frac{K_o}{C_o}\left(1 - exp\left\{-\frac{t}{\tau_o}\right\}\right) - \left(\frac{K_T}{C_T}\left(1 - exp\left\{-\frac{t}{\tau_T}\right\}\right)\right)\right] \tag{9}$$

Figure 2 shows the movement of the fabric selvage for all possible combinations of quantities included in equation (9).

In the obtained equation (9), the expression in the first bracket is the movement of the cloth-fell due to elastic system of fabric formation, i.e. when the machine is stopped; the cloth-fell is displaced immediately. Then there is a movement of the down due to development of high elastic deformation, depending on the duration of machine standstill (expression in the second bracket). We can also say that the direction of movement of the cloth-fell due to relaxation of heterogeneous elements (warp and fabric) of the elastic system of fabric formation during machine standstill depends on warp and fabric properties, and the magnitude of these movements depends on the tension of the elastic system of fabric formation.

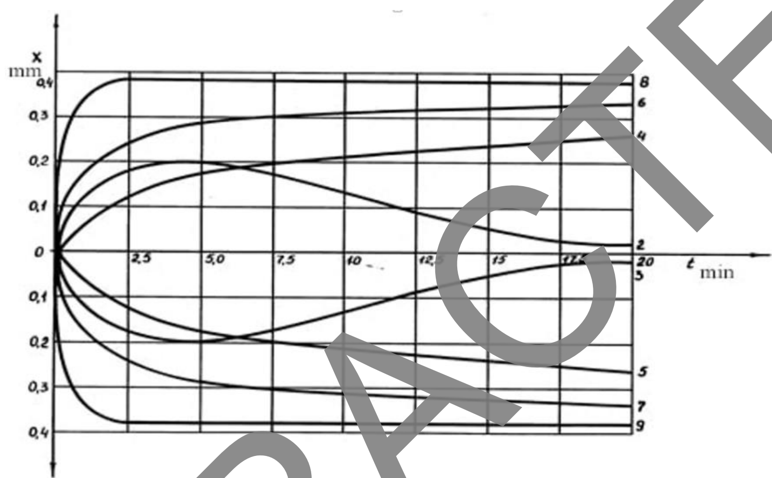

Fig. 2. Graphs of the movement of the fabric selvage for all possible combinations of values [1].

In this part of the work, the factors influencing the launch strips are experimentally investigated. The studies were carried out in production conditions, and the following tasks were set:

-determine the direction and amount of movement of the fabric selvage, depending on the position and duration of the stop, the loom, as well as the temperature and humidity conditions of the weaving shop;

-determine the nature of the change in the tension of the base and fabric threads in the unsteady mode of the loom;

-comparatively evaluate the nature of the movement of the selvage in the elastic filling system of the loom and the change in the tension of the base threads in an unsteady mode for fabrics made from natural rayon.

In order to solve the problems, a device and a sensor for measuring the movement of the fabric end during the machine's length have been developed, as well as sensors for the tension of fabric and the base thread tension [12,13].

The relaxation time of warp and fabric in the elastic system of fabric formation is determined by the following dependence [1, 7] (10):

$$\tau = \frac{t}{\ln T_н - \ln T_t} \tag{10}$$

where: t - exposure time in the elastic system of fabric formation;

Tн - initial tension of warp or fabric in the elastic system of fabric formation;

Tt - warp or fabric tension at the moment of time t.

Measurements of values Tн and Tt in the formula (8) were made directly on the loom, stopped in the position of minimum tension of warp yarns (cross position) and in the position of maximum tension of warp threads (open shed) under certain air parameters. Then the warp - fabric transition area was clamped with fixed clamps, the back rest were jammed. In the zone with lease rods – heald frames, a sensor of warp yarn tension was installed, and in the zone of clamp - breast a sensor of tension of fabric and at certain intervals recorded the change in tension of warp and fabric [6]. Table 1 shows the results of measurements at initial and final tension after twenty minutes of machine downtime for natural silk fabric.

Table 1. The results of measurements at initial and final tensions after twenty minutes of machine downtime for natural silk fabric

Name	Units of Measurement	Indicators of the warp yarn		Fabric Indicators	
		The loom stop -20^0	the loom stop - 260^0	the loom stop - 20^0	the loom stop - 260^0
Initial tension of warp or fabric, Tn	cN	13	18,5	13	18,5
Final tension of warp or fabric, Tt	cN	11	15,5	9,5	15

To determine the movement of the fabric selvage, the experiments were carried out on a STB loom filled with silk fabrics from natural and artificial fibers. Table 2 shows the technological parameters of weaving for natural and artificial silk fabrics [1].

Table 2. Technological parameters of weaving for natural and artificial silk fabrics.

	Name	**Unit of measure**	**Indicators**	
1	Type of weving loom		STB-220-SHL	
2	The size of cross position	grad.	15	36
3	Height of shed	mm.	100	100
4	Depth of shed	mm.	145	145
5	Shed take out	mm.	440	445
6	Tension of the warp yarns	cN	12	15
7	Types of fiber		natural silk	artificial silk
8	Linear density of warp yarns	teks	3,29	16,6
9	Linear density of weft yarns	teks	11,2	16,6
10	Density: weft	nit/sm	30	28
	warp	nit/sm	44	48
11	Weave pattern		Plain	

The movement of the selvage fell during loom downtime was recorded with the developed device, after a certain interval of time.

Looms were stopped in two positions: in the position of minimum tension of warp yarns (in the cross position) and in the position of maximum open shed (from filling dipstick). In this case, the humidity in the factory was in the range 47% - 55%. After processing the results, we plotted the curves of the movement of the downswing, depending on the downtime and humidity Figure 3 and Figure 4.

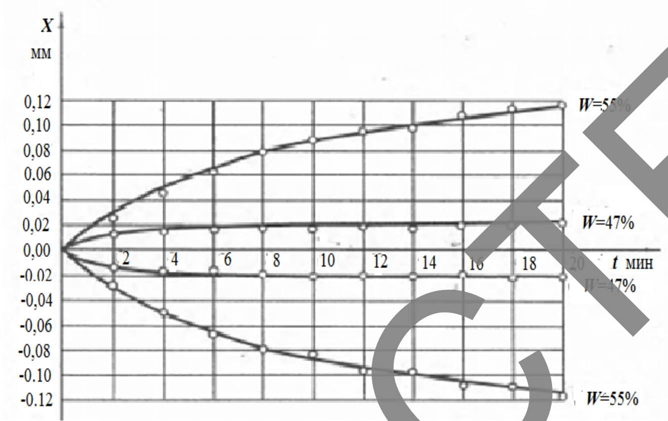

Fig. 3. Movement of the fabric selvage in natural silk depending on the downtime of the machine [1].

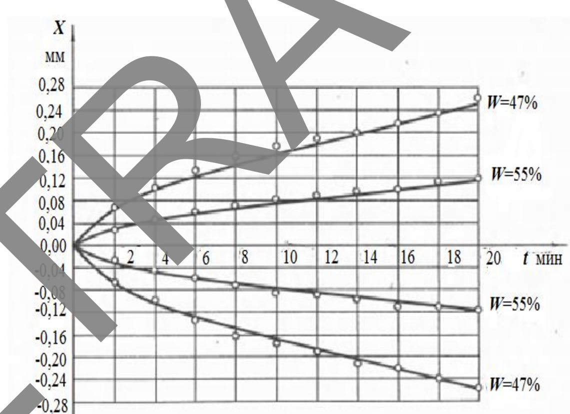

Fig. 4. Movement of artificial silk fabric selvage according to machine downtime [1].

Experimental studies of influence of type of looms such as pneumatic «Toyota» with micro-owners «Zulzer-Ryuti», rapier «R-190» and rapier «Somet» on movement of fabric selvage have also been conducted. Table 3 gives the results of the calculation of the movement of the fabric selvage, at deviation of the warp thread from the median line by a value from h = 0 (the moment of immersion) to h =45 mm (the moment of ejection). Where: h is the height of the zest; X - is the movement of the fabric selvage when the machine stops [11].

Table 3. The results of calculating the movement of the fabric selvage for different types of machines.

The amount of deviation of the warp threads from the middle line (height of the pharynx) h, mm	Moving of the fabric selvage when the machine is stopped X, mm			
	Type of loom			
	Toyota	**Zulzer-Ryuti**	**R-190**	**Somet**
0	0,066	-0,024	-0,023	0,066
5	0,068	-0,022	-0,022	0,068
10	0,070	-0,020	-0,021	0,070
15	0,074	-0,014	-0,016	0,074
20	0,084	-0,003	-0,006	0,084
25	0,101	0,016	0,010	0,101
30	0,125	0,045	0,033	0,125
35	0,160	0,084	0,066	0,160
40	0,206	0,136	0,109	0,206
45	0,265	-	0,0165	0,265

Table 4 shows the effect of the warp thread tension on the movement of the fabric selvage of various types of looms. The threading tension of the warp threads on the loom varied from 5 cN to 50 cN per warp thread [11].

Table 4. Influence of the filling tension of the warp threads on the movement of the fabric selvage of various types of looms.

Filling tension of warp threads, cN per warp thread	Moving of the fabric selvage when the machine is stopped X, mm			
	Type of loom			
	Toyota	**STB-175**	**R-190**	**Somet**
5	0,017	-0,006	-0,006	0,017
10	0,33	-0,011	-0,011	0,33
15	0,050	-0,017	-0,017	0,050
20	0,066	-0,024	-0,023	0,066
25	0,083	-0,028	-0,028	0,083
30	0,100	-0,034	-0,034	0,100
35	0,117	-0,040	-0,040	0,117
40	0,133	-0,045	-0,045	0,133
45	0,150	-0,051	-0,051	0,150

50	0,167	-0,057	-0,057	0,167

4 Discussion

The process of forming the fabric in the established mode of operation and in the unspecified mode of operation of the machine is different. The established working mode of the machine is characterized by: a given value of the filling tension of the strands of the base, the value of the release of the base and removal of the fabric; stability of the parameters of the mechanisms involved in the formation of the fabric. Unspecified machine operation is characterized by the following features. First, for ease of maintenance, the machine is stopped and started from the starting position. Therefore, with each subsequent start of the machine, the batan, and with it the reed, do not have time to gain the inertia force that they have when the machine is running, which can lead to insufficient weft surf force. Secondly, the tension of the warp, as a result of the relaxation of the warp and fabric, changes, which also leads to a change in the tension of the warp threads by the time of the first beat of the weft. Thirdly, features in the designs of the main mechanisms involved in the formation of fabric. Therefore, we should expect to develop a defect on the fabric "launching stripes”. To prevent "launching stripes" on machines, they use: special price seals i.e. systems of additional loading of the base when starting the machine; special mechanical and electromechanical systems for tensioning warp threads of reverse action, controlled from the machine start mechanism or from a microprocessor. In the resulting equation (9), the expression in the first bracket is the movement of the fabric selvage from the elastic deformation of the threading system, that is, when the machine stops, the fabric selvage is displaced instantly. Further, the selvage moves due to the development of highly elastic deformation, depending on the downtime of the machine (expression in the second bracket). It can also be said that the direction of movement of the fabric selvage due to the relaxation of inhomogeneous elements (base-fabric) of the elastic threading system during machine downtime depends on the properties of the warp and fabric, and the magnitude of these movements depends on the tension of the elastic threading system [13].

Let's analyze the curves in Fig. 2 obtained by formula (7):

1. The movement of the selvage fell from elastic deformation is equal to zero, and the movement of the selvage from highly elastic deformation develops and tends to a certain limiting value at $C_O = C_T$ and $\tau_O < \tau_T$ (curve 4), at $C_O = C_T$ and $\tau_O > \tau_T$ (curve 5);

2. Movement of the selvage from elastic and high elastic deformation of the elastic system tends to some limiting value at (curve 6), $C_O < C_T$ and $\tau_O < \tau_T$, $C_O > C_T$ and $\tau_O > \tau_T$ (curve 7);

3. The limit value of the elastic deformation movement of the selvage occurs at the moment of the loom stop, the high elastic deformation movement of the selvage does not develop, i.e., the selvage is stationary. In this case, $C_O < C_T$ and $\tau_O = \tau_T$ (curve 8), $C_O > C_T$ and $\tau_O = \tau_T$ (curve 9).

Curves 2, 4, 6, and 8 characterize the direction of movement of the selvage toward the breast, and curves 3, 5, 7, and 9 characterize the direction of movement toward the heald frames. The 10 above analysis shows that the nature and direction of selvage movement depends on the properties of the main yarns and fabric, as well as on the tension in the loom's elastic system of fabric formation. The total movement of the selvage is composed of the movement of the selvage from elastic and high elastic deformation in the elastic system of the loom setting. Also, the nature and direction of movement of the selvage theoretical curves 4, 5, 8 and 9 (Fig. 2) correspond to the experimental curves (Fig. 3 and Fig. 4).

An analysis of Table 1 shows that the initial tension of the warps or fabrics Tn of the indicators of the warp and fabric threads are reduced when the loom is stopped in the spade position (20°) and at the maximum shed coverage (260°). This is the basis of the fact that the density of the warp and fabric and the relaxation time of the warp and fabric of the same. The final tension of the warp or fabric, Tt, by 15% and 27%, respectively, when the loom is stopped in the spade position (20°). The final tension of the warp and fabric, Tt, by 16% and 19%, respectively, when the loom is stopped in the region of the maximum closing shed (260°). This is due to the fact that the rigidity of the warp and fabric threads and the relaxation time of the warp and fabric are the same. The final warp or fabric tension, Tt, decreases by 15% and 27%, respectively, when the loom is stopped in the spade position (20°). And the final tension of the warp and fabric, T_t, decreases by 16% and 19%, respectively, when the loom is stopped in the position of the maximum open shed (260°). The discrepancy between the final warp and fabric tension, Tt, is 80% when the loom is stopped in the spade position (20°). This is due to the fact that the location in the elastic system of filling the warp and fabric threads on the zero line of the spade, therefore, the fabric relaxes more intensively. The divergence between the final tension of the warp and the fabric, T_t, is 3% when the loom is stopped in the position of the maximum open shed (260°). When the loom stops at 260°, the warp threads, deviating from the average level, change the geometry of the dressing, while the increase in the warp rigidity occurs faster than the rigidity of the fabric and the relaxation times of the warp and fabric change accordingly. Table 2 shows that the technical parameters of weaving take into account the specific characteristics of the production of fabrics made of natural silk and artificial silk fabrics.

As it can be seen from received curves (Fig. 3 and Fig. 4), shifting of selvage occurs more intensively during first minutes of machine standstill. In this case, the direction of selvage movement depends on the stop position of the main shaft of the loom. When stopping in a jam, the cloth fell moves towards the breast and, when the machine is started from this position, there are also pronounced stripes (undercutting) on the fabric. When the loom is stopped in the maximum shed position (260° - 280°), the selvage moves to the side of the heald frames. In this case, the starting stripes are less pronounced or may be absent. The movement of the cloth fell towards the breast is due to the fact that the warp ends are less rigid than the fabric at midlevel, which means that the warp and fabric have less relaxation time. When the loom is stopped at 260°-280°, warp ends, deviating from the mean level, change the filling geometry, warp stiffness increases more rapidly than fabric stiffness, respectively, warp and fabric relaxation time changes. Relaxation times of the elastic system of fabric formation are significantly affected by the temperature and humidity conditions of the factory. With increasing humidity of the workshop, for natural silk fabric, the amount of cloth fell movement increases during machine downtime (Fig. 3), and for artificial silk fabric, the amount of cloth fell movement decreases (Fig. 4). For natural silk fabrics, it is possible to achieve minimal movement of the cloth fell by reducing the humidity in the workshop. But for the normal process of weaving natural silk production requires high humidity in the shop, which will increase movement of the cloth fell of the fabric. At the same time, the production of artificial silk requires a lower humidity in the factory, which will also lead to an increase in movement of the cloth fell fabric during loom downtime. Note usually both natural and rayon fabrics are processed in one mill, and fluctuations in mill humidity will result in different movements of the cloth fell. In most cases, the machine is stopped in the cross setting position, therefore, according to the results, the movement of the cloth fell occurs in the direction of the breast, and the fabric has a start undercut.

According to Table 3 and Table 4, when the loom is stopped, the movement of the selvage of the fabric (X) can have the following significant values: at zero value (X), the selvage of the fabric is motionless, we can expect the production of fabric without a defect; with a minus value (X), the selvage of the fabrics moves towards the breast, we can expect the appearance of defects on the fabric “starting gap”, i.e. underestimated fabric density per weft; with a positive value (X), the selvage of the fabric moves towards the shaft, we can expect the detection of a fabric defect “starting nick”, i.e. overestimated weft density. Experimental studies of the movement of the selvage of the fabric during the stop of the machine on various types of equipment were carried out. The analysis of tables 3 shows that the direction of movement of the fabric selvage (X) depends on the stop position of the main shaft of the machine. When machines with Sulzer-Ryti micro layers and rapier machines R-190 are stopped in the spade position (h = 0), the fabric selvage moves towards the chest, and when the machines are started from this position, stripes appear on the fabric (starting gap). On Somet and Toyota machines, the fabric selvage moves towards the shaft, which causes the appearance of stripes (starting nick). An increase in the height of the shed causes the transition to tissue from the starting undercut to the starting nick or a successful starting nick (Somet and Toyota). By selecting the stiffness coefficients of the warp and the fabric, the launching strip can be reduced somewhat.

It follows from Table 4 that on the machines pneumatic «Toyota», with micro-owners «Zulzer-Ryuti», rapier «P-190» and rapier «Somet» the absolute values of the quantities of defects of «launching strips» with increasing the filling tension of the threads of the base increase. Toyota machines provide a system to prevent the formation of launching strips that guarantee high quality fabrics. The system for preventing the formation of launching strips has: electronic release of the base and electronic removal of fabric, which unload the elastic filling system at the stop of the machine and load the elastic filling system at the point of contact of the thread; the starting mode of the main engine guarantees the full force of the surf already at the first refinement. Setting the permissible base tension reduction value in the event of machine shutdown or downtime is safe to avoid formation of launching strips.

5 Conclusion

The requirements that the textile industry places on textile machines today are many: flexibility and gentle handling of materials, many patterns on fabrics, absolute reliability in work and no defects on fabric. One of the main weaving defects that reduces the quality of stiff fabrics is the \"striping\" phenomenon that appears after stopping the machine. These stripes differ from shortcuts in that they only form when the loom is put into operation. The fabric formation process in the established working mode and in the undetermined working mode of the weaving machine is different. The established operating mode of the machine is characterized by: a certain value of the tension of filling the fibers of the base, the release value of the base and fabric removal; stability of the parameters of the mechanisms involved in tissue formation. The indefinite operation of the machine is characterized by the following features. Firstly, for ease of maintenance, the machine is stopped and restarted from the initial position. Therefore, with each subsequent start of the machine, the baton and the comb together do not have time to acquire the inertia they had when the machine was running, which can lead to insufficient frame glide force. Secondly, the warp tension changes due to the warp and fabric stretching, which also causes the warp tension to change at the time of the first weft beat. Thirdly, the design features of the main mechanisms involved in the formation of the fabric. Therefore, you can expect a defect to appear in the “release band” fabric. The flexible filling system consists of two heterogeneous elements: the warp and fabric have different stretch patterns, then during machine downtime their relative length and total tension change. At the same time, the total length of the elastic filling system does not change. Therefore, the edge of the fabric when the machine stops will move towards the stem or towards the reed. To solve the problem of movement of the fabric edge when stopping the machine, after the relaxation process of the elastic filling system, we used the method of studying deformations and the nature of their application in polymers (textile materials).) using a mechanical model. , consists of a combination of simple elements with elastic and viscous properties. The developed equation (9) allows to move the end of the fabric due to the elastic deformation of the elastic filling system and to move the fabric sheet thanks to the development of high elastic deformation depending on the length of the machine stop . The magnitude and direction of these movements arise from the limitations of the machine's elastic filling system as well as the relaxation of the heterogeneous elements (back fabric) of the elastic filling system during downtime. machine operation. Variations of the movement of the fabric edge are considered: it is possible to completely fix the fabric edge during dwell time at the same stiffness values and relaxation times of the base and fabric; The movement of the fabric boundary due to the elastic deformation at the moment of stopping the machine is extremely large during the subsequent development of the high elastic deformation of the machine's elastic filling system, which over time leads to stiffness and zero relaxation time of sole and fabric; the edge movement due to zero elastic deformation and the edge movement due to high elastic deformation are developed and tend towards a certain limit value; The displacement of the elastic edge and the high elastic deformation of the elastic supply system tend to a certain limit value; The maximum value of the edge movement due to elastic deformation occurs at the moment of stopping the machine and the movement due to high elastic deformation does not develop, i.e. the fabric edge does not move.

In all cases, the movement of the edge of the fabric in some cases characterizes the direction of movement of the edge of the fabric towards the chest (starting gap), and in other cases it characterizes the direction of movement of the edge of the fabric towards the stem (starting cut).). The recovery time of the base and fabric in the elastic filling system is determined experimentally as a function of the time t of the action of the tension on the elastic filling system; the initial tension of the warp or fabric in the elastic thread system; the tension of the warp or fabric at time t. It has been shown that in the production of silk and natural rayon fabrics, the movement of the edge of the fabric when the machine stops at the scoop position (20°) occurs towards the chest, and when the machine stops at the maximum opening. fall (260°), the movement of the edge of the fabric moves towards the top. It has been shown that as the humidity in the mill increases, the intensity of selvedge movement for synthetic silk fabrics decreases and for natural silk fabrics it increases. Rapid selvedge movement occurs during the first few minutes after stopping the machine, then gradually stabilizes.

The production process of artificial silk fabric is accompanied by more pronounced starting (shortening) bands than the production of natural silk fabric. A new device for determining the size and direction of fabric selvedge movement has been developed and tested. Experimental studies were also carried out on the movement of fabric edges when stopping the machine on different types of equipment, such as pneumatic \"Toyota\", with micro-layers \"Sulzer-Ryuti\", lance \"R \" -190\" and \"Someone\". On this device, when the weaving machine stops, the movement of the fabric edge (X) can have the following sign values: value 0 (X), the fabric edge is stationary. , we can expect to produce a perfect fabric; minus the value (X), the fabric edge moves towards the chest, we can expect defects to appear on the “launch space” fabric. , i.e. the weft density is underestimated; the higher the (X) value, the more the fabric edge moves towards the fabric body, we can predict the appearance of a \"thrown\" fabric defect, i.e. weft density is overestimated. Determine the direction of movement of the fabric edge (X) depending on the stop position of the machine spindle. When the Sulzer-Ryti microlayer and the R-190 machine stop at the scoop position, the edge of the fabric moves towards the chest, and when the machine starts from this position, stripes appear on the fabric (gaps) [14,15].

On the Somet and Toyota machines, the edge of the fabric moves towards the shaft, causing a strip (notch) to appear. The height of the crowd increases, causing the fabric to move from the ejection slot to the ejection groove or to reinforce the ejection groove (Somet and Toyota). By selecting the stiffness coefficient of the warp and the fabric, the ejection can be slightly reduced. In addition, on Toyota pneumatic machines, with Sulzer-Ryti microlayers, R-190 machines and Somet clamping machines, the absolute value of the defects of the ejection strip increases as the filling tension of the warp yarns increases. Thus, the theoretical and experimental studies carried out have shown that the behavior of the elastic system of fabric formation during the downtime of the weaving machine has been realized. It was determined that the tension in the elastic system of the fabric formation process, the warping and relaxation time of the fabric, as well as the temperature and humidity conditions of the weaving mill affect the size and direction of the loss of fabric movement. It was determined that when weaving fabrics from natural and synthetic silk, the movement of the fabric falling in the stationary state (20°-40°) is directed towards the chest, and in the stationary state of maximum opening movement (260°-280°), the movement of the falling tissue is directed towards the healing frame. It was found that as the humidity of the mill increases, the intensity of the falling movement decreases for the synthetic silk fabric and increases for the natural silk fabric. The rapid falling movement occurs in the first minutes of stopping the weaving machine, and then gradually stabilizes. The shrinkage of synthetic silk fabrics is accompanied by more pronounced starting stripes (cut lines) than that of natural silk fabrics. Developed and tested a new device to determine the intensity and direction of falling fabric movement.

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