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RESEARCH INTO THE CHANGE IN TENSION OF WARP YARNS (GROUND AND LOOP) ON WEAVING MACHINES DURING THE PRODUCTION OF TERRY FABRICS

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Abstract: *This study explores the dynamic tension behavior of warp yarns (ground and loop) during terry fabric production on weaving machines. A new high-sensitivity device was developed to measure thread tension with digital precision. Experimental analysis focused on terry fabrics with different weaving rapports using ITEMA R-9500 weaving machines. Results revealed significant tension fluctuations, with unevenness rates of 16.35% for a rapport of 3 and 29.5% for a rapport of 4. The study highlights the relationship between shaft rotation oscillations and tension variations, providing valuable insights for optimizing thread selection and weaving processes.*

Keywords: *terry fabrics, warp yarn tension, weaving machines, thread unevenness, textile engineering.*

Introduction.

From the practice of the technological process of weaving, it is known that the threads used as warps must have a certain threading tension, the value of which depends on the range of manufactured products, types and designs of weaving machines. And its value fluctuates during the shedding process.

In turn, the threads used in weaving have numerous types with a wide range of physical and mechanical characteristics.

The choice of the optimal option for matching the quality indicators of threads with a specific range of woven products and types of weaving machines is of great importance in the technical and economic indicators of industry enterprises.

The authors chose the technological process of producing terry fabrics as the object of this study, which differs from other assortments by the presence of two types of bases (ground and loop) and weaving machines of a special design.

The formation diagram of terry fabrics is shown in Fig. 1.

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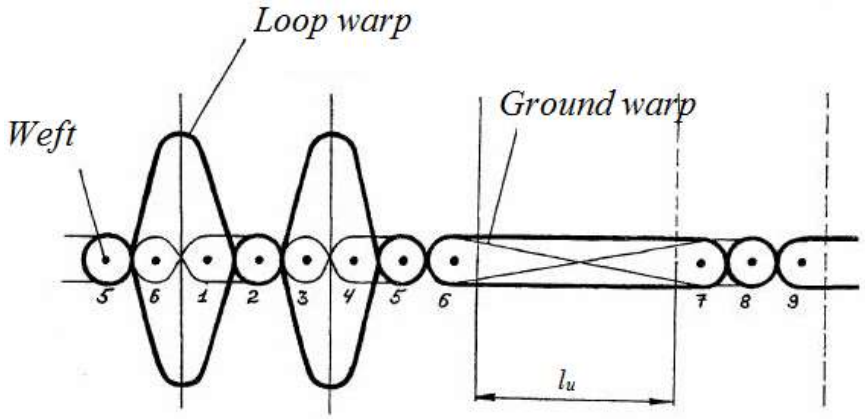

Fig. 1. The formation diagram of terry fabrics.

As can be seen from the diagram (Fig. 1), the insertion of the weft threads into the formed shed is inserted in groups of several threads (the number of threads depends on the selected rapport) and they must be nailed to the edge of the fabric cyclically, after a certain time depending on the distance (l_u) between the groups, called "undercut" and its value is set depending on the height of the loop of the terry fabrics.

A group of weft threads located at a distance (l_u) from the edge of the fabric, the simultaneous beating along the width of the fabric to the edge is carried out in two ways:

a) A special device installed at the reed mechanism, allowing the swinging movement of the reed to be carried out with a normal and increased amplitude. (these are weaving machines - Zultser Ruti model C6100, models SX-910, 736, etc.)

b) Special mechanisms implementing cyclic movements of the main warp along its length with an amplitude equal to (l_n) and an amplitude equal to the fabric working. (these are weaving machines of the firm "ITEMA" model R-9500, Silver DT, etc.)

The formation of a loop of terry fabrics occurs at the moment of beating a group of weft threads to the edge of the fabric, the so-called "hard" beating, and naturally, the warp threads, especially the ground thread, are under sharply changing and increased tension, due to the grip and mutual sliding of several weft threads on the ground thread, the amount of which depends on the fabric rapport. In practice and for research purposes, devices for measuring the tension of warps of various types and designs are used and their classification is given in the work [2].

Methods.

Based on the analysis of existing types of devices, the authors of this work developed and manufactured a prototype of a new device (Fig. 2).

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Fig. 2. Device for measuring the tension of warps.

The new device is highly sensitive, has 3 rotating thread guides, an electronic circuit aggregated with a personal computer providing information in digital form, and it can measure both a single and a group of threads in the operating mode of the machine.

To ensure the accuracy of the obtained thread tension values, the device readings were calibrated. For this purpose, a set of weights (class 4 according to GOST-7328) was used and the data obtained are given in Table 1.

Table 1.

A set of weights used and the obtained data

Standard weight, in gr.	Instrument readings in grams.			
	Max. values in gr.	Min. values in gr.	Average value of 10 measurements in grams.	Adjustment coefficient K
2,0	8,0	7,9	7,95	3,97
5,0	20,4	20,1	20,25	4,05
10,0	41,0	41,0	41,0	4,1
20,0	83,0	82,0	82,5	4,12
50,0	207,0	206,0	206,5	4,13
100,0	416,0	415,0	415,5	4,15
200,0	831,0	829,0	830,0	4,15
500,0	2082,0	2080,0	2081	4,16
Average value				4,1

From the data obtained in Table 1, it can be understood that this device is more sensitive, i.e. the coefficient of increase in digital data is 4.1 times higher than the actual value and this coefficient will be used when decoding the measurement results, i.e. the actual value of the thread tension is less than the data obtained in the computer.

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To test the performance of this device, we measured the tension of the ground warp when producing a terry towel with a weft rapport equal to three, on a R-9500 weaving machine from ITEMA (Italy) in the weaving production of NAM TOWELS LLC (Namangan).

The summary data on the measurement of the tension of the ground warp of terry fabric are given in Table 2.

Table 2.

The summary data on the measurement of the tension of the ground warp of terry fabric

№	Time of measurements (hour, minutes, sec)	Computer data of tensions in cN	Coefficient K	Actual tension value in cN
1	14.56.35,436	1031,98	4.1	251,6
2	14.56.35,668	913,63	4.1	222,8
3	14.56.35,893	932,17	4.1	227,3
4	14.56.36,081	1033,68	4.1	252
5	14.56.36,301	925,37	4.1	225,6
6	14.56.36,499	913,44	4.1	222,7
7	14.56.36,733	1047,14	4.1	255,3
8	14.56.36,926	919,18	4.1	224,1
9	14.56.37,165	927,0	4.1	226
10	14.56.37,348	1045,34	4.1	254,9
11	14.56.37,566	930,90	4.1	227
12	14.56.37,799	916,13	4.1	223,4
13	14.56.38,015	1053,21	4.1	256,8
14	14.56.38,199	917,64	4.1	223,8
15	14.56.38,433	935,80	4.1	228,2

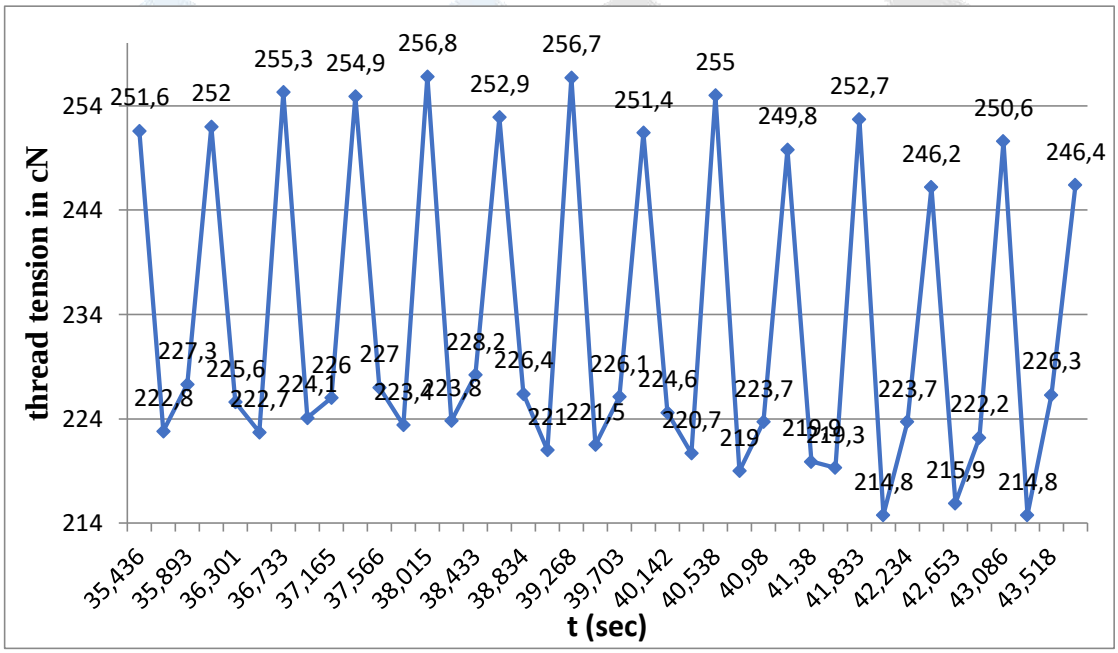

Fig. 3. The diagram of the tension of the ground warp of terry fabric.

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Table 2 shows parts of the digital data measurements obtained in the computer with subsequent recalculation taking into account the coefficient K, and Fig. 3 shows a graph of the change in the tension of the root warp in cN based on the data from Table 2, in time with an accuracy of one-thousandth of a second.

Analysis of the obtained data shows that the maximum value of tension is achieved during the "hard" beating and it occurs after every third beating of the weft thread. It is evident from the graph that two indicators (N_{38}-214.8 cN, N_{44}-214.6 cN) have the lowest tension values, this means that the tension of the root threads during shedding when 2 weft threads are inserted forms the background of terry fabrics. (shown in Fig. 1 in the form of weaving)

From the obtained data it is evident that the percentage of fluctuations in the tension of the ground warp is:

$$F_{g.w} = \frac{F_{g.w}^{max} - F_{g.w}^{min}}{F_{g.w}^{min}} * 100 = \frac{256,8-214,8}{256,8} * 100 = 16,35\% \quad (1)$$

In agreement with the management of the enterprise, the authors conducted an in-depth study of the tension of the threads of both the ground and loop warps on a new type of weave with a rapport on the weft 4 (Fig. 4), with the increased strength of loop fastening in the production of terry fabrics for sewing bath towels and robes.

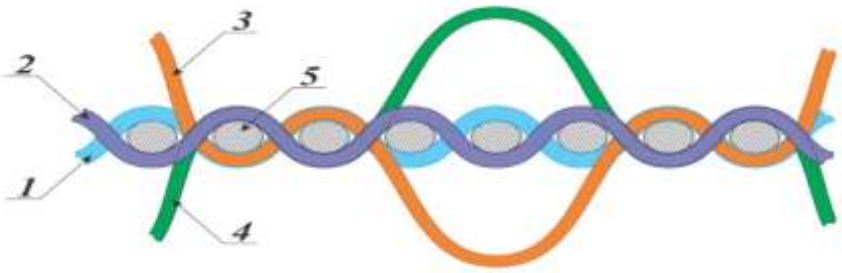

Fig. 4. Cross-section along the weft, according to the proposed new type of weaving of loop fabrics: where 1, 2 is the ground thread; 3 is the weft thread; 4, 5 are the loop threads.

Results and discussion.

The obtained results of measuring the ground warp tensions are given in Table 3.

Table 3

Results of measuring the ground warp tensions

№	Time of measurements taken (hour, minutes, sec)	Computer data tension in cN	Coefficient K	Actual tension value in cN	The surf time of one weft in sec. t	Number of revolutions of the main shaft of the machine in rpm
1	11.28.49,967	1113.54	4.1	271.59	0.204	295.5
2	11.28.50,170	1073.37	4.1	261.7	0.203	295.5
3	11.28.50,373	787.55	4.1	192.0	0.201	298.5
4	11.28.50,574	817.2	4.1	199.3	0.240	250.0
5	11,28,50,814	1090.17	4.1	265.8	0.205	292.6
6	11.28.51,019	1102.63	4.1	268.9	0.202	297.0
7	11.28.51,221	840.34	4.1	204.9	0.205	292.6

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8	11.28.51,426	848.24	4.1	206.8	0.237	253.1
9	11.28.51,663	1057.88	4.1	258	0.203	295.5
10	11.28.51,866	1068.11	4.1	260.5	0.202	297.0
11	11.28.52,068	802.84	4.1	195.8	0.201	298.5
12	11.28.52,269	851.35	4.1	207.6	0.238	252.1
13	11.28.52,507	1019.7	4.1	248.7	0.204	294.1
14	11.28.52,711	1067.76	4.1	260.4	0.203	295.5
15	11.28.52,914	804.86	4.1	196.2	0.205	292.6

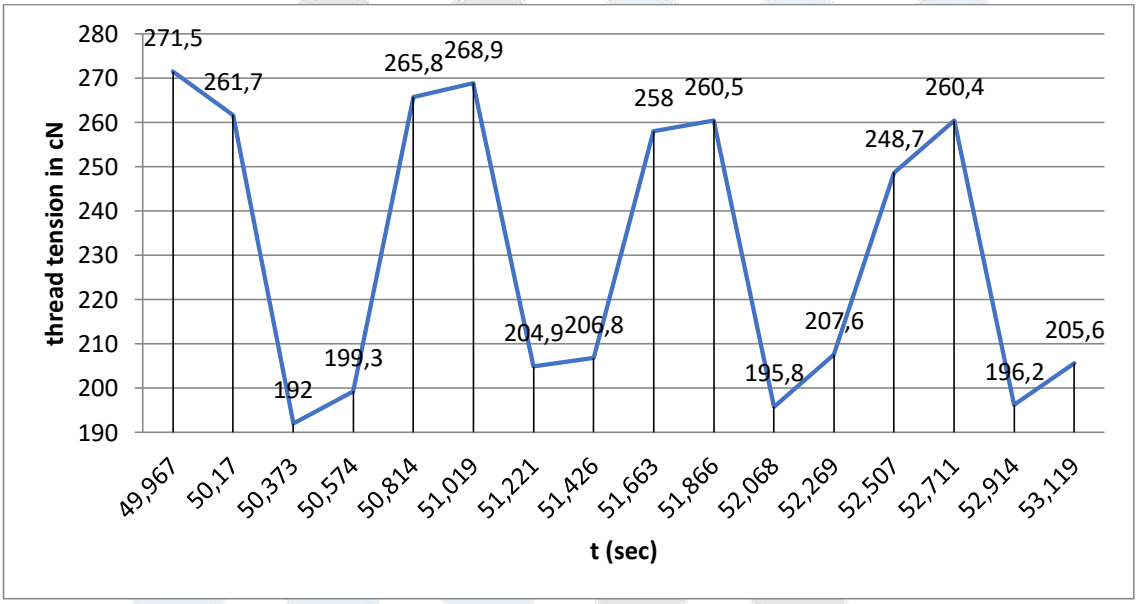

Fig. 5. The diagram of the results of measuring the ground warp tensions.

Based on the data from Table 3, Fig. 5 shows a graph of the change in the tension of the ground warp and its degree of oscillation is:

$$F_{g.w} = \frac{271{,}5-191{,}0}{271{,}5} * 100 = 29{,}5\% \quad (2)$$

Using the data from Table 3, we can determine the surf time of one weft.

For example: from 11 hours, 28 minutes, and 50.170 seconds, we subtract 11 hours, 28 minutes, and 49.967 seconds to get 0.203 seconds, i.e. the surf time of one weft.

The actual number of revolutions of the main shaft can be determined by the following formula:

$$R_{m.sh.} = \frac{60}{t} \text{ rpm} \quad (3)$$

Where t – surf time of one weft per second.

The digital data of changes in the values of the time of beating of one weft and the corresponding number of revolutions of the main shaft are given in Table 3 and its graphic representation is shown in Fig. 6. In this figure, the abscissa axis shows the time of beating of one weft in seconds and the ordinate axis shows the number of revolutions of the main shaft of the weaving machine in minutes calculated by formula (1).

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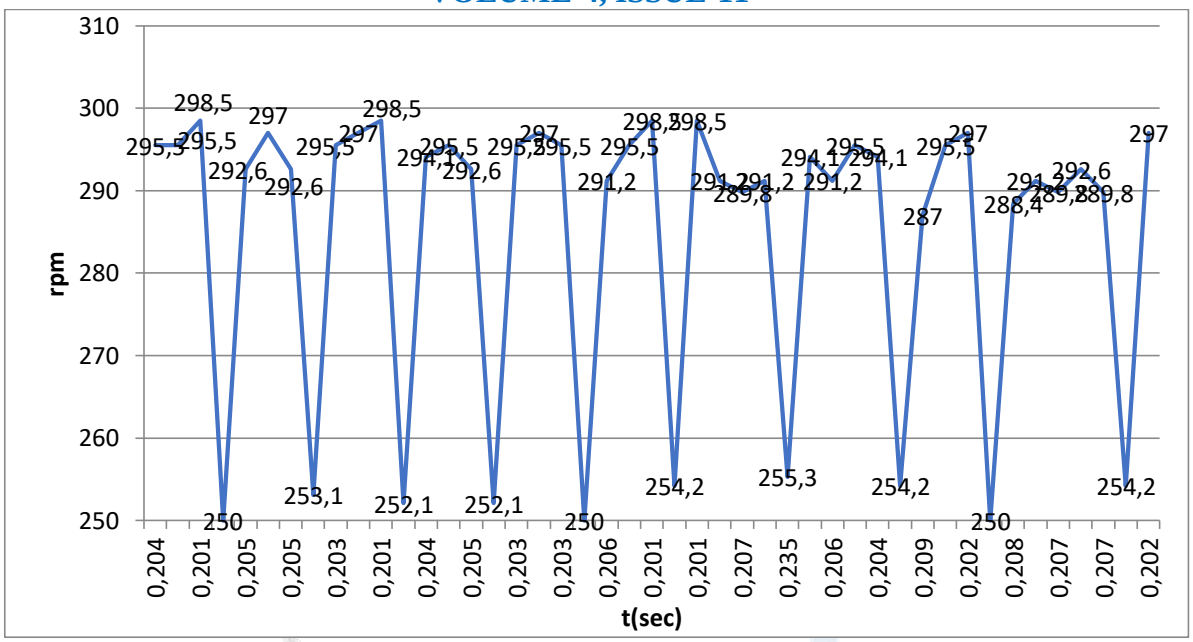

Fig. 6. The changes in the values of the time of beating of one weft and the corresponding number of revolutions of the main shaft.

The magnitude of the degree of unevenness of rotation of the main shaft of the machine, determined by the well-known formula, is equal to:

$$M = \frac{R_{max}+R_{min}}{R_{max}} * 100 = \frac{298,5-250,0}{295,5} = 16,2\% \quad (4)$$

Comparing the graphs in Fig. 5 and 6, it can be noted that the smallest number of revolutions of the main shaft corresponds to the largest value of tension of the ground warp with a rigid beat of the weft.

According to the above-described method, the tension of the loop warp was measured and its graphic representation is given in Fig. 7.

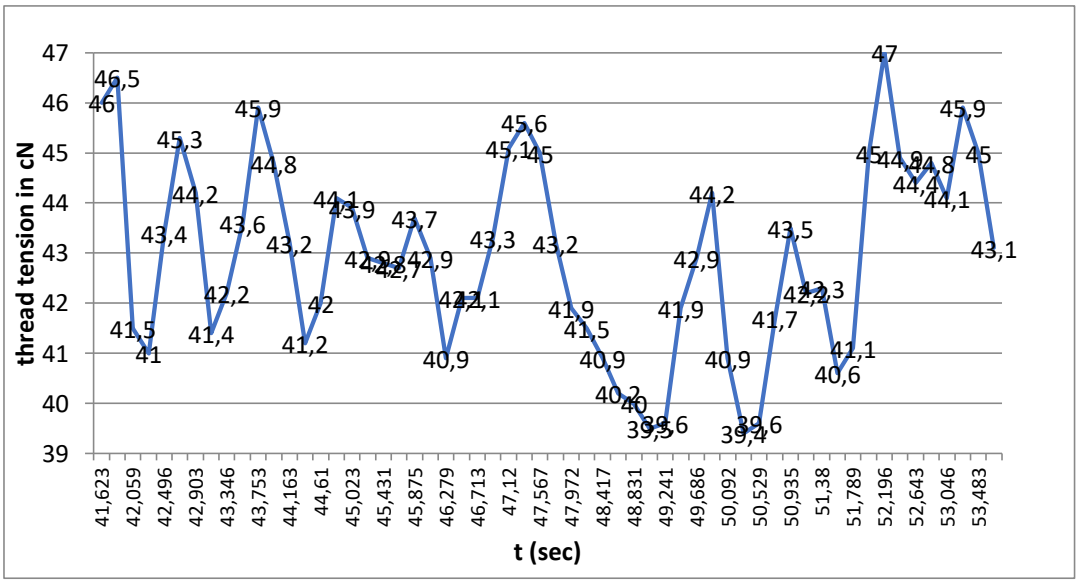

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Fig. 7. The tension of the loop warp.

According to the obtained data, the degree of tension fluctuations is equal to:

$$F_{l.w} = \frac{47-39,4}{47} * 100 = 16,1\% \quad (5)$$

Conclusion.

1. The created device with high sensitivity for measuring the tension of threads during the process of fabric formation has demonstrated its efficiency in operating machines.
2. Data on the tension of the ground and loop warps were obtained during the production of terry fabrics of two different weaves.
3. The unevenness of tensions with a fabric rapport of 3 was 16.35%, and with a rapport of 4 it was 29.5%.
4. Based on the data obtained, it was possible to determine the actual rotation value of the main shaft of the R9500 model ("ITEMA") and its unevenness was within 16.2%.
5. The dependence of the oscillation rotation of the main shaft on the magnitude of the tension of the main base of terry fabrics was determined.
6. Obtaining data on the tension of terry fabric warps will allow specialists to select the optimal types of threads.

REFERENCES

1. V.A. Gordeev, P.V. Volkov. “Weaving”. “Gizlegprom”. Moscow. 1958.
2. A.M.Akramov, P.D.Lastochkin. “Determination of thread tension on a weaving machine”. “CARJIS” Vol 2. 2022 year.
3. E.D. Efremov, O.A. Akhunbabaev. "Increase in tension due to surf". News of higher education institutions. "Technology of the textile industry". 1985. No. 5