NOVATEUR PUBLICATIONS
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN No: 2581 - 4230
VOLUME 7, ISSUE 10, Oct. -2021

DEVELOPMENT OF A LOOPER FOR TIGHTENING THE UPPER THREAD LOOP IN TWO CYCLES

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ABSTRACT:

The article discusses obtaining a two-thread chain stitch with a tightening of the upper thread loop in two cycles. The calculated data of the needle bar of the central crank mechanism from the upper and lower positions are also given.

Keywords: chain stitch, cycle, looper, needle, spool, needle bar, crank, connecting rod, sewing machine.

INTRODUCTION:

In the new method of obtaining a two-thread chain stitch with tightening the loop of the upper thread in two cycles, a rotating looper is used, which makes two turns in one cycle.

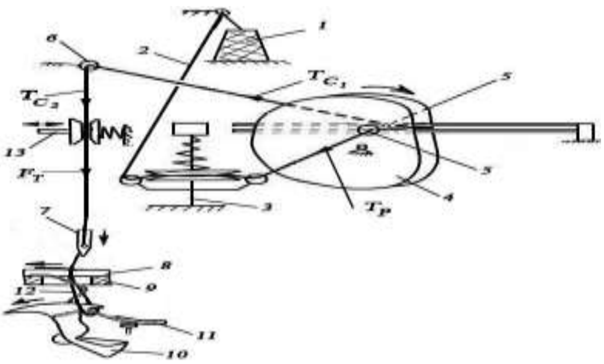

Fig. 1. The process of cutting the upper thread loop with the upper thread take-up in the patented two-thread chain stitch, when the upper thread is braked by the brake device and when the thread take-up starts to shorten the upper thread loop at 200^0

where: 1- coil; 2-top thread; 3-thread tension regulator; 4-disc cam take-up for upper thread; 5.6-thread guides; 7-needle; 8-stitched material; 9-needle plate; 10-looper; 11-bobbin thread pusher; 12-cut loop of the upper thread; 13-brake device; T_P - thread tension from the side of the thread tension regulator; T_{C1} - thread tension from the side of the stitch, created by the thread guide 5; T_{C2} - thread tension from the side of the stitch, created by the thread guide 6; F_T is the friction force of the upper thread created by the braking device.

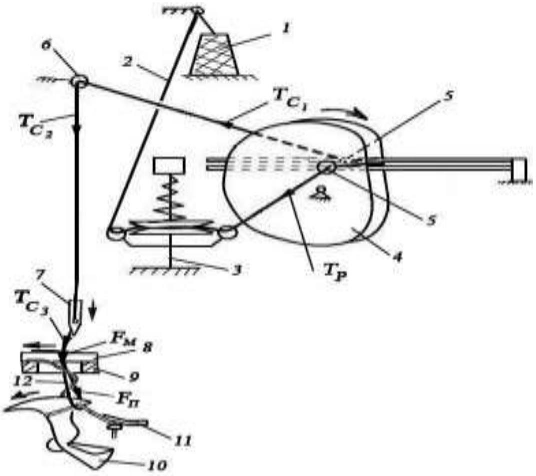

Fig. 2. The process of cutting the upper thread loop with the upper thread take-up in the new method of obtaining a two-thread chain stitch, when the thread take-up starts to shorten the upper thread loop at 185^0

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where: 1- coil; 2-top thread; 3-thread tension regulator; 4-disc cam take-up for upper

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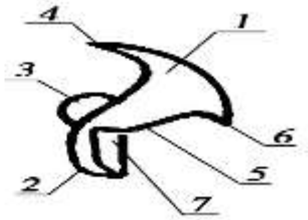
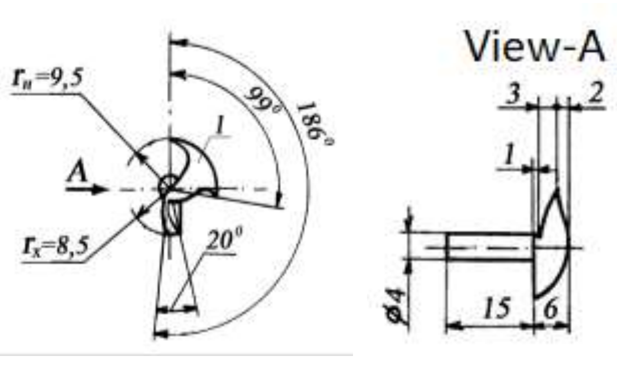
thread; 5.6-thread guides; 7-needle; 8-stitched material; 9-needle plate; 10-looper; 11-bobbin thread pusher; 12- shortened upper thread loop; T_P - thread tension from the side of the thread tension regulator; T_{C1} - thread tension from the side of the stitch, created by the thread guide 5; T_{C2} - thread tension from the side of the stitch, created by the thread guide 6; T_{C3} - thread tension from the side of the stitch, created by the eye of the needle 7; F_M - friction force of the upper thread in the hole of the puncture of the material; $F_П$ is the friction force of the upper thread created by the looper.

The rotating looper is shown in Figure 3. The looper is attached to the shaft by means of a roller 3, on the head 1 there is a spout 4, a heel 5 and a back spout 6. Spout 4 is used to capture the loop-overlapping of the upper thread formed by the needle, during its lifting from the extreme lower position, as well as to catch the bobbin thread fed by the pusher. The heel 5 and the back nose 6 are used to hold the loops of the threads. On the shank 2 there is an inclined plane 7, which serves to turn the loops of the threads by 180^0 in order to circle them around its body. To obtain a two-thread chain stitch with a tightening of the loop of the upper thread in two cycles, we will use a rotating looper from single-thread chain stitch sewing machines. In these sewing machines, depending on the thickness of the material to be sewn, loopers of various designs and geometric dimensions are used.

We have chosen for our new method of obtaining a stitch, a looper of a sewing machine of a single-thread chain stitch class 28 of the Podolsk Factory of Industrial Sewing Machines (Russia), where a looper with minimal geometric dimensions is used (Fig. 4.) and on the basis of this looper we will develop various designs looper. The smaller the radius of the nose r_H and the width of the looper, the shorter the length of the thread consumed by the looper. In addition, the radius of the looper nose r_H should be such that the needle, at its lowest position, does not touch the looper body. And the width of the looper should be of such a size that the point of the looper with high reliability passes through the area of the loop of the thread held by the heel of the looper. In addition, the size of the thread loop depends on the position of the looper in relation to the needle plate. The closer the looper is to the needle plate, the shorter the amount of thread consumed by the looper will be. However, a feed dog moves in an elliptical path between the looper and the throat plate, which limits the minimum distance between the looper nose and the throat plate.



Rice. 3. The design of the rotating looper.
1-head; 2-shank; 3-roller; 4-nose; 5-heel; 6-back spout;
7-inclined plane.



Rice. 4. The design of the rotating looper.

The geometric dimensions of the looper will directly overestimate the parameters of the needle mechanism. The prototype of the sewing machine uses a central needle crank mechanism. The main parameter of such a needle mechanism is the ratio $\lambda = r / l$ (r — is the length of the crank; l — is the length of the connecting rod) and the total stroke of the needle is S=2r.

In a prototype sewing machine, the length of the crank is r = 16 mm, and the length of the connecting rod is l = 36,5 mm, then the ratio r / l is: : λ = r/l = 16/36,5 ≈ 0,44, and the total stroke needles - S=2 r =2·16=32 mm. A needle tucked through the eyelet with the upper thread in the sewing machine serves to pierce the material to be sewn and pass the upper thread through it and form a loop-overflow of the upper thread near the eye of the needle, when it is raised from the lowest position.

The countdown movement of the needle down S_v is taken from the upper dead position (Fig. 5. a), and, lifting the needle up $S_н$ is taken from the lower dead position (Fig. 5, b).

Since the needle bar moves progressively, the movements of all its points will be equal to each other. But to assess the needle bar, it is most convenient to take the center of the hinge B, which connects the needle bar to the connecting rod AB (Fig. 5.). The simplified formula for calculating the movement of the needle bar from its top dead position has the following expression [ ]:

$$S_в = r\left(1 - \frac{\lambda}{4}\right) - r \cdot \cos\varphi_в + \frac{\left(r \cdot \lambda \cdot \cos(2\varphi_в)\right)}{4}$$

Sometimes it is required to determine the angle of rotation $\varphi_в$ of the main shaft of the machine, at which the needle drops from the top dead position to $S_в$:

$$\cos\varphi_в = \frac{1}{\lambda} - \sqrt{\frac{1}{\lambda^2} - \left(\frac{2}{\lambda} - \frac{2S_в}{r\lambda}\right) - 1}$$

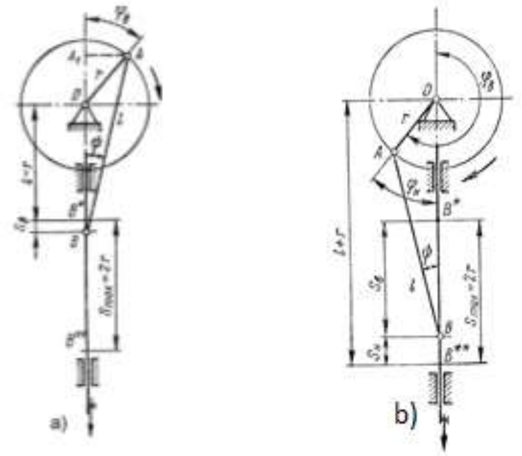


Fig. 5. Moving the needle bar of the central crank mechanism from the upper (a) and lower (b) dead positions.

The simplified formula for calculating the movement of the needle bar from its bottom dead position is as follows:

$$S_н = r(1 + \frac{\lambda}{4}) - r\cos\varphi_н - \frac{(r\lambda\cos(2\varphi_н))}{4}$$

The angle of rotation $\varphi_н$ of the main shaft, at which the needle rises from the bottom dead position to $S_н$, can be determined by the formula:

$$\cos\varphi_н = -\frac{1}{\lambda} + \sqrt{\frac{1}{\lambda^2} + 1 + + \frac{2}{\lambda} - \frac{2S_н}{r\lambda}}$$

The total needle travel S is the sum of the needle travel in the fabric and under the fabric: $S_{max} = S_{rab} + S_{xol}$
where, S_{rab} is the working stroke of the needle in the material; S_{xol} - idle stroke of the needle from the uppermost position to the beginning of the entry of the needle point into the material.

We determine the movement of the needle bar from the lower dead position according to simplified formulas when the needle is raised from the extreme lower position by an amount of в = 2 mm, to form a loop near the eye of the needle - an overflow from the upper thread.

For the first position of the working bodies of the machine, we conventionally take the most extreme lower position of the needle.

Determine the angle of rotation of the main shaft at which the needle rises from the bottom dead position by the value в = 2 mm, i.e. at $S_н$ = в =2 mm

$$\frac{1}{\lambda} + \sqrt{\frac{1}{\lambda^2} + 1 + \frac{2}{\lambda} - \frac{2S_{н1}}{r\lambda}}$$

$$\frac{1}{0,44} + \sqrt{\frac{1}{0,44^2} + 1 + \frac{2}{0,44} - \frac{2\cdot 2}{16\cdot 0,44}}$$

$\varphi_н$ = arccos(0,912) = $24^0 13^/$

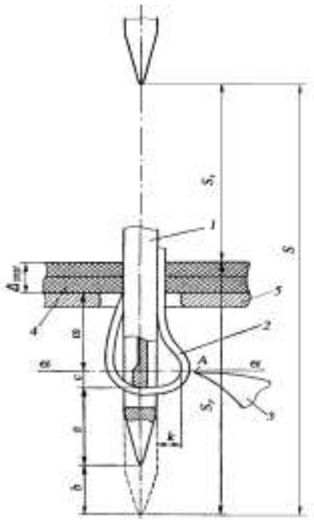


Fig. 6. Needle working stroke.

Thus, when the needle is raised by 2 mm, the main shaft of the machine turns through an angle $\varphi_н = 24^0 13^/$.

The most important parameter of the sewing machine is the working stroke $S_р$ of its needle, which is understood as the movement of the needle in the materials to be sewn. The working stroke determines the total displacement S of the needle bar, the radius r of the crank of its mechanism and a number of other parameters of the machine. The smaller the working stroke, the faster the sewing machine can be made. This is due to the fact that with a decrease in the working stroke, inertial loads in the needle bar mechanism decrease, limiting an increase in the speed of the sewing machine.

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