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# THEORETICAL AND EXPERIMENTAL STUDIES OF THE CALCULATION OF THE TIME SPENT ON THREAD AND YARN FILLING ON A SEWING MACHINES

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**ABSTRACT**

*In this article, a special device design has been developed to prevent the time spent sewing the item on the sewing machine, the time spent filling the yarn, and the excess electricity used to fill the yarn. It was found that when filling the shuttle tube to the thread, the machine is stopped and after the thread is filled, it takes 2-2.5 minutes for the sequence of operations to be carried out, which saves time and increases productivity by 1.5 times.*

*In this article, a special device design has been developed to prevent sewing on the sewing machine, the time required for sewing, and excessive energy consumption of the yarn. It was found that the machine is interrupted due to threading, and after the completion of the thread, it takes about 2-2.5 minutes to complete the machine, which improves productivity by 1.5 times.*

**KEY WORDS:** *Sewing machine, strut, needle, needle mechanism, thread, tube, body hose, mock, tube.*

## INTRODUCTION

Labor productivity, durability and quality of the sewing machine depend mainly on the design of the shuttle mechanism. The shuttle parameters affect the tube replacement time, the needle thread stiffness.

Suites can be conditionally grouped according to location, movement, appearance, and tube structure.

1. Divided into the following groups by location:
a) mo, which is located in the vertical plane and the axis of rotation is horizontal
kilar;
b) Shuttles located in a horizontal plane with a vertical axis of rotation;
c) Shuttles located under the platform.
2. The movement is divided into:
a) forward-reversing shuttles;
b) Rotary shutters;
c) Rotary shutters
3. There will be shuttles in the following views:
a) Cylindrical shutters are mainly used in low-speed household sewing machines;
b) Rotary shutters are vibrating and are more commonly used in semi-automatic sewing machines;
c) Lycopene shutters are mostly flat rotating and are mounted on tube holders. Such shutters are widely used in high-speed sewing machines [1].

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The shuttles can be centered or decentralized. The shuttle path coefficient Km is important in the shuttle price formation process and can be found by the following formula:

$$K_m = \frac{\varphi_m}{\varphi_0}$$

where: $\varphi_m$ - is the angle of rotation of the main shaft from the moment the needle thread ring for the shuttle is hung and rotated around it;
$\varphi_0$ - is the total turning angle of the main shaft [2].

On sewing machines, the Km coefficient is in the range of 0.25 - 0.42. The main technological disadvantage of the shuttle device is that it takes a long time to replace the tube. 3. Figure 1 (a) shows a graph of the change in time taken to replace the tube (1) and to tie it when the thread is broken (2), as well as the dependence of machine labor productivity Q on the tube size $V_n$ (3).

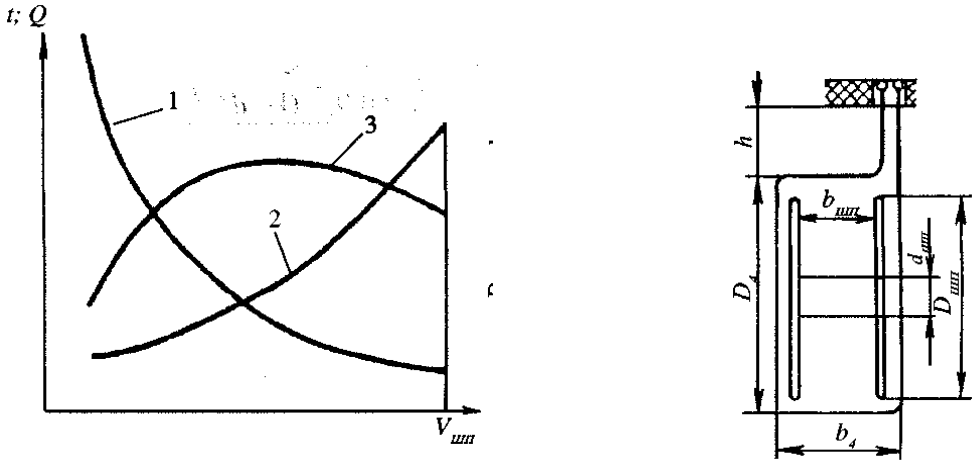
Research shows that the reliability of the rope around the shuttle yarn length L m will be spending almost a needle thread L b length is equal to the ratio:

$$K_u = \frac{L_m}{L_b}$$

The length of the needle thread to be used for one stitch is found as follows:

$$L_b = (C + \Delta)\eta_T$$

Where: C - line step; Δ - is the thickness of the material being sewn; $\eta_T$ - coefficient of tension k of the price [3].




a) b)

**Figure 1. Graph of change of time t and labor productivity Q with respect to tube volume Vn (a), as well as the diameter section of the shuttle (b)**

We determine $L_m$ from the diametrical section of the shuttle.

$$L_m = 2K_0(D_m + b_m + h)$$

Or

$$D_m \pm b_m = P = \frac{L_M - 2n_0 h}{2K_0}$$

Where: $n_0$- is the coefficient indicating that the shape of the ring deviates from the allowable; h - is the distance from the trajectory of the shuttle to the needle plate; P - shuttle parameters.
The volume of the tube is found by the following formula:

$$V_n = \frac{\pi}{4}(D_n^{\,2} - d_n^{\,2})b_n$$

Where: $D_n$ and $b_n$ - are the diameter and width of the tube; $d_n$ – is the diameter of the tube

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The operating time of the sewing machine in the tube replacement interval is determined by the following formula:

$$T = \frac{60L}{l_{cm}n} = \frac{60D_n^{\ 2}(1-d^2)b_n}{d_n l_u n}\xi_{\overline{YP}}$$

Where: $H$ - is the number of bets generated per minute, $D_n$- The diameter of the [4].

## RESULTS AND DISCUSSION

### Results of experimental studies of the proposed yarn filling device

Before using the machine to wrap the thread around the tube, the thread is removed from the needle eye and the kick is lifted by turning the knob clockwise. The electric drive is activated by lifting the handle at the bottom right of the desktop cover.

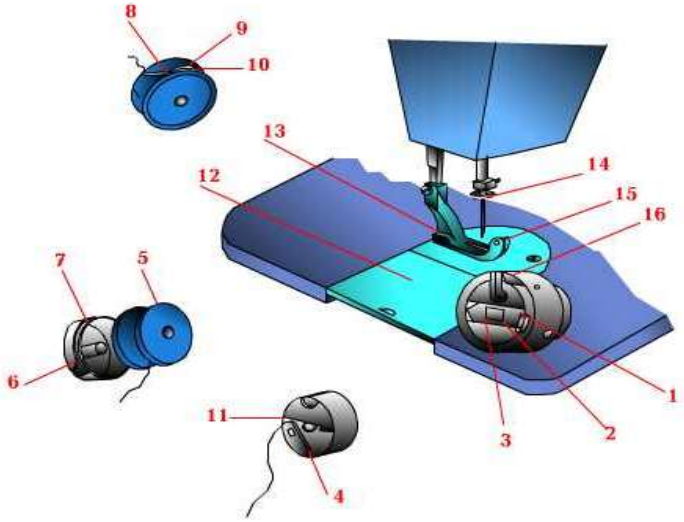


**Figure 2. Tailor on a 1022-M sewing machine detailing scheme.**

When the pedal is depressed, the rotational motion from the electric drive is transmitted to the car's flywheel and main shaft via a belt drive. After a sufficient amount of thread is wound on the tube, the spindle stops. The tube is removed from the spindle, leaving enough thread tip to remove the bottom thread from the shuttle device. When placing (tying) the lower thread on the shuttle, hold the tube (Fig. 2) in the right hand and put it on the hollow rod 7 of the tube cap 6, which is in the left hand . Insert the end of the thread from the tube cap into the groove 10, and when the plate-shaped spring 8 is brought to the bottom, its tongue is moved behind the 11. The sliding plate 12 is pushed to the left and the needle 14 is raised by turning the flywheel, the kick should also be raised [5].

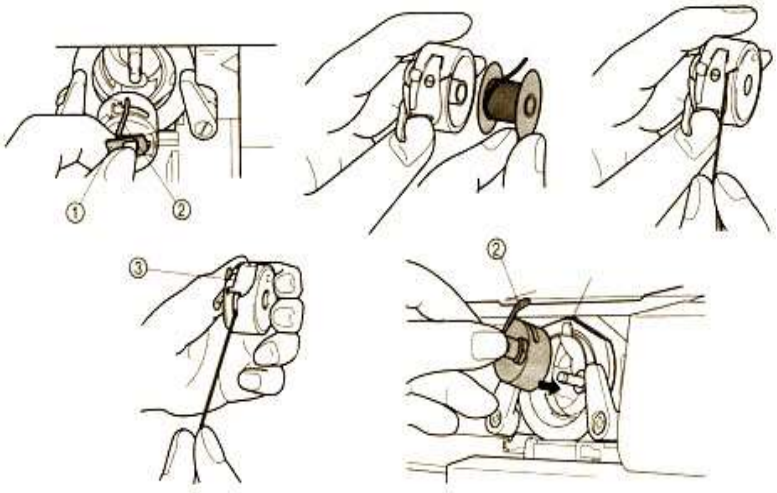


**Figure 3. Scheme of tying the bottom thread on a sewing machine type 1022-M**

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When the shuttle thread is finished, to replace it with another filled tube, first stop the machine (Fig. 3, 4), remove the shuttle tube and switch the machine to idle mode, install the tube on a special device and fill the thread from the spool to the tube. The sewing process is then continued by setting the thread-filled tube in place. This leads to a lot of time spent sewing the item and in turn a decrease in work productivity. Therefore, it is important to improve the sewing machine by filling the tube with yarn at the same time, ie during the sewing process.

**Figure 4. The work to be done during the automatic filling of the shuttle tube**

In order to overcome the above shortcomings, by continuing to sew it in place without removing the shuttle tube, it promotes the time it takes to fill the thread and the electricity saved for this work [6].

The extra time spent sewing in the preparation of the item also leads to a slight decrease in work productivity. At present, these indicators do not meet the technical requirements. It is advisable to do this to fill the tube without stopping the machine, but while the sewing process is in progress. For this reason, a pulley with a diameter of 20mm was installed by lifting the head of the sewing machine (Fig. 5) to install the thread filling device on the tube 5, so as not to interfere with other details in the location closer to the shuttle device of the shuttle shaft. Attach a second pulley of the same size to the car body and attach it to the shuttle tube knocked. The rotary motion to the tube is transmitted from the shuttle shaft by a belt drive 4 from a pair of newly installed pulleys (Fig. 5) [7-15].

**Figure 5. The process of installing a shuttle automatic filling device**

Tube 5 is filled from a separately placed yarn spool 7 (Fig. 6). To do this, attach the thread from the spool to the spare tube and attach it to the second pulley shaft, and the sewing process can continue on the machine. When the tube is full of thread, press the button 6, which is attached to the tube, and a specially mounted knife for cutting the thread from the top moves downwards and stretches the thread. When the shuttle thread is finished, the machine is stopped for a moment, replaced with a tube filled with spare thread, and the process is repeated.

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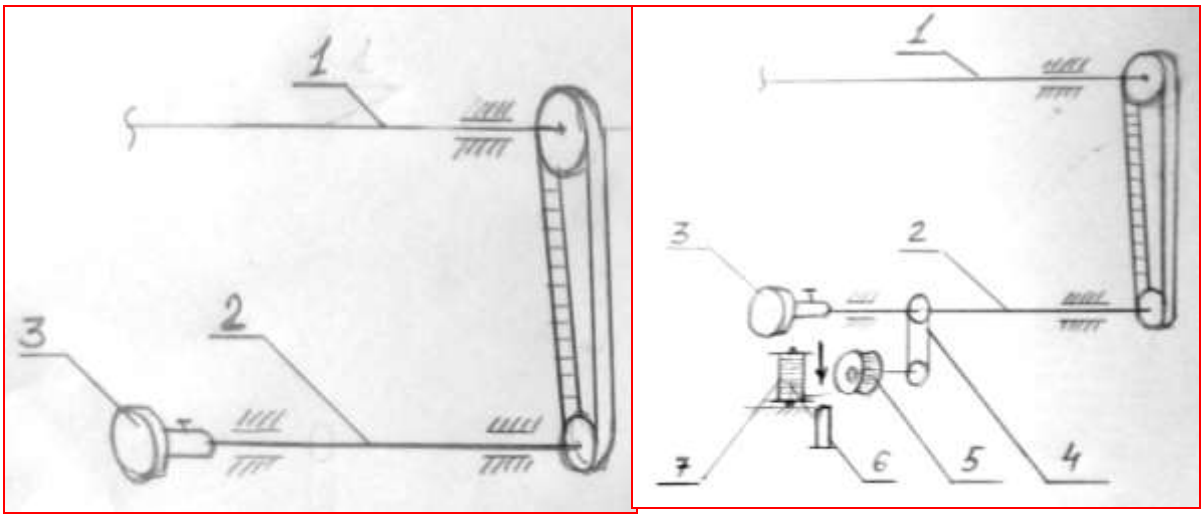


**Figure 6. Automatic filling device of the shuttle pulley existing and proposed scheme**

1st head shaft, 2nd shuttle shaft, 3rd shuttle, belt drive, 5th tube, 6th tube full sensor button, 7th thread spool [16-20].

## CONCLUSION

Experiments have shown that in order to sew a single suit pants, you need to fill the shuttle thread into the tube 4-5 times. The proposed installation of an additional automatic thread filling device saves time spent on thread filling when used. Considering that it takes 2-2.5 minutes to stop the machine and fill the yarn each time, it takes 13-15 minutes for the item to be fully sewn. If you save such time in each machine, you will save at least 1 hour to fill the thread when sewing 4 suits during the shift. If the time saved is spent on sewing, you will be able to sew 5 suits instead of 4 during the shift. This means that if the company sews suits on 10 of these sewing machines, it will be possible to increase productivity by 10-12% by sewing 10 suits during the shift due to the saved time.

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