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EXPERIMENTAL STUDY OF THE DYNAMICS OF A NEW PRESSER FOOT DESIGN WITH ADDITIONAL TAPERED SPRINGS

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Abstract: The article deals with the experimental studies of the dynamics of the proposed presser foot design. The scheme and working principle of the improved design scheme of the presser foot with an additional conical spring are presented. The essence of this phenomenon is that the presser foot receives and bounces off the material when the toothed rack is lifted.

Keywords: sewing machine, conical spring, presser foot, tension, fabric, strain gauge, amplifier, friction, elastic force, create, tension, cylindrical spring.

INTRODUCTION

In order for the conveyor belt to be able to move the materials to be crosslinked, there must be sufficient friction between the conveyor belt and the materials. This force is provided by the pressure of the presser foot. The purpose of the presser foot is also to hold the materials to be sewn at the level of the needle plate when the needle and the non-tractor move upwards. In addition, the presser foot must provide a certain amount of compression to the materials to be sewn. This makes it much easier for the thread tensioner to retract the stitches and ensures that the compressed materials have elastic forces that create sufficient tension in the stitches after the presser foot has stopped acting on the materials [1,2].

With the Yamata, the pressure of the presser foot on the materials to be sewn is created by a cylindrical spring attached to a stem. The spring force can be adjusted by screwing a sleeve into the head of the machine, which also serves as a guide for the presser foot.

MATERIALS AND METHODS

In some sewing machines such as the Yamata. Instead of a cylindrical spring a flat spring is used. Such a spring has no particular advantages over the cylindrical. If the presser foot has a cylindrical spring, the pressure force N of this spring in Newtons can be calculated by the expression

$$N = \lambda M d^4 / (8 D^3 n), \qquad (1)$$

where λ — compression of the cylindrical spring, м; $M = 8 \cdot 10^4$ МН/м² — shear modulus of steel; d — diameter of the spring wire, м; D — average diameter of its coil, м; n — number of coils.

$\lambda = \lambda_{\max}$ We obtain the maximum possible pressure of the cylindrical spring $N_{\max}$. For example, in the machine "Yamata". foot spring parameters are: $\lambda_{\max} = 36$ мм; d = 1,2 мм (0,0012 м); D = 10 мм(0,01 м) и n — 24. Calculations according to formula (1) give $N_{\max} = 30$ Н.

The required foot pressure on the materials to be sewn depends on their thickness. The force $N_{max} = 30$ H is the maximum thickness of the materials that can still be sewn with the machine in question. In other cases it will be less. In heavy machines, where the thickness of the materials to be sewn is much greater than in universal machines, take $N_{max} = 50$ H.

When the machine is running, the presser foot uses a spring to create the pressure necessary for normal material advancement. The presser foot pressure can be adjusted from 20 N to 50 N. Incorrect presser foot pressure or, if the spring is not correctly dimensioned, may cause the material to not adhere to the rails and the stitch length to change at different machine speeds [3,4].

With an increase in the speed of the main shaft, there is a so-called hang-up of the presser foot. The essence of this phenomenon is that the presser foot receives and bounces off the material when the toothed rack is lifted. The size of the bounce and its duration depend on the characteristics of the spring and the impact. The presser foot, having received an initial impulse, does not have time to return to its original position in time before the end of the material advance. In this case, the material remains unclamped, the clutching force of the toothed rack with the fabric is reduced; the phenomenon is reflected in the stitch length.

And the nature of the change in force N has a significant impact on the conditions of interaction between the rail, presser foot and the materials to be sewn [5,6].

RESULT AND DISCUSSION

To solve this problem, we have developed an experimental setup based on a sewing machine "YAMATA" ordinary design with the possibility of installing a standard and proposed spring designs on it. General view and structural diagram of the experimental setup is shown in Fig. 1 and Fig. 2.

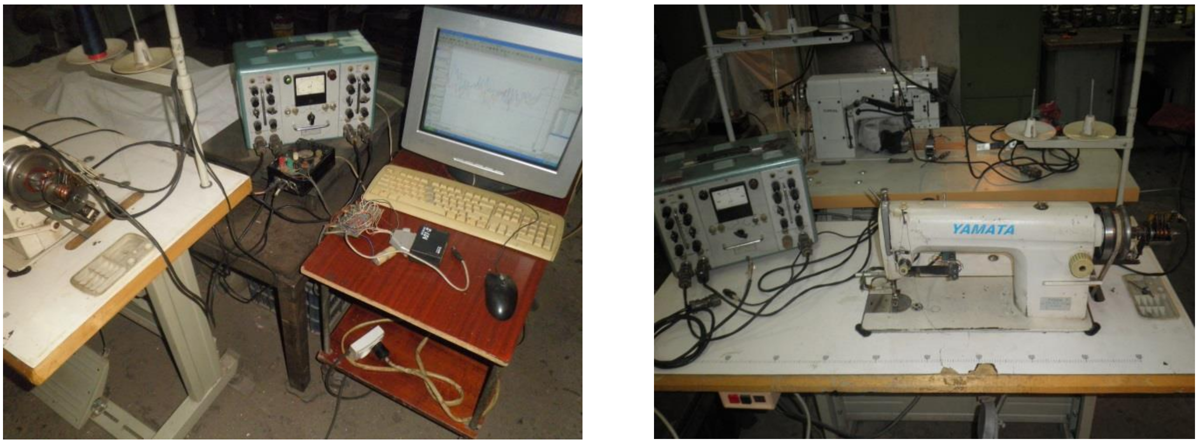

Fig.1. A general view of the experimental installation of a sewing machine with an advanced presser foot design with an additional spring.

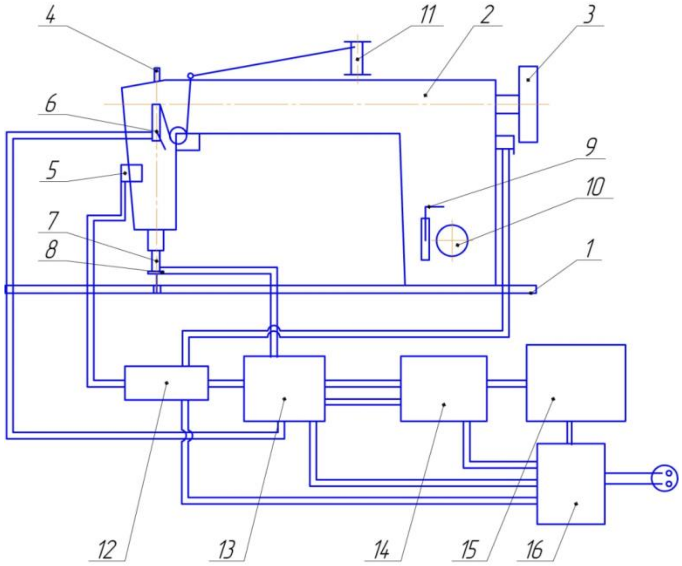

Fig. 2. The structural diagram of the experimental setup for measuring the load on the sewing machine foot.

Sewing machine 1-Such a sewing machine. 2-Sewing machine. 3-Drive pulley with Hall sensor. 4-the presser foot bar.5-the needle position control sensor.6-the strain gauge for thread tension control. 7-sewing needle. 8-press foot with strain gauge sensor to monitor the load on the foot. 9-regulator changes the direction of the stitching.10-stitching step control. 11-coil with a thread. 12-tensometric amplifier UT-4 and 13-modulator of oscillations for comparative evaluation on the records of oscillograms.14-digital converter LTR-154. 15-COMPUTER. 16- Power supply unit with voltage stabilizer.

The scheme of an experimental foot with clamping system with additional springs of conic shape and strain gauge sensor for recording the movement of the foot and the load acting on the foot, is shown in Fig. 3. A distinctive feature of this measuring system is that the measurements were taken simultaneously with the load and the value of movement of the foot vertically [7,8].

Also to compare the results on the oscillograms recorded the position of the needle in relation to the needle plate, the rotation frequency of the main shaft of the sewing machine and the torque on the shaft.

Load measuring device works as follows.

On the stem 8 of the sewing machine mounted on guide bushings 11 is fixed foot 5 with a bolt 7. The design of the foot is modified according to the requirements of experimental research and measurement requirements of the dynamic parameters of the foot with a rack-and-pinion mechanism, on which the load cells brand 2PKB 20-200 are glued in advance. Foot 5 has a groove in the upper part is installed on a rod 8 with a pin 6, the holder can freely move up or down, depending on the load acting on it. To press the foot to the materials to be sewn 3 and 4 foot presses the spring 9 of conical shape, which is located on top of the presser foot holder.

When the rail raises together sewn materials foot 5 in the top movement of the foot is fixed plate 14 with load cells 16, one end of which is mounted on a bracket 15.When moving the foot up or down, detects the difference in force created by the springs foot moving along the slot, which is fixed by a movement sensor.

General view of the displacement sensor is shown in Fig. 4.

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To adjust the load on the foot, presser foot spring 13 installed on the sewing machine on one side is pressed by the adjusting screw, which is shown in Fig. (Fig. 2 3.2) and on the other side resting on the bushing 12 presses the foot to the needle plate.

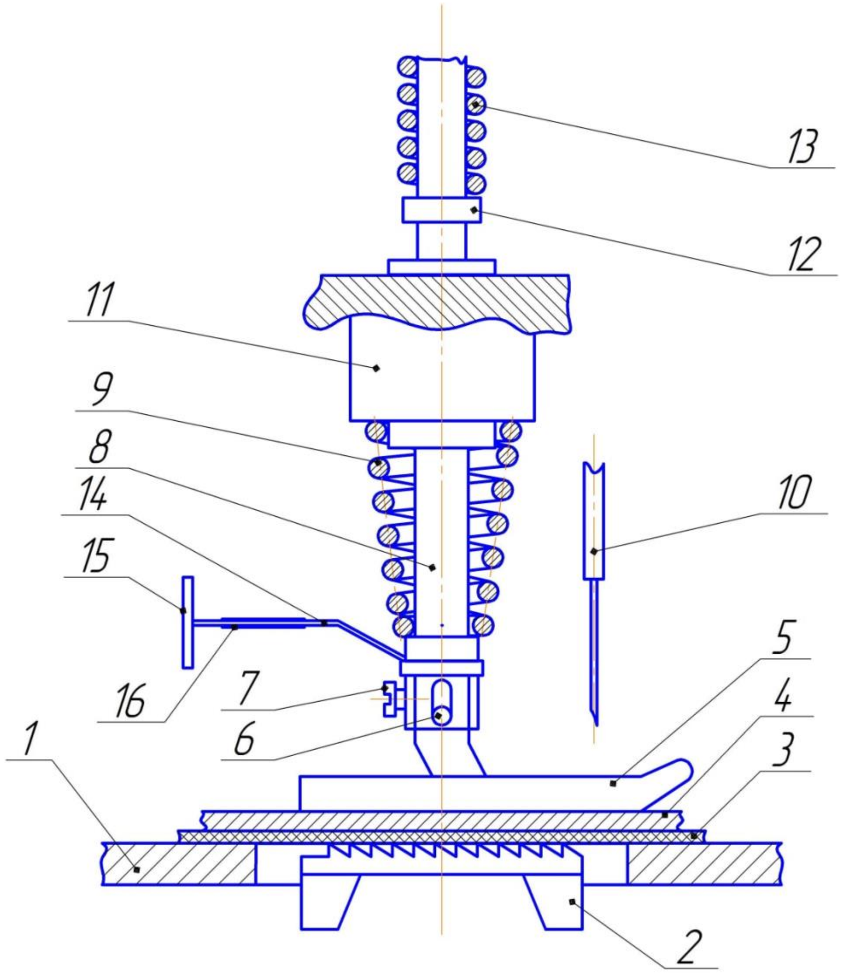


Fig.3. Schematic of the foot mounted on the stand with strain gauges to control the load on the foot.

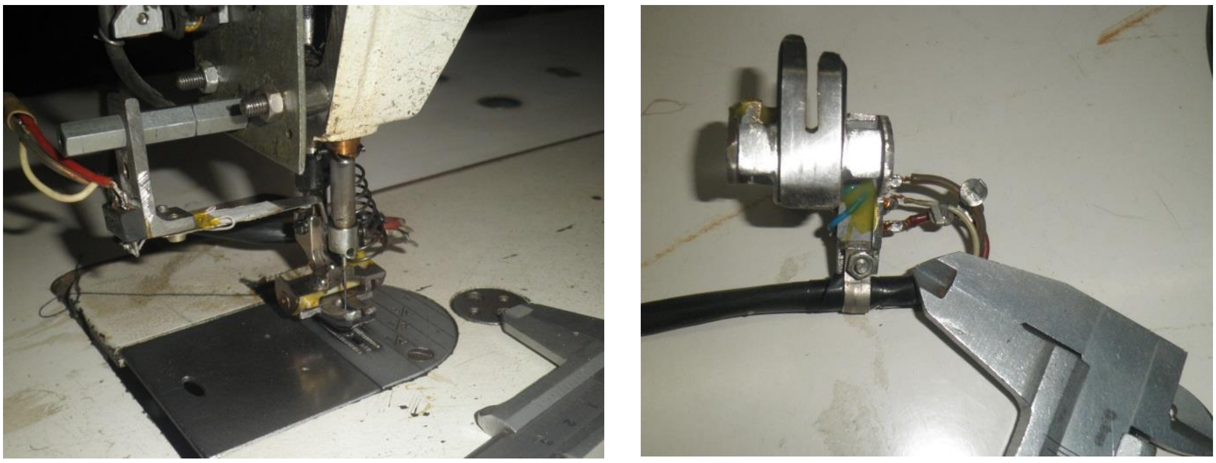
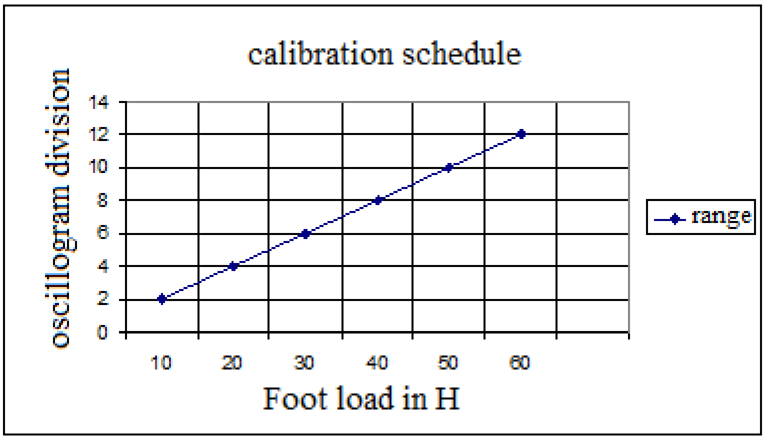


Fig.4. General view of the foot with the foot movement control sensor.



The foot itself is mounted on a specially made bracket, which is a drying element, as for the impact of the conical spring and for pressing the foot of the main spring to the needle plate. When loaded by the spring, the axis is forced to move along the groove, due to the difference of the load created by the upper cylindrical spring and the foot conical spring, which provides the absorption of foot oscillations at the moment of the lath detachment in the reverse stroke [9].

CONCLUSION

Experimental studies were carried out on the base machine "Yamata".

We have established that the height of exit of teeth of the toothed rack above the level of the needle plate is 2.5 mm, pressures of the foot - Nl = 2-6 kGs, and the stitch length - up to 5 mm.

Measurements were carried out by strain gauge method. The measuring scheme is shown in Fig. 2 it consists of a bridge built of wire strain gauges brand 2PKB - 20 - 197X; resistance with a base - 20 mm; R = 198 Ohm; amplifier (TU - 4 - 1); vibration modulator; digital converter type LTR 154 and computer with information processing program turned. The measuring circuit is shown in Fig. 2.

The measuring bar, the general view of which is shown in Fig. 4, was made from the elastic spring-like plate, on the surface of which, according to the known technology, the sensor of 2PKB - 20 - 197X with the base of 15 ÷ 200 X is glued.

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