MATHEMATICAL MODEL OF A DEVICE FOR APPLYING A POLYMER COMPOSITION ON CLOTHING PARTS

Mehrinur Samadova Odil qizi
PhD student of Bukhara Institute of Engineering Technology

Abstract*: The article presents a structural diagram and the principle of operation of the installation of a sewing machine for applying a polymer composition to the stitch lines of tarpaulin materials. The calculation schemes and the mathematical model of oscillations of the axis of the composite roller during the application of the polymer composition along the lines of materials are presented.*

Keywords*: Sewing machine, device, roller, polymer composition, vibration, rigidity*

This device can be represented as a unit that includes a polymer dosing unit, a unit for applying it to a part, a plate with holes in the form of a given geometric pattern, and a container with a liquid-phase polymer. Additional nodes are a tank with a tightly closed stopper mounted on the head of a sewing machine and a pipeline through which a liquid-phase polymer composition enters. A device for processing sections of textile materials includes a holder with which the device is attached to the needle bar of a universal sewing machine, a control unit and a gear rack mechanism. Between the gear rack mechanism and the needle bar, there is a dosing tube and a means for supplying a liquid-phase polymer, made in the form of a piston with a conical head and a transverse groove [1].

A device is known for applying a polymeric composition along the sections of garment parts in the sewing industry instead of overcasting to secure the sections from shedding. The device contains a system for supplying a liquid-phase polymer, a unit for applying the polymer to the sections of the garment parts, a support for placing the product with a gear rack for moving it [2].

The liquid-phase polymer is applied to the sections of the parts by contact using counter-rotating rollers, one of which has a special geometry on the rim, and the other, covered with a porous material (spongy polyurethane coating), is signed with a polymer composition.

Both designs of the analogue securely secure the fabric sections from shedding for the entire service life, stabilize the geometry of the sections and ensure the saving of sewing threads.

A device containing two rotating rollers covered with a porous material, the rollers are installed on the body of the sewing machine on both sides of the parts to be sewn behind its presser foot and toothed rail and are interconnected by an overlapping belt drive, the liquid polymer composition supply system contains an upper bath connected to the surface of the upper roller through a supply tube with a feed regulator, and a lower bath installed under the working platform of the machine, into which the lower roller is partially immersed [3].

The main disadvantage of the well-known designs is low reliability due to the lack of a drying process for the applied polymer coating on the seams of the materials to be ground.

The objective of the invention is to increase the reliability and strength of thread connections in garments made of fabrics of movable structures, namely, to reduce the spreadability of threads in the seams by fixing the fabric structure in the seam area with a polymer-composite material while reducing labor intensity and multi-stage processing of the product, as well as due to timely drying of the applied polymer composition on the seams of the materials to be sewn, the design of the device has been improved and forced drying of the coating immediately after its application.

Structural diagram of the recommended device for applying polymer to the lines of materials.

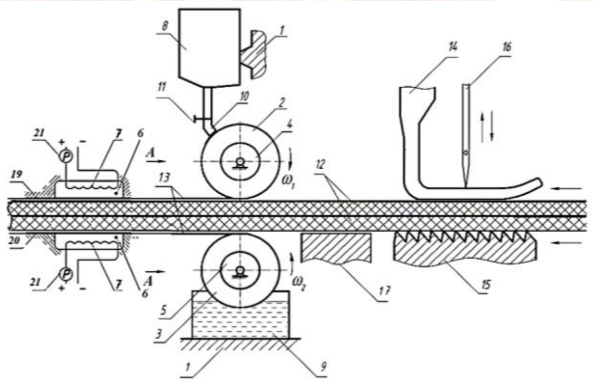


Figure 1. Apparatus for applying a polymer composition to garments

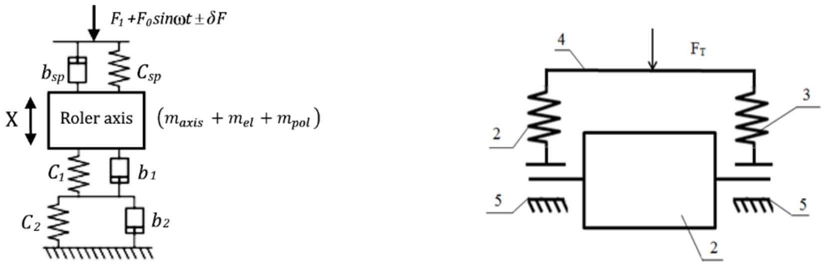
The design makes it possible to increase the reliability and strength of thread connections in garments due to the timely drying of the materials applied to the materials to be sewn.

Calculation scheme and mathematical model of vibrations of axis of the compound roller of device (Figure 2).

Lagrange's second-order equations [4] are used to obtain the differential equation representing the oscillations of the roller according to the calculation scheme:

$$\frac{d}{dt}\left[\frac{\partial T}{\partial \dot{x}}\right]-\frac{\partial T}{\partial x}+\frac{\partial P}{\partial x}+\frac{\partial \emptyset}{\partial \dot{x}}=Q(x) \qquad (1)$$

here, x- generalized coordinate, vertical displacement of the roller; T,P – kinetic and potential energies; $\emptyset$- The dyspeptic function of the relay, Q (x) – generalized power.



1 – roller, 2,3 – ressors, 4 – frame bar, 5 – body support
a – calculation scheme, b – roller placement diagram

Figure 2. Calculation scheme of polymer coating equipment for tarpaulin seams and layout scheme of roller equipment

Kinetic energy in the motion of the roller along the vertical X;

$$T = \frac{1}{2}\left(m_{axis} + m_{el} + m_{pol}\right)\left(\frac{dx}{dt}\right)^2 ; \qquad (2)$$

here, m_{axis}, m_{el}, m_{pol}- the masses of the polymer on the roller axis, the flexible bushing and the surface, respectively.

$$P = \frac{1}{2} C_l x^2 \qquad (3)$$

here, C_l – the given virginity coefficient of the elastic elements.

$$C_l = \frac{c_1 \cdot c_2 \cdot c_{sp}}{c_1 \cdot c_2 - c_{sp}(c_1 + c_2)} ; \qquad (4)$$

here, c_1, c_2, c_{sp}– compression springs, roller rubber bushings and tarpaulin material coefficients, respectively.

The dissipative function of the relay [6]:

$$\Phi = \frac{1}{2}\left(b_{sp} - b_1 - b_2\right)\left(\frac{dx}{dt}\right)^2 ; \qquad (5)$$

here, $b_{пр}, b_1, b_2$– compression springs, roller rubber bushing and tarpaulin material dispersion coefficients, respectively.

Taking into account the obtained expressions (2), (3), (4), (5) and the external forces, we determine the additions to equation (1). As a result, we create a differential equation that represents the motion of the composite roller axis along the vertical axis.

$$\left(m_{axis} + m_{el} + m_{pol}\right)\left(\frac{d^2x}{dt^2}\right) = F_1 + F_0 sin\omega t \pm \delta F_1 - \left(b_{sp} + b_1 + b_2\right)\left(\frac{dx}{dt}\right) - \frac{c_1 \cdot c_2 \cdot c_{sp} x}{c_1 \cdot c_2 - c_{sp}(c_1 + c_2)} ;$$

(6)

Solution of the problem and analysis of the results of vibrations of the device roller axis

The analytical solution of the second-order differential equation (6), which represents the oscillation of the axis of the roller of the polymer composite coating on the tarpaulin seam on the sewing machine, was determined using the existing method without taking into account the random component of external force.

In this case, the following initial conditions are t = 0; x = x_0; The solution was obtained at x _0 = 0;

$$X = \frac{F_0^{/} sin\,(\omega t - \beta)}{\sqrt{\left[\frac{c_1 \cdot c_2 \cdot c_{sp}}{(m_{axis}+m_{el}+m_{pol})[c_1 \cdot c_2 - c_{sp}(c_1+c_2)]} - \omega^2\right] + \left[\frac{\omega(в_{sp} - в_1 - в_2)}{m_{axis}+m_{el}+m_{pol}}\right]}}; \qquad (7)$$

$$F_0^{/} = \frac{F_0}{m_{axis}+m_{el}+m_{pol}};$$

Correspondingly, the specific oscillation frequency of the equipment component roller force:

$$f_x = \sqrt{\frac{c_1 \cdot c_2 \cdot c_{sp}}{(m_{axis}+m_{el}+m_{pol})[c_1 \cdot c_2 - c_{sp}(c_1+c_2)]}}; \qquad (8)$$

The numerical solution of the obtained (8) was performed at the following initial values of the parameters: $C_{sp}=(3,8\div4,5)\cdot10^3$ *N/m;* $C_1=(1,5\div2,4)\cdot10^3$*N/m;* $C_2=(1,8\div2,5)\cdot10^3$ *N/m;* $m_{axis}=(3,5\div4,5)\cdot10^{-2}$*kg;* $m_{el}=(2,0\div2,4)\cdot10^{-2}$*kg;*$m_{pol}=(0,6\div0,14)\cdot10^{-2}$*kg;* $b_{sp}=(3,0\div4,0)$ *Ns/m;* $b_1=(0,8\div1,1)$ *Ns/m;* $b_2=(0,7\div0,9)$ *Ns/m.*

LITERATURE:

1. Veselov V.V., Gorbunov I.D., Molkova I.V. 2007. A device for applying a liquid-phase polymer to sections of cut parts. Izvestiya vuzov. Technology of the textile industry. No. 3. Page 97-99.

2. Veselov V.V., Kolotilova G.V. 1999. Chemicalization of technological processes of sewing enterprises: Textbook / Edited by Veselov V.V. - Ivanovo: IGTA

3. Tashpulatov S.Sh. et al. 2014. A device for applying a polymer composition to clothing parts. Patent No. FAP00885, Bull. No. 3, Uzbekistan.

4. Djuraev A.J. et al. 2004. Mechanism and machine theory. Tashkent: G.Gulom, - 532 p.