ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 4 , April 2020

Analysis of studies of the angular movement of the lever rails in sewing machines

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ABSTRACT: The article provides an analysis of studies of the angular movement of the lever rails in sewing machines. In the analysis of studies of the mechanism of material movement, graphics are defined. The values of the parameters of the trajectory of the point of the staff rail of the lever mechanism for moving the material.

KEYWORDS: rail, material movement, trajectory, absolute speed, angular speeds and link accelerations, lever, mechanism, crank, connecting rod, amplitude, oscillations.

I.INTRODUCTION

One of the complex mechanisms used in sewing machines is the material movement mechanism. In order to reduce loads in the movement mechanism, elastic energy storage devices in the form of a torsion spring are used. An elastic energy storage device in the form of a spring is mounted on the displacement shaft in such a way that when the rack is moved in the opposite direction, the spring is twisted and accumulates excess dynamic energy. And during the movement of the material, the accumulated energy of the spring returns the feed to the shaft, and thus, when performing technological work, the drive for horizontal feed of the rack is partially or completely unloaded.

The material movement mechanism makes horizontal and vertical movement. In the proposed mechanism for moving the material, the rail 6 receives movement from the crank 1, the connecting rod 8 and the two-armed rocker 7 in the horizontal direction, and through the right crank 1, the connecting rod 2, the two-arm lever 3, the connecting rod 4 makes vertical movements.

When analyzing studies of the mechanism of material movement, the following graphs are formed:

- Patterns of changes in the movement of the rack lever from changes in the angular movement of the crank;
- Changes in the angular velocity of the rack arm as a function of angle;
- Patterns of changes in the angular movements of two shoulders levers (rocker) of movement and lifting;
- Dependences of the change in the angular displacement of the rack arm as a function of the angular displacement of the crank, etc.

In fig. 1a shows the law of the angular displacement of the rack arm as a function of the angular displacement of the crank, and in Fig. 1 b the angular speed of the rack lever with a variation in the length of the crank.

An analysis of the obtained graphs shows that with an increase in the length of the crank, the value of the angle of movement and the angular velocity of the rack arm increase. In this case, the oscillation frequency remains unchanged. So with the length of the crank and the amplitude of the oscillations reaches, and with the length of the crank the amplitude of the angular oscillations of the rack arm reaches 9.6. Accordingly, the values of the amplitudes of the angular velocity of the rod lever reaches and. It should be noted that the parameters of the two shoulders of the lever 7 provides horizontal movement of the rack 6, and the two shoulders of the lever (rocker) 3 and the connecting rod 4 provide the raising and lowering of the rack 6. In Fig. 2 a shows the patterns of change in the angular displacements of two shoulders levers (rocker arms) 3 and 7 from the angular displacement of cranks 1 and 2.

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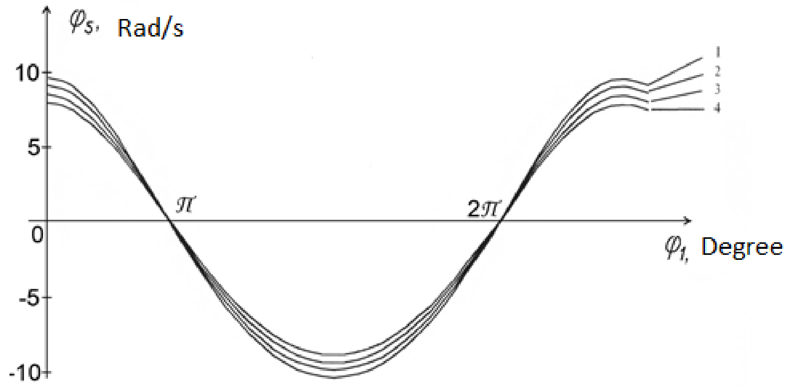
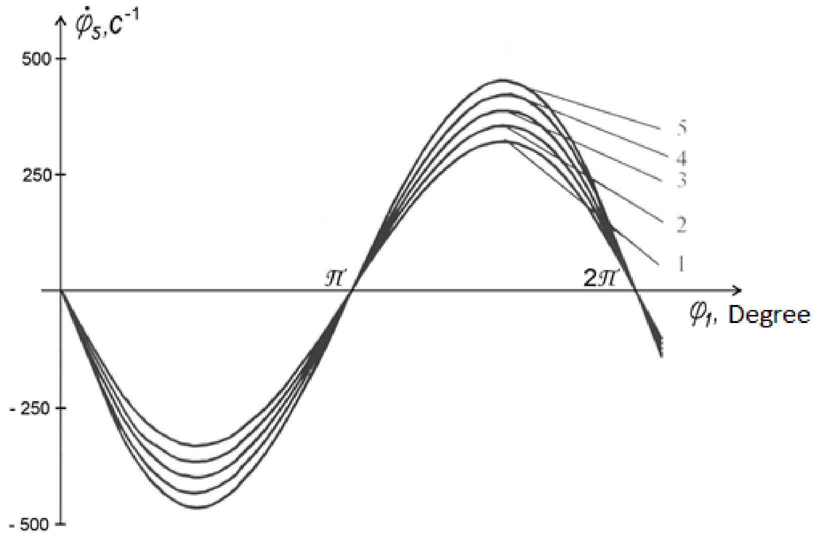


Patterns of changes in the movement of the rack lever from changes in the angular movement of the crank

Where, 1 - $l_1 = l_1^1 = 40 \cdot 10^{-3} м$; 3 - $l_1 = l_1^1 = 30 \cdot 10^{-3} м$;
2 - $l_1 = l_1^1 = 36 \cdot 10^{-3} м$; 4 - $l_1 = l_1^1 = 24 \cdot 10^{-3} м$;



Graphs of changes in the angular velocity of the rack arm as a function of angle φ_1

Where, 1 - $l_1 = l_1^1 = 24 \cdot 10^{-3} м$;
2 - $l_1 = l_1^1 = 28 \cdot 10^{-3} м$;
3 - $l_1 = l_1^1 = 32 \cdot 10^{-3} м$;
4 - $l_1 = l_1^1 = 36 \cdot 10^{-3} м$;
5 - $l_1 = l_1^1 = 40 \cdot 10^{-3} м$;

Fig. 1

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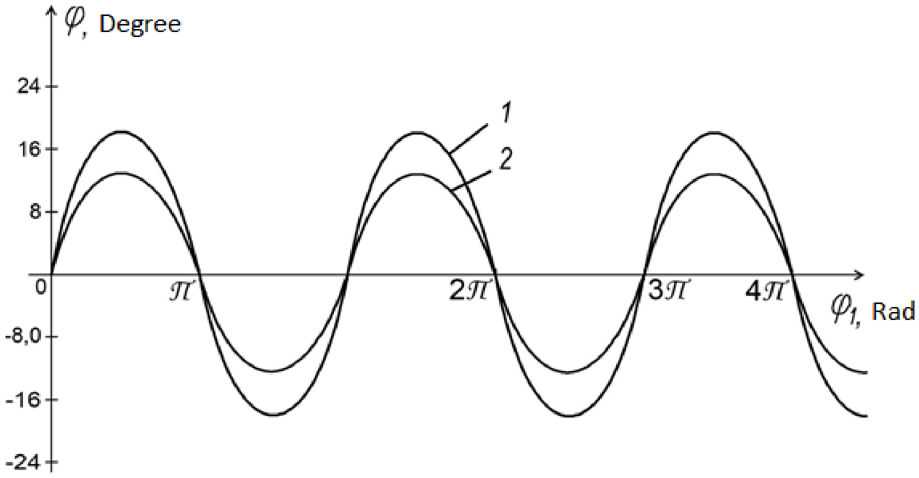
It can be seen from them that the oscillation frequency is the same, corresponding to one revolution of cranks 1 and 2. The vibration amplitude reaches 18.4, and the vibration amplitude reaches 13.7 with the calculated values of the parameters of the material moving mechanism. To reduce the amplitude of the oscillations, it is advisable to decrease the values, and to reduce the amplitude of the oscillations, it is necessary to decrease the values. By varying the lengths of the levers of the material transfer mechanism, it is possible to obtain changes in the patterns of angular movements of the lever 5 of the rack 6. Figure 2b shows the graphical dependences of the change in angular displacements as a function of the ratios of the length of the mechanism levers. It should be noted that with certain ratios of the length of the levers of the mechanism for moving the material of a closed type, the oscillation frequency can be changed. High frequency oscillations may also occur. This will be especially pronounced when the ratio changes. With a decrease in the ratio, the amplitude of the oscillations increases significantly. So when vibrating during one revolution, the crank occurs twice, and when the lever arm oscillates, it corresponds to the rotation cycle of the crank of the movement mechanism. An increase in the oscillation frequency leads to a change in the technological process of the formation of stitches, which is undesirable. With the ratio, the amplitude of the oscillations reaches 8.2, and with the amplitude of the oscillations of the rack arm decreases to 4.4. An increase in the amplitude of the oscillations leads to an increase in the pressure of the lath on the stitched material, and a decrease in the amplitude leads to a decrease in this pressure, thereby reducing friction between the lath and the material. To ensure the required pressure, the pressure between the rail and the material, as well as the oscillation frequency corresponding to the crank speed, is recommended values: Fig. Figure 3 shows the patterns of change in the angular displacement of the lever of the rack of the mechanism for moving the material when varying the ratios of the length of the rocker arm of horizontal movement to the length of the lever of the rack. With an increase in the length of the rocker arm, displacement leads to an increase in the amplitude of oscillations of the rack arm. With multiple ratios of the length of the levers of the movement mechanism, some additional oscillations arise, as well as some phase shift (see fig. 3a). An increase in the length of the connecting rod of the branch of horizontal movement relative to the length of the connecting rod of the branch of raising - lowering the rack from 0.7 to 1.7 times leads to a decrease in the amplitude of oscillations from 12.8 to 8.1. Moreover, the pattern is more complex (see fig. 3b).



a

Patterns of change of angular displacements of two shoulders levers (rocker) of movement and lifting

1 - $\varphi_7 = f(\varphi_1)$; 2 - $\varphi_3 = f(\varphi_1)$;

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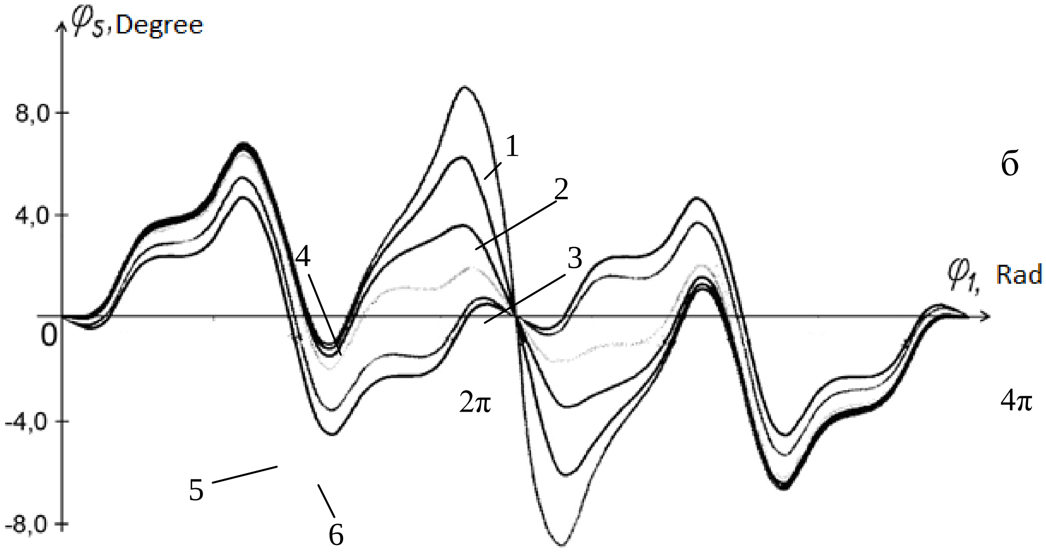

Dependences of the change in the angular displacement of the rack arm as a function of the angular displacement of the crank

1 - when $l_5/l_4 = 3{,}5$; 2 - when $l_5/l_4 = 4{,}5$;

3 - when $l_5/l_4 = 5{,}5$; 4 - when $l_5/l_4 = 6{,}0$;

5 - when $l_5/l_4 = 6{,}5$; 6 - when $l_5/l_4 = 7{,}0$;

Fig. 2

Given the above and the requirements of the technology for the formation of stitches when stitching materials using the recommended seven-link lever-hinged closed mechanism for moving materials, the path of the rail is important. Moreover, according to the solution of the problem, the angular displacements of the mechanism levers are obtained. For each position of the levers, one can determine the corresponding trajectories of the points of the links of the mechanism, so the elementary movement of the point M is determined $\Delta lm = \Delta\varphi_5 \cdot l_{HM}$. Accordingly, the elementary displacement of point M can also be determined from the side of the branch of raising and lowering the mechanism.

φ_5

Degree

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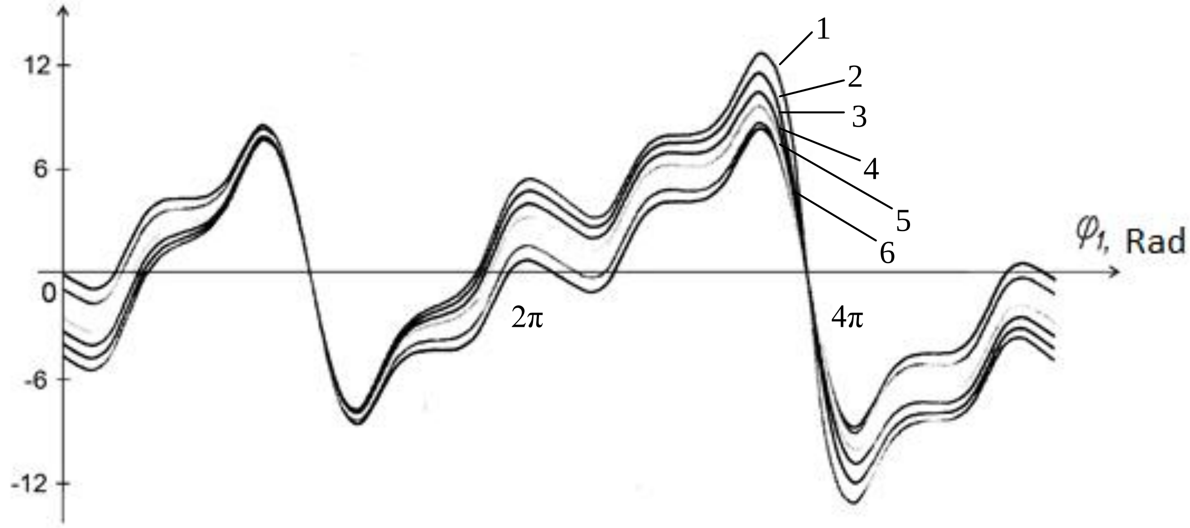
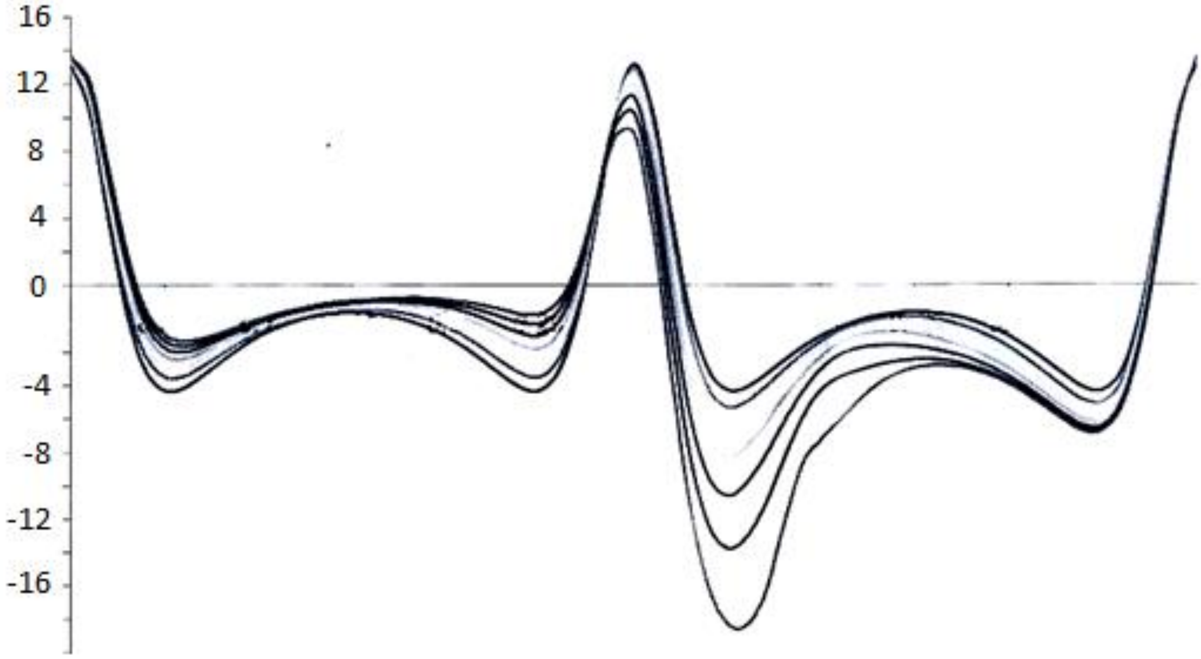


Dependences of the change in the angular displacement of the lever of the rail of the mechanism for moving the material from the change in the angle of rotation of the crank with variation l_7/l_5

Where, 1 – $l_7/l_5 = 6{,}2$; 2 - $l_7/l_5 = 5{,}6$; 3 - $l_7/l_5 = 5{,}0$;
4 - $l_7/l_5 = 4{,}0$; 5 - $l_7/l_5 = 3{,}5$; 6 - $l_7/l_5 = 3{,}0$.



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Where, 1 – $l_8/l_2 = 0,7$; 2 – $l_8/l_2 = 0,9$; 3 – $l_8/l_2 = 1,1$;
4 – $l_8/l_2 = 1,3$; 5 – $l_8/l_2 = 1,5$; в – $l_8/l_2 = 1,7$.

Fig. 3

For the considered options, we determined samples of the trajectory of the M rail point, which are presented in Fig. 4. So in fig. 4a shows the trajectory of the point M with the ratio, and in Fig. 4b, with the relation in Fig. 4c shows the trajectory of the points of the lever of the rail of the mechanism for moving the material with the ratio, and in Fig. 4e, with values of the length of the levers of the mechanism:. The analysis of the obtained motion trajectories shows that the variant in Fig. 4e is considered the most acceptable, in which the upper part is more smoothed to a straight line. This increases the area of contact of the rail with the material being moved, and horizontal movement of the stitched materials is ensured. Therefore, the selected parameter values for this option will be recommended.

The trajectory of the point of the rail of the lever of the mechanism for moving the material

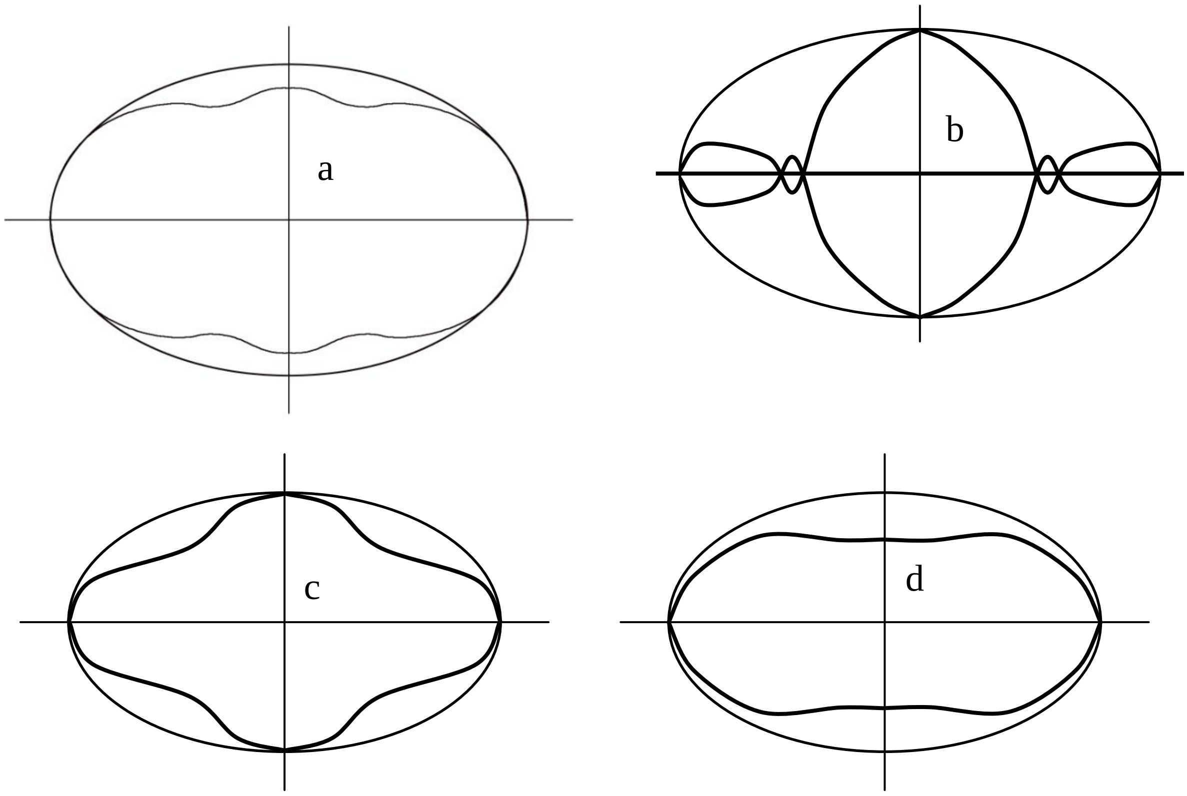

Fig. 2.12

II. CONCLUSION

A methodology for kinematic analysis of the material movement mechanism was developed taking into account changes in the length of the connecting rod and rocker arm with a rail. Formulas are obtained for determining the angular displacements of the connecting rod and beam with a rail. By numerical method, the regularities of changes in the angular displacement and angular velocity of the rocker arm with a rail as a function of the position of the crank of the material moving mechanism are obtained.

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