# Research of Dynamics Picking Mechanism of Sulzer Projectile Loom

A. Jomartov and K. Jomartova

***Abstract*—**One of the main and responsible units of **Sulzer** projectile loom is picking mechanism. It is specifically designed to accelerate projectile to speed of 25 m / s. Initial speed projectile of Sulzer projectile loom is independent of speed loom and determined the potential energy torsion rod. This paper investigates the dynamics picking mechanism of Sulzer projectile loom during its discharge. A result of calculation model, we obtain the law of motion lever of picking mechanism during its discharge. Construction of dynamic model the picking mechanism of Sulzer projectile loom on software complex SimulationX can make calculations for different thickness of torsion rods taking into account the backlashes in the connections, the dissipative forces and resistance forces

***Keywords*—**Dynamics, loom, picking mechanism, projectile, SimulationX.

## I. Introduction

ONE of the main and responsible units of Sulzer projectile loom is picking mechanism (See Fig. 1). It is specifically designed to accelerate projectile to speed of 25 m/s. Initial speed of projectile Sulzer projectile loom is independent of speed loom and determined the potential energy torsion rod. Acceleration of projectile of picking mechanism is due to the elasticity a twisted torsion steel rod, and at the time of acceleration and braking mechanism works independent of the other machine components, because in this period did not have the kinematic connection with main shaft machine. Picking mechanism is connected with the transmission of loom only during charging (twisted) of torsion rod and output from the power lock. Picking mechanism is sharply defined dynamic motion mode during acceleration and braking. Switching time of picking mechanism is 0.005-0.01s, depending on the setting of the initial angle of twist and the size of torsion rod. Picking mechanism is cyclical, high-speed mechanisms of variable structure with significant dynamic loads

## II. Picking Mechanism

Fig. 1 shows a scheme of the picking mechanism of Sulzer projectile looms. In the mechanism of the shaft 21 is rigidly fixed the picking cam one that continuously rotates clockwise. Under the shaft 21 is mounted three arms lever 2, being able to swing around a fixed axis. Three arms lever 2 is composed of two identical plates. Roller 17 mounted between the plates on the shaft, which is in contact with the picking cam 1. Upper lever arm 2 by rod 3 is connected with lug movable pipe 10, which is on both ends of the pins inserted in them with liners. Right liner installed in the fixed pipe 11 and the left - on the frame. In holes movable pipe 10 is mounted a torsion rod 9. One end of the torsion rod 9 is fixed by slotted joint in a moving pipe 10, and the other - in the clockwork coupling 12 to be installed in a fixed pipe 11. At the end of movable pipe 10 clamping bolts B is mounted picking lever 4. Picking lever 4 through rod 5 is connected to shoe 6, which may make forward movement on its tracks. Shoe 6 has lugs D, which it sets in motion a projectile 15. Acceleration projectile is carried out due to the elastic force of torsion rod of picking mechanism and is independent on the speed of rotation of the main shaft of loom.

In each period of motion of the main shaft, torsion rod is twisted by cam mechanism and accumulates potential energy of elastic deformation. This energy of the torsion rod transmits motion to the links of the mechanism and projectile. The value of the potential energy depends on the angle of twist and torsion rod diameter.

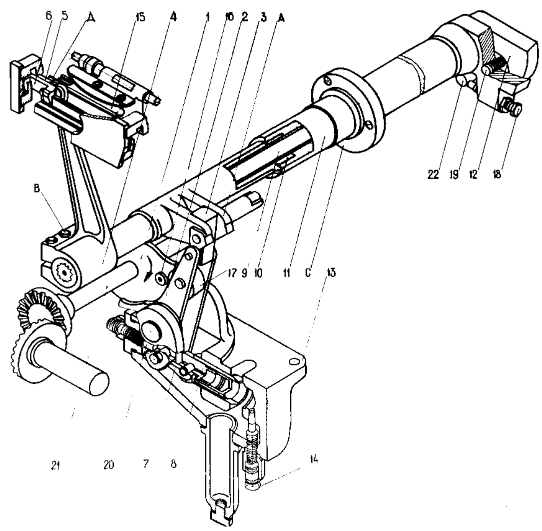


Fig. 1 Picking mechanism of Sulzer projectile loom

Kinetic energy of the picking mechanism is damped special amortizable device, made in the form of oil cataracts 13. Oil

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cataracts 13 is a plunger 8, pivotally connected to a lever system 7 picking mechanism and enters during braking into the cylinder. Amount of braking of oil cataracts is changed by the adjusting needle 14.

Full period of work of picking mechanism consists of four separate processes: charging the torsion rod; outputting of mechanism from a dead Charging the torsion rod; discharge (unwinding) of the torsion rod and acceleration of projectile; braking of mechanism.

## III. Dynamic Model of Picking Mechanism

For modeling the movement of picking mechanism during its discharge (See Fig.2), we represent it as an equivalent scheme [1]-[4], shown in Fig. 3. Scheme contains the torsion rod and a movable pipe. Fixed pipe is presented as anchorage end torsion.

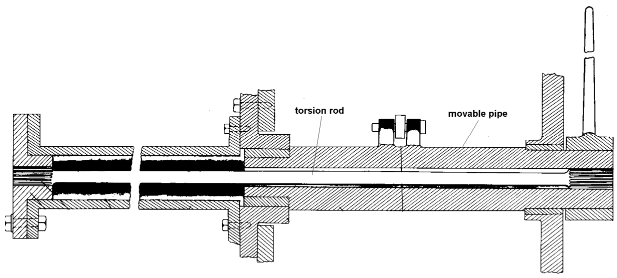


Fig. 2 Scheme of picking mechanism

Moments of inertia of the picking mechanism presented in the form of discs 1 and 2 with the reduced moment of inertia $J_1 = J_1(\varphi), J_2 = J_2(\varphi_2)$. By disc 2 is applied reduced torque resistance by an oil plunger $M_C(\varphi_2)$.

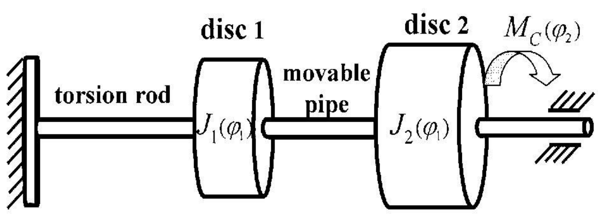


Fig. 3 Equivalent scheme of picking mechanism

For the dynamic analysis of the picking mechanism are using software system SimulationX.

SimulationX is a simulation software for physical system simulation, developed and sold commercially by ITI GmbH, based in Dresden, Germany [5]. Scientists and engineers in industry and education use the tool for the design, analysis and virtual testing of complex mechatronics systems, as the software models the interaction of components from a multitude of domains including their mutual interaction and feedback on one platform. ITI launched SimulationX, the successor of ITI-SIM, in 2000 in response to rising demand for system simulation.

Fig.4 shows the dynamic model of the picking mechanism of Sulzer projectile loom for a period of discharge in SimulationX,

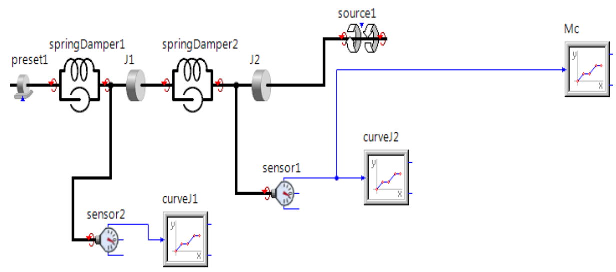


Fig. 4 Dynamic model of the picking mechanism of Sulzer projectile loom

The calculation was made for picking mechanism with torsion rod in diameter 15 mm and twisted by 31 degrees. Torsion stiffness is 590 $Nm/rad$, a movable pipe stiffness is 80911 $Nm/rad$.

Diagrams of reduced moments inertia

$J_1 = J_1(\varphi), J_2 = J_2(\varphi_2)$ [6], [7] are shown in Fig. 5 and Fig. 6 respectively. Reduced moment of force of resistance from the oil plunger $M_C(\varphi_2)$ [7] is shown in Fig. 7.

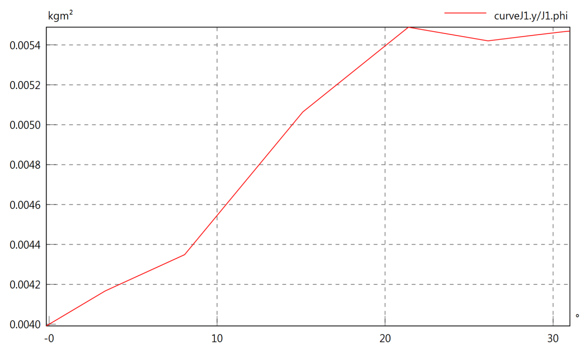


Fig. 5 Reduced moment inertia $J_1 = J_1(\varphi)$

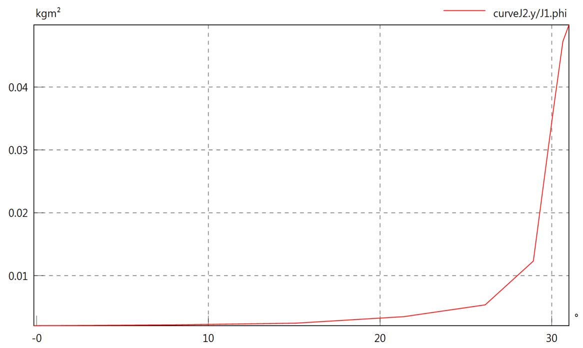


Fig. 6 Reduced moment inertia $J_2 = J_2(\varphi_2)$

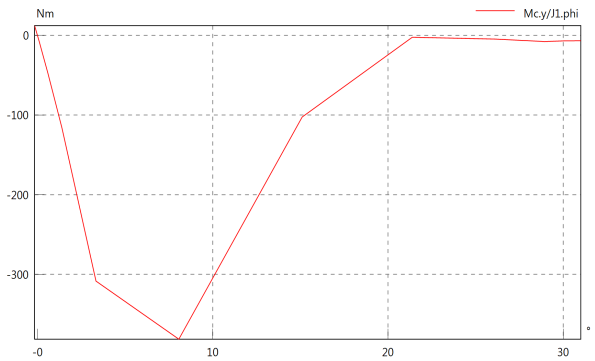


Fig. 7 Reduced moment of force of resistance from the oil plunger $M_C = M_C(\varphi_2)$

## IV. Results of Modeling

We obtained the law of motion of lever of picking mechanism during its discharge. Fig. 8 shows a diagram of angular displacement of lever of picking mechanism during its discharge. Fig. 9 and Fig. 10 show diagram of the angular velocity and acceleration of lever of picking mechanism during its discharge.

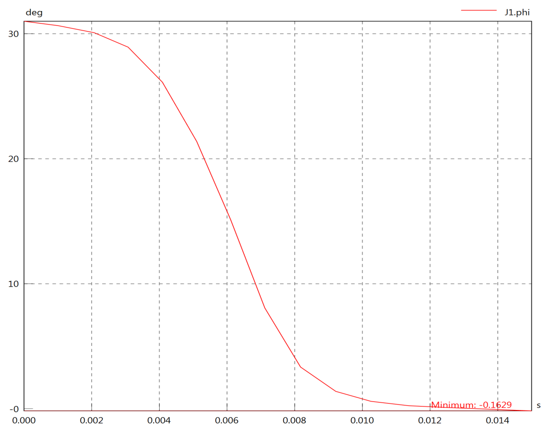


Fig. 8 Angular displacement of lever of picking mechanism during its discharge

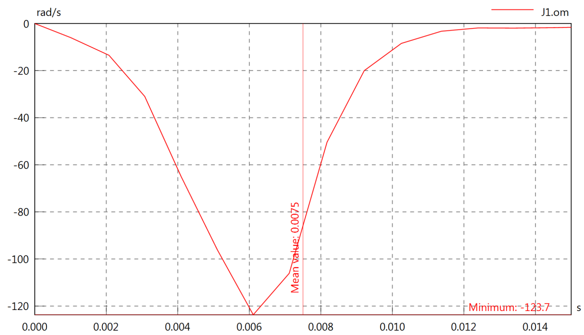


Fig. 9 Angular velocity of lever of picking mechanism during its discharge

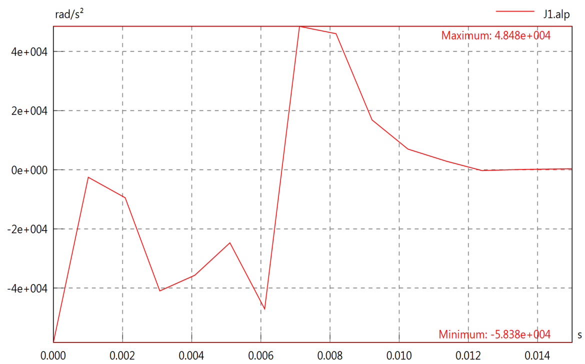


Fig. 10 Angular acceleration of lever of the picking mechanism during its discharge

Fig. 11 and Fig. 12 show a diagram of angular displacement and angular velocity of a movable pipe of picking mechanism during its discharge.

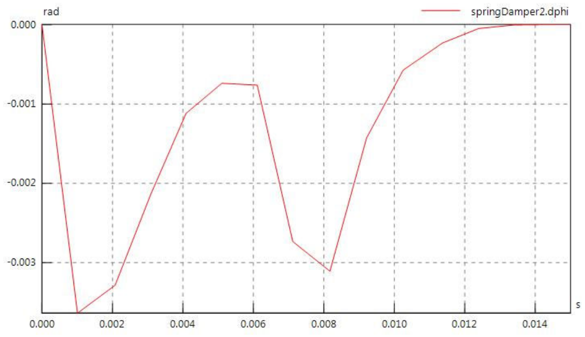


Fig. 11 Angular displacement of a movable pipe

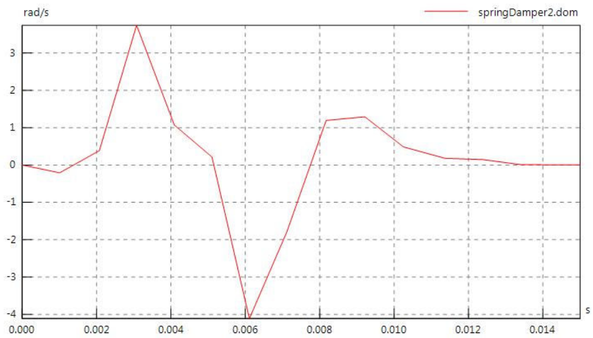


Fig. 12 Angular velocity of a movable pipe

Fig.13 and Fig. 14 shows a diagram of change of potentional energy of torsion rod and a movable pipe of picking mechanism during its discharge. Fig. 15 shows a diagram of change of spring torque of torsion rod.

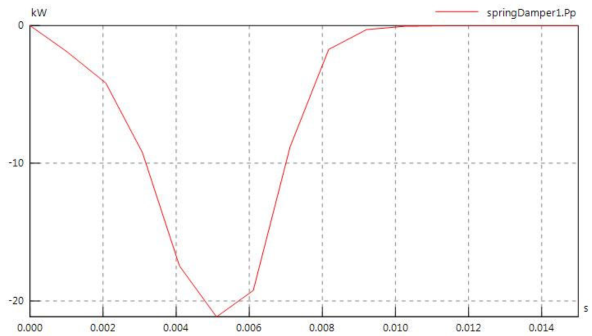


Fig. 13 Change of potentional energy of torsion rod

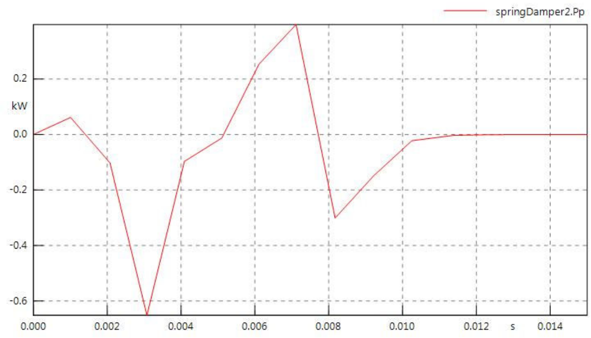


Fig. 14 Change of potentional energy of a movable pipe

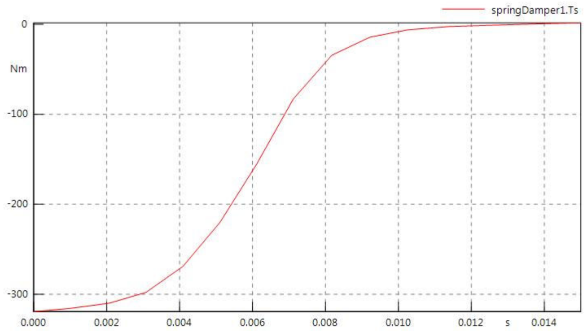


Fig.15 Change of spring torque of torsion rod

Table I shows the natural frequencies and modes of the picking mechanism. In Fig. 16 shows a diagram of Campbell.

TABLE I
NATURAL FREQUENCIES AND MODES\NATURAL FREQUENCIES

| No. | Value | f[Hz] undamped | f[Hz] undamped | D[-] | Time constant [s] |
|---|---|---|---|---|---|
| f1 | -19.663± 312.38i | 49.816 | 49.717 | 0.062822 | 0.-50856 |
| T1 | -3388.3 | | | | 0.00029514 |
| T2 | -17712 | | | | 5.6459E-005 |

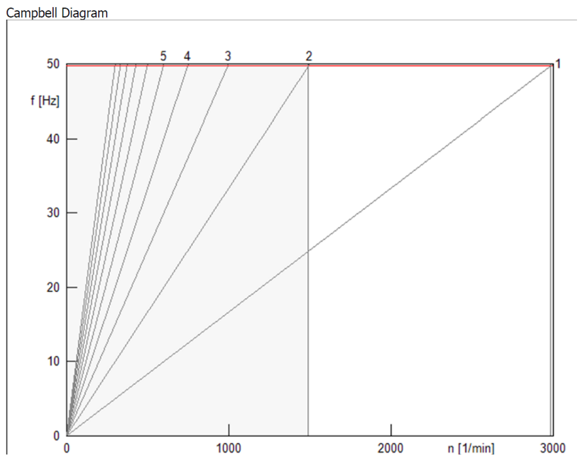


Fig. 16 Diagram of Campbell

## V. Conclusion

As shown in Fig. 6 maximum angular velocity of lever of picking mechanism is $\omega = 123.7 rad / c$ at $t = 0.006\ c$. Projectile of weft starts flying at a speed $V = 22.89\ m / c$ at the time $t = 0.006\ c$, in good agreement with experimental results shown are in [7].

Construction of dynamic model the picking mechanism of Sulzer projectile loom on software complex SimulationX can make calculations for different thickness of torsion rods taking into account the backlashes in the connections, the dissipative forces and resistance forces.

The necessary results can be obtained in a graphical form and carry out automatically analyze the natural frequencies and mode shapes.

## References

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