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ANALYSIS OF THE QUALITY OF THE CRANE ROTATION MECHANISM DEPENDING ON THE INFLEXIBILITY OF ITS ELEMENTS

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During the operation of portal cranes, insufficient controllability of the rotation mechanism was noted. The operation of the rotation mechanism is accompanied by large, slowly damped oscillations of the rotary part [1, 2]. This phenomenon makes it difficult to orient the load handling device, leads to increased dynamism and deteriorates the reliability of the rotation mechanism. The operating mode of the rotation mechanism shows that the fluency of its operation is affected by the inertia due to the boom system of the crane at large outreaches. The design of the rotation mechanism includes gears, shafts, couplings and is a flexible nexus. This flexible nexus partially absorbs the engine torque and does not allow for an absolute feedback between the control link – the motor and the controlled link – the rotary element of the crane. If you change the inflexibility of the drive, you can get a different quality of control. Therefore, a study was made of the rigidity of the rotation mechanism [3, 4].

The object of research is a gantry reloading crane. The study was carried out on the basis of a mathematical model, which was obtained after differentiating the equations of crane motion. The study of the crane rotation mechanism was carried out within 35 seconds from engine start to stable operation of the mechanism. The start-up time was five seconds. As a result of the study, the main criteria for the quality of the mechanism were determined. This is the motor torque, the angular speed of the motor shaft, the angular speed of the slewing part of the crane, the angle of deflection of the load from the swing plane of the boom. The variable parameter was the inflixibility of the rotation mechanism.

It was found in the work that the inflixibility of the portal edge rotation mechanism has a significant effect on the angular speed of the engine, the slewing part of the crane, and causes high-frequency fluctuations in the engine torque, especially during the acceleration period (fig. 1). Low-frequency oscillations of the motor torque of a sinusoidal nature are caused by large values of the moment of inertia of the rotating masses (fig. 2).

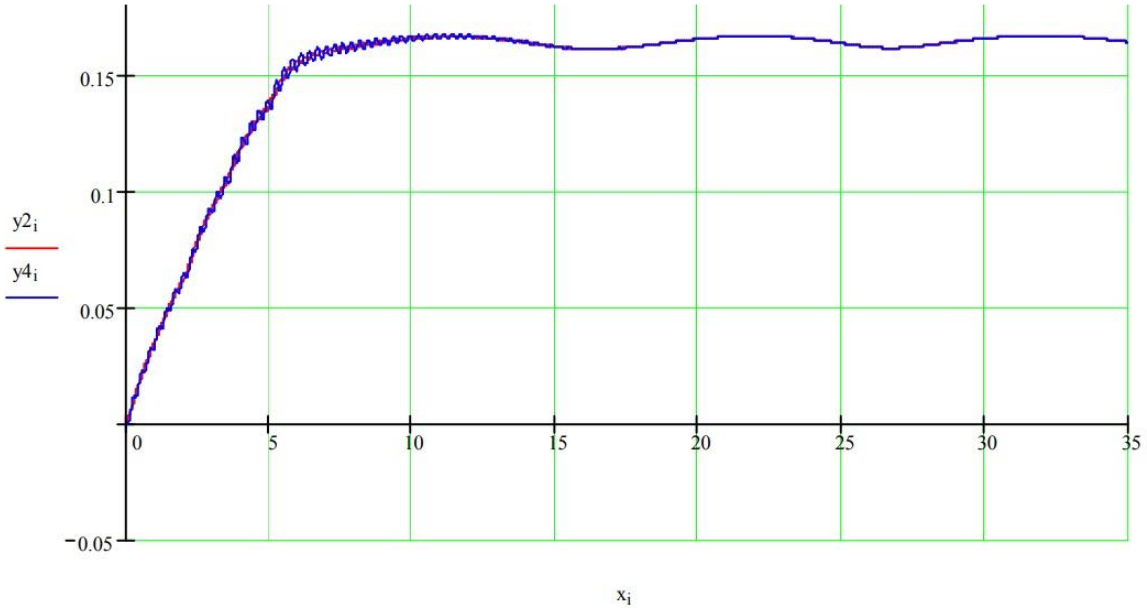

Fig. 1. **Diagram of the dependence of the angular speed of the engine shaft to the axis of rotation of the crane and the angular speed of the slewing part on the turning time**
[author's development]

It is recommended that when creating new cranes and upgrading, it is imperative to calculate the stiffness and check its effect on the main parameters of the crane.

To improve the performance of the engine, you can set the feedback on the engine torque, so that its speed is not constant, but changes depending on the load on the engine. This will make it possible to avoid high-frequency fluctuations in the engine torque.

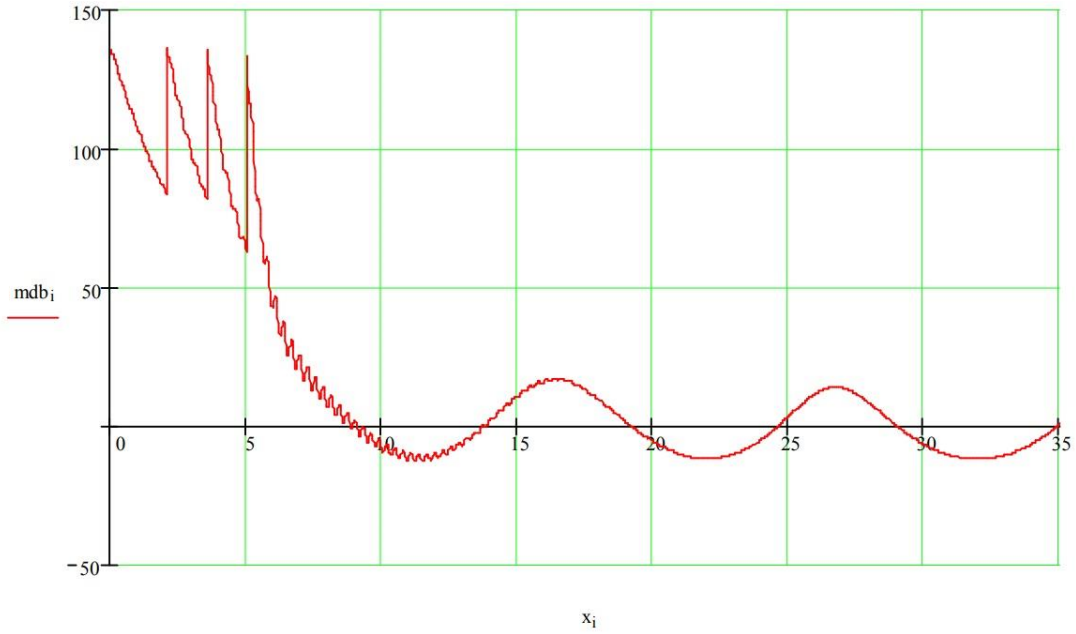

Fig. 2. **Diagram of the dependence of the engine torque on the turning time**
[author's development]

Braking can be made stepwise, so that the speed is reduced to a stop in several stages. This will make braking smoother and minimize dynamic shock when the crane stops swinging.

References:

[1] Suglobov, V. & Tkachuk, K. (2019). Analiz avariinosti mekhanizmiv i opornykh vuzliv portalnykh kraniv. *Innovatsiini priorytety rozvytku naukovykh znan: Proceedings of the Conference*. March, 30, 2019, Kyiv, UA [ukr] http://molodyvcheny.in.ua/files/conf/other/34march2019/34march2019.pdf#page=145

[2] Kovalenko, V. A., Bernikov, D. O., Moiseenko, A. F. (2015). Puti povyshenija nadezhnosti raboty mehanizma izmenenija vyleta portal'nyh kranov. *Mashynobuduvannia,* (15), 18-27. [rus] http://nbuv.gov.ua/UJRN/Mashbud_2015_15_5

[3] Nezhencev, A. (2021) Ustrojstvo dlja dinamicheskogo tormozhenija mehanizmov gruzopodemnyh kranov. *The XIV International Science Conference «Current issues of modern science and practice»*, May 17 – 19, 2021, Rome, Italy [rus] https://eu-conf.com/wp-content/uploads/2021/05/XIV-Conference-Current-issues-of-modern-science-and-practice.pdf#page=199

[4] Bazil', Sh., Savich, S. (2010). Jenergeticheskie pokazateli asinhronnyh jelektroprivodov mehanizmov povorota. *Elektrotekhnichni ta kompiuterni systemy,* (1), 41-44. [rus] http://nbuv.gov.ua/UJRN/etks_2010_1_9.