RESEARCH OF KINEMATIC AND STRUCTURAL PARAMETERS OF WORKING TOOLS WHEN PROCESSING THE CYLINDER LINERS

ИССЛЕДОВАНИЕ КИНЕМАТИЧЕСКИХ И КОНСТРУКТИВНЫХ ПАРАМЕТРОВ РАБОЧЕГО ИНСТРУМЕНТА ПРИ ОБРАБОТКЕ ГИЛЬЗ ЦИЛИНДРОВ

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Abstract: *Viewed the theoretical questions regarding the kinematic and structural parameters of the working tool when rolling out the cylinder liner.*
KEYWORDS*: TEHNOLOGIES, CYLINDER LINER, SURFACE LAYER, ROLLIN, DEFORMATION.*

1. Introduction

One of the key technological issues that increase the durability and technical readiness of the engines is using of progressive technological processes of details` recovering that enhance the quality of recovery and, accordingly, the resource of refurbished machines.

The quality of the treated surface of the part is largely determined by the type of processing workflow. The condition of the surface layer determines the processes arising from the interaction of the machining tool with the treated surface. The quality of the surface layer of parts has a significant impact on the performance parts, assembly units of the machine. In this regard, the research questions at the option of the kinematic and structural parameters of the working tool when rolling out the cylinder liners are relevant.

2. Preconditions and means for resolving the problem

The surface layer of the processed material of details endowed with excess energy, as the surface atoms and molecules because of the presence of dangling bonds promote occurrence of phenomena such as adhesion, sticking, due to which the surface layer acquires a special structure.

The surface layer is formed by different processes that impart desired surface shape, material properties, and also cause a change in properties at the surface of the items. At the same time physical parameters of the surface layers, the structure is largely different from those of the rest of the workpiece material.

One of the promising technological processes, which considerably enhance the physical properties of the surface layer, is a combined method of treatment by rolling the cylinder liners in combination with an anti-friction treatment. This method allows not only to harden the surface layer but also obtain more ductile copper coating which reduces the friction coefficient and accordingly to improve durability of the entire node [1].

3. Results and discussion

One of the reasons that hinder the implementation process at the repair facilities for rolling cylinder liners is the relative complexity and lack of study of the kinematics of these tools. In the course of studying the literature [2, 3], it can be concluded that the productivity of the process depends on the kinematic scheme of rolling operation.

Thus, according to G.M. Azarevich and G.S. Bernstein [2, 3] there are several possible options for rolling liners depending on the driving member and the availability of zero speed at individual units.

Considering applied rolling scheme under the condition (Fig.1): unrolling (ball) is rotated (n_t); housing (separator) revolves with balls (n_s); processed liner is fixed ($n_{liner} = 0$); unrolling has forced displacement (S) along the axis of the liner; sliding of balls missing.

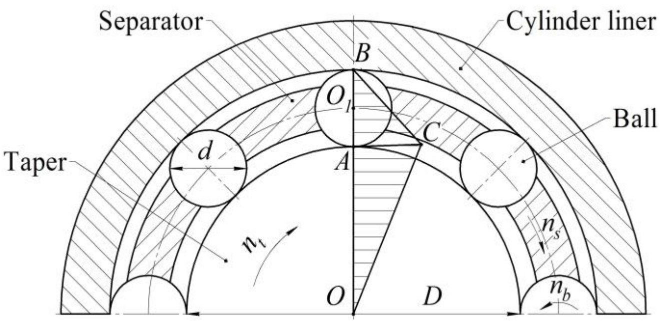

Figure 1. Scheme of rolling of liner by rotating tool

In this scheme, the linear velocity of the point A can be defined by mathematical expression:

$$V_A = \omega_b \cdot R = \frac{\pi n_t}{30} R = \frac{\pi n_t d}{60}, \tag{1}$$

where d – diameter of the ball; n_t – speed of rolling taper; ω_b – the angular velocity of the ball; R – radius of the ball.

At the same time the speed of the ball V_b at point A is numerically equal to the speed of rolling and defines by the vector:

$$V_b = \overline{V_t} = \overline{AC}. \tag{2}$$

The absolute velocity of the center of the ball O_1 is:

$$V_{O_1} = \frac{V_b}{2} = \frac{\pi n_t d}{120}. \tag{3}$$

Velocity of the center of ball is equal to its carrying speed. Point B is the instantaneous center of velocity for the ball. Then build the velocity profile for the ball, connect the dots in the end of the vector AC. The relative angular velocity of the ball is equal to:

$$\omega_b^r = V_A \cdot d = \frac{\pi n_b^r}{30}. \tag{4}$$

From this we can find the speed of the relative motion of the ball:

$$n_b^r = \frac{30 V_A \cdot d}{\pi}. \tag{5}$$

Rotational speed of the ball in a figurative movement is:

$$n_b^c = \frac{n_b}{2}\left(\frac{D-2d}{D-d}\right). \tag{6}$$

The rate of deformation of the liner is defined as the drive speed of the point of contact between the ball and the deformable surface:

$$V_d = \pi D \frac{n_b}{2}\left(\frac{D-2d}{D-d}\right). \tag{7}$$

Kinematic parameters of rolling and experimental results allow us to determine the process parameters of rolling for getting optimal roughness and physical and mechanical properties of the surface (Table 1).

Table 1. Technological parameters of rolling of cylinder liners

Parameters	Value
Roughness before treatment, microns	0,63
Rotational speed of rolling, rpm	500
Radial feed, mm	0,12
Feed of rolling on turnover, mm/r	0,1
The magnitude of interference, mm	0,1
Speed of rolling, m/mm	144

4. Conclusion

In the static indentation of the ball in the deformable surface remains the imprint that in the process of rolling passes in the trace of the deformed portion of the ball. The collection of such traces and forms the final roughness of the machined surface.

5. Literature

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