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L. Ravenets, I. Marchuk, S. Grinyuk, A.M. Eshteivi
Lutsk National Technical University

TECHNOLOGICAL PROCESSING SYSTEM SUPERFINISHING RACEWAYS RINGS ROLLER BEARINGS

The most appropriate method of treatment, which increases the load carrying ability, and corrects the errors of the surface shape of the workpiece geometry in cross section, a superfinishing.

Setting up the machine according to standard procedures do not take into account the phenomenon of technological heredity deviations of form and often does not provide precision machining that is required.

The study analyzed the existing methods and devices for superfinishing processing poverhnotey rotation in order to use a number of technical solutions used in the processing of roller rings.

Keywords: *technological sequence, superfinishing, ultrasonic vibrations.*

Introduction. One of the major problems of modern engineering is to increase the durability and reliability of the machines. So take relevance high demands on the performance properties of parts when choosing a method of finishing treatment.

There are many methods for fair treatment of the working surfaces of parts but not all methods provide high performance surface details. Processes such as fine grinding, diamond proof, break-surfaces roller, diamond burnishing, polishing provides a significant reduction in surface roughness. However, most of these methods are ineffective in the case where the desired geometry correction and increasing the bearing surface mating parts.

The most appropriate method of final processing, which effectively increases the bearing surface and corrects the error of surface geometry detail in cross section are superfinishing. When superfinishing, including enhanced dimensional accuracy, increased residual compressive stress and toughness contact details, reduced surface roughness and initial depreciation that would reduce parts wear during operation, longer life and precision machinery.

Main content. A detailed analysis of the advantages and disadvantages of the traditional methods of honing and superfinishing processing in scientific papers [1, 2, 3] (Tab. 1), which surely proves that the advantages of the abrasive block processing include:

- grinding in the bar to the treated surface, which allows processing pieces of geometric errors, much less than the value allowance, which was withdrawn;
- self-cleaning bar of chips and sludge that enhances the removal of metal and increases productivity processing;
- the ability to significantly reduce the surface roughness and waviness components;
- low temperature in the contact zone, no risk of thermal defects in the surface layer parts.

The main disadvantages of the process squared blasting shall take the following:

- relatively low productivity (120-200 pieces per hour), especially during the high surface roughness pieces;
- high sensitivity to the quality of the original surface of the workpiece;
- low degree of removal of the irregularities of low frequency (ovality, grandest);
- the need for processing several technical transitions, which significantly complicates the design of the equipment and increases its cost;
- low versatility of technological equipment;
- the complexity of setting up the equipment, the need to attract highly qualified fitters, the need for frequent tuning due to high wear of the bar.

These disadvantages of the process squared abrasion necessitate its improvement. A radical solution of this problem is the development of the implementation process of bar abrasive processing and creation on this basis of new technological equipment.

Quite a lot of developments in advanced methods in the process of honing the details [4, 5], namely vibration honing [3], electrochemical honing, galvanic honing [4], diamond vibration slotted honing [3], flat-summit honing [4], honing on a slope, covering honing cylindrical surfaces, diamond honing limited spherical surfaces, etc .. [3.5, etc ..], but a closer look at technical solutions to improve the efficiency superfinishing processing details.

The results of the research. One of the ways to intensify the process of superfinishing is imposed on the bar ultrasonic vibrations. A device that provides this method of treatment is shown in figure 1., this acoustic unit consisting of the magnetostrictors 4 and concentrator 5, which converts the electrical vibrations into mechanical ultrasonic generator.

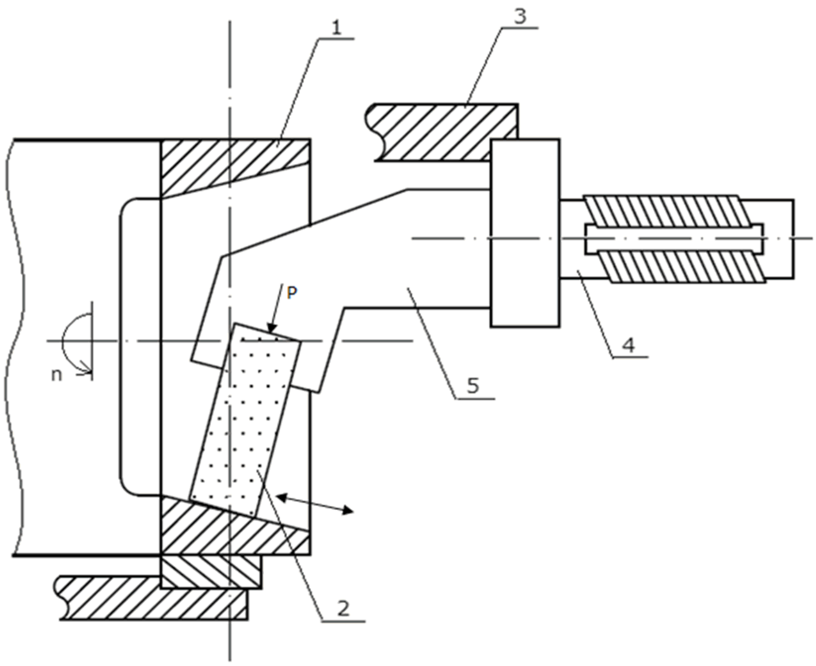

Fig. 1. Device for processing of the raceways of roller bearing rings superimposed on the whetstone (bar) of ultrasonic vibrations.

Node is attached to the lapping knob 3. Ring 1, 2 superfinish whetstone (bar), attached to the concentrator 5, which transmits the ultrasonic vibrations. As shown in fig. 2, overlay bar ultrasonic vibrations under the same conditions of treatment (v_{rin}=120 m/min., n_{br}=7 Hz, bar 63sm10) degrades specific tangential component of cutting force in P 1,3-2 times.

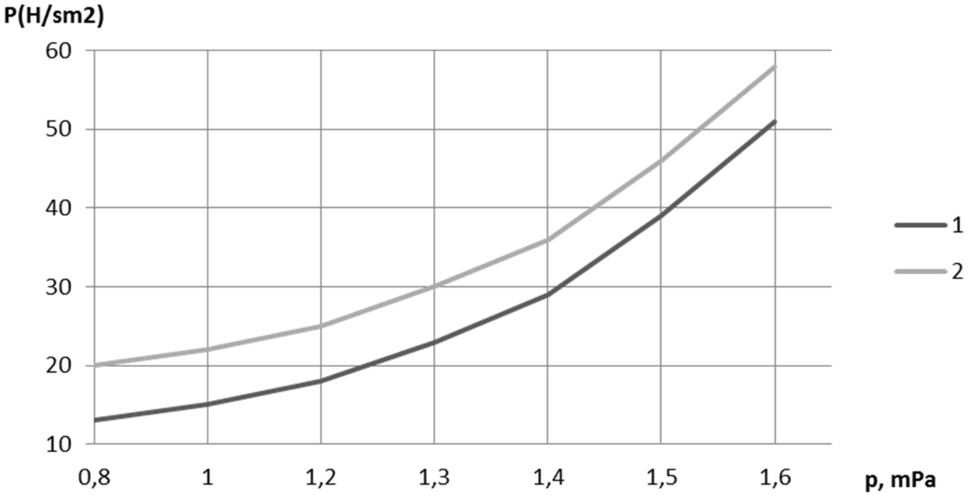

Fig. 2. The dependence of the tangential component of cutting force P from the onslaught whetstone: 1 – superfinishing in the usual way; 2 – superfinishing with ultrasonic vibrations.

Using ultrasound creates favorable conditions for the cutoff and grinding chips, waste cutting area, contribute to the improvement of self-sharpening whetstone (bar) and eliminating sticking to its surface. Said phenomenon is best shown by the example of the study of cutting forces during superfinishing.

In fact, the imposition of a bar of ultrasonic vibrations facilitates cutting conditions and improves self-sharpening of the bar indicates the feasibility of using this method of treatment during superfinishing components from materials that are difficult to process, have low hardness and high ductility (non-ferrous, titanium, superalloys, stainless steel, etc.). The main issue during superfinishing these materials in the usual way of education, the buildup of metal on the cutting surface of the bar which lead to the deterioration of surface quality due to the appearance of a separate, deep scratches and breaks. The use of ultrasonic superfinishing for machining bronze, steel 45, steel SH 15 and 40X steel bars 63SM2K provided that the pressure 0,2 MPa, longitudinal feed 0,5 м/min, the frequency of rotation of the ring n=800-900min^{-1}, the frequency of oscillation of the bar13-15 Hz indicates that the use of ultrasound allows to increase the removal rate of steel SH 15 and heat-resistant steel 40X (see Fig. 3). During the cutting surface of the bar without sticking of the metal, which makes it possible to provide uniform surface treatment without defects.

A series of experimental studies of superfinishing surfaces of rotation superimposed on the bar of ultrasonic vibrations. The experimental studies conducted on production, established important regularities of this process during the processing of the raceways of roller bearing steel SH 15 (62-65 HRC). The frequency of ultrasonic vibrations is 24 kHz. Overlay bar of ultrasonic vibrations allows cutting circular speed items more than 120 m/min. Magnification v_{rin} from 120 to 240 m/min makes it possible to increase the intensity of metal removal in 2 times, due to the increase in the amplitude of ultrasonic oscillations from 2 to 4 mkm processing performance Q_2 зростає на 40-50% (Fig. 4.) Similar to superfinishing in the usual way increase the graininess of the bar leads to increase the performance of metal removal as well as during processing superimposed on the bar of ultrasonic vibrations. It should be noted that the influence of ultrasonic vibrations is determined in the same manner as the influence of the oscillation frequency of the bar. The influence of the pressure of the bar 63SM14SM2KL (v_{rin}= 250 м/min, a_{us} = 3,8 mkm, n_{br}= 8 Hz) the intensity of metal removal during ultrasonic superfinishing be described:

p, MPa 0,8 1,4 1,6 1,8

Q_2, mm^3/s............................ 0,88 1,22 1,48 1,82

Thus, the increased pressure leads to increased metal removal intensity (Fig. 3, Fig. 4) is similar superfinishing the usual way.

When superfinishing of ultrasonic vibrations should be used bars which have hardness SM1, SM2. The use of softer bars leads to intense shedding and harder to clogging, and therefore to decrease and increase output of metal machined surface roughness.

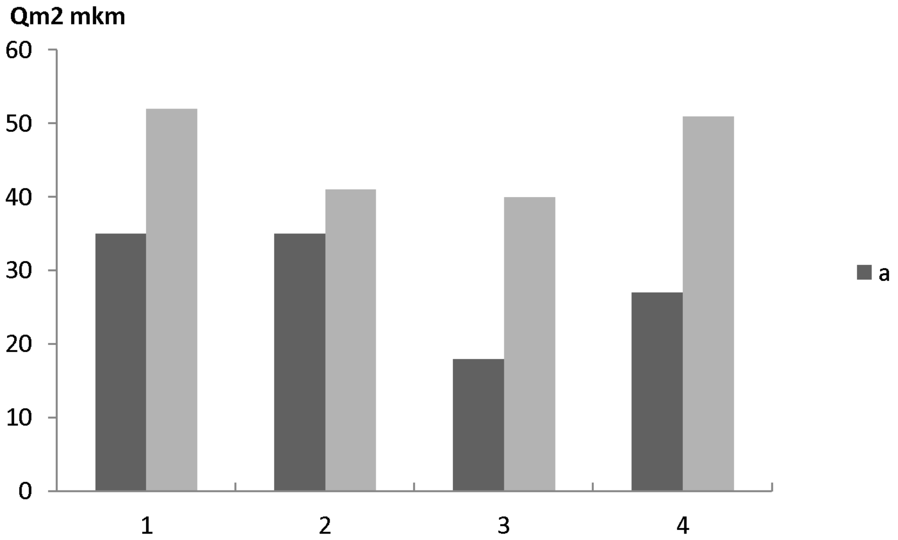

Fig. 3. Metal removal at superfinishing various materials: 1 - bronze, 2 - steel 45; 3-steel 40X, 4-steel SHKH15; a - superfinishing in the usual way, b - superfinishing with ultrasonic vibrations.

Superfinishing with ultrasonic vibrations is carried out in a two-stage cycle. In the second mode (friction-polishing), ultrasonic vibrations are switched off. Due to the greater hardness of the bar process translates easily from mode cutting mode of the friction-polishing under the following parameters: v_{rin}= 250 м/min, n_{br}= 8 Hz, p =1,1 MPa.

In some cases, the transition to the regime of friction – polishing off quite only ultrasonic vibrations without changing other parameters. The roughness of the machined surface during treatment with ultrasonic vibrations (cutting mode) depends on the grain bar, pie rate details amplitude of ultrasonic vibrations and does not depend on the pressure bar. This is because the ultrasonic vibrations directed along the normal to the surface and their impact on the micro-relief surfaces is more significant than the effect of pressure bar.

The dependence of the roughness of the machined surface of hardened steel from the processing parameters and grain bars are given in table. 1. As the table shows, the increase in the amplitude of ultrasonic vibrations by 33% leads to an increase of the roughness parameter R_a at 28-33%. Superfinishing in the regime of friction-polishing is recommended with off ultrasonic vibrations only when you have the following options: v_{rin}= 250 м/min, n_{br}= 8 Hz, p =1,1 MPa.

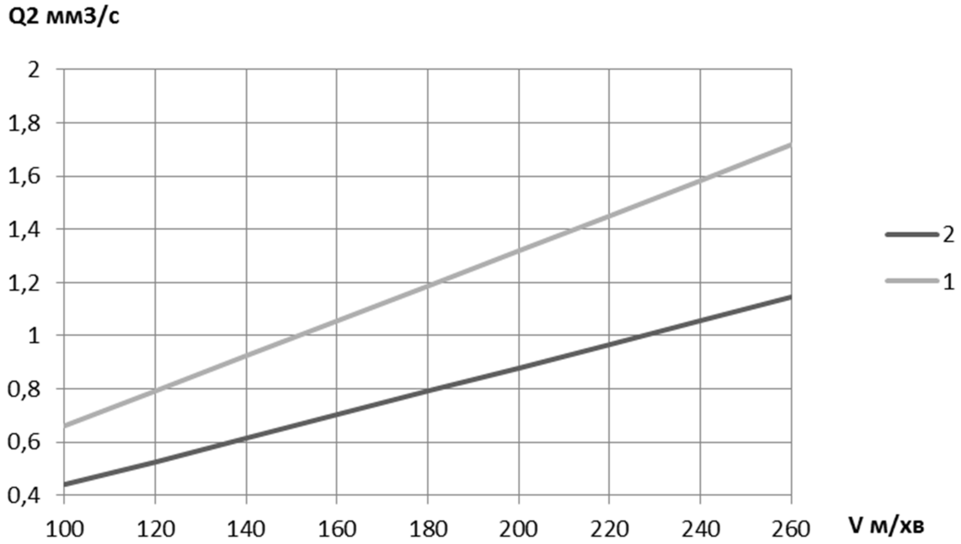

Fig. 4. Dependence of intensity of metal removal Q_2 from the circular speed details v_{rin} and amplitude of ultrasonic vibrations a_{us} (bar 63SM14SM2KL, p=1,8 MPa)

Superfinishing with ultrasonic vibrations, the same superfinish familiar pattern, provides a waviness of 0.05-0.1 mkm. Treatment with ultrasonic vibrations in dvostupenevy cycle contributes to the hardness of the surface layer of metal by 60-80%.

Table 1

The dependence of the roughness of the machined surface of hardened steel from the processing parameters and grain bar (cutting mode)

The peripheral speed of the part, m/min	The roughness parameter					
	a_{us} = 3 mkm			a_{us} = 4 mkm		
	M10	M14	M30	M10	M14	M30
120	0,09	0,13	0,21	0,12	0,18	0,28
160	0,08	0,11	0,18	0,10	0,15	0,23
200	0,07	0,10	0,16	0,09	0,13	0,21
240	0,06	0,09	0,14	0,08	0,12	0,18

For example if the initial hardness of 6200-6400 MPa after processing grain bars M10-M30 hardness increased according to 9700-11250 MPa. Intense increase hardness during processing ultrasonic vibrations compared to treating the usual way due to the increased level of libel as a result that ultrasonic vibrations of the bar directed normal to the surface, which is subjected to treatment.

Conclusions. Research and practice superfinishing found that during processing on machines provided superfinish decrease surface roughness increases the bearing surface area increases the accuracy of size, surface microhardness increases, the error is corrected form (details nekruhlist profile) and waviness is eliminated. However, the processing of parts with greater detail or size of the ovality with cut with a small number of faces, requires greater investment of time and their alignment minor.

Defects of the part profile in the longitudinal section: manuaalisesti, gnutt, bulge during the classic superfinishing almost impossible to solve.

When superfinishing external surfaces of shafts, especially if the surface treatment is limited sides (including indigenous and neck crank crankshaft), the process superfinishing performed classical way in which the shaft rotates with a given mutual speed and makes reciprocating movement along the axis of rotation with the frequency 3-5 Hz oscillations and barsqueeze the surface treatment of a defined force. Model superfinish of semi-automatic machines for machining the crankshaft journals are different sizes of shafts, number superfinish heads depending on the number of simultaneously processed necks. Superfnd semi-automatic model 3875KH19 allow you to perform one installation of rough and finish processing surface of the neck, changing in the process of the processing cycle in automatic mode the appropriate settings. However, this method suffers from the general disadvantages of classical superfinishing; glazing tool, the impossibility of effective and guaranteed correction of errors of the geometric shape of the processed surface, etc. Elimination of these shortcomings would improve the important problem of improving the quality of processing of surfaces of rotation, thereby to increase the life of machines and mechanisms. The various advantages of the considered methods superfino treatment we are particularly attracted by the possibility of precision profiling machined surfaces of parts. In practice and theory superfinishing investigated only the possibility of giving the surfaces a convex form, and not discussed the form itself and not the mechanism of formation of the profile of the workpiece. And so, exactly how the shape of the profile of the contacting surfaces of the parts most affect the performance of tribo-pairing, the practical interest is investigation of the effect of process formo-education superfinishing on the shape of the surface that is being processed.

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Равенець Л.М., Марчук І.В., Гринюк С.В., Ештеіві А.М.
Луцький національний технічний університет

ТЕХНОЛОГІЧНА СИСТЕМА СУПЕРФІНІШНОГО ОБРОБЛЕННЯ ДОРІЖОК КОЧЕННЯ КІЛЕЦЬ РОЛИКОПІДШИПНИКІВ

Найдоцільнішим методом остаточного оброблення, що збільшує несучу здатність поверхні та виправляє похибки геометричної форми поверхні деталі в поперечному перерізі, є суперфінішування.

Налагоджування верстатів згідно з стандартними методиками не враховує явище технологічної спадковості відхилення форми і часто не забезпечує точності оброблення, що вимагається.

У дослідженні проведений аналіз існуючих способів та пристроїв для суперфінішного оброблення поверхонь обертання з метою використання ряду технічних рішень, що застосовуються під час оброблення кілець роликопідшипників.

Ключові слова: *технологічна спадковість, суперфінішування, ультразвукове коливання.*

Равенец Л.Н., Марчук И.В., Гринюк С.В., Ештеиви А.М.
Луцкий национальный технический университет

ТЕХНОЛОГИЧЕСКАЯ СИСТЕМА СУПЕРФИНИШНОЙ ОБРАБОТКИ ДОРОЖЕК КАЧЕНИЯ КОЛЕЦ РОЛИКОПОДШИПНИКОВ

Наиболее целесообразным методом окончательной обработки, что увеличивает несущую способность поверхности и исправляет погрешности геометрической формы поверхности детали в поперечном сечении, есть суперфиниширование.

Наладка станков согласно стандартным методикам не учитывает явление технологической наследственности отклонения формы и часто не обеспечивает точности обработки, что требуется.

В исследовании проведен анализ существующих способов и устройств для суперфинишной обработки поверхностей вращения с целью использования ряда технических решений, которые применяются во время обработки колец роликоподшипников.

Ключевые слова: *технологическая наследственность, суперфиниширование, ультразвуковое колебание.*