Constructive ensuring the accuracy of processing of the spherical ends of the bearing rollers

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Abstract. The article focuses on ensuring the accuracy of the ends of the rollers of tapered bearings when machining on sphere grinding machines. Reviewed of the design the spherical grinding machine tools, with the periphery of the wheel profiled by a given radius have been given. The use of a corrected radius for profiling a circle is proposed, for which the design of the device for the basing and moving the rollers has been developed. Experimental studies of the use of the device are held. The results showed that the proposed constructive solution ensures the accuracy of processing the sphere of the end face of the tapered bearing roller.

Improving machines — increasing service life, increasing speeds and productivity, reducing size and weight, and improving accuracy — places high demands on reliability and performance, both on individual machine components and on the whole structure, which largely depend on the perfection bearings. Reliability and durability of rolling bearings work depend on the accuracy of manufacturing parts for bearings. Therefore, high requirements are imposed on the accuracy of rolling elements — tapered rollers.

Particular attention in the processing of rollers is paid to the improvement of technology in the final operations for the manufacture of bearing parts - of the grinding. Grinding spherical ends of tapered rollers is performed after preliminary treatment of the tapered surface.

Spherical ends of rollers of tapered bearings with a diameter of up to 18 mm are machined on center less grinding machines using a continuous method periphery of circle.

To machines in which the continuous method of grinding is carried out, productive machines like BSh-200 and 6S180 belong. The design of these machines is based on the center less method of installing the tapered rollers, carried out by rolling them between two profile discs, rotating in different directions. The number of revolutions of the discs 1 and 2 is different, therefore the rollers in contact with them, except for rotation around their axis, receive additional movement along an arc around the axis of rotation of the discs along the generatrix of the grinding wheel, which is profiled along a radius equal to the radius of the sphere of the roller face. The rollers placed between the discs are separated by a separator. The axis of rotation of the discs is horizontal. At the top of the disc is loading of the rollers. Having passed the working area, the rollers in the lower position fall out. So continuous grinding of rollers is carried out. In order to obtain high quality machined surface, a grinding wheel of several abrasive layers with different characteristics is used on these machines.

The host drive is removable for each type of roller. Working surfaces of the leading disks are grinding in assembled form with a high precision (allowable beating up to 5 microns).
Such a grinding scheme is also based on the design of the 6S180 machine, only one of the disks is made rigid, the other is elastic.

Machines operating by the continuous method peripheral of the circle have the following advantages:
- high performance due to the continuity of grinding;
- getting enough of the right sphere at the end of the roller;
- ensuring the required surface roughness;
- favorable conditions for process automation.

The disadvantage of machine tools is low versatility, as they are used for grinding the ends of rollers with a radius of spheres up to 300-400 mm.

Machine changeover is laborious and challenging. Therefore, the use of these machines has tangible advantages in large-scale production.

The processing of spherical ends of the rollers on the BSSh-200 machines is carried out with a grinding wheel, the periphery of which is profiled along a radius equal to the nominal radius of the end face sphere. In this case, an error is generated in the profile of the sphere due to the different time of interaction of the work piece with the circle at different distances from the center of the roller end. Therefore, the metal is removed at the end of the roller unequally - the center is larger, hence, the actual radius of the sphere is greater than the required. The occurrence of the error in shaping sphere of the end is considered in detail in [1].

In this regard, ensuring the accuracy of the spherical ends of the tapered roller bearings during processing is an actual task.

In a device for basing and moving rollers was proposed, in which at the end of hard disks there are built-in prisms located with uniform angular pitch, as well as adjustable supports made on the internal cylindrical protrusion of the hard disk. This provides the contact of the outer conical surface of the roller with two supporting elements of the prism, and the end opposite to the spherical end face, with an adjustable support. With this design, the basing of the rollers occurs by the surface of the outer cone and the surface of the end face opposite to the spherical one [3]. The research results showed that faceting and the waviness of the machined surface was improved however, this technical solution does not affect the accuracy of the sphere radius of the roller end, since the rollers were grinding with a circle with a radius equal nominal value the radius of the sphere.

To ensure the accuracy of the sphere of the end of the rollers, it is proposed to perform processing with a grinding wheel, a shaped corrected radius that is less than the nominal, and is calculated depending on the magnitude of the error [1]. This should allow compensating for the error occurring in the processing of sphere of the end. At the time, the center of the circular feed of the roller is displaced relative to the center of the sphere to be machined, which leads to the slippage of the rollers relative to the discs in the grinding zone. Was developed device for basing and moving rollers was proposed, in which both disks are made teams. Each of the discs has an outer (1 and 2) and an inner (3 and 4) ring (figure 1).

The working ends of the rings for interaction with the conical surface of the roller has a small length, therefore the length of their contact with the conical surface of the rollers is much less compared to the length of contact of the continuous conical surfaces of the disks, which reduces the amount of sliding friction between the rollers and the surfaces of the disks in contact with them. The outer rings of both discs are fixed fixedly, respectively, on sleeves 5 and 6, and the inner rings are placed so that there is a possibility of angular movement relative to the outer rings. The speed of the relative rotation of the inner rings is small. She is determined by the difference between the actual speed of rotation of the roller in the cross section of contact with the working ends of the inner rings, driven by the outer rings and the speed that this section would have if the points of the vertices cones of the rollers coincided with the axis of rotation of the disks.

The difference is compensated by the relative movement of the inner rings. This disc design provides the required location of the spherical ends when grinding, both in the case of coincidence and in the case of mismatch of the vertices of the cones of the rollers at a point on the axis of rotation of the discs.
Experimental studies of the proposed device for basing and moving the rollers were carried out when grinding the spherical ends of the rollers. The processing was carried grinding wheel, the periphery of which is profiled along radius 144 mm. Observation of the processing process was carried out within 3-4 hours of the between the correctional period grinding wheel of the machine. The end beating, faceting, roughness and radius of the roller end face sphere were controlled.

In an experimental study of the proposed device when grinding the tapered rollers, the results were obtained: end beating 1-4 microns, the faceting of 1-4 microns and the roughness $Ra = 0.16-0.32$ microns, radius of sphere of end of the roller 146-155 mm, which meets the requirements for this type of tapered rollers.

The results of grinding of the spherical ends of the rollers 7606 of the proposed design with the corrected machining radius were compared with the results obtained using the existing device for basing and moving the rollers with solid hard disks and the nominal radius of the sphere.

When grinding of the spherical of the end of the rollers the grinding wheel, the periphery of which is profiled along radius equal to the nominal radius of the sphere 156 mm and using the device with solid hard disks, the results were as follows: end beating 1-6 microns, faceting 1-5 microns, roughness $Ra = 0.2-0.32$ microns, the radius of the spherical end of the roller was in the range of 155-168 mm, which is significantly higher than the permissible values by 12 mm.

From comparing the results of the experiments of the proposed device for basing and moving the rollers and the existing one, it can be seen that the beating of the spherical end of the rollers has decreased by 50%, faceting by 20%, the roughness is locate within allowable limits, and the radius of the end face sphere does not exceed the allowable values.

Consequently, on the basis of the research results, we can conclude that the processing of the spherical ends of the rollers with a grinding wheel, a shaped corrected radius, which is less than the nominal one, and the use of the developed design the device for basing and moving the rollers, allowed us to obtain the required accuracy of the end face sphere.

References
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