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PROLONGATION OF TERMS OF OPERATION MOBILE CONNECTIONS

M. Zenkin , Doctor Sciences Technical , the Professor
Kyiv National University of Technologies and Design

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Reliability and durability of machines depends very much on a condition and service life of details of mobile connections (units of friction), which make up their construction. The mutual movings of the details, conjugated in such connections, cause not only elastic, but also plastic deformations in their surface and, as a consequence, - the friction of catching of the first sort, abrasive and oxidizing tear. Thus it is necessary to note, that a ration and development of these kinds of tear depend on the construction and working conditions of the connection [3]. Often the tear of details of mobile connections hidden from direct supervision and its results are found out only at occurrence of significant backlashes, shock loadings or even destructions of any constructive element because the features of a construction of machines and conditions of its exploitation.

It is known, that the friction of sliding is typical for the given type of conjugation. Sliding bearings of various purpose, gasket of mobile details, guides and supports, power transfers of a screw-nut, etc are the mobile conjugation. The task of increasing of reliability and durability of machines requires increasing wear resistance of friction units. Thus the importance has the development of calculation methods, because they allow to set the required characteristics of friction and wear resistance of units at a stage of their designing. For the trustworthy wear resistance forecasting the most crucial typical conjugations, despite of significant development of calculation methods [2], it is necessary to carry out special tests with the purpose of receiving of the specified regularity of tear, taking into account the influence of the construction features, and working conditions of conjugation.

For this purpose the research by a method of the accelerated test of spherical conjugation (Fig.1), working in conditions of constant greasing in environment of oil was carried done in the Kiev National University of Technology and Design according to basic points in publication [5]. The making of research in conditions of greasing of surfaces was provided by the special hermetic chamber. As lubricant environment ЦИАТИМ-201 (ГОСТ 6267-84), Свинцоль-01 (ГОСТ 1012-82), И20А AND АМГ-10 (ГОСТ 6794-85) were used, which now are used at exploitation of machines of light industry [4]. The conjugation was tested on a specially made installation described in detail in paper [5], ensuring imitation of working conditions of its application, and also speeding up of loading and speed of sliding accordingly up to 80 and over 20 % of maximum exploitation.

The test lasted 100 hours. The micrometric measurement of details wear were taken after 10, 20, 40, 60, 80 hours of work and upon finishing the test, that provided revealing run-in sites both established processes of friction and tear.

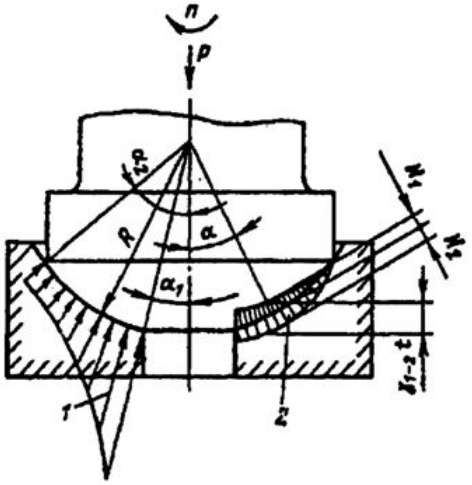

Fig. 1. The calculation scheme of spherical conjugation: 1 - pressures curve; 2 - wears curve

The area of normal allowable wear and critical loading (18 MPa), the excess of which gives the area of inadmissible wear accompanied by destruction of surface catching of the second sort were revealed by the method of series increase of loading. The specified regularity of tear were received for the area of normal wear:

$$\left.\begin{aligned}\gamma_1 &= k_1 p_{cp} \vartheta - b_1 \ ; \\ \gamma_2 &= k_2 p_{cp} \vartheta - b_2 \ ,\end{aligned}\right\} \qquad (1)$$

where γ_1 and γ_2 - speed of tear of the connected details; p_{cp} - average pressure; ϑ - speed of sliding; k_1 and k_2 - coefficients of wear; b_1 and b_2 - coefficients describing entry conditions of realization tear on size of parameter.

The analytical dependences on the basis of regularity (1) on a known technique are received:

For calculation of pressures curve

$$p = \frac{\left[2P - \dfrac{2R(b_1+b_2)(\sin a_2 - \sin a_1)}{n(k_1+k_2)}\right]\operatorname{ctg} a}{\pi R^2(\sin 2a_2 - \sin 2a_1 + 2a_2 - 2a_1)} + \frac{b_1+b_2}{2\pi R n(k_1+k_2)\sin a}; \qquad (2)$$

For determination of tear speed of conjugation

$$\gamma_{1-2} = \frac{4Pn(k_1+k_2) + 4R(b_1+b_2)(\sin a_2 - \sin a_1)}{K_k R(\sin 2a_2 - \sin 2a_1 + 2a_2 - 2a_1)}; \qquad (3)$$

For calculation of wear size in any point of a spherical surface

$$\left.\begin{aligned} И_1 &= \gamma_{1-2}\cos a \frac{k_2 p\vartheta - b_1}{p\vartheta(k_1+k_2) - (b_1+b_2)} t_p; \\ И_2 &= \gamma_{1-2}\cos a \frac{k_2 p\vartheta - b_2}{p\vartheta(k_1+k_2) - (b_1+b_2)} t_p; \end{aligned}\right. \qquad (4)$$

where $И_1$ and $И_2$ - the wear of details of conjugation in a direction of their convergence; p- axial loading; R - radius of sphere (see fig.1); α_1 and α_2 - internal and outside corners of scope of conjugation (see fig. 1); n - frequency of relative rotation of details; $К_n$ - dimensionless coefficients of design features; t_p - operating time of conjugation.

200 spherical pairs during 100 hours everyone were subjected to test at Pcp = 7-19 MPa and V = 0,45-0,9 m/s. The possible forms of the mathematical description of process of tear in time were investigated at the results processing of experiment with PC use by the method of the least squares; most trustworthy have appeared approximating function of the first order of a type

$$И_{1-2} = И_п + \gamma_{1-2} t_p \qquad (5)$$

where $И_п$ - wear in run-in process. The results processing have shown also sufficient accuracy and stability of results of experiment (quadratic average the deviation of all tests has made on size of wear 7,8 %, on speed of tear - 10,9 %; the fiducial interval at fiducial probability 0,99 is in a range 2,8-15,7 % of value mean γ_{1-2}; it allows, by calculating speed of tear of conjugation γ_{1-2} on dependence (3) or by defining it experimentally, with sufficient for practice reliability to predict wear size of conjugation on the equation (5) or resource T of conjugation under the formula

$$T = \frac{k_y И_{max}}{\gamma_{1-2} \pm \sigma_\gamma} \qquad (6)$$

where k_y - coefficient of acceleration of tear at the accelerated test determined on a technique [11]; $И_{max}$ - limiting size of allowable wear; $\gamma_{1-2} \pm \sigma_\gamma$ - quadratic average a deviation of average speed of tear received at the accelerated test.

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