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BASES OF FORMING OF THE ATTENDED INTERFACED QUASISCREW SURFACES ON BASE OF SELF-REACTANCE KINEMATICS SCREW

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Worked out geometrical and computer models that allow eliminating interference. Free of interference gear-wheels and tool piece allow to avoid paring of teeth and dangerous concentration of tension.

Keywords: quasiscrew surfaces, interference, parametrization, kinematic screw.

Formulation of the problem. When constructing the technical conjugate forms of surfaces of modern machines, in some cases it is almost impossible to solve the problems without identifying the conjugated surfaces. Such difficulties have resulted in widespread use of the theory of conjugated surfaces, in the design of transmissions with spatial engagement, profiling gear-cutting tools and many other solutions to technical problems.

Analysis of recent research and publications. Existing modern methods and algorithms of theoretical developments and simulation studies of conjugated nonlinear surfaces are considered. In the analysis, it was found that in order to solve the problems of forming a new geometry of conjugate non-aligned surfaces of engagement, the existing methods proved to be complex and ineffective. Some of them are quite possible to apply, but when simulating a new kinematics of engagement with links that carry complex movements, a vivid real picture of the design change of gears directly on the diagram is required. In order to solve this problem, in this paper we propose to extend the possibilities of the existing theorem of professor A.M. Podkorytov, which defines the characteristics of nonlinear screw surfaces.

Formation of the purposes of the article. Development of methods of geometric and computer simulation of quasi-screw surfaces. The work on the formation of the basis of quasigree surfaces that exclude interference is devoted to work [2].

Main part. The development of the scientific basis for the formation of surfaces with point contact is a theorem [1]: If each of the conjugate surfaces $\sum_A$, $\sum_B$, is pairwise conjugated with intermediaries Φ_A and Φ_B, and if intermediaries Φ_A and Φ_B, are also conjugate, then the point of contact to the conjugate surfaces $\sum_A$ and $\sum_B$ is defined as the point of collision of 4 surfaces $\sum_A$, $\sum_B$, Φ_A, Φ_B.

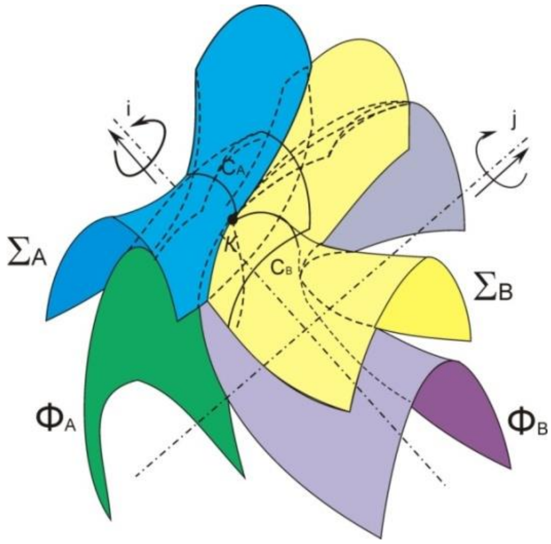

Fig. 1. Geometric model of conjugate surfaces
with point contact

With the help of Theorem [1] a geometric problem of finding the common point of contact K is solved by means of 4 surfaces. Point K is defined as the point of intersection of characteristics (Fig. 1).

The development of a computer model for the formation of conjugate quasi-screw surfaces is aimed at increasing the accuracy and performance of calculation and graphic works in the design of cutting tools and gear transmissions. The computer model is based on the following technology.

The following algorithm is proposed for the most common case of constructing the characteristics of the conjugated surfaces with the help of a spatial parametric kinematic screw to form conjugate acoids given by 13 interrelated parameters. The basis of the construction of a three-dimensional model is the diagram of the kinematic screw [1], which is presented in Fig.

Algorithm of construction:

1. AB - the distance between intersecting axes i i j;
2. h_1 - step of helicoid Σ_A;
3. h_2 - step of helicoid Σ_B;
4. γ - the angle between the axes i i j;
5. ω_A - axis rotational speed i;
6. ω_B - axis rotational speed oci j.

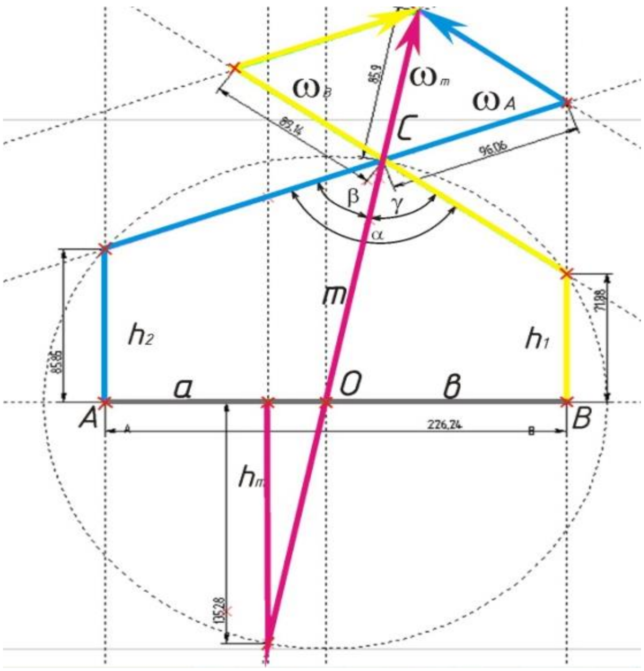

Fig. 2. The kinematic diagram screw

The program defines the necessary parameters for the screw, namely:

1. a - the distance between intersecting axles i and m;
2. b - the distance between intersecting axles j and m;
3. f - transfer ratio (f=a/b);
4. α - the angle between the axes i and m;
5. β - the angle between the axes j and m;
6. h_m - step of helicoid Ф;
7. ω_m - speed of rotation of the axis m.

Thus, in order to form a diagram of the spatial parametric kinematic screw in the Autodesk Inventor CAD system, it is enough to set parameters AB, h_1, h_2, γ, ω_A and ω_B (Fig.2), other parameters are determined automatically by the program (Fig. 3).

When developing a subroutine for CAD, Autodesk Inventor created a three-dimensional model can be used as a template, with parameters such as α, β, ω_m, f, h_m, a, b can be defined by the formulas:

$$\omega_m = \sqrt{\omega_A^2 + \omega_B^2 - 2\omega_A\omega_B\cos(180-\gamma)};$$

$$\alpha = \arcsin\frac{\omega_A \sin(180-\gamma)}{\omega_m} = \gamma - \beta;$$

$$\beta = \arcsin\frac{\omega_B \sin(180-\gamma)}{\omega_m} = \gamma - \alpha;$$

$$a = \frac{AB\omega_A\cos\alpha}{\omega_m}, \text{ если } h_1 = 0, h_2 = 0;$$

$$b = \frac{AB\omega_B\cos\beta}{\omega_m}, \text{ если } h_1 = 0, h_2 = 0;$$

$$f = \frac{a}{b};$$

$$h_m = b \cdot tg\,\alpha = a \cdot tg\,\beta, \text{ i.e. } h_1 = 0, h_2 = 0,$$

the following parameters are the starting point (Fig. 3): AB, γ, ω_A, ω_B, h_1 and h_2.

With the help of the created computer method, one can also construct a quasi-intimate contact surface (Fig. 3).

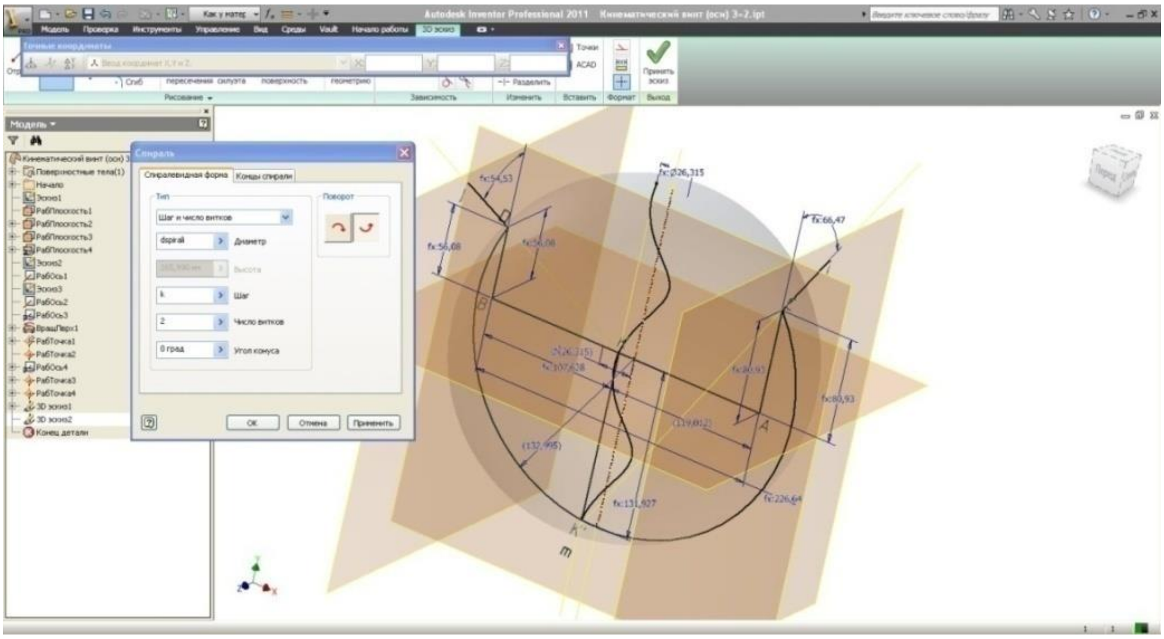

Fig. 3 Parameters of a quasi-wire surface of a contact

Parameters of the kinematic screw for conjugated convoluted helicoid are presented in Table. 1

Table 1

Initial settings			Obtained options		
Parameter	Marking on fig. 1	Parameter	Параметр	Marking on fig. 1	Value
AB	AB	226.64 мм	α	$\angle wAOwm$	66.47°
h_1	AC	80.93 мм	β	$\angle wBOwm$	54.53°
h_2	BD	56.08 мм	ω_m	wm	55.086 мм
γ	$\angle COD$	121°	a	AK	119.012 мм
ω_A	wA	52.34 мм	b	BK	107.628 мм
ω_B	wB	58.92 мм	h_m	KK'	131.927 мм

The development of a computer model that simulates the spatial diagram of a kinematic screw allows to construct a quasi-screw surface of the contact of helicoid and to improve the accuracy of the profiling of conjugate surfaces. Accuracy is increased due to the fact that the developed automated method allows to construct a large number of pairs of conjugated helicoids, and to determine their contact surface of engagement, thereby increasing as a result the productivity of design work, and the quality of the products received at the design stage.

Conclusions. In order to increase the accuracy and reliability of a wide class of products of spacecrafts, aviation, machine building, the scientific foundations of the formation of conjugate quasi-screw surfaces that exclude interference are developed. Dedicated gears and cutting tools are free from interference, which avoids fissures, stiffening and dangerous stress concentrations, as well as increases the accuracy and reliability of a sophisticated cutting tool and gear linkage.

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ОСНОВЫ ФОРМИРОВАНИЙ СОПРЯЖЕННЫХ КВАЗИВИНТОВЫХ ПОВЕРХНОСТЕЙ НА БАЗЕ ПАРАМЕТРИЧЕСКОГО КИНЕМАТИЧЕСКОГО ВИНТА

Подкорытов А.Н., Исмаилова Н.П., Маковкина Т.С.

Разработаны геометрическая и компьютерная модели, которые позволяют исключить интерференцию. Свободные от интерференции зубчатые колеса и режущий инструмент позволяют избежать подрезаний зубов и опасной концентрации напряжения.

Ключевые слова: квазивинтовые поверхности, интерференция, параметризация, кинематический винт.

ОСНОВИ ФОРМУВАНЬ СПРЯЖЕНИХ КВАЗІГВИНТОВИХ ПОВЕРХОНЬ НА БАЗІ ПАРАМЕТРИЧНОГО КІНЕМАТИЧНОГО ГВИНТА

Подкоритов А. М., Ісмаілова Н. П., Маковкіна Т.С.

Розроблені геометрична і комп'ютерна моделі, які дозволяють виключити інтерференцію. Вільні від інтерференції зубчасті колеса і різальний інструмент дозволяють уникнути підрізувань зубів і небезпечної концентрації напруги.

Ключові слова: квазігвинтові поверхні, інтерференція, параметризація, кінематичний гвинт.