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Development the Graphical Method of Calculating Structural Elements for Fixing a Gear in a Self-Centering Chuck through the Involute

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Abstract. The article discusses the developed graphical method of calculating the size rolls diameter and the radius of their contact with the jaws.

Introduction

In the manufacture of gears (planetary gears, gearwheels), in the process of their production, there are difficulties related to ensuring the shape and size accuracy of the gearwheel hole involute profile, as well as their relative position relation to each other [1]. During chemical-thermal and heat treatments (cementation, hardening, etc.) of the gear, warping of its surfaces appears, an error of eccentricity arises. Therefore, finishing operations (grinding of working and base surfaces) are introduced into the technological process. The influence of the gear hole shape is described in [2-5].

In the gears manufacturing the final processing of its central hole, two fixing charts (locating, clamping) are mainly used:

1) along an involute profile through size rolls in a self-centering chuck [6–15];
2) along the outer contour of the gearwheel (without size rolls) in a self-centering chuck;

Initial data: $\alpha = 20^{\circ}$ - profile angle of the initial contour; r = 22.5 mm - the radius of the gearwheel pitch circle; Re = 25 mm - outer radius of the gearwheel; m = 2.5 mm - gearing module; z = 18 - number of teeth. The analytical calculation of the device structural elements can be performed according to the method described in [16, p. 183].

The fixing chart calculation by the graphical method is carried out using a simplified way of drawing the tooth profile with the subsequent selection of the size rolls diameter, so that the contact points of the teeth profile with the rolls lie as close as possible to the radius of the gearwheel pitch circle. Let's consider this tracing with an example.

All tracings are performed on a computer in the modern computer-aided design system Compass V19.1 (Any other CAD system can be used for tracing).

Main body

From point O the radiuses of the circles r_{VP}, r_O, r, R_e (Fig. 1) are drawn. From point O at the gear vertical axis, angle φ is postponed. From the point of intersection of the right angle φ with the radius of the pitch circle, are being drawn a chord in both directions equal to $S_H/2$ (the tooth thickness along the chord of the pitch circle). At both ends of the chord, points A and B are being mark. Point A is being connected with center O by a straight line. The center O_1 are being found by dividing the line OA by 2. From the center O_1 the radius of the circle R_1=OA/2=r/2 is being drawn crossing point A, draw it to the intersection with the main circle radius r_O, find the point O_2. Draw an arc CAE from point O2 with radius R2. The resulting curve is a tooth involute. Point B is being connected with center O with a straight line. Dividing line OB by two, we find the center

O_1 '. From the center O_1 'draw the radius of the circle R_1'=OB/2 = r/2, crossing point B, draw to the intersection with the radius of the main circle r_O, find the point O_2 '. Draw an arc KBF from point O_2 'with radius R_2'. The resulting arch is a tooth involute. The CAEFBK points are the tooth profile outline. Using the function (mirror image relative to the gear vertical axis), is being obtained the profile of the second tooth. The teeth root is being constructed using a circle (a circle tangent to three curves - two involutes and the radius of the circle of the root r_{VP}). Circle is being entered d '= 5 mm between two teeth (diameter of the size rolls).

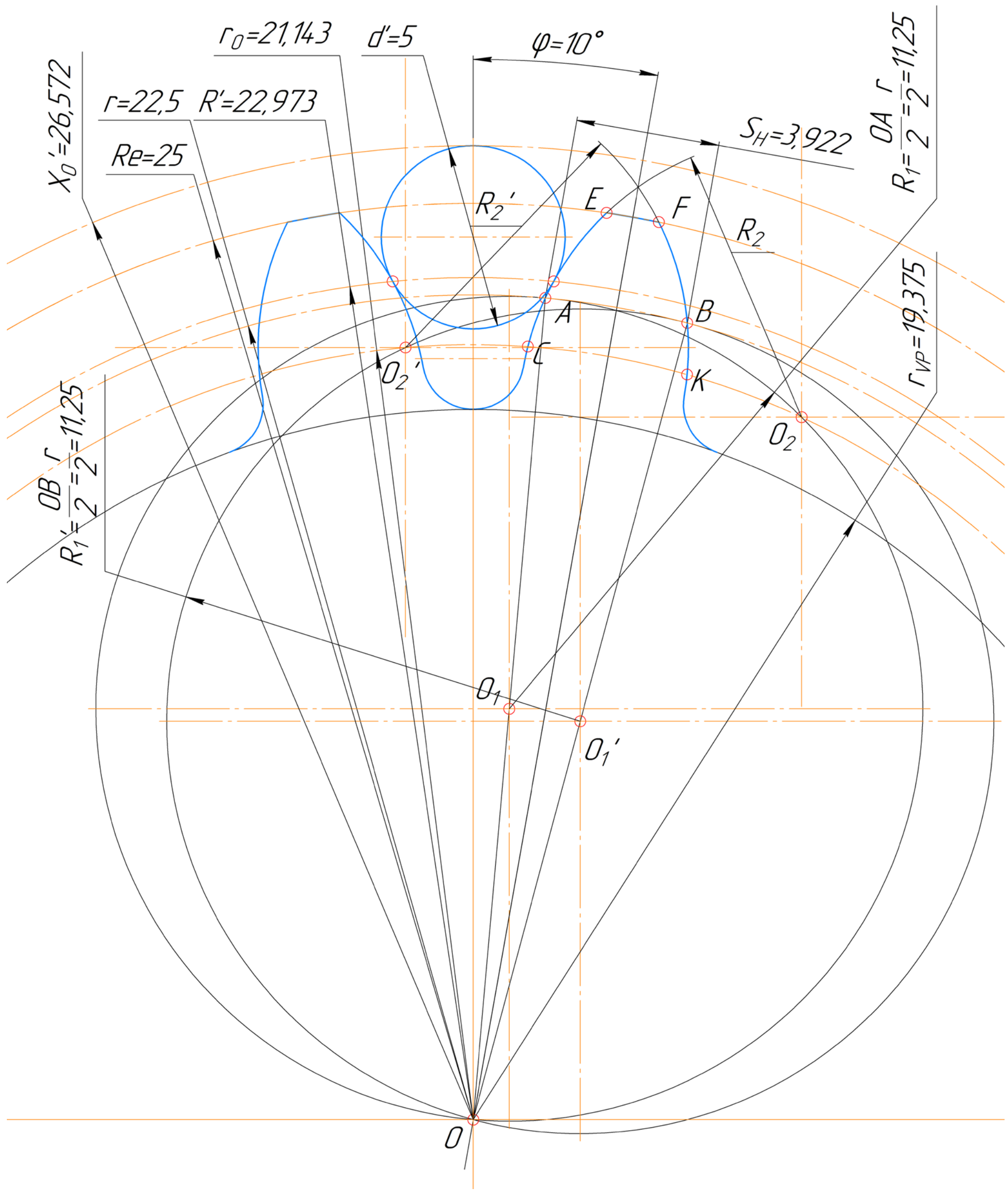

Fig. 1. *Calculating chart for the roll diameter and the contact radius with the jaws by the graphical method.*

To determine the radius value of the circle on which the contact points of the roll with the teeth are located, using the snapping from the center O, a circle draw through the contact points of the circle d ’with the teeth, graphically defining that R’ = 22.973 mm.

To determine the value of the chuck jaws contact radius with the rolls at the moment of fixing when the gearwheels are being machined, from the center O a circumscribed circle is being drawn around the size rolls. Graphically are being determined that X_O’= 26.572 mm.

Conclusion

The developed graphical calculation method is convenient for use in production, easy to understand, does not require calculating the engagement angle involute or finding its value in tables. It is possible to fully automate the construction of a tooth profile in CAD - Compass V19.1.

Acknowledgments

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