

ASPECTS ABOUT THE ACHIEVEMENT OF THE HOBBIING CUTTER FOR ROUGHING

ОБ ОСУЩЕСТВЛЕНИЕ УЛИТКАЯ МОДУЛЯ ФРЕЗА

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Abstract/Pezлome: The paper presents the achievement method of the hobbing cutter with protuberance on the grinding machine by backing off for gearing processing with the material adding for grinding. Processing with such tools permits a better processing at the gearing finishing; the decrease of vibrations and abrasive disk wears (essential thing for gearing grinding).

KEYWORDS: HOBBIING CUTTER, GEARING FINISHING, VIBRATIONS, ABRASIVE DISKS WEARS

1. Introduction/Введенue

Taking into consideration the importance and spreading of gearing in machine building, they have been directed to improve their operating performances [1].

The wished performances of the gearing (e.g. division, load limits, noiseless running, efficiency, life capacity, and consumptions of materials) are conditioned by the localization of contact and by the geometrical precision of tooting [2].

The achievement of the gearing with external teeth by rolling method using hobbing cutter is one of the used processing proceedings. Usually, in the case in what follows the finishing of the gearing teeth, the processing with the hobbing cutter is very productive and with a sufficient quality.

To create the optimal conditions for finishing, the profile form and the main geometrical parameters of hobbing cutter for roughing is recommended to have tooth in the protuberance form. In the Figure 1 it is presented a hobbing cutter for roughing.

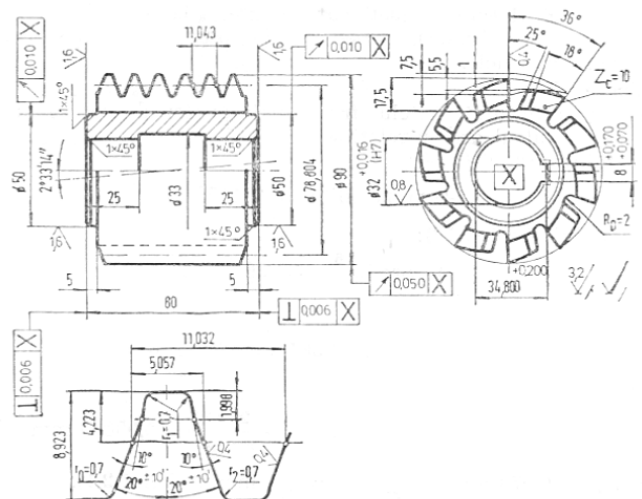


Fig.1. The hobbing cutter for roughing [7].

Generally, for wheels under the seventh precision class and with high life are used stainless steel that permits the face-hardener and nitro-face-hardener.

It is obtained teeths with higher life by 2,5-3 times at the flank contact and by 1,5 times at the flexion of tooth than improved teeth. But these treatments produce the maximum deformations requiring the grinding of the teeth and, therefore, the existence of the material addition. By adapted form of the profile and main

geometrical parameters of hobbing cutter can be realized the better technological conditions for the finishing of gearing by grinding [4].

2. Content/Codepuyumoe

The achievement of the hobbing cutter with the modified profile with protuberance offers the obtaining possibility of the constant finishing addition on the gearing flank except to the by zone where is has the value equal to zero and the supplementary escape at the teeth bottom by overfulfilment of the by line with a well determined value Δ_0 .

The constructive geometrical specific features of the hobbing cutter with protuberance profile are presented in the Figure 2. To determine the parameters, it is mentioned an unfolding after a normal plane on the reference propeller [5].

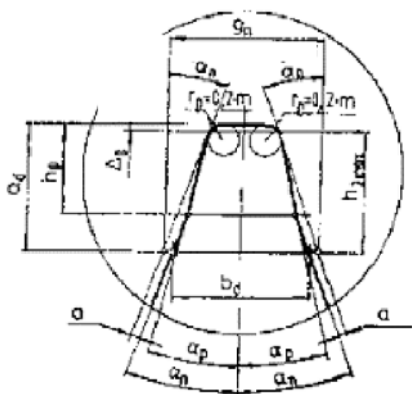


Fig.2. The tooth with protuberance profile [3].

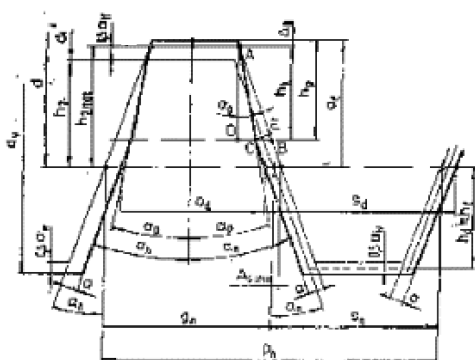


Fig.3. Auxiliary construction [3].

The nominal diameters of the profile are endowed with afferent deviations:

- a_{iv} –inferior deviation of the head diameter;
- a_{it} –inferior deviation of the leg diameter.

With the minimal deviation of the tooth thickness A_{dmin} (endowed for the ensurance of the minimal play between flanks and the finishing addition size on the flanks with the relations that give the reference mail profile (reference propeller angle).

$$tg\theta = \frac{p_E}{\pi m} = \frac{z_1 m}{d} = \frac{z_1}{q} \quad (1)$$

and

$$g_n = s_n = 0,5\pi \cos\theta \quad (2)$$

From (1) and (2) results the formula for the calculating of the hobbing cutter tooth thickness on the division diameter of snail.

$$s_d = 0,5\pi m \cos(\arctg \frac{z_1}{d}) + A_{d \min} - \frac{2a}{\cos\alpha_n} \quad (3)$$

The recommended values for the finishing addition are correlated with modulus value until to 0,2 for the modulus until to 2 and until 0,55 for the modulus over 12 (Table 1).

Table 1 – The recommended values for finishing addition [6]

Axial modulus, m [mm]	Finishing addition on flank, a [mm]
Up to 2	Up to 0.2
2...4	0.2...0.25
4...6	0.25...0.3
6...9	0.3...0.4
9...12	0.4...0.55
Over 12	Over 0.55

To assure a technological play between the gearing tooth bottom and the finishing tool top, the hobbing cutter tooth head height will be:

$$a_d = h_{2 \max} + \Delta_0 \quad (4)$$

where Δ_0 is the value overfulfilment of the leg line of the gearing tooth.

According to the modulus, it is recommended $\Delta_0 = km$ where k has values from 0,06 to 0,3.

The linear protuberance elements of the hobbing cutter tooth are determined below:

-inclination angle:

$$tg\alpha_p = tg\alpha_n - \frac{a}{0,65h_{2 \max} \cos\alpha_n} \quad (5)$$

where

$$h_k = 0,65h_{2 \max} \quad (6)$$

(experimental)

-protuberance height:

$$h_p = 0,65h_{2 \max} + \Delta_0 \quad (7)$$

The achievement of the hobbing cutter with such profile with protuberance can be obtained on the grinding machine by backing off using special grinding heads that permit a suitable and controlled profiling of the abrasive disk.

The machine on that was made the profiling in this case is type HSF-33D-Klingelnberg equipped with grinding head ZK4a for the abrasive disks until to the diameters equal to 80 mm.

First, it is used the profiling method of a flank and, there, of the other flank inverting the turn sense and turning back the tool with 180 degrees.

The grinding head is equipped with a fitter situated in oscillatory arm that can be regulated after a scale with divisions of angle. For the adjustment of the abrasive disks, they are equipped with two diamonds actuated by hand. One is radial adjustable than the abrasive disk under what is placed and which adjusts the circumference. The second diamond is destined to the conical adjustment of the disk flanks, its guiding could be rebated at the flanks semiangle regard to a scale disk. With this device for adjustment the disk can be adjusted in a straight line or regard to a cubic profile (protuberance) made up more lines.

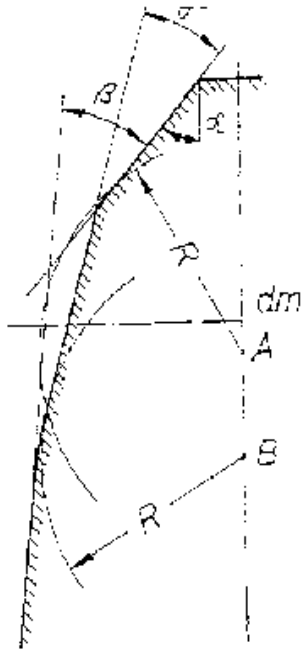


Fig.4. Abrasive disk profile [8].

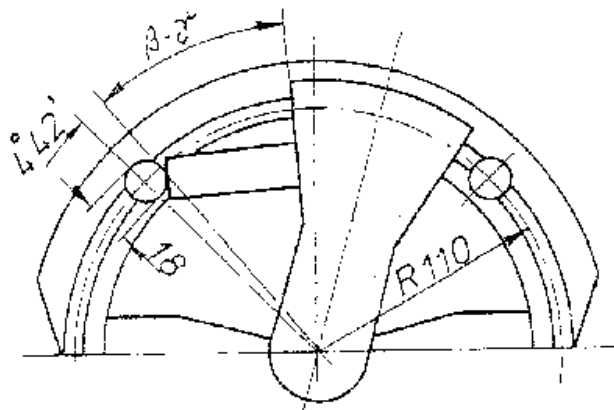


Fig.5. Adjustment of the gauge angle [8].

The abrasive disk profile has to draw, certainly, as a function between median line and division circle enlarged by 50 times. The maximum and minimum angle profile lines have to prolong until to the crossing point.

The radius R that forms a tangent at these prolonged lines is searching by compasses starting at the median (central line). It is noted the center A (fig. 4). The center B on median is searching with the same radius R.

The outlying has to be tangent at the profile line in the center. The special diamond –support (47) is situated on the regulation gauge and the diamond is pushed to the intermediate gauge block (5mm+R) where is fixedly tightened. The diamond – support is fixed on the adjustment shaft, which is pushed by hand to the check. The anterior bearing support (8) of the adjustment device (7) is regulated at the maximum adjustment angle after the screw clearing away (49), then, the check (11) is regulated and locked.

This thing is valuable in the case of the both flanks (fig.6). The adjustment at the minimum adjusted angle is made with gauge block, which are situated between the check (11) and the bearing support (8).

The thickness of the gauges (fig.5) is calculated with the following relation:

$$L = 110\sin(\beta - 4^{\circ}42') - 9 \quad (8)$$

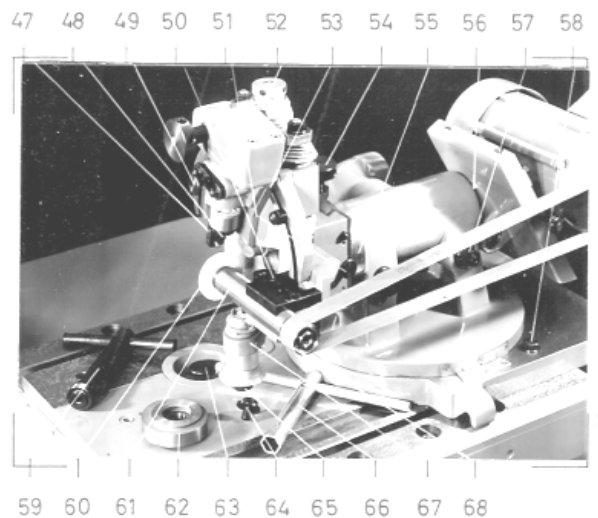
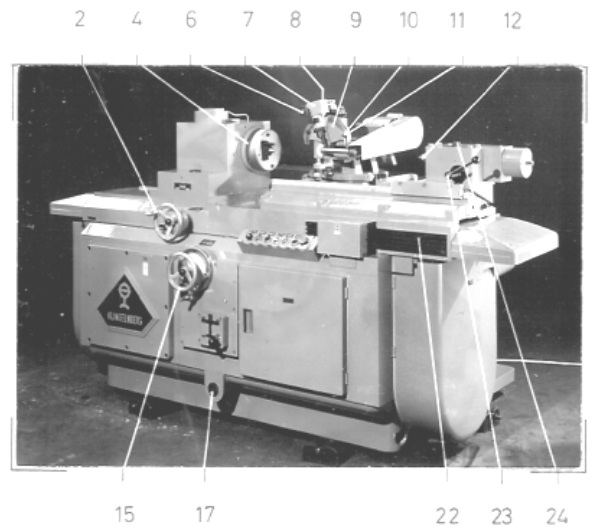


Fig.6. Device for adjustment [8].

Not only the maximum angle, but also the minimum angle is adjusted with the displacement on vertical of the device for adjustment. To adjust the medium angle the device has lower with the distance AB from the drawing enlarged by 50 times by rotating of the knob (54). A division is equal to 0,01 mm. Before this adjustment it is necessary to note the place on the disk.

The bearing support (8) adjustment for the medium angle is made, also, with gauges with parallel faces.

For the adjustment of the diamond support contraflanks (47) has to be rotated with 180 degrees until the check (48) pushed by hand and locked with screw (49) again. The adjustment of the frontal profile is made with diamond support (67) collapsible under the abrasive disk (60). The positioning value and the scale division are the same as to flank adjustment.

To avoid the rough errors it is used the verification of the flank profile with a template.

For the ZK4 head exists an apparatus (device) for the radius adjustment that permits concave and convex abrasive disks adjustment at the head radius backing off for the semicircular and other similar forms of the milling tools (cutters) presented in Figure 7.

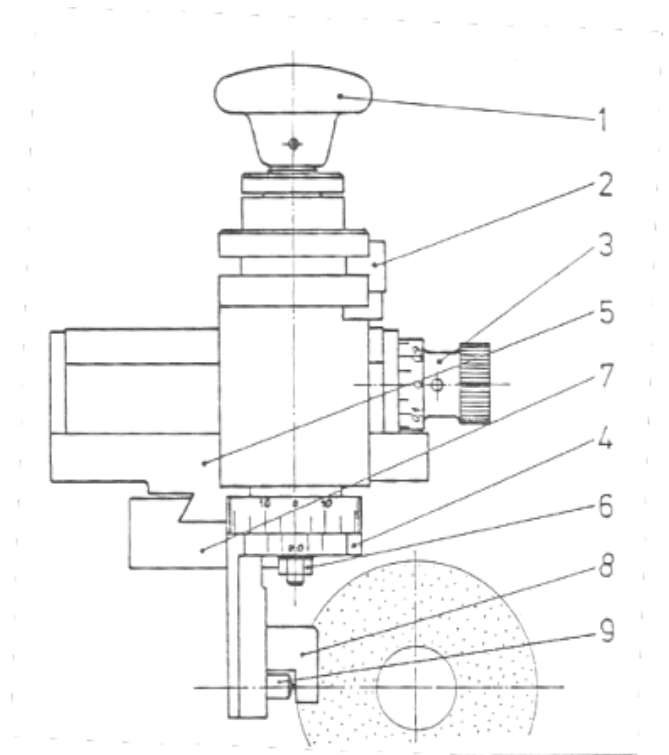


Fig.7. The device for the radius adjustment [8].

The radius for adjustment is made by diamond support (4) displacement, the hexagonal screw nut (6) having to unlocked and then compressed again. With the scale it can regulate until 10 mm before and after center.

First, it is necessary to bring the diamond (9) at the rabbating center with gauges (8).

The complete fitter (5) is fixed on shaft support with the feed-head (runner) (7).

The diamond support operates in the abrasive disk back thus the piece and the abrasive disk should remain in the working position.

The rabbating domain can be limited with the check (2) and the adjustment positioning is made by the knurling knob (3).

The working motion is realized by the handle in the star form.

3. Conclusions/Заключение

It is realized some advantages by this obtaining method of the milling with protuberance:

-The stress, respective wear of abrasive tool top reduces very much because of the decrease of the finishing addition and even its cancellation at the teeth by line;

-The finishing tool (abrasive disk) works only on flanks because of the tooth bottom escape achievement. From this reason it is obtained a better processing reducing the vibrations in the same time by facilitation of the finishing process.

This method is recommended for the optimization of the grinding conditions in the case in which is required the modification of the teeth reference pot – hanger imposed by technological and functional reasons.

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