Increase Accuracy of Toothed Vein by Gear-Shaving Operation

Mohammed Hamdan

Mechanical Engineering Department, Faculty of Engineering, Shaqra University, Addawdimi, Kingdom of Saudi Arabia
E-mail address: mhamdan@su.edu.sa

ABSTRACT

Quality and technical features to product a machine building, in the composition which enter sprockets, to a great extent hang from the quality last. So for instance, inaccuracy of step of teeth cause additional dynamic loads in grappling, concentration of load appears at presence of inaccuracy of direction of teeth, inaccuracy of profile of teeth are reason for breaking a kinematics of mechanism. Reduction of inaccuracy of toothed vein allows greatly raise loading ability of issue, reduces size of mechanism, enlarges its CUA and lifetime. Experience of production and usage of toothed issues, study of intercoupling their technical level with methods of Form shaping toothed vein be indicative of that, technical level an index loading ability of toothed issue greatly depends on the method of clean processing teeth. From number of methods finishing processing teeth of sprockets in machine building broad using has a process gear shaving. In spite of greater amount of work, directs by theoretical and experimental study of process gear shaving, quality of processing sprockets does not exceed 8th degree accuracy. Considering that increasing of accuracy of processing sprockets can be an important reserve of increase the loading ability of issue and factors of technical level of product as a whole, way development of rising accuracy processing gear-shaving may be an actual problem for the theory tooth Form shaping and practice of machine building.

Keywords: Tooth vein; inaccuracy; accuracy; shaving; teeth; conjugate surface.

1. INTRODUCTION

Sprockets with number of teeth z = 6 ... 12 find a use in oil pumps, planetary transfers and many other mechanisms. Shaving these wheels inconveniently does not allow receiving accuracy of gear ring parameters above than 8 degrees on Standard (Russia) 1643-81. Considering that, increase accuracy of processing gear sprockets allows essentially to raise characteristics of products, development effective ways of their clean processing – that is very important scientific and practical task. Known Shaving methods disk cutter (Shaver) in conditions free rolling are known at rotation on crossed axes shaver and process able wheel, of longitudinal and radial submission Kohan(1962) . Lack of these methods is, that on surfaces teeth process able sprocket in zone dedendum circle cutting during processing, the layer of metal is more than size gap on processing, therefore on this site the profile of a tooth has the large error. Are

known a shaving methods disk shaver, at which for increase accuracy of an involute tooth profile sprocket in zone dedendum circle a tooth profile shaver modify (Sioia,1964; Luneev and Bulatov,1974) .

These methods have lacks. The first lack consists that size, form and situation of a site of the modified a tooth profile shaver depends on parameters of a process able wheel, owing, to what grows time for polishing cutter part of shaver. The second lack consists that size, form and situation of a site of the modified profile teeth shaver change on a measure cutter part shaver. As the size shaver change, owing, to what the processing cutter parts shaver becomes complicated. The third lack consists that the size, form and situation of a site of the modified profile teeth of the finally processed sprocket, owing to what the surfaces teeth of shaver and teeth of a process able sprocket on passes previous to last clean pass, are not connected. Because of it these ways do not allow to receive accuracy of processing above than eighth degree on standard 1643-81. The offered method shaving involute of gear cylindrical wheels allows increasing accuracy and productivity of processing (Naden ***et al***.,1997; Hamdan,1996).

2. MATHMATICAL ANALYSIS

The essence of an offered method consists that teeth on preparation before gear shaving cutting with an slopping angle distinguished from an slopping angle teeth of a finally processed sprocket on size

$$\Delta\beta_1 = \pm \frac{2\cos\beta_0 \cos\beta_1}{m_n\left(z_1 tg\,\beta_1 \cos\beta_0 + z_0\, tg\,\beta_0 \cos\beta_1\right)} \Delta a \qquad (1)$$

Where m_n - normal module, mm;

Z_1, Z_o - Number teeth of sprocket and shaver accordingly;

β_1, β_0 - slopping angles teeth of wheel and shaver on inside cylinders,

Appropriate to a situation to the termination process of processing Accordingly;

Δa - Gap on processing on center axial distance,

And at processing curve of sprocket teeth, an slopping angle teeth of preparation increase at the same direction teeth of shaver and sprocket; reduce at different aim a direction of teeth shaver and sprocket, and at processing straight teeth sprocket right shaver a direction of teeth of preparation is left, at processing left shaver it will be right.

At such performance of preparation on each pass, since first, provide conjugate the lateral surfaces teeth shaver and sprocket, that allow in tool machine gearing to execute the law of movement the spatial mechanism formed by shaver and sprocket

$$\frac{d_{\omega 0i}\cos\beta_{\omega 0i}}{d_{\omega o1}\cos\beta_{\omega 1i}} = \frac{z_0}{z_1} = const \qquad (2)$$

As, on each pass is satisfied condition

$$\Sigma = \beta_{\omega 0i} + \beta_{\omega 1i} \qquad (3)$$

Where $d_{\omega 0i}$, $d_{\omega 1i}$ - diameters of initial cylinders shaver and sprocket on given i pass accordingly;

$\beta_{\omega 0i}$, $\beta_{\omega 1i}$ -Slopping angle teeth shaver and sprocket on initial cylinders on i pass accordingly;

$\sum$ - Angle crossing of axes shaver and sprocket;

i - Number of pass.

On subsequent behind the first passes slopping angle teeth of a process able sprocket received after the previous pass automatically changes on size

$$\Delta\beta_{n-1} = \frac{2\cos\beta_0 \cos\beta_1}{m_n\left(z_1 tg\,\beta_1 \cos\beta_0 + z_0\, tg\,\beta_0 \cos\beta_1\right)} S_{ri} \qquad (4)$$

Where n - number of passages;

S_{ri} - Radial submission on i passage.

3. EXPERIMENTAL ANALYSIS

By the specified method processed straight teeth gear oil pump with number of teeth z_1 = 10, module m = 3 mm, factor of displacement x_1 = 0.3445, shaver without modify teeth profile, number teeth of shaver z_0 = 53, slopping angle teeth of shaver β_0 = 15°, direction of shaver teeth is right. Processing processed on universal toothed gear shaving machine tool.

Teeth of gears under gear shaving have cut on toothed milling machine tool and have a polish surface, leaving gap on gear shaving operation on inter axial distance Δa = 0.10 mm. Direction of sprocket teeth left with slopping angle $\beta_{\omega 1}$ = 0.4449°, which determined by equation 1.

4. RESULTS AND DISCUSSION

The results of measurement on each tooth of the maximal and minimal deviation parameters are given in table 1

Table 1. Maximal and Minimal deviation of accuracy parameters

Parameter	Designation	Deviation
Direction of teeth, micron	$F_{\beta r}$	1... 0
Palpation of a gear ring, micron	F_{ir}	8... 6
Fluctuation of length general normal, micron	F_{vWr}	6... 4
The defect of profile, mm	f_f	No more than 0.01 (did exceed thickness of drawing line tooth profile on all height of a tooth).

Analysis of results of experiments shoes that non dependence from source stocking up polish or non polish sprocket, already on first passages of inaccuracy of toothed vien is put in the rate 5^{th} … ^{6th} degree of accuracy at one draft pass.

5. CONCLUSION

1. Degree of reducing inaccuracy of toothed vein on the passage, which executed, depends on geometricies of surface of sprocket teeth, received on the preceding passage and corresponding to an angle slopping of teeth and crossbreeding the axis to the center axial distance on given passage.
2. The offered method allows already on first passages to get quality factors of toothed vein within 6^{th} degree of accuracy.
3. Realization the offered method shaving with variable angle slopping of sprocket teeth is not required modernization of tool grappling.
4. The offered method allows increasing accuracy and can be easy introduced in the production.

REFERENCES

KOHAN, G.I. (1962) Processing of gear wheels. M. -L.: mech.

LUNEEV A.B & BULATOV G.D. (1974) Improvement of accuracy of a structure teeth at gear shaving of gear wheels. Inform.paper № 183-74, Altay interbranch territorial center of the scientifically technical information and propagation, 2 pages.

HAMDAN, M (1996) On one method arising accuracy of processing involute sprockets under gear shaving, Kirovograd – Ukraine

NADEN, V.S., HAMDAN, M. & KOVRESHKIN, N.A.,(1997) Method Gear shaving of Involute cylindrical wheels. Patent of Ukraine MKI B23 F21/28

SIOIA, To. (1964) Gear shaving cylindrical straight teeth of wheels with small number of teeth. Fudzinski Is silent, T.20. - № 3. - Page 12-15. Translation № 67/8812.