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ЗАСТОСУВАННЯ ЗБІРНИХ ЧЕРВ'ЯЧНИХ ФРЕЗ ІЗ ТВЕРДОСПЛАВНИМИ ЗУБЦЯМИ ЗМЕНШЕНОГО КУТА ПРОФІЛЮ ДЛЯ ЗУБОФРЕЗЕРУВАННЯ ЦИЛІНДРИЧНИХ ЗУБЧАСТИХ КОЛІС ВЕЛИКИХ МОДУЛІВ

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Анотація. Запропоновано обґрунтоване удосконалення процесу нарізання евольвентних циліндричних зубчастих коліс великих модулів розробленими збірними черв'ячними фрезами з твердосплавними зубцями із зменшеним кутом профілю.

Ключові слова: зубчасте циліндричне колесо, збірна черв'ячна фреза, зубці з твердого сплаву.

APPLICATION OF ASSEMBLY GEAR HOBS WITH CARBIDE INSERTS BY THE DIMINISHED PRESSURE ANGLE FOR THE GEAR HOBBING OF THE CYLINDRICAL GEARS BY THE LARGE MODULES

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Abstract. The reasonable improvement of the cutting process of involute cylindrical gears with the large modules is offered by the worked out assembly gear hobs with carbide indents with the diminished pressure angle.

Keywords: cylindrical gears, assembly gear hob, carbide inserts.

Introduction. The cylindrical gears are widely used in driving gears of machines and equipments that are used to work out, mining and transportation in the mineral resource industry. The adjustment functions of cylindrical gears are determined by hard working conditions; however the most significant functions are their loading capability and reliability. The parameters of gears have an influence on the functionality of the gears. Mainly, they are ensured at the manufacturing cutting operations of the gear tooth.

The gear-hobbing operations are the most widespread and significant. They are characterized by considerable duration and high prime cost. The execution of manufacturing operations becomes complicated by the cutting of the gears with the large modules by gear hobs. These operations are characterized by insufficient productivity for the modern manufacture, high costs and relatively low tool life of the instruments and considerable expenses, which are directed to the support of the instruments in serviceable condition. The increase of the performance criteria for the cylindrical gears wheels reaches because of the use of the gears with heightened hardness. The cutting of these gears with the large modules is difficult manufacturing task, which, at the state-of-the-art, is solved by the means of the use of the improved structures of the hobs.

The assembly hobs with carbide inserts belong to these structures. These hobs have the heightened steadiness and recommended high speed of the cutting. It ensures the high processing accuracy and permits to increase, essentially, the productivity at the milling operations of the gears.

For the cutting of the cylindrical involute gears with the large modules, the manufacturers propose the assembly gear hobs Sandvik CoroMill 176, Ingersoll Finish Hobs BPII 75X8Z, assembly gear hobs by the V. Bakul Institute for Superhard Materials. In the structures of the gear hobs, the teeth are manufactured

from the carbide inserts by the trapezoidal shape with the standard pressure angle 20^0. These carbide inserts have additional geometrical elements, which transform them into the complex items that are delivered by only the manufactures of the gear hobs. These inserts also have high costs, and their large number for the one gear hob and high cost of the case of the gear hob essentially influence at the operating costs and the prime cost of the manufacture of the gears [1, 2].

There are the well-known standardized lathe inserts of hard alloy of the trapezoidal shape of the different standard sizes, in which the angle between the lateral cutting edges is equal to 34^0 (type 32) or 15^0 (type 51). The inserts are produced of such hard alloy that these inserts have high steadiness during the cutting with the beats and the vibrations. In general, these inserts are assigned for the cutting of the cylindrical grooves or the trapezoidal threads. The trapezoidal shape of the inserts for the type 32 (type 51) is similar to the shape of the inserts that are used in mentioned assembly gear hobs.

The aim of the work. The development of the scientific well-found recommendations of the technological ensuring of the cutting process for the cylindrical involute gears with large modules with the standard pressure angle by the means of the innovative assembly gear hobs with the carbide inserts that have reduced pressure angle.

The material and the results of the studies. There were developed the structural fulfillment of the assembly gear hob with the trapezoidal inserts of the hard alloy for the cutting for the cylindrical involute gears with the module m = 10 mm. There were used the carbide inserts with the type 32250 (GOST 25412) with the angle between the lateral cutting edges $2\alpha_{02} = 34^0$. The pressure angle for the milling tooth was $\alpha_{02} = 17^0$, which is less than the standard pressure angle $\alpha_{01} = 20^0$. The rack tooth profile with the reduced pressure angle is created from the profiles of the carbide inserts of the trapezoidal shape. The angle between the lateral cutting edges is $\alpha_{02} = 17^0$.

By the means of the rack tooth profile with the reduced pressure angle, the formation of the involute tooth profile on the gear is realized in modified machine-tool gearing, in which the modified initial circle must have the reduced diameter (d_{w12}); the initial rack tool profile has the reduced tooth pitch P_{02} ; the centre distance between the axis of the hob and the axis of the cut gear reduces; the new cutter tool pitch point is created.

The developed gear hob belongs to the type of the gear hobs of the constant setting. The counterpart rack for the gear hob are combined from the right-hand and the left-hand parts, in which the carbide inserts execute the profiling of the gear teeth only correspondingly right-hand and the left-hand lateral cut-

ting edges. For the full forming of the interdental gear wheel surface, 2 – 4 carbide inserts with the pressure angle α_{02} are arranged in the gear hob's body. At the tops of these inserts were formed the chamfers with the angle 35^0.

For the realization of the gear milling operation, there were proposed for the cutter teeth of the gears to execute the control of the tooth thickness on the constant chord S_{C12}, which is located at the teeth height h_{C12} to this chord:

$$S_{C12} = S_{w12} \cdot \cos^2 \alpha_{02} \; ; \qquad h_{C12} = \frac{1}{2} \cdot \left(d_{a1} - d_{w12} - S_{C12} \cdot \operatorname{tg} \alpha_{02}\right),$$

S_{W12} – the tooth thickness at the modified generating pitch circle d_{W12} ;

$$\left(S_{w12} = d_{w12} \cdot \left(\frac{S_{w11}}{d_{w11}} + (\operatorname{tg} \alpha_{01} - \alpha_{01}) - (\operatorname{tg} \alpha_{02} - \alpha_{02}) \right); \quad d_{w12} = d_{w11} \cdot \frac{\cos \alpha_{01}}{\cos \alpha_{02}} \right);$$

d_{a1} – the diameter of the addendum circle of the gear; α_{02} – the reduced pressure angle for the rack-type tool ($\alpha_{02} = 17^0$); S_{W11} – the tooth thickness of the gear at the generating pitch circle d_{W11} for the starting rack-type tool with standard pressure angle ($\alpha_{01} = 20^0$).

Conclusion. There were developed the arrangements for the improvement the cutting process of the cylindrical involute gears with the large modules by the assembly gear hobs, which are equipped with standardized carbide inserts with reduced pressure angle.

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РОЗРАХУНОК ОСНОВНИХ ПАРАМЕТРІВ ТА РЕЖИМІВ РОБОТИ ОБЛАДНАННЯ З ГВИНТОВИМ РОБОЧИМ ОРГАНОМ

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