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STRUCTURAL AND TECHNOLOGICAL FEATURES OF GEARS

A gear is a kind of machine element in which teeth are cut around cylindrical or cone shaped surfaces with equal spacing. By meshing a pair of these elements, they are used to transmit rotations and forces from the driving shaft to the driven shaft. Gears can be classified by shape as involute, cycloidal and trochoidal gears. Also, they can be classified by shaft positions as parallel shaft gears, intersecting shaft gears, and non-parallel and non-intersecting shaft gears. The history of gears is old and the use of gears already appears in ancient Greece in B.C. in the writing of Archimedes.

A gear tooth consists of a head and a leg of a tooth, and the surface separating the head of a tooth from its leg is a separating surface. The most important elements of gears, transmitting rotation, are the profiles of the teeth. The gears were known as early as the 1st century BC; however, the theory of the hooking of the tooth profiles was developed only at the end of the 17th century. In the 1950s a gear with a convex-concave shape of the tooth profile was proposed [1].

Gears got wide distribution due to greater reliability, to the structural features providing the less sizes of drive. The first gears were wooden and used in devices to transmit or transform mechanical energy from a natural source, for example in irrigator devices, millstones mills, pumps.

There are many types of gears such as spur gears, helical gears, bevel gears, worm gears, gear rack, etc. These can be broadly classified by looking at the positions of axes such as parallel shafts, intersecting shafts and non-intersecting shafts.

It is necessary to accurately understand the differences among gear types to accomplish necessary force transmission in mechanical designs. Even after choosing the general type, it is important to consider factors such as: dimensions (module, number of teeth, helix angle, face width, etc.), standard of precision grade (ISO, AGMA, DIN), need for teeth grinding and/or heat treating, allowable torque and efficiency, etc [2].

To compensate for future errors in manufacturing, assembly and deformation, affecting the drive robot, at the stage of manufacturing gear wheels distort the geometry of the tooth profile with a deviation from the main surface, which according to GOST (technical standards) 16530-83 is called a modification. GOST 16530-83 distinguishes between longitudinal modification (along the line of the tooth), profile (along the profile of the tooth), and other types of modification. Under the profile modification of the gear teeth, we mean the change in the gearing geometry, which improves the actual gearing process and increases the strength of the structural elements and the reliability of the gears. Modification of a gear tooth with parallel axes of rotation along the length of the tooth reduces the sensitivity of the gear to assembly errors, and in height it softens the interaction of the teeth at the moment when one pair leaves the gear and the other enters. There are both experimental methods and theoretical methods for determining the magnitude of the modification. The practical method is more accurate, but costly and time consuming, besides the wrong choice of modification can lead to the destruction of not only the gearbox, but also the engine. Various forms of modified

tooth profiles are known. As a rule, the profile modification is reduced to the replacement of the side surface area of the tooth with a straight, involute or second order curve. A non-rounded, sharp edge of the teeth without modification may contribute to the formation of an adjacent tooth on the leg, which can make the transfer robot unpredictable. GOST 13755-81 provides for the modification of the original tool contour with a straight line depending on the gear module [3].

Sometimes, two or more gears are made to mesh with each other to transmit power from one shaft to another. Such a combination is called gear train or train of toothed wheels. A gear train is a mechanical system formed by mounting gears on a frame so the teeth of the gears engage. The purpose of gear train is a transmission or rotation. The nature of the train used depends upon the velocity ratio required and the relative position of the axes of shafts. A gear train may consist of spur, bevel or spiral gears. In gear train, combination of two or gears are used to transmit power.

The gear train is classified into following types:

– Simple gear train – there is only one gear is mounted on each shaft.
– Compound gear train – two or more gears are mounted on each shaft.
– Riveted gear train – the compound gear train in which input and output shafts are collinear to each other.
– Epicyclic gear train – one gear is moving upon and around another gear.

In the first three types of gear trains, the axes of the shafts over which the gears are mounted are fixed relative to each other. But in case of epicyclic gear trains, the axes of the shafts on which the gears are mounted may move relative to a fixed axis [1].

REFERENCES

1. Зубчасте колесо : методичні вказівки та завдання для виконання графічної і самостійної роботи студентами денної форми навчання з курсу «Інженерна графіка» / Ковбашин В.І., Пік А.І. – Тернопіль : Тернопільський національний технічний університет імені Івана Пулюя, 2017. – 16 с.

2. Кротов А.О. Модификация профиля зубьев зубчатых колес – один из способов повышения их технологичности / А.О. Кротов // Молодежный научный вестник. – 2016. – № 12(12). – С. 63-66.

3. Печенкин М.В. Моделирование многокоординатного формообразования фрезерованием зубьев гиперболоидных зубчатых колес двойной кривизны : дис. ... канд. техн. наук : 05.02.07 : защищена 28.04.2015 / Печенкин Михаил Владимирович; науч. рук. А. Н. Лунев ; Казан. нац. исслед. техн. ун-т им. А.Н. Туполева – КАИ. – Казань, 2015. – 132 с.