

TRAINING OF GEARS FROM THE COURSE MACHINE PARTS

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ABSTRACT

Before introducing the concept of gear transmissions, we define it as: A gear is a mechanism that serves to transfer motion from one shaft to another through rotational motions and changes the frequency of rotation by means of a gear wheel. Called the lead.

KEYWORDS: machine, detail, concept analysis, gear, gear extension, drive, diameter, gear.

INTRODUCTION

Before explaining a new topic, the speaker asks the students the following questions to reinforce the previous topic:

How many types of extensions are there?

Student extensions are divided into 4 types. These are mechanical, hydraulic, electrical and pneumatic transmissions. The answer is that in the machine parts course, we mainly study mechanical transmissions.

How many groups of mechanical transmissions are there?

Mechanical transmissions are divided into two groups depending on the type of motion transmission. 1. Gear, chain, worm and screw transmissions that move due to coupling. 2. Belt and friction transmissions due to friction[1-5].

Lead and lead links are divided into two groups according to their interconnectedness. 1. Friction, gear, screw and worm gears connected by contact. 2. Transmission belt and chain transmissions with flexible coupling.

What do you know about gear transmissions?

Students share their insights about gear transmissions.

The speaker evaluates the students who gave the correct answers according to the evaluation criteria.

The speaker then continues the lesson by linking the new topic to the previous one.

Before introducing the concept of gear transmissions, we define it as: A gear is a mechanism that serves to transfer motion from one shaft to another through rotational motions and changes the frequency of rotation using a gear wheel. called. The smaller of the two pairs of wheels is called the gear, the larger the wheel, and the term "gear" refers to both parts.

The use of gear extensions is common in modern machinery, and their level of reliability in the work process is very high. Reliable operation, compact, high efficiency (FIK), simple operation, long service life and can provide any power [1-7]. There are specific advantages and disadvantages of gear transmissions, and below, in accordance with the program of the course "Machine Details", we will reveal a methodologically relevant topic related to the above concepts.

1. To have a general idea of the advantages and disadvantages of gear transmissions, areas of use

As mentioned, the mechanism of transmission of motion from one shaft to another by means of gears is called a gear transmission.

At a time when gears smaller than 1 mm in diameter are used in precision instrumentation, it can be seen that in heavy industry they can reach several 10 m in diameter. The involute profile teeth on the involute proposed by Euler in 1760 are still the most widely used in practice.

Its advantages are:

1. Can transmit large (several thousand kW) power at speeds up to 150m per second and the number of transmissions reaches several hundred;
2. Its surface dimensions are relatively small;
3. The force exerted on the anchor points is not very large;
4. High efficiency (0.97... 0.98);
5. There will be no slip event that will negatively affect the number of transmissions;
6. It is possible to make from different materials.
7. Disadvantages:
8. Relative complexity of preparation;
9. Noise depending on the speed during operation;
10. The damage of the forces acting on the impact is more noticeable;
11. The geometry of the bevel gear has its own characteristics.

It is recommended to use bevel or chevron gears when the rotational speed of the extension is $V > 6m / s$, because the accuracy of their preparation must be very high for the correct gears to work satisfactorily at such a speed [2-7].

The speaker demonstrates the formulas for calculating gear transmissions, visual materials using slides or explains the essence of the content to students by writing on the board.

Students gain new knowledge on the topic, write down the necessary information.

2. Learning to calculate the geometric parameters of gears

1. The distance between the arrows:
is calculated through.

$$a_w = K_a (i + 1) \sqrt{\frac{K_{H\beta} T_2}{\psi_d i^2 [\sigma_H]^2}}, \text{ MM}$$

2. Extension module: $m = (0,01 \dots 0,02) a_w, \text{ MM}$

3. The smallest value of the angle of inclination for inclined gears:

4. The total number of $\beta_{\min} = a_z c \sin 4m / e_2$ extension wheel teeth:

$$Z_{\Sigma} = 2a_w \cos \beta_{\min} / m \quad \beta = 8^{\circ} \dots 20^{\circ}$$

5. The number of teeth of the drive and driven gears:

$$Z_1 = Z_{\Sigma} / (i + 1) > Z_{\min}$$

The calculated value of Z_1 is rounded up and is appropriate for both straight gears and bevel gears.

1. Number of drive wheel teeth:

If we look at $Z_{\min} \geq 17$ the $Z_{\min} \geq 17(\cos \beta)^3$ $Z_2 = Z_1$ rotational diameters of the extension wheels, they consist of the following:

a) Diameters of the dividing circle:

b) Outer diameters: $d_1 = m_n z_1 / \cos \beta$ $d_2 = m_n z_2 / \cos \beta$

c) Internal diameters: $d_{a1} = d_1 + 2m_n$ $d_{a2} = d_2 + 2m_n$

Forces generated in $d_{f1} = d_1 - 2,4m_n$ $d_{f2} = d_2 - 2,4m_n$ gear transmission:

1) Circular power:

$$F_t = 2T_2 / d_2$$

2) Circular power:

$$F_r = F_t \operatorname{tg} \alpha \cos \beta$$

3) Longitudinal force:

$$F_a = F_t \operatorname{tg} \beta$$

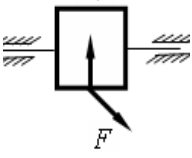
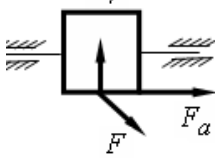
Cylindrical extension with curved gear [1-6].

Cylindrical extension with curved gear. The splitting cylinder is a toothed wheel along a helical line - β curved gear. The curvature of the tooth is determined by its angle relative to the shaft axis. Smooth and noiseless transmission of motion, the size of the load level is the advantage of the curved gear wheel. Its disadvantage is the increase in the resistance of the wheel to sliding F_a – along the shaft axis under the influence of longitudinal force on the joint.

Basic geometric dimensions. Normal step $P_n = \frac{P_t}{\cos \beta}$ and module $m_n = \frac{m_t}{\cos \beta}$ here

$$\beta = 8 \dots 15^\circ. \text{ Dividing diameter } d = \frac{m_n \cdot z}{\cos \beta}.$$

The forces at the joints of the cylindrical drive with straight and curved gears are set to the pole point [1-7].

Straight gear cylindrical extension		Cylindrical extension with curved gear				
	circular	radial		circular	radial	along
	$F = \frac{2M}{d}$	$F_n = F \cdot \operatorname{tg} \alpha$		$F = \frac{2M}{d}$	$F_r = F \cdot \operatorname{tg} \alpha$	$F_a = F \cdot \operatorname{tg} \beta$

Here are three ways to use pedagogical technology to reinforce a previous topic and introduce a new topic.

1. "Concept analysis" pedagogical technology. To do this, students will be asked to fill in the table below to determine how well they have mastered the concepts.

Concepts	Contents
Extensions	
Mechanical extensions	
Design account	
Alloy steels	
Gear extensions	
Degree of accuracy	
Number of transmissions	
Connection module	
Crushing of the tooth surface due to fatigue	
Crushing of the tooth surface due to fatigue	
Reductor	
Multiplicator	
Open extensions	
Fracture of teeth	

When filling in this table, it is necessary to provide an analysis of the concepts in general with the following content.

Transmissions - mechanisms that are located between the power supply and the working part of the machine, connecting them and allowing the movement to the required level, are called transmissions.

Mechanical transmissions - Mechanical transmissions are divided into two types:

1. Friction-operated transmissions (friction, belt, screw).

2. Couplings (gear, worm, chain).

Design calculation is the calculation of the dimensions of details using expressions that correspond to the basic workability (e.g. strength, durability, wear resistance, etc.).

Alloy steels - a) steels that contain intentionally added elements (e.g., chromium, nickel, molybdenum, tungsten, vanadium; b) or more permanent additives in excess.

Gears - When rotational motion is transmitted from one shaft to another by means of interlocking gears, such transmissions are called gear transmissions. It is a mechanism consisting of two gears and a support.

Accuracy level - in mechanical engineering, details are made on the basis of the standard with an accuracy of 1, 2, 3 ... 12 classes, with a decrease in the level of accuracy as the value of the numbers increases. Each level of accuracy is determined by three accuracy norms, which are:

- Kinematic accuracy - the limit of errors in the angle of rotation when the wheel is turned once;

- Smooth operation - additional dynamic load and noise limit;

- Limit of contact surface volume in adjacent teeth.

The number of transmissions is the ratio of a large angular velocity to a small angular velocity. This number can be equal or greater than one.

The modulus of adhesion is a linear quantity that is p times smaller than the pitch of the circle dividing the modulus of the tooth. As the module enlarges, the height of the tooth profile increases.

Crushing of the tooth surface due to fatigue - occurs on wheels operating in closed capital conditions. The main cause of failure is exceeding the limits of technical capabilities, violation of the operating mode of the transmission (overload, overheating). In such cases, unknown cracks appear at some points on the tooth surface, which gradually enlarge and form streaks.

A reducer is a device that reduces the number of revolutions by increasing the torque.

A multiplier is a device that increases the number of revolutions by reducing the torque.

Open transmissions are transmissions that work without a box. Lubrication of such transmissions is mainly done intermittently or accidentally. During the operation of gears, there is a possibility of abrasive elements (dust, oils, etc.) falling on the surface of the gears. Mainly open transmissions are used in agricultural machinery, hoisting cranes and other slow-moving mechanisms.

Fractures of teeth - Fractures of teeth are caused by two types: 1) the load is too large, in which the stress generated in the tooth exceeds the allowable stress of the material; 2) Impact loading also leads to tooth breakage. Special load-limiting devices are used to prevent breakage. Fracture as a result of fatigue is mainly related to the long-term exposure to alternating stress.

Students assess their knowledge and skills by comparing the correct answer to how well they have mastered the concepts on the topic. They further strengthen their knowledge of the subject.

It is appropriate to use the pedagogical technology "Analysis of Concepts" after the completion of a particular subject, section, chapter of the subject, and this method is very convenient to strengthen the acquired knowledge.

Concept Analysis can also be used to review, reinforce, or determine students' initial knowledge of a new topic at the beginning of a lesson and what they learned from today's topic at the end of that lesson.

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