



APPLICATION AND USE OF CYLINDER, CONICAL AND WORM GEAR MECHANISMS USED IN AUTOMOTIVES

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Abstract:

This article discusses the technical aspects of automobiles, including tooth wear, breakage, reduction of tooth contact surface due to improper meshing of gear teeth in cylindrical, conical and worm gears used in automobiles; grinding of gear teeth, etc. As a result of the use of gear mechanisms, the basic forms for the use of gear mechanisms are presented.

Keywords: Machine, mechanism, lever, gears, motion, power.

Introduction

Today, it is difficult to imagine our lives without vehicles. While vehicles were once considered a luxury, today they are compact, fast, inexpensive, and have become a daily necessity. They are increasingly becoming part of our lives with their advantages of making people's lives easier, making long journeys shorter, and other advantages.

Gears are the main parts of machines. Gears of various designs are used. Spur gears, bevel gears, cylindrical gears, conical gears, external and internal gears, special gears, different meshing angles, different number of teeth, different modules, single or combined with other parts (gears), gears are made of steel, cast iron, bronze, textolite, nylon and other materials. They participate in all types of power transmission at different speeds. In some equipment, the number of gears is more than a hundred. During operation, gears undergo various wear and tear.

Technical requirements for the manufacture of gears, types of materials and raw materials used.

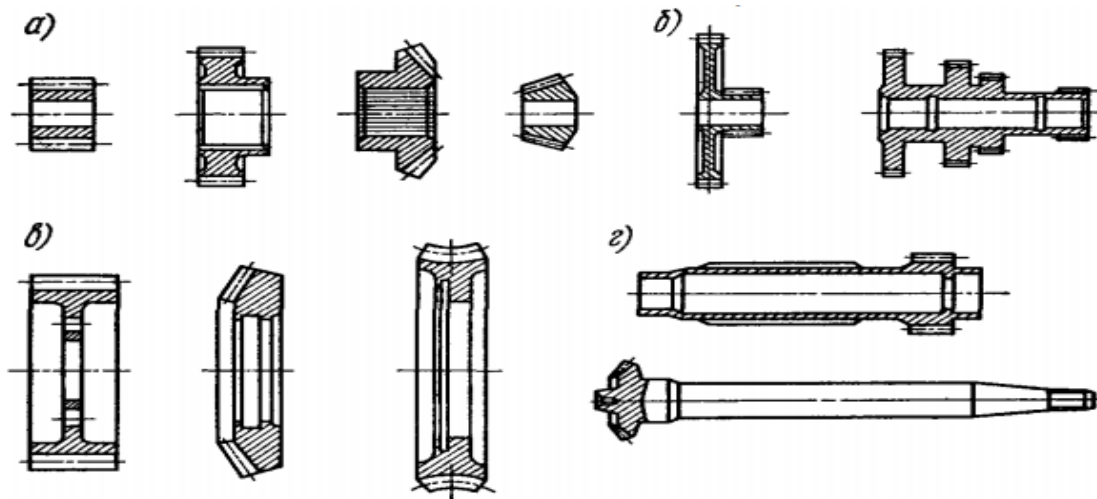


Figure 1. Types of gears.

The material for the manufacture of gears is selected depending on the amount of transmitted torque and rotational speed. Gears operating under low forces and at low speeds are made of unhardened structural steels 30, 35 or 45, plastics, gray or malleable cast iron. Gears operating under high forces and at high speeds are made of heat-treated steel 45 or alloyed steels 40X, 12XN3A, 18XGT, etc.

The type of raw materials and methods of manufacturing gears depend on the type of their material and the production program. Raw materials for making cast iron are cast. With small sizes of gears (up to 50 mm), in all types of production conditions, raw materials are made by cutting the required sizes from the rolling mill. In the conditions of single-piece and small-series production, raw materials for gears with large sizes are made by free hammering on hammering machines. Raw materials for gears with medium sizes in small batches are made by stamping methods. In the conditions of multi-series and mass production, raw materials are prepared in closed dies on hammering machines, presses and horizontal hammering machines, with a central hole formed at once.



Research materials and methods

As is known, in order to set machines and mechanisms in motion, first of all, there must be some source of energy. An internal combustion engine, a steam engine, and electric motors can be used as energy sources. Often, the operating characteristics of the units used as energy sources differ from the requirements imposed on the working part.

The shaft that directly receives energy from the energy source of the transmission is called the driving shaft, and the shaft that receives energy from this shaft and transmits it to the working part is called the driven shaft. The power and speeds of the driving and driven shafts are the main characteristics of the transmission. In addition, the useful working coefficient and the number of gears of the transmission are indicators characterizing their operation.

The useful work coefficient of the gears is determined as follows [1]:

$$\boxed{\eta} = \frac{N_2}{N_1} \quad \text{yoki} \quad \boxed{\eta} = \frac{N_H}{N_1} \quad (1)$$

In this case: – wasted power due to the presence of harmful resistances in the transmission of motion from the driving shaft to the driven shaft. N_H

If the number of revolutions of the driving shaft is n_1 and that of the driven shaft is n_2 , then the gear ratio is expressed as follows:[2],

$$\boxed{i} = \frac{n_2}{n_1} \quad (2)$$

The ratio of the angular velocities of any two shafts, regardless of the direction of the energy flow, is called the transmission:

$$\boxed{i_{1-2}} = \frac{n_1}{n_2} = \frac{\omega_1}{\omega_2}; \quad \boxed{i_{2-1}} = \frac{n_2}{n_1} = \frac{\omega_2}{\omega_1};$$

Where: and are the angular velocities of the first and second shafts in Rad/sec.

The gear ratio is a general concept and can be greater than, less than, or equal to one. The gear ratio is, in general, equal to the ratio of the number of revolutions of the large value to the number of revolutions of the small value, so it is usually greater than one. In most mechanical transmissions, since the number of revolutions of the first shaft is greater than the number of revolutions of the remaining shafts, the concept of gear ratio is mainly used in the calculation. $\omega_1 \omega_2$

In cases where the power and number of revolutions on the shaft are known, the torque on them is determined as follows:[3]:

$$M_1 = 97400 \frac{N_1}{n_1} \text{ k}\Gamma \text{ cm va } M_2 = 97400 \frac{N_2}{n_2} \text{ k}\Gamma \text{ cm} \quad (3)$$

where and are powers, divided by the torque in kWN₁N₂M₂M₁[3],

$$\frac{M_2}{M_1} = \frac{N_2 \cdot n_1}{N_1 \cdot n_2} = n \cdot i; \quad (4)$$

comes from, and in this case $\boxed{i} = \frac{M_2}{M_1 \cdot \eta}$

Thus, the number of transmissions can be expressed as follows:.

$$\boxed{i} = \frac{n_1}{n_2} = \frac{\omega_1}{\omega_2} = \frac{M_2}{M_1 \cdot \eta} \quad (5)$$

If the transmission has several stages, its total number of gears is:

$$\boxed{i} = i_1 \cdot i_2 \cdot \dots \cdot i_0 = \frac{n_1}{n_0} \quad (6)$$

where and are the number of gears found for the first, second and final stages; - the number of revolutions of the final shaft. i_1, i_2, i_0, n_0

Multi-stage transmissions do not have to be made up of a single type of gear. For example, belt, worm, and gear transmissions can be combined to form a multi-stage spur transmission.

Gears are of great importance in mechanical engineering. Therefore, it is necessary to study them, create new types, and pay great attention to existing ones.

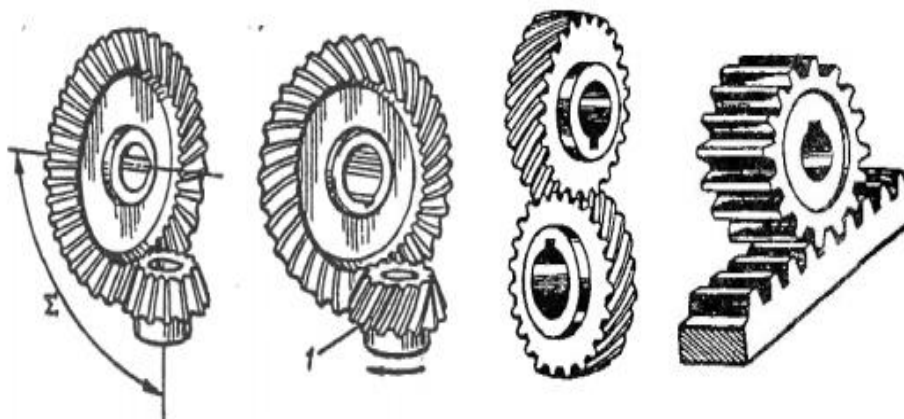


Figure 2. Gears operating by meshing.

Advantages of the extension:

- the transmission speed is up to 150 m/s, and the transmitted power can reach up to 50,000 kW;



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- external dimensions are somewhat small;
 - the amount of force applied to the supports is relatively small, higher than the FIK value ($= 0.97 - 0.98$);
 - no slipping occurs;
 - works reliably when operating;
 - can be made of metal and non-metal materials;

Disadvantage:

- the number of transfers is limited: u_{max} = can be up to 12.5;
- relative complexity of the trick;
- noise when operating at high speed;

When motion is transmitted from one shaft to another by means of gear wheels, such a transmission is called a gear transmission. The diameter of the gears can be from 1 mm to 10 meters. Depending on the location of the shaft axes relative to each other, gear transmissions are divided into the following types: cylindrical gear transmissions, in which the shaft axes are parallel to each other and are engaged externally or internally; conical gear transmissions, in which the shaft axes intersect; helical cylindrical and hypoid, conical gear transmissions, and worm gears, in which the shafts are mutually inclined.

Depending on the location of the teeth on the wheel surface, they can be spur, helical, or circular. Depending on the profile of the teeth, they are divided into involute, circular, and cycloidal types.

When the teeth are prepared without any corrections, with the parameters specified in the standard, these circles are also considered to be parting circles.

Gear ratios are calculated by calculating the contact voltage..

Analysis and results

Due to the serviceability of gears, special attention is required to prepare their central holes and gear surfaces. Thus, the error in the mutual location of these surfaces should be within 0.01-0.1 mm. The perpendicularity of the surface of the flange part of the gears to the axis of the central hole is required to be 0.05-0.1 mm. The central hole is of quality accuracy IT6..IT8 and the surface finish is Ra 1.25 Ra 2.5.



Conclusion

During the service period, the load exceeds the specified mass, the movement of the gears is not regulated during the replacement, rough movements, and the oil is not changed in a timely manner, which leads to the failure of the gears. The worn gears are replaced in pairs with new ones. Since there are no matching gears, they are repaired. In order to restore the worn teeth, the gear wheel is considered as a complete welding method.

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