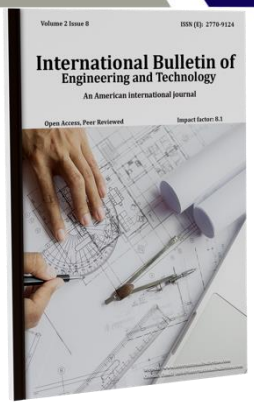

APPLICATION OF CYLINDRICAL GEARS IN RAILWAYS

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Abstract:

Today, creating machines and aggregates that meet international standards is an urgent issue. Gears are mainly used in the machinery and equipment industry. Of the above-mentioned gears, straight-toothed cylindrical gears are used the most. In this article, the use of gears in Elektrovoz trolleys is studied.

Key words:

Cylindrical gear, gear speed, tooth cracking, tooth surface wear, contact stress. Tooth cracking is a common phenomenon in spur gears. However, the dynamic behavior of gears with cracks and poor lubrication, which cause friction between the teeth, is not well understood, limiting the reliability and accuracy of the gear transmission. This paper proposes a comprehensive model to study the dynamic behavior of a single-stage helical gear with cracked teeth under poor lubrication conditions. The inter-tooth friction caused by the displacement of one surface relative to the other occurs as a result of the change in the radii of curvature of the two mating teeth as the contact point moves along the contact line. In addition, under the load transmitted between the mating teeth, the total elastic deformation field, calculated according to the Hertzian theory, also changes and produces a modulated and constant amplitude noise. The addition of this friction-induced noisy vibration to the impulsive periodic response was found to closely mimic the natural behavior measured experimentally in a test rig specially designed for this study. According to the time domain statistics, the study showed that the combination of the frictional noise components and the primary impact response was found to accurately and realistically simulate the dynamic motion of the gear [1].

With the growth of tooth faults in gears such as pitting, cracking and spalling, the amplitude of the mesh stiffness changes and, as a result, the dynamic characteristics of the gear system change. Different depth levels of severity are modeled. The effect of tooth holes on the stiffness of the gear mesh is studied. A relationship between depth severity and mesh stiffness is established [2].

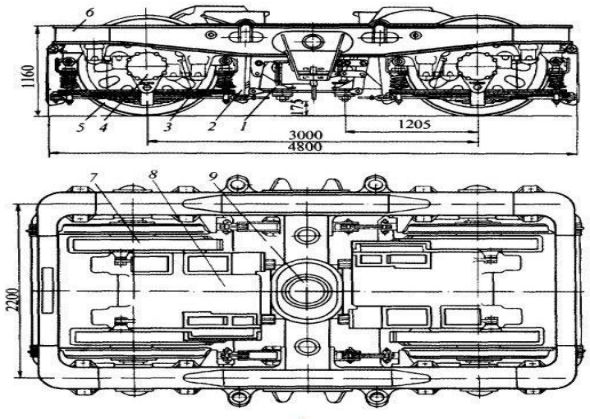
The speed of the transmission is up to 150 m/s, the transmitted power can be up to 50,000 kW, the surface dimensions are relatively small, the ratio of the force falling on the supports is small U.V.C(useful work coefficient) the relatively high value of η=0,97÷0,98, the absence of slippage that negatively affects the number of transmissions, the reliability and durability in work, and the size of the drive wheels, made of various metals and the possibility of manufacturing from non-metallic materials are the advantages of the cylindrical gear. The disadvantages are that the value of the number of transmissions in one step is limited, and the value can be up to umax=12.5; relative complexity of preparation; making noise while

working, especially when working at high speed; the difficulty of manufacturing gear wheels with high accuracy [3].

Despite the mentioned disadvantages, gears are mainly used in the machinery and equipment industry. Of the above-mentioned gears, straight-toothed cylindrical gears are used the most, because these gears are reliable in operation, have relatively small dimensions, and are relatively easy to manufacture. In cases where it is necessary to change the direction of movement during operation, conical, screw, and worm gears are used.

There can be two different reasons for breaking teeth. 1. It is very expensive. In this case, the tension generated in the tooth exceeds the permissible strength limit for the material. In such cases, the wheel teeth made of plastic materials are deformed, change their shape or break. And the teeth of the wheel made of fragile materials will definitely break. In order to prevent the tooth from breaking due to these reasons, a measure is taken to ensure that it does not become too heavy. If for some reason it is not possible to achieve this, it is taken into account that the calculation of the gears may be excessive. 2. Long-term exposure to alternating voltage. In such cases, first of all, a crack appears near the base of the tooth due to the exhaustion of the material. This crack becomes bigger and bigger and causes the tooth to break. Usually, a crack is formed where the stress concentration occurs. In order to prevent this type of fracture, it is recommended to take measures to reduce the concentration of stresses as much as possible, along with calculating the durability of gear wheels. In general, in order to protect the teeth from breakage, it is recommended to increase the module, change (correct) the teeth and heat treat them, reduce the debris falling on the edges of the teeth (this is achieved by cutting the edge of the teeth at a certain angle), and use barrel-shaped teeth. Erosion of the surface of the teeth. When gear wheels rotate under the influence of load, their tooth surfaces are periodically loaded, the value of contact stress at these points periodically changes from zero to the maximum value. The changing contact stress leads to fatigue of the surface layer of the parts.1. Decay of the surface of the teeth due to exhaustion. This type of tooth decay is most common in closed gears. There are two types of drying. The first type of wear appears during the initial start-up of the transmission, and then disappears. This type of grinding usually occurs in wheel teeth made of materials with a hardness of less than NV≤350 due to inaccuracies in their preparation due to the concentration of stresses generated at certain points of the surface of the teeth. Known - unknown unevennesses formed due to inaccuracies in the preparation of the gear wheel are smoothed out due to wear and crushing during the subsequent work of the gears. This situation leads to the loss of the points where the concentration of stresses occurs, and therefore, the hardening process stops. Thus, it can be said that the above-mentioned type of grinding does not have a negative effect on the operation of gears, but the second type of grinding is one of the main reasons for the loss of working capacity of gears. This type of grinding often has a hardness of NV>350 occurs in wheel teeth made of materials larger than and operating under extreme conditions. In such cases, known and unknown cracks appear at some points of the tooth surface due to the concentration of stresses created due to irregularities on the tooth surface. Because the extension works in wet conditions, oil begins to enter such cracks under high pressure. As a result, cracks become larger and cause the separation of small pieces from the surface of the tooth. As a result, pits of various sizes begin to appear on the tooth surface. Due to the appearance of such pits and the increase in their number during work, the shape of the tooth is distorted, the surface becomes uneven, and the impact forces increase. As a result, the

combustion process accelerates, the transmission heats up and the noise increases. In the end, it is necessary to replace such wheels. In order to eliminate wear of the tooth surface, the surface layer of the teeth is strengthened by thermal treatment, the gears are designed according to the contact stress, angle correction is used, and the teeth are made with high precision. 2. Erosion of the surface of the teeth. The surface of the teeth is in three different conditions; it can be eaten in the environment with abrasive particles, during the period of adaptation of the teeth to each other, during the start and stop of the gear transmission. Spreading of the tooth surface in an abrasive environment is more common in open gears that are not sufficiently lubricated, because in such cases the possibility of the formation of an abrasive environment (dust and other solid particles falling between the teeth) is greater than usual. In some cases, this kind of eating can also be found in closed transmissions. In such transmissions, the abrasive environment results from a certain level of contamination of the oil over time and insufficient measures to prevent dust. Gears working in such conditions are often found in agricultural machines, transport, lifting and transporting machines. Attrition, which occurs until the teeth fit together, mainly continues until the irregularities on the surface of the teeth are smoothed out. When this process is completed, this type of eating process stops. In general, this type of eating is not harmful. On the contrary, this kind of eating causes the surface of the teeth to be smoothed, and the falling load is evenly distributed. The wear that occurs during the actuation and stopping of the pressure transmission is characteristic of transmissions used in lifting cranes and city transport. This type of wear is especially dangerous for heavy duty transmissions. In such cases, if the value of the plaque exceeds a certain limit, the erosion will turn into erosion of the tooth surface. In the process of starting and stopping gears without pressure, it does not happen as above. Corrosion of the extension teeth leads to the widening of the gap between the teeth in the coupling, and the widening of the gap leads to the appearance of noise due to additional dynamic forces. In addition, the cross-section of an overgrown tooth decreases, which reduces the strength of the tooth. In such cases, the sprockets must be replaced immediately, otherwise their tooth will break and cause the car to stop unexpectedly. In order to prevent corrosion, it is recommended to increase the hardness and cleanliness of the teeth, to protect the transmission as much as possible from falling abrasive particles, and if necessary, to use oil with a special chemical substance.



In electric trolleys, the torque of the electric motor is used to transmit the torque to the pair of wheels with the help of a pinion and a toothed wheel.

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