

The Influence of Tooth Wear and Damage to the Noise of Gearing

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Abstract The technical development of machines and machineries was focused in the past on the acquisition of the highest capacity and durability. Safety and fluency of plant operation depends on fail-safe operation of technological devices too. The interruption of all the technologic device is causes mainly the failures of power transmissions. The important role in determining and secure the safe operating conditions is character of gearing failures, divided according to broad variety of its causes, plies an. This paper deals about defect of real cargo truck gearing and bevel gear of small hydropower hydrogenerator.

Keywords Spur gear, bevel gear, damage of gears.

1. DEFECT OF GEAR

Classification of gear faults by cause of the utmost importance, as it allows defining operating conditions, which led to the damage. American Standard provides up to 22 different kinds of tooth damage gears, but in our environment while there is no uniform classification [1].

Damage as a result of gear defect divided into two groups, namely damage to the tooth surface and damage to gear teeth fracture. Damage to the tooth surface can be divided on wear, seizing, plastic deformation caused by rolling, tapping, or the action of foreign bodies, pitting, pitting corrosion (running-in, progressive, micropitting) - expression of surface fatigue side teeth, peeling coating - fatigue tooth surface expression of surface-hardened [2].

Break of tooth from congestion occurs when crossing the static tensile strength of the tooth [10]. The most common cause of fracture is fatigue damage of the material due to repeated stress on the tooth bending.

2. DAMAGE OF SPUR GEAR

The Figure 1 shows the damaged gear wheels of the truck, which causes tooth damage to be specified. Both gears are very damaged. The damage is extensive at full circumference gears. Both wheels are damaged as well. Damaged are just tip of teeth. The teeth are damaged all, not one tooth is not remained intact.



Fig. 1 Damage of spur gears

The pinion gear has a number of teeth $z_1 = 76$, bevel angle of teeth is right, the second gear in the meshing has a number of teeth $z_2 = 97$, bevel angle of teeth is left. By visual inspection, it appears always more damaged one side of the side of the tooth on both gears.

The gears have progressive tracks seizing. The seizing can occur from brief overload of the transmission (in a few hours, even minutes), with an important role in its formation also have physical and chemical properties of the lubricating oil. Further damage to the teeth can cause broken teeth scattered pieces in oil. On visual inspection were found places where had to be plastic deformation (see lift gears).

Vehicle Operator is indicating increased short-term noise associated with the lighting up of additions to the gear lubricant. Failure to observe this signal have resulted in further (although even short) operate a vehicle damaged teeth and the lockout of the vehicle.

Suspected cause damage to these gears are seizing the influence of insufficient lubrication of gears in the gear box, respectively, inappropriate choice of lubricating oil. So extensive damage to the gears could be prevented in the first immobilize vehicles increased noise transfer and control light is illuminated when the amount of gear oil.

3. DAMAGE OF BEVEL GEAR

This chapter is devoted to damage teeth in small hydro generator of small hydroelectric (power) plant. After 10 years of activity is reflected increased noise. By measuring the vibration frequency analysis and subsequent hydro-generator which evaluated the mechanical vibration of rolling bearings and bevel gear has been found to be an error teeth of gear. After removing the gearbox is determining the extent of damage.

A bevel gearing with curved teeth, it is also the bevel pinion and bevel gear has been widespread damage to teeth.

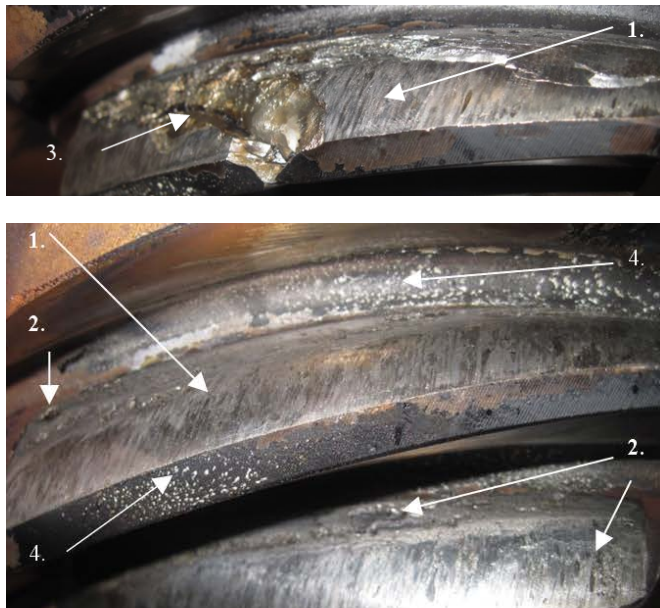


Fig. 2 Damage of bevel pinion

Damage to the bevel pinion gear (Fig. 2) can be divided into four categories:

1. Damage to the tooth flanks of the pitch to the head of the tooth vertical grooves that go over the heads of the tooth towards the tooth root belongs to damage teeth sticking.
2. Damage to the tooth flanks muffins, which occurs around the side of the tooth, but more significantly in pitch from the root transition is one of the focal damage to the tooth flanks.
3. Damage to one bevel pinion tooth fracture.
4. Damage to the tooth tip and tooth root has elements of abrasive wear.

Damage described in paragraphs 1, 2 and 4 show all tooth pinion, while the quarry has only one tooth.

A bevel gear (rim) there was extensive damage to tooth fracture. All teeth are damaged, or not to leave one is intact, and we can distinguish two types of fractures (Fig. 3). Corner tooth fracture (A), this fracture is damaged every tooth cone wreath. Fold in the middle of the tooth face width (B), so only a few were damaged teeth.

Fatigue failure starts at the tooth surface and tensile stress fracture has two distinctive parts - fatigue (fine-grained) and power (crystalline, rough). Fatigue failure may also start working on the side of the tooth, causing the cracks after sanding.

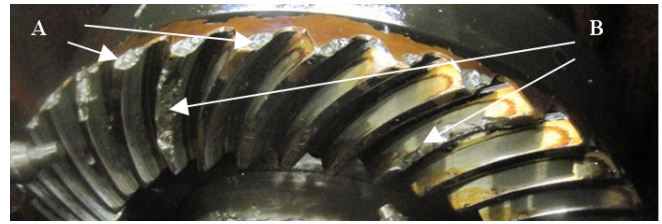


Fig. 3 Tooth fracture on the bevel gear

Fracture surface static fracture is approximately equal and perpendicular to the direction of tension. Its surface is grainy, rough, coarse or subtle, depending on the grain size of the material. Because it was breaking open only part of the tooth can be an unbalanced tooth. This may be caused by improper tooth meshing, which could be caused by assembly (wheel bearings) gearbox, improper storage shafts and thereby excite vibrations, etc.

For flawless operation must be fulfilled to ensure lubrication has been fluid friction, if these conditions are not met leads to tooth wear and time to seizure. In this case the seizure was caused by impurities in the lubricant. In case of insufficient lubrication, respectively due to impurities in the oil occurs to metal contact between the tooth flanks, which leads to micro weld and then splintering due to the relative motion tangential to the surface. This is explained in the holes of the head towards the tooth spacing. Impurities in the oil are due to peeling paint surface inside the gearbox and coat gears (Fig.4).

The damage was due to a combination of several causes. The first is application of inappropriate coating (prescription or non-compliance with protective coating applications) inside the gearbox. He caused the contamination in lubricants and defective lubrication of the gearing. Insufficient lubrication resulted in damage to the tooth flanks contact pitting. Effect of external or internal stresses which exceed the ultimate strength or fatigue strength of the material led to fracture teeth. If the material is brittle, explodes and arise cracks or break of tooth.

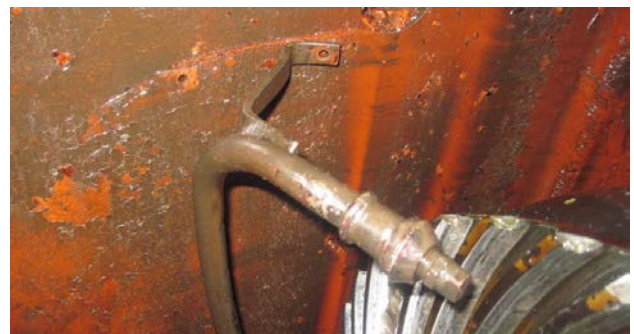


Fig. 4 Error primer coating gearbox

Influences that lead to it are varied, may be an inappropriate design (not suitable shape or size), inappropriate material (solid poorly or insufficiently tough), the error in the manufacture or assembly (indentations caused by stress due to improper technology) or the influence of temporal changes material properties (fatigue). So extensive damage to the gears could be prevented shutdown of the machine when the first increase in noise transfer and subsequent correction of errors that can be detected by checking the status gear already at this stage.

4. CONCLUSION

Damage to gears may arise by the action of unfavorable conditions on the lubrication of gears, shock loading, improper traction conditions, material errors, but also in structural and technological errors. Damage to gears may be caused by the construction, manufacturing, assembly and during operation. It is manifested by an increase in noise transmission mechanisms. Safety and flow of traffic production facilities depends on securing the reliability of technical systems. In particular defects of transfers are usually the cause of stopping the process equipment. Characteristics of faults in the gears according of the emergence causes has important role in determining safe operating conditions.

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