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Research Article

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Technical Analysis of a Planetary of Gears of an Automobile Differential

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Keywords

Planetary,
Microhardness,
Gear Shift,
Conical Gear

Abstract

This work constituted a study of a failure in the planetary of the differential of a gear shift of a certain automobile, where only one of the gears of the system was deformed intensely. This deformation proved to be so strong that the teeth of the smaller conical gear were totally destroyed. microhardness tests, optical metallography and visual analysis were performed. In front of the data, it was concluded that the damaged gear did not show the occurrence of an apparent cementation layer, which was verified by visual inspection. However, we observed that the hardness of the region where the cementation layer should have been between 500 and 900 HV0.1 was much lower than expected, averaging 300 HV0.1.Also, the damaged gear presented fractures with material accumulation that remained in contact during the rotation of the same, because the fact of presenting low hardness in the toothed region, allowed the intense deformation caused.

Introduction

Gears are considered the muscles of any automotive transmission, be it manual or automatic. They are used to transfer torque and force and can promote changes in speed and direction in the vehicle. Planetary gear sets are used as the basic means of transfer or multiplication of motor torque. They are so named because of the physical arrangement of three or four gears, which generally form a planetary game as show Figure 1.

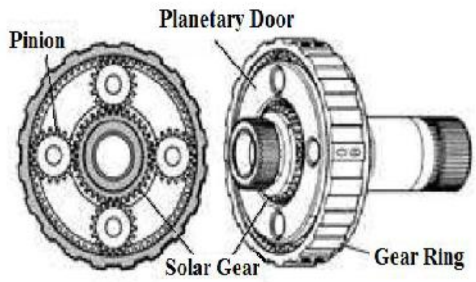

Figure1. Aspect of a set of planetary gears

The planetary gears are mounted on a support and revolve around the solar, similar to the planets orbiting the Sun, in our solar system. These gears form a joint known as a planetary gate assembly. The pinion-type gears are constantly engaged in the solar and the ring. In turn, the annular gear engages the entire set of gears and thus has teeth constructed in its inner diameter. In turn, the annular gear engages the entire set of gears [1]. Figure 2 shows a general aspect of a gearbox planetary, where the gears drive the transmitting shaft for rotation and ease of the car.

Straight Bevel Gearbox

Figure 2. Aspect of the studied straight gearbox

On the other hand in Figure 3 we have the real aspect of the system studied, as this skill required work from our laboratory an important commitment to resolve the incident that happened exactly in one of the conical pinion gear [2].

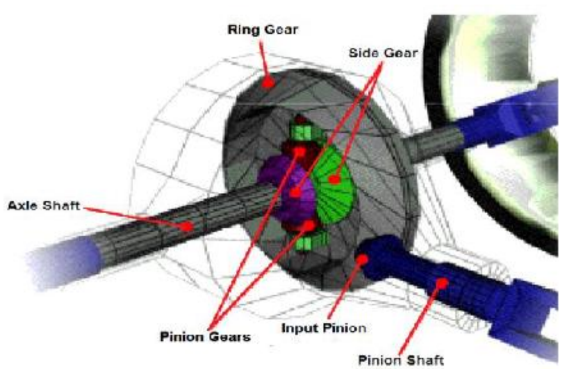

Figure 3. Internal components of the gearbox

While generally race transmissions with straight gears are very strong, its not because of the straight teeth on the gears. What may shock you is that straight cut gears are actually weaker than a same sized helical gear. The reason for this is quite simple: helical gears have more teeth meshing and thus have a greater load bearing surface area.[3,4]

Study developed

With the gear set, where only one was damaged, we performed metallographic, visual and hardness studies comparatively between the damaged sample and the others [5]. Figure 4 shows a real macrograph of the teeth of the damaged gear and the other undamaged ones. All samples were prepared according to ASTM E3- 11 [6], which requires reference to standardize the grain topography of the samples and better results in the hardness test, which was performed on a Panantec ATMI hardness recorder code 3737.15.

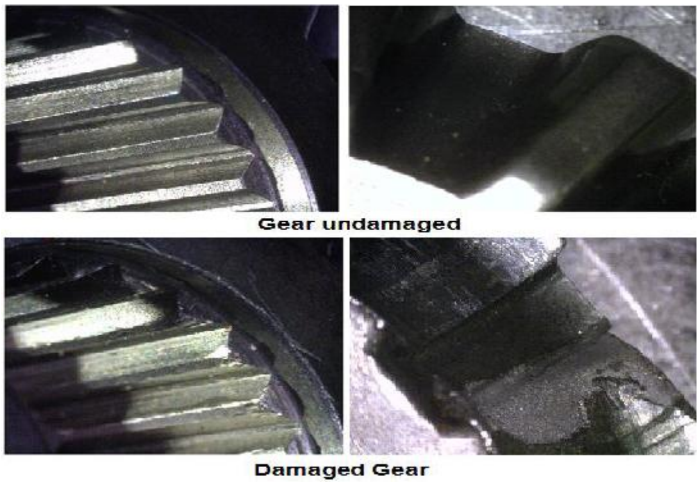

Figure 4. Macrography of damaged and undamaged parts

However, the metallographic analyzes were carried out in a microscope analysis with a 50-fold magnification of the DINO-LITE mark to obtain a better view of the fracture textures. Results and discussions The results of this work converged to a comparison of the spiral gear straight teeth with the others of the planetary, because this parameter allowed to verify the discrepancy of the damaged of the others [7,8]. The microhardness tests were performed on the specimen following a measurement profile to standardize the topography and obtain better responses in the measurements. The measurements followed the profile of measurements according to Figure 5 and 6 both for the undamaged and damaged specimen, where the points identified from 1 to 5 were restricted in measurements from the base metal to the cemented layer.

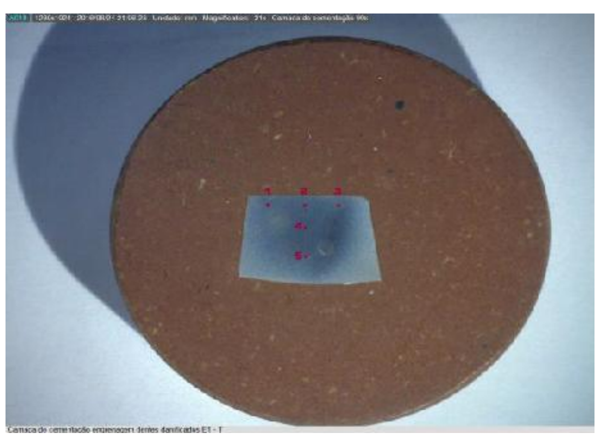

Figure 5. Topography of the measurements from the base metal to the cemented layer of the undamaged specimen.

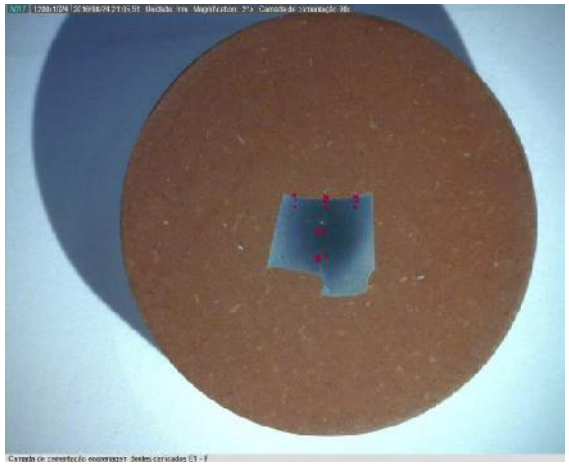

Figure 6. Topography of the measurements from the base metal to the cemented layer of the damaged specimen.

The Table 1 shows he results of the ring gear support undamaged

Sample of the ring gear support undamaged	
1	867.0
2	929.5
3	797.4
4	838.1
5	867.0
Average	859.8

The Table 2 shows he results of the ring gear support damaged

Sample of the ring gear support damaged	
1	312,1
2	321,9
3	321,9
4	305,8
5	277,0
Average	307,7

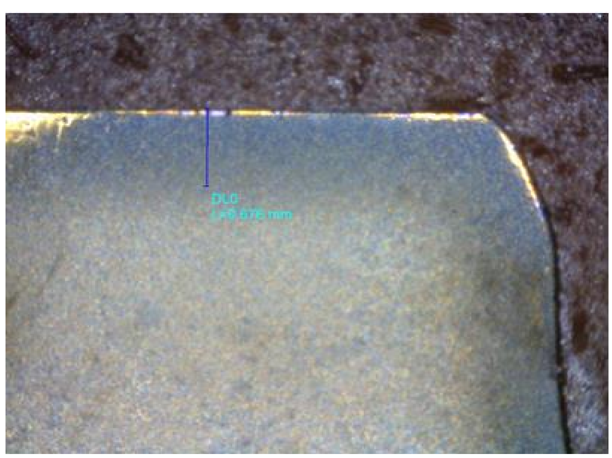

Figure 7 - Thickness of the cementation layer on the undamaged tooth

In Figure 7, we observed that in the top section of the teeth, the cemented layer had an average thickness of 0.676 mm, sufficient to resist transmission wear.

Conclusion

In this paper along from the measurements of hardness and revealing of the carburizing layer, we can conclude that the damaged gear did not present the same hardness as the gear with differences from 266 HV0.1 to 859.8 HV0.1, that is, with a load of 100 g However, the damaged gear did not show the occurrence of an apparent carburizing layer, which justifies the hardness of the region where the carburizing layer should have been below of 500/900 HV0.1. Also, the damaged gear showed fractures with accumulation of material that remained in contact during the rotation of the same, because the fact of presenting low hardness in the dentate region, allowed the intense deformation. Therefore, we can conclude that the intensely deformed and fractured gear may not have been thermally treated and improperly mounted in the respective planetary of this differential studied.

References

1. Belton, V., 1985. Gear types and efficiencies: http://www.roymech.co.uk/Useful_Tables/Drive/Ge ar_Efficiency.html
2. W. M. Berg Gear Reference Guide (PDF). Archived from the original (PDF) on 21 April 2015.
3. MuncieM21/22 information source: http://442restoration.homestead.com/files/muncie_4 _speeds.htm
4. John Milmont, Straight cut gears vs helical, April 18, 2011
5. Functioning 'mechanical gears' seen in nature for the first time, Cambridge University, 2013.
6. ASTM E3 - 11(2017) Standard Guide for Preparation of Metallographic Specimens.
7. Fred Eberle (2014). "Materials Matter". Gear Solutions: 22.
8. Robertson, Adi (2013). "The first-ever naturally occurring gears are found on an insect's legs". The Verge.

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