

Analysis on Noise Reduction in Winger Bs-4 Gearbox

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Abstract - Noise is an unwanted sound. The noise can be generated in various parts of the vehicle. Gearbox is one of the parts of the vehicle where maximum amount of noise can be generated. The entire gearbox has very complex structure so to find the actual origin of sound becomes very challenging. The main aim of the gearbox is to transmit power from engine to the wheels of vehicle. Many researcher works on the problem to minimize noise level which is generated in gearbox. 4M are widely used in industry to improve the quality of product for root cause analysis to find out actual problem in the gearbox behind the generation of noise. 4M has components of material, machine, method and man. In this project we reduced noise in winger gearbox. Winger is front wheel drive car. In winger, transaxle with synchromesh gearbox is used. Using the 4M method we find the actual cause of noise generation in winger gearbox. This paper deals with the problems found in winger BS4 gearbox and their solutions.

Key Words: Noise Reduction, Gearbox, Transaxle, 4M, Winger, Synchromesh gearbox.

1. INTRODUCTION

Winger is a front wheel drive car in which transaxle is used with synchromesh gearbox and transaxle is major mechanical components that combine the component of driven axle into complete assembly. There is unavailability of propeller shaft in between the gearbox and differential. To carry out loads transaxle is used in light motor vehicles compared to heavy motor vehicles. To transmit power from input shaft to output shaft synchromesh type of gearbox is used. In the synchromesh gearbox synchromesh devices is used and in constant mesh gearbox dog clutch is used. This is the only difference in synchromesh gearbox and constant mesh gearbox.

1.1 LITERATURE REVIEW

1. S.H.Gawande, S.N.Shaikh, R.N.Yerraw K.A.Mahajan have studied the transmission system by using the planetary gear set. To reduce the noise level and vibration they built one setup and trials were taken by using two methods i.e. with phasing and without phasing. At last they conclude that noise and vibrations were reduced by using the concept of phasing in the article "Noise Level Reduction in Planetary Gear Set" published in the Journal of Mechanical Design and Vibration in the year 2014.

2. Mats Akerblom did the survey of literature on the gear noise and vibration. He classified his research into three

parts, i.e. transmission errors, dynamic models and noise and vibration measurement. He given the brief idea on above three topics and did the literature survey in the article "Gear Noise and Vibrations - A Literature Survey" published in research gate in the year 2015.

3. Jianxing Zhou, Wenlei Sun and Qing Tao have studied the procedure to calculate dynamic response and generated noise radiation in gear reducer. They built the dynamic model with some consideration and calculate required parameters by numerical method and finally calculate gearbox panel acoustic contribution at the resonance frequency range. They researched stiffness improving plans of two gearboxes in the article "Gearbox low- noise design method based on panel acoustic contribution" published in Hindawi Publishing Corporation in the year 2014.

4. E. Balaji, D.Mouli, P.Rajasekaran, and S.Sudhakar have studied the types of noises and why noises are occurring. They have studied the tip relief method and crowing process to reduce noise in the ZF gearbox. They calculate all the forces which are acting on the gearbox and finally they implemented the above processes to increase the life of gearbox and reduce the tooth failure in the article "Reduction of Noise in ZF Gearbox" published in International journal of mechanical engineering and technology in the year 2017.

5. Rushil H. Sevak and Saurin Sheth have studied the parameters like temperature and noise which affect the gearbox performance. They applied the design of experiment technique (DOE) to control the temperature and noise level in the gearbox in the article "Study and Investigate Effect of Input Parameters on Temperature and Noise in Gearbox Using DOE" published in International Journal of Engineering Development and Research in the year 2014.

2. METHODOLOGY

Kaizen means continuous improvement and it is a Japanese word. This process gives continuous improvement and small changes for customer satisfaction. Kaizen main aim is to give better quality to customer at lower cost. Kaizen eliminate the waste and in this we used kaizen 4M method which contains man, material, method, machine. In this small changes can done for improvement in area of quality, cost and delivery. In 4M method we used root cause analysis to find out all the problems. Also to minimize noise we use Ishikawa diagram or fish bone diagram.

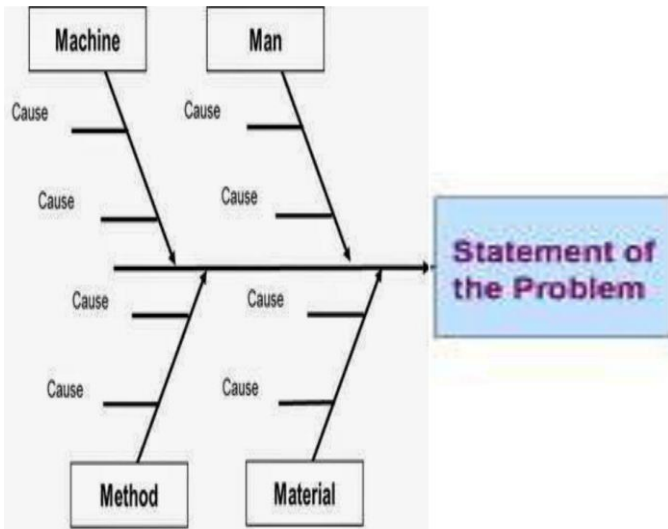


Fig No.1

This methodology is very useful and effective for problems solving in any industry.

Man

Persons working in the industry should know all the activities in details that are coming their way. They must have sound knowledge of machines to be used for production of components in their industry. Workers working on the machine must be efficient in their task. They should be alert for any break down or emergency situation. The task in front of the authorized or managerial person is, to allow the right person on the right machine and observe his quality, precision, time taken and dedication of doing that assigned work. Workers working in the industry should have enough experience with them and they must be problem conscious.

Material

Raw materials are very important factors in any manufacturing process. The quality and properties of the raw material used, will decide the quality of the end product. When raw material is coming from the supplier, that should be checked as per the set standards of the organization. Inspection person have to check the properties of material like hardness, geometrical properties etc. he can use the sampling method for this task. Impurities and irregularities of the raw material must be checked at the point of acceptance from the supplier. Appropriate material used for manufacturing the component will give the finest quality, service life and safety of the final product.

Method

Selection of correct method for manufacturing a product requires a proper planning before finalizing it. Operation sequence should be appropriate while making. There must be more than one methods for producing the some components but it should able to find the most efficient way.

This method will give the highest production rate, quality, safety and less inspection rate. The finalized method for manufacturing any component should be simple and complex operation should be avoided. Do not compromise on the safety and the quality standards set by the organization. Many industries follow the simple technique that, use the right method for the right job in the right way.

Machine

Machines used in the industry must be in good condition. It should require less operator skill as well as less supervision. Machine must be easy to handle for the operator working use. Timely maintenance is required to maintain the machine in good condition. Lubricating or cooling system of machine should be good for producing fine finished product. Machine should give the component a good dimensional accuracy. Most important aspect in machine selection is the cost parameter. It should have low cost and should be very efficient.

3. PROBLEM STATEMENT

The noise comes due to three main reasons in the transaxle gearbox that are listed

- 1) Shaft of reverse gear touches the fourth and fifth gear due to increase in PCD of gear.
- 2) When we used soft material, at one point irregular shape will occurs.

3.1 ROOT CAUSE ANALYSIS OF FIRST PROBLEM:-

The shaft of reverse gear touches the 4th and 5th gear due to increase in size of both the gear. Due to change in BHARAT STAGE EMISSION STANDARDS the size of 5th gear has increased. In BS-3 vehicles the naturally aspirated engines are used but in BS-4 turbochargers are used. So when turbochargers are used the size of 5th gear are increased by 0.6mm. We are using the 4M method for analyzing the problem as follows:-



Fig No.2.

- A. Material: The properties of material like ductility, strength, hardness etc. are good. Hence there is no defect in the above problem can cause due to material.
- B. Machine: The machines which are used for cutting of gears have good dimensional accuracy hence there is no defect in the above problem can cause due to machine.
- C. Method: If standard procedure is followed as per the given consideration then there is no defect can cause due to method.
- D. Man: NA & TC gearbox design cannot change totally but there will be minor changes in TC gearbox. Hence designer fails to check dimensions of reverse shaft so the defect can cause due to MAN.

Every time specifications of materials is not same. If hardness number is less then material is called as soft material.

Solution for problem:-



Fig No.3

The 5th gear size has been increased by 0.6mm hence 0.6x45 deg. chamfer will be given to reverse gear shaft.

3.2 ROOT CAUSE ANALYSIS OF SECOND PROBLEM:-

When soft material is used, at one point irregular shape will occurs. For manufacturing of gears we are using 16MnCr5 as a material.

Specifications:

C % :- 0.14-0.19

Si % :- 0-0.4

Mn % :- 1-1.3

S % :- 0-0.035

P% :- 0-0.25

Cr% :- 0.8-1.1

Tensile strength:- 800-1100 (N/mm²)

Hardness :- max 206 HB

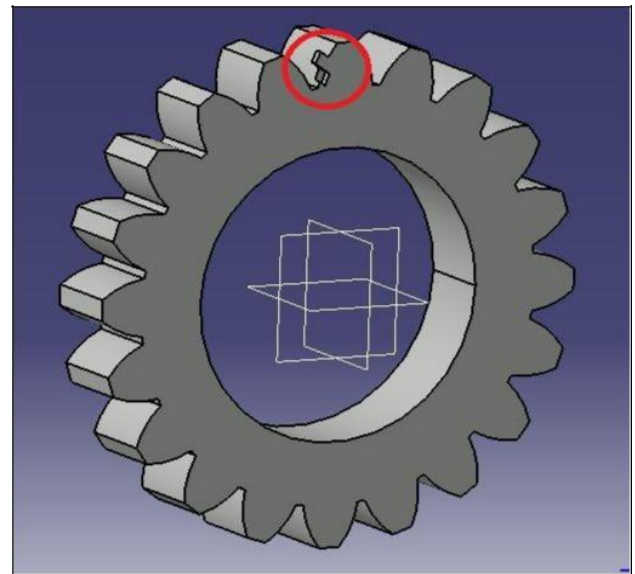


Fig No. 4

- A. Material: The properties of material changes with change in hardness number. If gear material (16MnCr5) is soft, then while testing of gear, high point will come on one tooth. hence there is defect in the above problem can cause due to material.
- B. Machine: The machines which are used for cutting of gears have good dimensional accuracy hence there is no defect in the above problem can cause due to machine.
- C. Method: If standard procedure is followed as per the given consideration then there is no defect can cause due to method.
- D. Man: There is no defect can cause due to man in the above problem.

Solution for problem:-

High point from gear tooth can be removed by using oil stone as shown in fig.



Fig No.5

4. CONCLUSION

We refer all the above papers and we have found main reason behind the generation of noise in the winger gearbox. In the early year's natural aspirator were used in vehicle but due to Bharat stage emission standard-4 turbochargers are used in vehicles. Now by using the 4M (Man, Machine, and Method & Material) method, we can find the actual cause of noise in the winger gearbox.

5. REFERENCES

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