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Research on gear box with adjustable center distance

H Sun¹ C Wang² and Y M Ma³

1 School of Mechanical Engineering, University of Jinan, Jinan 250022, China

2 School of Mechanical Engineering, University of Jinan, Jinan 250022, China

3 School of Mechanical Engineering, University of Jinan, Jinan 250022, China

E-mail: C Wang , me_wangc@ujn.edu.cn

Abstract. The invention discloses a test gear with adjustable center distance gear. The invention comprises gearbox housing, a sliding bearing seat and a fixing device. The sliding bearing seat comprises a set of T guide rail and two groups of moving sliders. A bearing seat is arranged on the movable slide block to complete the changing process of the gear center distance. The movable slider structure has a sliding groove which opens two fastening bolt holes on the right. When the bearing seat moves to the desired position, the slider installed with the bearing seat is fastened to the gear box shell by fastening bolts, and the change of the center distance of the gear box is completed. The invention has the advantages of simple structure, convenient operation, and structural design does not affect the oil mixing and lubrication of the gear when it is working, and meets the needs of different gear center distance experimental devices.

Keywords. Sliding bearing block; Gear box; Center distance variable

1. Introduction

The gear has the advantages of high transmission ratio and high stability, so gear mechanism is the most widely used transmission device. However, in the actual production and daily life, the effective life of gear mechanism and its transmission efficiency have great influence on our work. Therefore, we usually analyze the service life and transmission efficiency of gears. So it is necessary to design the test-bed for the gears under test, which requires the gears that mesh with each other to be installed in the gearbox [1-3].

At present, DCS-150 gear test-bed, CL-100 gear test-bed, JG-150 gear test-bed and ZHD82-A closed gear test-bed can't change the center distance at will. But in practice, the test stand we built has been reused. Therefore, it is impossible to choose different gear boxes for the tested gear in order to meet the installation requirements of different center distance gears in the design of test bed. In order to satisfy the requirement of the test bench for different center distance gears, we designed a test box with adjustable center distance gears. The invention has the advantages of simple structure and



convenient operation, and does not affect the oil stirring lubrication of the gear box in the working process.

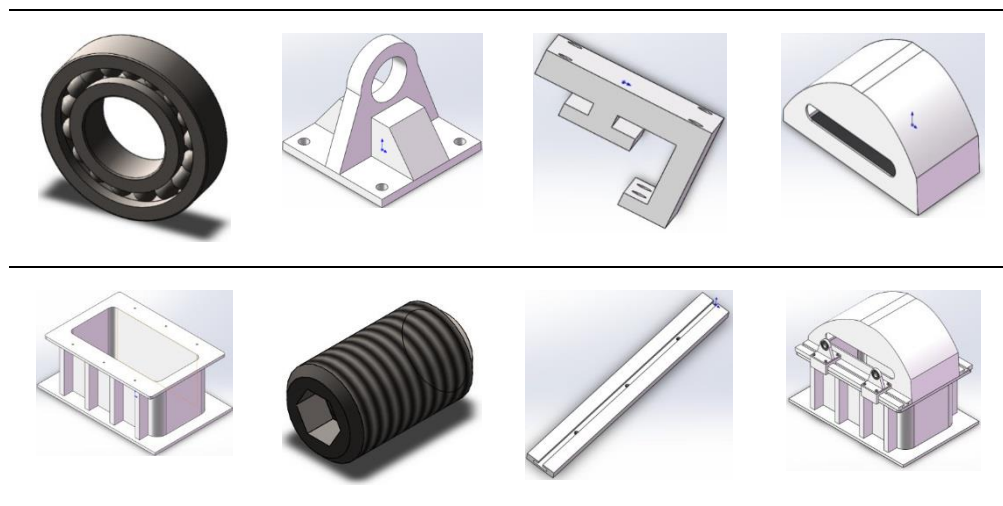
2. Summary of the invention

Cylindrical gears include spur gears, helical cylindrical gears, arc tooth cylindrical gears, etc. In actual production, gear is the main component of mechanical transmission, its failure will directly affect the normal operation of the machine. In order to make the gear mechanism work reliably, it is necessary to measure the bending strength, contact strength and check bearing capacity of the gear teeth, so as to analyze the mechanism of gear failure and provide a basis for the design of gear transmission. Such a complex process can only be carried out on the gear test-bed. Based on this, we design and invent a new method “A gear box with adjustable center distance”.

The purpose of the invention is to provide an experimental gear box with distance. It meets the installation requirements of different center distance gears in the design of the test bed. Its structure is simple, easy to operate, reduces capital investment and cost investment, easy to manage, and saves human resources. It hasn't affected the gear oil lubrication when gearbox is working [4].

As shown in table 1, the invention mainly comprises a gear box shell (1), a T-type guide rail (2), a moving slider (3), a bearing seat (4), a mounting bolts (5, 7), a fastening bolt (6) and a positioning block (8). (Where are numbers of position in the Table?)

Table 1. Center distance adjustable gearbox parts



The T-type guide rail is mounted on the gearbox housing through mounting bolts. Moving slider is combined with the T-type guide rail. The bearing block is installed on the movable slide block through mounting bolts. Sliding chute is designed with chutes [5]. The chute can hook the gearbox housing. Fastening bolts secure the moving slider to the gearbox housing when moving the slider to a proper position. When moving the slider, it needs to ensure its parallelism. In order not to interfere with the lubrication of the gears in the gearbox case, a positioning block is used to ensure the parallelism of the moving slider.

3. Specific operation method

In the design of the gearbox cover, we used two elliptical grooves on the side wall of the gearbox cover. The specific size is based on the size of the required gearbox. The elliptical groove can facilitate the shifting of gear shaft while changing different center distance gears. There is no need to change the corresponding gear box cover. The operation process is simpler and more convenient.

As shown in Figure 1, in the replacement of gears with different center distance, the specific operation is as follows: First of all, we need to loose the fixed bolts of the fixed slide rail to change the position of movable bearing block. At the same time changing the movable bearing seat, we use external location blocks to locate the moving bearing block. The objective is to ensure the parallelism of the movable bearing seat. We need to position the block together with two movable bearing bases corresponding to the same gear shaft, and push the positioning block to carry out the position transformation of the movable bearing seat. After the position transformation is completed, the fixed bolts are tightened to complete the replacement of the gears with different center distance.

In the movable gear box, because the lower box and the upper box are fixed, the lower box plays a supporting role, the upper box plays a role in preventing oil spill and dust fall. However, the main component of the movable gear box is the movable bearing seat. Its strength and hardness are directly related to the service life of the movable gear box and the accuracy of the experimental data.

In order to test its strength, we have carried out a static analysis of the bearing seat, and its family. Fixed force, deformation during observation period. First, as shown in Table 2, we need to select our material and test its properties, where we choose annealed stainless steel. Its material properties include elastic model, Poisson's ratio, mass density, tensile strength, yield strength, coefficient of thermal expansion, thermal conductivity, specific heat, etc.

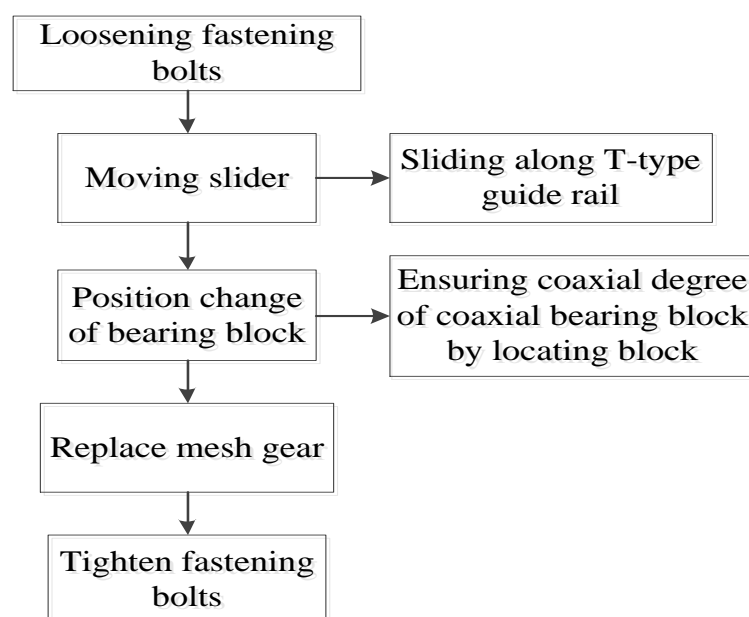


Figure1. Operation process of mesh gear replacement

Table 2. Material properties

Attribute	Numerical value	Dimension
Modulus of elasticity	2.07e+011	N/m ²
Poisson ratio	0.27	
Mass density	7860	kg/m ³
Tension strength	685000000	N/m ²
Yield strength	292000000	N/m ²
Coefficient of thermal expansion	1.7e-005	1/K
Thermal conductivity	16.3	W/(m • K)
Specific heat	502	J/(kg • K)

By fixing the bottom end of the bearing seat and exerting an axial force, the strength and deformation of the bearing seat are analyzed. As shown in Figure 2, the displacement and strain of the bearing pedestal are observed after applying an axial force of 100N.m. The biggest change was found at the top of the bearing pedestal and its displacement was 1.014e-005mm. The largest strain is the middle part of the bearing block, with a maximum of 8.463e-008.

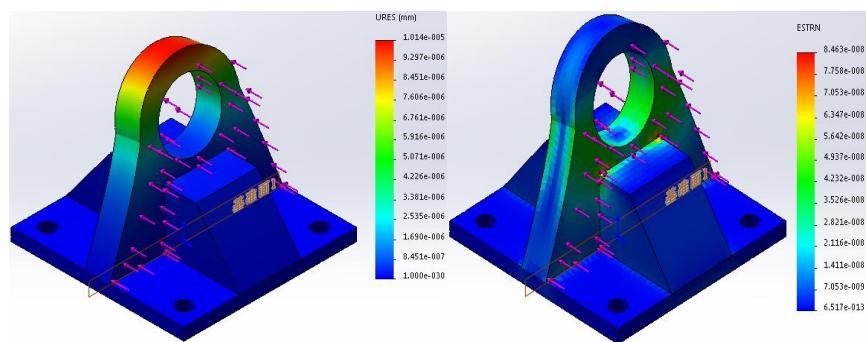


Figure2. Force analysis of bearing block

Because the slider plays a very important role in the adjustable center distance gearbox, it is mainly used to fix the sliding bearing seat on the gearbox after changing the position, so as to ensure that the sliding of the bearing seat will not occur in the operation of the gearbox, which will lead to gear meshing errors, and then lead to the failure of gear testing. Because of its importance, the material of slider is alloy steel. Its hardness, modulus of elasticity, coefficient of thermal expansion and yield strength all meet our needs. Through the model analysis of the alloy steel material in slide block in SolidWorks, the minimum safety factor is obtained.

4. Conclusion

Gear box is the most common device in gear experiment. Different gears are tested according to different center distance. But most of the gearboxes are one-to-one, that is, a set of gears correspond to a set of gearboxes. This not only increases the test cost, but also reduces the test efficiency and increases the actual size.

The error is tested. Through the improvement of the gearbox, the variable center distance gear box we invented mainly includes four parts: the lower box, the upper box, the movable bearing seat and the fixing device of the bearing seat. By moving the bearing seat mounted on the lower box, the center distance can be changed, the test cost can be reduced and the test efficiency can be improved [6-7].

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