Study on Maintenance Technology of Key Components of Emu Bogie

Qiupeng Wang

Xi 'an railway vocational and technical college

Email: 418812152@QQ.com

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Abstract: With the rapid development of China's economic level, China has made great progress in railway, especially in recent years with the progress of science and technology, emu in China is more and more popular, and gradually replace the trend of traditional railway trains. Because of the rapid development and application of bullet train, people pay more and more attention to the safety of bullet train operation. The bogie is closely related to the running safety of the bullet train, and its state will have a critical impact on the running of the train. The key parts of the bogie have direct influence on the running state of the bogie. Therefore, the maintenance of the key parts of the bogie has been paid more and more attention. This paper firstly summarizes the basic structure and working principle of the bogie, and establishes the key components of the emu bogie on the basis of consulting a large number of materials, and establishes the maintenance model, according to the maintenance model, analyzes the faults of several key components and puts forward the relevant maintenance strategies. It is not only conducive to the maintenance and normal operation of trains, but also plays a certain role in promoting the safety development of China's high-speed train industry.

1. Introduction

With the development of national economy, bullet train is gradually promoted in railway operation. At the same time, people pay more and more attention to the operation safety of emu. Bogie is an important part to ensure the safe operation of bullet trains. Therefore, the maintenance and repair of the bogie is directly related to the safe operation of bullet trains [1]. If the failure of the bogie of the bullet train cannot be eliminated and repaired in time, the operation of the bullet train will be interrupted seriously, which poses a great threat to the safety of the bullet train. If the maintenance is unreasonable, there will be insufficient and excessive maintenance, which will also affect the operation of bullet trains [2-3]. The study on the bogie fault of emu is related to the safety of train operation, and also closely related to the actual operating cost of bullet trains. Therefore, it is of great significance to study the key components of the bogie [4-5]. At present, the repair rate of key parts of the emu bogie in China is still relatively low, which makes the failure repair effect of emu is not obvious, and there are many deficiencies. Therefore, it is an urgent problem to study the maintenance technology of key components of emu bogie.

At present, domestic and foreign scholars have conducted a lot of research and analysis on the maintenance of key components of emu bogie [6]. Based on the analysis of these studies, can know the emu bogie maintenance mainly includes two levels, regular maintenance level and application level, is the present status of the moving vehicle maintenance technology in China, it seems, the bogie troubleshooting of key parts but also a lot of deficiencies, still have a lot of room for improvement [7-8]. Regular maintenance means that the service life of emu sets a fixed maintenance time for key parts; Application maintenance is determined according to the actual loss of parts and components during the operation of the bullet train [9-10]. However, if we can repair the failure of key components of the bogie in the first time, we can remember to reduce the probability of failure during the operation of the mobile vehicle and ensure the operation safety of the emu to the greatest extent [11-12].

This paper firstly summarizes the basic structure and working principle of the bogie, and

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establishes the key parts of the bogie of emu on the basis of consulting a lot of materials, mainly including gear box, brake setting and wheel equivalence. In addition, a maintenance model was established on the basis of experiments. According to the maintenance model, faults of several key parts were analyzed and relevant maintenance strategies were proposed [13-14]. It is not only conducive to the maintenance and normal operation of trains, but also plays a certain role in promoting the safety development of China's high-speed train industry. At the same time, it provides a certain theoretical basis for future relevant research [15].

2. Method

2.1 Bogie Overview

The bogie is a key component of the bullet train, a device used to support the body of a bullet train and drive it along the track. Emu bogie needs to undertake many tasks, including support, traction, guidance, buffering and braking. Its composition is also relatively complex, mainly the following relatively important parts: wheelset, axle box, gear box, spring suspension, traction and braking and driving device. The conversion of electrical energy into mechanical energy is the main conversion process of bogie energy. Driven by electric power, the wheelset is driven by the movement of the gear box. The axle box and the relevant positioning device enable the car body to maintain smooth operation and normal operation along the track. Spring suspension can make the uneven road caused by the shaking of the motor car greatly reduced perspective to a certain extent can reduce the rail vibration on the motor car operation caused by adverse; The base brake can change the internal friction between the wheelset and the brake shoe into external friction, which increases the friction, so that the bullet train can brake quickly.

2.2 Identification and Maintenance Model of Key Parts and Components

A bogie is a complex system of many parts. About the determination of the parts of the bogie, here from many aspects to determine, including parts failure frequency, danger level and other aspects, at the same time, this paper also combined with the railway departments of the emu parts of the division of the emu parts to determine the key parts of the bogie. Use RPN to represent the risk of parts. If RPN≥2 means the risk is above moderate, it is a key part. It is easy to find that RPN of bogie parts in the bogie, such as wheelset, brake device, gear box and central suspension device, is ≥2 after consulting relevant information and making statistics on the RPN of the emu bogie. In other words, it is above moderate risk and belongs to the key parts.

For some emu bogie maintenance of key parts in a large number of collection and analysis, on the basis of numerical algorithm to simulate the data collected from the related statistical analysis, and then with the help of MATLAB programming calculation, system software can key the two failure occurs from the bogie is consistent with the two parameter weibull distribution, detailed parameters are: shape specific parameter is beta 4.01, scale specific parameters eta is 45.62. So the train bogie of key parts failure probability is as follows:

$$\lambda_s(t) = \frac{\beta}{\eta}(\frac{t}{\eta})^{\beta-1} = \frac{4.01}{45.62}(\frac{t}{45.62})^{3.01} \quad (1)$$

The reliability of emu bogie is:

$$R_s(t) = \exp(-(\frac{t}{\eta})) = \exp(-(\frac{t}{45.62})^{4.01}) \quad (2)$$

From the aspect of reliability, it is mainly considered from the influence of bogie faults on the operation safety of high-speed car, the influence of bogie common faults on the operation function of high-speed car and the average failure rate of the bogie itself. In this case, the key components of the emu bogie can be analyzed comprehensively.

3. Experimental Procedures

Step 1: collect and sort the bogie fault data; Refer to relevant information to sort out and analyze in detail the failure data of important parts of the rail car bogie. Then the key parts of the bogie are determined with the help of the obstacle of each part and the relevant RPN value.

Step 2: data calculation and analysis; With the help of relevant algorithms, the weights required for maintenance of key components of the high-speed car bogie are generated. The maximum weight of each group is the influential factor of components with the highest priority, and the minimum value is assigned to the influential factor of components with the lowest priority. Then, according to the formula, the evaluation value of the importance of components of the bogie is calculated, and the components of the bogie are arranged according to the importance evaluation index from the largest to the smallest.

Step 3: conduct detailed statistical analysis of fault data according to the sequence results obtained in the above steps, obtain the final accurate evaluation result of bogie parts importance, and then provide sufficient data support for determining the specific maintenance mode of the bogie.

4. Discuss

4.1 Experimental Results and Analysis

According to the above experiments, it is easy to find the important role of the key components of the bogie of the bullet train. At the same time, with the help of the data maintenance model of key parts, the maintenance methods of different key parts are obtained. The specific data of the experiment are shown in table 1 and figure 1. The data are the results of the author's experiment.

Table 1. Weight and priority ranking of each factor

Number	Factor	Weight	Priority Sort
1	S	0.2345	1
2	SF	0.0861	4
3	FR	0.0754	6
4	MC	0.0643	7
5	BL	0.1767	2
6	I	0.0710	8
7	DT	0.1601	3
8	MD	0.0925	5
*Data came from the experimental collation			

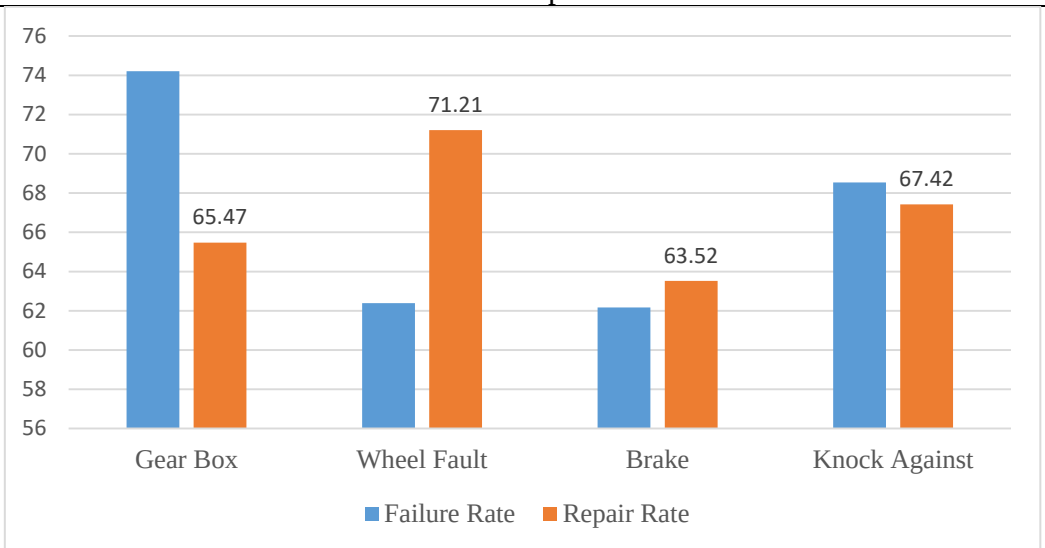

Figure 1. Table of failure and maintenance of several key parts

4.2 Failure Analysis and Maintenance of Key Components

(1) Fault and maintenance of gear box

From the above experimental data, it can be seen that the failure rate of the gear box in the key parts is 69.32%, and the oil seepage fault is the main fault of the gear box. Gear box oil leakage mainly has the following two reasons, the first is the high-speed operation of the vehicle makes the heat can not be sent out from the closed space, because the pressure inside the box increases will appear oil leakage; The second is the failure to timely deal with other related faults caused by gear box oil seepage fault. So in the gear box maintenance must be strictly in accordance with the relevant maintenance standards for maintenance, their own control of the closed parts, and the gear box for periodic maintenance and repair.

(2) Fault and maintenance of brake device

The failure of braking device is more likely to occur in the key parts of the emu bogie. At present, the braking mode of bullet train is mainly air braking, so there is a close relationship between the braking device and the normal operation of bullet train. If there is a problem with the braking device of bullet train, it will affect the normal operation of bullet train and seriously threaten the life safety of bullet train passengers. The common faults of the braking device of the motor vehicle mainly include the poor transmission effect, the lack of braking force, the emergency braking cannot be reset in time and so on. The braking effect of the brake device has a great relationship with the connector, including the contact between the connectors. Therefore, it is necessary to pay attention to these key parts when carrying out the maintenance of the brake device.

(3) Wheel set fault and maintenance

Wheel tread wear, brake disc eccentric wear is often the fault of moving wheels. The phenomenon of off-wear of brake disc is closely related to the brake clamp disc. The main reason for the damage of the wheel tread is the condition of the road fork and the speed of running through the road fork. So the maintenance of the wheel on the fault must be regular and periodic. During the service period of the train, check and repair the brake plate, tread and other parts. If the fault is found, timely replacement and maintenance must be carried out strictly according to the management standards.

(4) Failure and maintenance of component bump

The speed of the bullet train will reach its maximum when it is running. It is affected by various factors such as the route and the weather. The flying of the running section may cause some damage to the key parts of the bogie, resulting in the failure, which will more or less affect the operation of the bullet train. There are certain knock against standards for parts of different types of bullet trains in relevant documents of bullet trains. Therefore, the knock against faults must be repaired strictly according to the prescribed standards. At the same time, the train conductor should make reasonable adjustment to the speed of the train according to the actual situation, and regularly arrange relevant staff to maintain the running line of the train, so as to minimize the probability of bumping into faults.

5. Conclusion

Generally speaking, bogie plays an extremely important role in the safe operation of bullet trains, and its maintenance status is closely related to the safety of bullet trains. Meanwhile, the important parts of the bogie are related to the overall structure of the bogie. Therefore, from this perspective, the key parts of the bogie are also related to the safety of the whole high-speed car. Therefore, the maintenance of the bogie should be accurate to the maintenance of each key part and avoid from the details. Only in this way can the safety of the train in the process of operation be guaranteed to the greatest extent and the life safety of relevant personnel be guaranteed to the greatest extent.

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