

Development of Railway Vehicles New Products and Technology of Developed Countries

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Abstract. Currently, the urbanization process has speeded up, and with the rapid development of industries, the number of vehicles has increased, accompanying with the issue of traffic congestion. In order to relieve the traffic congestion and reduce the pollution from automobile exhaust, after analyzed the reality of cities development, the suggestions have been proposed accordingly, such as increasing the construction of rail transit. There are several cities are already in use or in construction of light rail, underground and aero-trains, and according to the feedback of these projects, the advantages of these rail transit are mainly fast speed, no traffic jam, covering less floor space and environmental friendly. The rail transit is the inexorable trend of city development. Therefore, in this paper, the research on new products and technologies of railway vehicles of developed countries has been done and will provide the significant reference for the development of railway transportation of our country.

Introduction

Light railways and undergrounds have been started in construction from 60th of last century; after 30 years, rail transit has entered the primary development stage in cities, which is used in city of Beijing and Shanghai and received acknowledgement widely. Recently, undergrounds have been settled in Wuhan, Shenzhen and Nanjing; while in Changsha, Qingdao and Suzhou, the rail transit is under planning and constructing. In general, China has welcomed its golden time of city rail transit running. In the design and development of rail transit vehicle products, the technology and process of production should be improved as the requirements; meanwhile the improvement must learn from the success of developed countries to promote the development on the advantages of city rail transit of our country. This paper has discussed the future development of our rail transit vehicle, combining with the new products and technology of rail transit vehicles from developed countries.

Rail transit Vehicle Bogie Technology and Application Development

The bogie technology is the fundamental component of rail transit vehicles, related to the running and load bearing. It provides the support to the body of vehicles, to ensure the smooth, steady and safe running of vehicles. The bogie consists of foundation brake, springs, drive and swing bolster, and existing different forms as uniaxial, biaxial and multi-axial forms. Most bogies of rail transit vehicles are in biaxial form. Currently, the bogies of rail transit vehicles have changed from biaxial form to the uniaxial link bogies, with shorter and wider body of vehicle structure. For this kind of vehicles, its running radial direction can be adjusted, and its bogie has used the modular design technology, with better development and application.

Application of uniaxial bogies can be divided into several situations: one is the integrated structure of wheel and axle; the other one is that the relative rotation is existed between car body and axle, in which the wheel is independent. Recently, some countries and areas have employed the rail transit with uniaxial bogies and research and improve the technology continuously in order to realize business operation. In fact, in the structure of rail transit vehicles, the application of bogies is not fixed. Therefore, the design and manufacture of bogie could depend on the real requirements from different countries and areas, considering about the purpose, operating pressure and the

characteristics in the operation area of the vehicles. Therefore, the future development direction of rail transit vehicles is lighter, faster, more environment-friendly and more reliable.

Currently, the developed countries in Europe, America and Asia have increased the research on the system of bogie; Japan is the main producer and researcher of bogie in Asian area, especially the research on high-speed bogie. As the increasing requirements of urban railway systems in cities, our country has realized the importance of research and optimization on bogie, and promoted the development and optimization of rail transit vehicles.

Rail Transit Vehicle Signaling System and Application Development

In the process of rail transit, a lot of new technologies are involved in. The application and innovation of signaling system is one of the significant issues, which is also the infrastructure to protect the safety and steady operation of vehicles. Generally, a signaling system for rail transit vehicles contains three important components, respectively automatic train protection system (ATP), automatic train operation system (ATO) and automatic train supervision system (ATS). The application of ATP is to connect the ground devices and the carried devices on the vehicle, and perform the supervision and control in the whole process of operation. The main function of ATO is to control the travel of vehicle. ATS contains devices on the vehicles and in the stations. All the signals are sent to the control center, and the center gives the unified commands and the distributions of vehicles. The application of the three systems has create a closed loop in the operation of vehicle, which can realize the control of ground information and the signal sending timely and perform stable control during the operation, to protect the safety of the vehicle.

The signal system of rail transit vehicles is divided into two categories, fixed and moveable. Most of the signal systems are moveable. If use the fixed one, the transportation speed cannot be guaranteed when the vehicle is under the bad operation condition or under the lower performance of the vehicle, no matter it has mature technology and less cost. Currently, Siemens of Germany, GRS of America and Westinghouse of Britain are developed and used the signal system with speed pattern. Meanwhile, the undergrounds in Shanghai and Beijing have brought in this signal system as well to ensure the vehicle running with in the target distance and the high passing rate. The moveable signal system has created a closed loop for information transmission, which will protect the vehicles from the two-way operation, and give better play of vehicle operation. Line 10 of underground in Beijing has used this moveable signal system.

In some developed countries, in order to improve the security, stability and rapidity of rail transit vehicles, several technologies for safety protection have been used in the vehicle structure, such as digital signal processing and real-time control system. They can guarantee the normal communication of signals, improving the devices on the vehicle, and realizing the intelligent and digitalized development of vehicle. The new technology has combined the automatic control with communication technology and form a new technology of signaling system, which can ensure the stability in operation of vehicles. The vehicle control system has used the automatic control system based on the technology of wireless communication system. The application will improve the speed and stability and it has become the advanced and practical signal control system. The feature and advantage of this system has included the following: for one, the different vehicles on different rails have formed two-way wireless channel. This system is suitable for requirements of long-distance and short-distance transportation. For two, there is still closed loop in this system, mainly the fixed pattern, adopting axle counter and transponder, making the structure simpler and maintaining the previous length.

Rail Transit Vehicle Monitor and Control System and Application Development

The function of monitoring system cannot be ignored in the transportation of vehicles, which covers the power equipment and mechanical equipment. It is to protect the efficiency and safety of the vehicles via the computer integration system and reaching the goal of information share. modern

integrated supervisory control system of rail vehicle transportation is based on the technology of computer, performing the real-time supervision on the operation of vehicles and the devices, to make sure the data can be sent normally and to adjust the vehicle as the operation requirements; if any malfunction of devices is detected the system will provide the alarm message; With the use of integrated monitoring system, it will protect the integration of data and the signal distribution center will obtain the parameters for the vehicle operation real-time, to make the timely and effective decisions, and when malfunction has occurred, the system can locate the place of the malfunction and take relevant actions. The utilization of vehicle monitoring system has provided us with the extensive operation mode, which can increase the functions as requirements. With the development of science and technology, the integrated development of information and industries, in order to cope with the latest requirements on rail vehicles, the supervisory system has played the significant role in distribution, operation planning and maintenance of vehicles, finally realized the systematic and intelligent development of integrated supervisory control system.

Information System Supervision

The basic supervisory system is mainly responsible for the management of distribution plan, vehicles operation and safety operation. However, previously it relies mainly on single-way data transmission which is not the unified supervisory system. The information supervisory system has combined with the reality of industrial development, focusing on the combination of control on lower layer and management in higher layer. As the development of information, more requirements of automation have been proposed, including process control and operation management. The information control system has realized the control from sensors on vehicles to the whole operation system. In order to keep the integration of data in the supervisory period, it is to form the support with overall assistance, to avoid the situation of information isolated island. For the whole supervisory system, it is mainly in hierarchy distributed structure and the system is open and extensible. The system can flex the distribution according to the operation of vehicles and monitoring requirements.

Safety System Supervision

The operation safety of rail vehicles involves in multiple factors, including devices operation, signal transmission and systems interactions. Current integrated monitor system is lack of consideration on safety, which should be improved. It requires the concentration and analysis on system safety and detects the potential dangerous factors that may happen in the operation and takes the countermeasures. As it has employed widely in rail vehicle transportation widely over the world, the safety issue is the most concerned one. In the newest international standard specifications, the lifetime of software and hardware of programmable, electric and electronic system has been determined, which provided the reference for the evaluation of rail transportation safety. Therefore, in our country, the professional criteria and standards must be proposed in refer to the safety criteria in European countries and combined with the reality of domestic rail transit vehicles.

Intelligent System Supervision

Currently, the wireless communication technology is relatively mature which includes the application of private network and public network. Meanwhile, the technology has already penetrated in the automation and information systems in various industries. The application of wireless communication technology is very necessary and significant. For the rail transit vehicles in cities, the digital cluster communication technology will ensure the routine operation management and play better function of control system. This technology has combined with mobile communication system and integrated supervisory system, providing local and remote distribution tasks in coordinating the urban railway systems, such as wireless emergency commanding, analysis and adjustment on passenger flow volume, and the control of energy-saving operation.

Integrated monitor system has employed the mode of depth integration wireless communication system, to protect the remote service of monitoring system, and have changed the control merely in central distribution room. Therefore the integrated monitor system has embodied the advantages of mobile, and protects the safety of vehicles better. Meanwhile, the application of this system will help the staff to make plans for maintenance and help the decision-making process. For example, the system will provide alarm when it has detected fire hazard and the relevant emergency plan can be

made timely. Additionally, the coordinators of undergrounds can use the mobile terminal such as smartphone and tablet PC to realize the mobile office mode.

Rail Transit Vehicle New Products and Technologies Development

The future development of rail transit vehicle must contain the factors of high technology and high intelligence. The future research direction of our rail transit vehicle can have the following directions, referring to the advanced production and operation technology from developed countries:

Charging Technology in Application of Rail Transit Vehicles

Currently Canada has started the research and application of wireless charging in rail transit vehicles with existing infrastructure, to ensure the energy required in operation. For example, put the wireless charging cushion under the road, in charging the bus, electric bus and rail transit vehicles. The research hotspot is how to charge the cars in running. As railway transportation has its fixed running route and operation mode, and the wireless charging cushion will provide the satisfactory charging, through the connection of charging port with the cushion via the magnetic induction.

Land Airbus Running Mode Development

In order to relieve the traffic congestion, the light rails and undergrounds have been employed, extending the railways elevated or undergrounded rather than take up the floor space; at present the two relevant technologies are gradually mature. And the future development of transportation is the "land airbus". The main purpose of this concept is to split the flow: separate the pavement, motorway and bicycle lane from each other; the bridge type platform of the land airbus is to avoid taking the floor space, so as to the crowd. The land airbus will use the skylight door, and the whole car is suspending in midair. The vacant area under the airbus allows the small vehicles to pass. Additionally the bus can be charged with solar energy, to protect the requirements of energy. It has zero exhaust, which satisfied the requirements of environmental protection.

In conclusion, according to the successful experience in developed countries of rail transit vehicles, the rail transit vehicles will effectively relieve the traffic jams and reduce the exhaust of automobiles, which is the necessity of country; it is a very important transportation approach in some developed countries with relatively mature process and technology; In our country, the relevant technology is still at the early stage while most cities are not in use of rail transit vehicles, and some technologies still need to be explored. We have to refer to the experience of rail transit vehicles of developed countries to speed up the construction of rail transit vehicles, to realize the development of economy and to satisfy the requirements of city development.

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