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Chief introduction for the door of metro made in China

Shangjun Guan[a], Ke Yang, Zhiyuan Pan

College of Mechanical Engineering, BeiHua University, Jilin 132021, China

Abstract

This paper describes the types, uses and structure of the door of Metro made in China, making an introduction of the advantages and disadvantages on different structural forms passenger compartment door.

Keywords-metro vehicle; cab door; back door; passenger compartment door

* Corresponding author. Tel.: 86-18643205988.
E-mail address: gsj6509@163.com

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1. Introduction

The vehicle is a subway tunnel running on the road or part of the urban railway transport lines. The car doors are one of its important components, their settings and the design is reasonable or not, not only directly impact on passengers' comfort and convenience, but also to the safety of vehicle operation and vehicle's overall performance index, so for the subway car doors should be designed taking into account the underground railway vehicle running and structural characteristics and the characteristics of urban transport. Here are several common domestic subway doors.

2. Types and uses of the door of Metro made in China

Metro urban rail vehicle door system includes a cab doors, rear doors and passenger compartment doors. Cab driver's cab door usually includes the side door, rear cab doors and emergency evacuation of the front door.

Cab drivers side door is designed for on and off a door, China's current production of subway cars generally use the folding door, sliding door to use more foreign countries.

Driver's cab and passenger compartment are separated by the cab rear doors that are usually folding doors.

The emergency evacuation front doors are set up to prevent the event of an emergency during vehicle operation, therefore, they are also known as escape doors. Emergency evacuation front doors can be classified into folding doors and folding doors which are flipped down, China's production of subway cars generally use the folding door, part of the subway cars in the European use the folding doors which are flipped down. The subway of Shanghai that is produced by Germany just uses this kind of folding doors, which are flipped down. This kind of doors is more meaningful to escape in case of emergency.

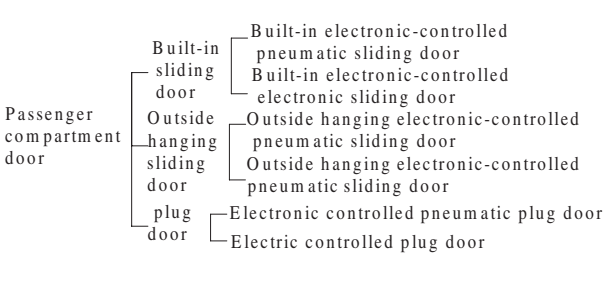
The back door is the door must be located by the no windshield vehicles, and the door is locked when the vehicle's normal operation. In a windshield vehicle, in order to ensure the tightness of the vehicle, also has this door. In foreign production of some higher-end vehicles, since the windshield seal good performance, and in order to increase the aesthetics and the carrying capacity of the passenger compartment, they abolished the side door and use the completely through-type, between the vehicles is no side door. China's production of subway cars have two kinds of side doors which are manual folding doors and manual sliding doors, manual end sliding door is divided again with the sliding door of ordinary manual and automatic reset institutions of end sliding door.

Passenger compartment door is the door for passengers to get on and off, according to drive mode and structural type, metro city urban rail passenger compartment door substantially can be divided for electrically controlled pneumatic plug door, electric control electric plug door and so on six kinds of doors (Fig.1).

3. The structure and function of the door of Metro made in China

3.1. Cab side door

Cab side door are generally manual folding doors (Fig.2).



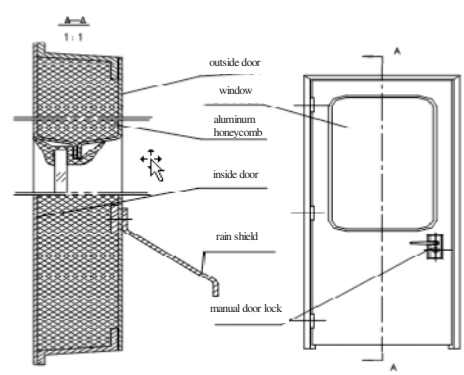


Fig. 1. Types of passenger compartment door; Fig. 2. Cab side door

Door plank is sandwich structure, internal and external doors and middle aluminum honeycomb bonded together after adding in adhesive plastic and the vacuum pressure between them. Doors equipped with glazing and manual lock. Glazing can be designed according to user's requirements into a pull-down movable window (Fig.3).

Manual folding door's advantages are its structure is simple and sealed performance is good. The disadvantage is between door and body wall panels have a greater level, affecting the appearance of the vehicle model, the door occupies driver cabs' a large effective space when it is opened.

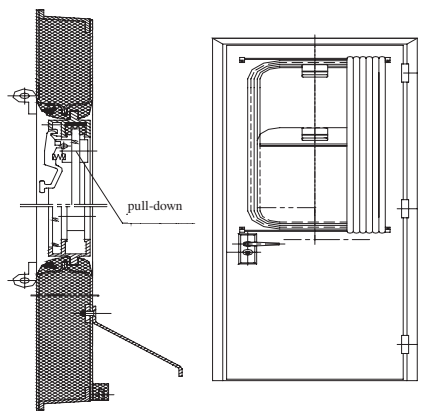
3.2. back door

3.2.1. Manual folding door

Manual folding side door's structure is similar to manual folding door in Fig.

3.2.2. Built-in manual sliding door

The Beijing FuBaXian subway car's manual side sliding door with automatic reset mechanism is as shown in Fig.4.



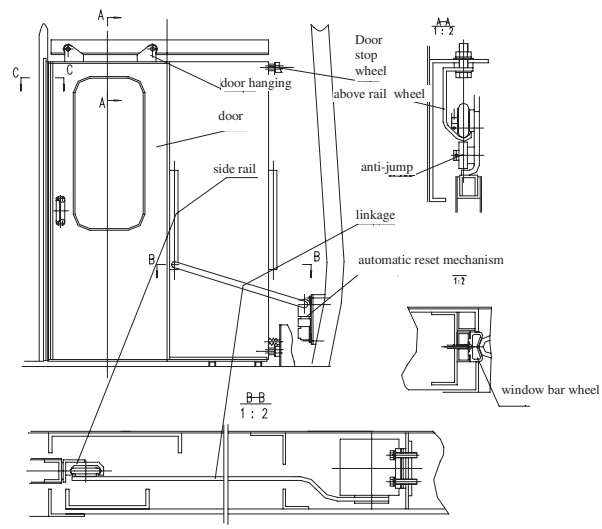


Fig.3. Cab side door with pull-down movable; Fig.4. Manual side sliding door with automatic reset mechanism

The side sliding door consists of door leaf, door hanging, above rail anti-jumping wheel; automatic reset mechanism, linkage, side rail, windbreak bars and doorstop and so on.

The advantage of manual side sliding door with automatic reset mechanism is when pulled side sliding door to the fully opened position, the door will remain in fully opened position under the action of the

door stop cad; When side sliding door is not pulled to the fully opened position, then the sliding door will automatically shut down under the action of the automatic reset mechanism.

And because of the role of automatic rest mechanism, side sliding door itself will not open on its own because of the train vibration.

In addition, under the action of the automatic reset mechanism, the closing force can be adjusted continuously in 2 ~ 7kgf, closing speed can be adjusted continuously too, that is, the time of closing the door automatically can be adjusted arbitrarily after fully opened the door; The door will be hidden in the side wall after it is opened and it will not take the passenger compartment's available space. Its disadvantage is that sealing performance is not good.

3.3. Passenger compartment door

3.3.1 *The comparison of the advantages and disadvantages of passenger compartment door*

The comparison of the advantages and disadvantages of such passenger compartment door are shown in table 1.

Table 1 . Contrasts on the Advantages and Disadvantages of the Various Passenger Doors

Types of the Passenger Door	Aesthetics	Tightness	Sound and Heat Insulation	Procurement Costs	Maintenance Costs
electric plug door	Good	Good	Good	High	Lower
pneumatic plug door	Good	Good	Good	Higher	High
electric build-in sliding door	Bad	Worse	Worse	Lower	Lower
pneumatic build-in door	Bad	Worse	Worse	Lower	High
electric outside hanging sliding door	Worse	Bad	Bad	Higher	Lower
pneumatic outside hanging sliding door	Worse	Bad	Bad	Higher	Good

Because the structure of electronic-controlled pneumatic door is complex and the air quality of its air source must be higher. Particularly important is that electronic-controlled pneumatic door cannot achieve the functions that can be easily achieved in electronic-controlled electronic door. Therefore in addition to a very items are still using pneumatic door, almost all of metro and light rail projects are using electronic-controlled electric door so far.

By comparing the advantages and disadvantages of various doors, it is easy to find that the plug doors are better than built-in door and plug-in door in terms of sealing, noise and aesthetics. So more advanced international metro transit vehicles use the electronic-controlled electric plug door.

3.3.2 *Electronic-controlled electric plug door*

Shenzhen metro line 2 is the A-type vehicle. Each vehicle on each side has 5 sets of double open electronic-controlled electric plug door. The net height of open door is 1860mm and the net width of open

door is 1400mm.The subway car's plug door mechanism is made up of drive gear, bearing guide device, locking device, operating device and so on. The schematic diagram of the plug door mechanism is as shown in Fig.5.

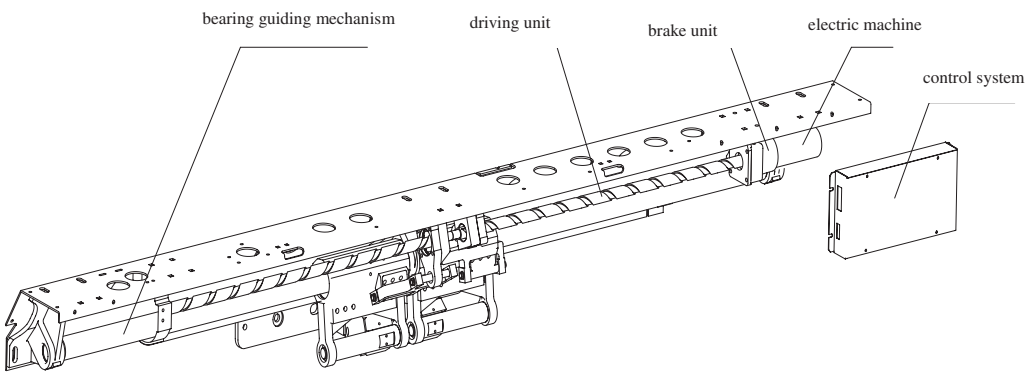


Fig.5. Schematic diagram of the plug door

4. Conclusion

The metro vehicle's door system includes cab doors, rear doors and compartment doors. Whether the passenger compartment door's setup and design are reasonable, not only directly affects passenger's comfort and convenience but also related to the safety of vehicle operation and vehicle's overall performance indicators. The passenger compartment door system of our country's urban rail vehicles usually uses the more advanced international technology of passenger compartment door—electronic-controlled electric gate technology. The system has high reliability, compact structure, light weight, good maintenance, long life and so on advantages that have reached the international advanced level.

References

[1] Shiyou Zhu, Wenwei Hu. Structure control principles and improvement ideas on Guangzhou metro car doors. Rolling Stock, Vol 38, pp.59-61, December 2000.

[2] Gongan Tao, Lixiang Yuan. Metro vehicle for Guangzhou line NO.3. Electric Drive for Locomotives, Vol 4,pp.53-59, July 2006.

[3] Yougen Peng. The passenger door system of Guangzhou metro line 2 and its control principle. Electric Locomotives&Mass Transit Vehicles, Vol 28, pp.47-49, November 2005.

[4] Zhenmiao Zhang. Urban Rail Transit Vehicles. Beijing: China Railway, 2003.

[5] Yougen Peng. Failure Analysis of Modification to the Door system of Guangzhou Metro Line 3 trains. Electric Locomotives & Mass Transit Vehicles, Vol 32, pp.53-54, February 2005.

[6] Yaobin Zhan, Baojian Wang, Hong Liang. Improvement of the Door System for Vehicles on Guangzhou Metro No.1 Line. Rolling Stock, Vol 42, and pp.20-30, July 2004.

[7] Zhiping Xie. Faults and overhaul of plug door in Guangzhou metro line 4. Modern Urban Transit, Vo3, pp.53-59, March 2009.

[8] Xiaofeng Liu and Yunlong Li. A Type Metro Vehicle of 100km/h Speed Grade. Electric Locomotives & Mass Transit Vehicles, Vol 33, pp.50-53, January 2010.