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Key Technologies used in Olympic Electric Bus

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Abstract

In the period of 2008 Olympic Games, 50 pure electric buses had completed the service on the Olympic Village inner loop line and other two lines successfully. This was the first large-scale use lithium ion power battery electric buses internationally. In order to make everyone knows the technical level of Olympic electric bus, the key technologies used in it were introduced. These technologies mainly include whole vehicle system integration, key components development and engineering application model for public transport. Based on these advanced technologies, the Olympic electric buses had provided a model and technical reserves for the electrical upgrade of city buses.

Keywords: battery electric vehicles; Battery charge; Maintenance; Public transport

1 Introduction

Under the dual pressures of energy and environment, the development of electric vehicles becomes one of the world's research and development hot spots. When applying to host the 2008 Olympic Games, Beijing had proposed the concept of 'green, science & technology, humanities'. In order to express it's determination and ability on energy saving and emission reduction, Chinese government had committed to use electric vehicles in the period of the Olympic Games. Under the leadership of Beijing Institute of Technology, The project team successfully developed the Olympic electric bus, which owns the complete intellectual property right. At present, this bus has obtained the national automobile product announcement, 50 electric buses were manufactured and provided service on the Olympic Village inner loop line and other two lines in the period of Olympic Games. This paper will introduce the key technologies used in these buses.

2 Vehicle system integration

The outward appearance of Olympic electric bus is shown in figure 1. It is a low floor bus with zero

Figure 1 Olympic electric bus

emissions and free pollution. By means of using new type lithium ion batteries and the dispersion rapid replacement plan, synchronous automatic plug of the power wires and the communication circuits was realized in the fast replacement process of the power battery box. Because of the integrating of alternating current (AC) motor and automated mechanical transmission (AMT), the

electric drive system raised the efficiency of motor and the service life of battery. The performance of this bus is shown in table 1.

Table 1 Technical parameters

Power battery	Lithium power battery 388.8V,360Ah
Power driving system	AC motor 100kW + AMT
Length-Width-Height(mm)	11700×2550×3370
Kerb mass(kg)	13700
Full-load mass(kg)	17000
Max Velocity(km/h)	80
Accelerating time (0～50km/h)(s)	≤22
Maximum grad ability	≥20%
Energy consumption (kWh/km)	0.94
Driving range @40km/h (km)	180

The Whole vehicle system configuration is shown in figure 2.It has broken through the key

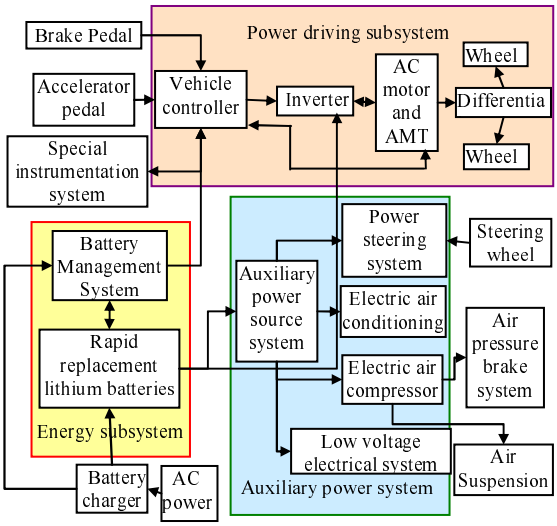

Figure 2 System configuration

technical of electromagnetic compatibility; achieve the goal of vehicle networking control; solved the regenerative braking energy recovery technologies, making energy-saving rate attain to 12 - 16%. Besides these, it also cans compatible bow-net power supply.

3 Key components technologies

3.1 Motor and its controller

The outward appearance of motor and controller are as shown in figure 3. They had resolved the

Figure 3 Motor and its controller

issues of electromagnetic compatibility and electrostatic discharge under the state of suspended. By adopt the control strategies of over-temperature protection, under-voltage protection and motor speeding protection, it resolved the applicability of motor and controller in the mode of electric trolley buses, and reached the design requirement of second insulation. Through the CAN bus, it achieved the motor speed control and good meet the requirements of AMT shift.

3.2 Power battery group application

The energy of these buses comes from new type manganese lithium-ion battery, which installed in the entire closed box. The structures of outer box and inner cabinet are shown in figure 4. They can

Figure 4 Structures of outer box and inner cabinet

be rapid replaced with the help of machinery. The boxes are insulated suspension fixed in the vehicle to meet the needs to improve service life and reduce maintenance cost. Equipped with automatic or manual monitoring device , the battery management system (as shown in figure 5), can imply real-time accurate monitoring and

Figure5 Battery management system

management to each cell, and on-line forecast the remainder electricity (SOC) of system to ensure the battery life and high efficiency applications.

3.3 AMT control technology

Based on CAN bus communication, a pure electric vehicles shift control strategy were adopted in these buses. It resolved the problem of shift impact for pure electric vehicles transmission without

clutch, shorten the time of shift. Integrated AC motor and special three-block AMT, the integration electricity- driven systems increased the driving efficiency and battery life. The AMT and its controller are shown in figure 6.

Figure 6 AMT and its controller

3.4 CAN Bus technology

As shown in figure 7, through 3 CAN-bus and a battery management system inner bus, the separately communication and control were carrying on to the low-voltage electricity, the high-voltage electricity and the battery. The vehicle system signal can up to 364, and the designed bus load rate is between 7% and 12%. With this, the information sharing of entire bus has realized. The intellectualized CAN instrument has the function of demonstrating each kind of information and warning.

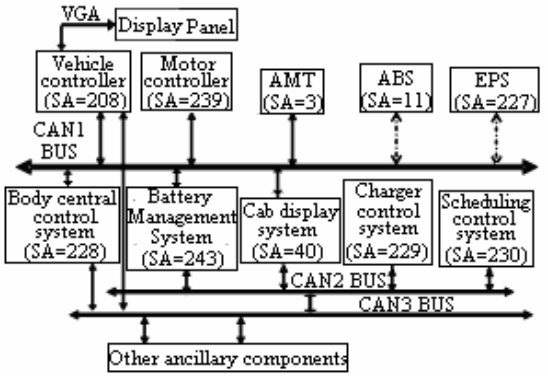

Figure 7 CAN-bus used in Olympic electric buses

3.5 Integration air conditioning

By means of the first time using horizontal scroll compressor and electric free-level regulation of energy conversion, through the DC-AC inverter power control module, the integration air conditioning(as shown in figure 9) designed for electric buses realized the course of variable frequency-class start-up, fundamental frequency cooling and drop frequency maintain for electric scroll compressor. This thoroughly changed the traditional control mode of the bus air conditioning, improved the comfortably and achieved energy saving.

Figure 8 Integration air conditioning

4 Engineering application model

4.1 Construction of infrastructural facilities

A centralized charging station was designed. The charging station is mainly include battery replacement area, distribution area, charging workshop, parking area, maintenance area, offices and vehicle scheduling zone. The battery replacement area is shown in figure 9, which can achieve a new model of battery leasing, rapid auto replacement and focus charging and maintenance.

Figure 9 Charging station and replace system

4.2 Intelligent scheduling monitoring

An Intelligent scheduling monitoring technology had been used, which can ensure the Olympic electric buses complete the service on the Olympic Village inner loop line and other two lines successfully. The monitoring method and area as shown in figure 10.

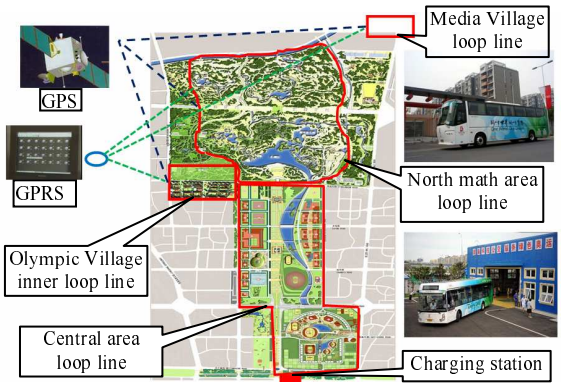

Figure 10 Monitoring method and area

Carrying out real-time monitoring is easy to master the situation of the vehicle in time, so that the vehicle may be early warning before failure. It can provide real-time rescue, emergency dispatch command, remote fault diagnosis, and enhance reliability and security. With the help of intelligent scheduling monitoring technology, the electric buses were effective applied in the Olympic Games.

5 Operating results

From August 8 to August 24, 50 pure electric buses were arranged to provide service on the Olympic Village inner loop line and other two lines. The total mileage of these buses is 53271 km, and the total power consumption is 84256 kWh, so the average power consumption of one vehicle is 1.58kWh/km. The total number of replacement batteries is 787, and no accident caused by batteries was happen in the course of replacement and using. Not only that, no larger faults such as breakdown, Leakage and so on had happen. These buses had completed the service successfully.

6 Conclusion

Beijing 2008 Olympic Games had provided a perfect opportunity for the mature and industry of electric bus. With the technologies introduced in this paper, the Olympic electric buses were realized the first Large-scale application of electric vehicles in China. It had provided a model and technical reserve for the electrical upgrade of city buses.

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