Public Safety Escape Device Design in Electric Vehicles under the Principle of Pneumatic Drive System

Rong Zhang*, Cong He, Tao Zhou
School of Mechanical and Electrical Engineering, Wuhan Donghu College, Wuhan, China

*Corresponding author: zhangrong@wdu.edu.cn

Abstract. In an emergency situation at present when the bus escape difficult problem, this paper based on the principle of pneumatic drive system design a public safety escape device, so subtly alter the body structure and body separated from the right side of the box car, using pneumatic transmission system, by a pneumatic cylinder connected to the body and the casing, the use of electrical components to achieve control in the bus when an emergency occurs, the right side of the box lifted up, leaving a large escape space for people to open channels of life, can achieve good results at the dangerous situations, to fundamentally solve the difficult problem of escape.

Keywords. Bus; emergencies, shell separation, pneumatic.

1. Introduction
Bus is applied to in life the most traffic tools, but there are a lot of bus safety issues, especially in personnel crowded peak, once the event of a fire or other public safety issues, due to the crowded and narrow escape, it is difficult to derive escape. Feasibility current safety hammer broke down the glass to get the low escape in a hazardous environment is difficult to play a very good effect. In recent years, Xiamen City, Shanxi, Hubei and other places, there are overcrowded because people cannot get to escape, which led to the tragedy. Based on the realistic problems, through structural transformation of the bus so as to achieve the purpose of safe escape is a good solution.

2. Overall structural design
As shown in Figure 1, 2, shell automatic separation device mainly consists of an emergency door, airbags, cylinder device, limit self-locking device, emergency safety valve, alarm, emergency safety valve extension arm.
2.1. Design Principles
In an emergency during the bus driving, turn off the engine to stop the bus. Then the emergency safety valve extension arm closed due to power-off and the safety valve of emergency door 1 opens automatically, so the driver can open the emergency door 1, and the alarm burps. Under the effect of emergency door cylinder, the emergency door 1 rises up along the rail track until it reaches the highest point. Then it (emergency door 1) locked in the work of a limit auto-locking switch to prevent the emergency door from falling down. Now the security airbag begins to release, people can hold the security airbag and escape successfully. In case of a failure of cylinder pneumatic, the emergency door 1 can be lifted up manually until it is locked. In order to prevent the pneumatic device from a malfunction in an accident, the people inside and outside can manually lift up the emergency door 1.

2.2. Pneumatic System Design
Pneumatic drive is a technology that works on the medium of compressing air to transfer energy and transmit signals. The pneumatic drive consists of the four parts: air supply devices, the control element, actuating element, and the auxiliary components.

2.2.1. Gas Supply. An air supply device is an air compressor in form of reciprocating-piston. By the motion of a piston in cylinder, it comes to the suction and exhaust in the compression process, thus provide sufficient air for pneumatic system.
2.2.2. **Pneumatic actuators.** Pneumatic actuator is a device of compressing air pressure into mechanical energy, to achieve lift of the box by the right side, use a cylinder for reciprocating motion or swing. The right side of the box in the fast-rising process, due to excessive speed is bound to have an impact, in order to make a smooth movement of the cylinder, so use a buffer cylinder of QGB series, which takes the way of combining gas and liquid. According to access to information, take Xiamen Golden Dragon XMQ6122G (FCB1) bus for example, due to the limitation of the extension distance of the pneumatic cylinder, the cylinder of the piston rod is used as a hydraulic cylinder, the diameter of the piston rod is 11mm according to the strength and stability check of the pressure bar, which makes the two chambers of the hydraulic oil discharge substantially equal, this not only saves the amount of oil, but also makes the start and stop steady. At this point the oil tank is only used to replenish the fuel tank leaks and reduce the amount of oil, generally using the oil cup to supply, so the use of multi-stage pneumatic cylinders, according to the force and efficiency analysis and calculation. The outer cylinder of the pneumatic cylinder is a cylinder with a diameter of 3.5 cm, and the diameter of the contact between the 2 stage piston with the air pressure is 2.5cm, which can achieve a higher height in a shorter cylinder, just to meet the design requirements of a long stretch, and when the order of retracting can make the air cylinder to keep a very small axial dimension.

2.2.3. **Pneumatic control components.** Pneumatic control components mainly include safety valve and pressure reducing valve, their main function is to regulate the compressed air pressure, flow and direction to ensure the components of work carried out in accordance with the normal procedures.

In the process of bus rises in order to maintain state after the right side of the cabinet rises, then will be pressure, using the relief valve for pressure, when the air tank pressure set above a certain value or loop, with a relief valve to vent, overload protection effect on the relief valve in the system.

Pressure reducing valve adopts the QTY straight moving type relief valves, through the role of the throttle valve opening pressure, by the balance of force on the diaphragm to stable output pressure, adjusting knob can adjust the output pressure, lower the outlet pressure and maintain a constant, to ensure the stability of the bus on the right side after raising a certain state.

2.2.4. **Pneumatic systems assembly.** Gas produced by the air compressor, passes through the filter, and finally into the drier air tank, when necessary the gas get into the cylinder through the control device to complete the upward movement. The figure 11 in the figure 3 is the parallel hydraulic pressure retaining damping device. When the need of homing, the cleanly gas will be again into the storage tank through gas pipelines and the gas is repeatedly used to reduce the compressor power consumption. System of opening and closing is controlled by the electrical components.

![Figure 3. Pneumatic system assembly drawing.](image)

1-air compressor, 2-filter, 3-dryer, 4-air tank, 5-pressure regulating valves, 6-pressure gauge, 7-muffler, 8-reversing valve, 9-pressure gauge, 10-telescopic pneumatic cylinder, 11-hydraulic suspension system, 12-back to the pneumatic valve
3. Conclusions
Based on the principle of pneumatic drive system design a public safety escape, from the fundamental to overcome the low efficiency of the traditional means of escaping, it has a good stability, high safety factor, the existing bus escape device has a certain guiding significance and great application value, and it is worth a wide range of promotion and application.

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