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Multi-manual Emergency Escaping System of Air Control Bus Door Based on Driver and Passenger Manipulation

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Abstract. For controlling emergency escaping by a bus driver in the case of air control door cannot be opened normally, the paper presented a multi-manual emergency escaping system of pneumatic bus door. Bus driver and passenger can control doors expediently. The pneumatic circuit of the system and its overall arrangement is discussed. A manual control device with special valve core structure is designed. The working performance of the manual shift directional valve is analyzed. The results indicate that driver and passengers can control the bus doors under the state of abnormal condition via manual control devices in series connection rapidly. Driver and passengers control is without mutual interference. Manual shift directional valves are convenient, reliable and fast.

Introduction

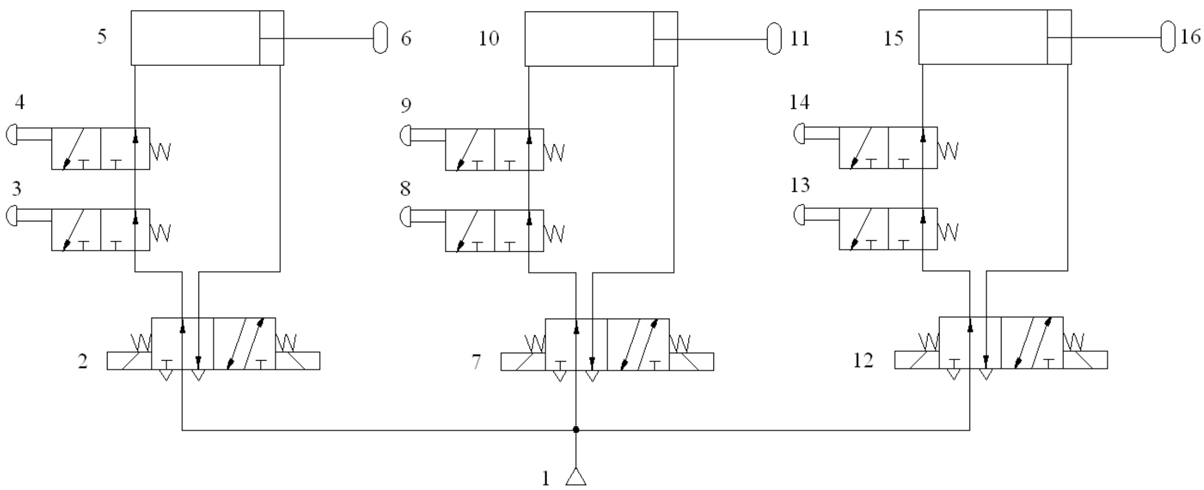
Bus is the most important public transport in city and town. It provides large capacity intensive mode for Passengers' travel [1, 2], Residents care about not only fast and comfortable but also safe. And the bus safety is premises and basis [3]. In recent years, people care more about fire of bus because the fire caused great casualties and property loss. Therefore, bus safety has become an issue which people give more attention about. Bus safety problem caused the attention of whole society. Bus safety problem includes two aspects, the vehicle safety issues and emergency issues. The core of these issues is if a problem occurs, how to ensure the safety of personnel within the bus space, how to ensure passengers to escape as soon as possible [4-6]. The doors of bus usually can not be opened by driver in case of emergency. And the time of passengers and driver escaping are very short. Now bus usually set the safety hammers, and emergency button above the door position. Every bus door has an emergency button. But in a short few minutes escape time, the problem is that passengers are flustered, and they usually do not find and use the emergency button. Using the safety hammer needs to spend more time and escaping channel is small [7-9]. Passengers hurry-scurry when emergency. Therefore, we studied a manual emergency escaping system which opens the bus door by not only driver but also passengers in emergency. And a kind of emergency safety valve is designed.

Demand analysis of Multi-manual Emergency Escaping System

According to the synthesis of existing pneumatic bus door system analysis, if driver can't normally control the air-control bus door in case of emergency, he also lost on the door control in his seat. He has not emergency button. The manual emergency escaping system of pneumatic door of bus should have independent passenger's manual control device and drive's manual control device for one bus door. The two manual control devices do not interfere with each other. These can achieve that the drive can control the bus door in case of emergency too. Manual control device can carry out to release the pressure air of door's air cylinder.

Pneumatic Circuit of Multi-manual Emergency Escaping System

The manual emergency escaping system of pneumatic door of bus is designed on the basis of the existing pneumatic door control system. For a bus with front, middle and back door, the multi-manual emergency escaping system consists of an air supply, three opening and closing door pneumatic cylinders s, three passenger's manual control devices, three driver's manual control devices, three electromagnetic reversing valves, and some air pipelines. The pneumatic circuit of the system is shown in Figure 1.



1. air supply 2. double electromagnetic reversing valve 3. manual shift directional valve for driver 4. manual shift directional valve for passenger 5. pneumatic cylinders of opening and closing front door 6. front door of bus

Fig. 1 The pneumatic circuit of multi-manual emergency escaping system

The pneumatic circuit includes similar three parts, they control front, middle and back door in case of emergency. As shown in Figure 1, 5 is pneumatic cylinders of opening and closing front door, 10 is pneumatic cylinders of opening and closing middle door, 15 is pneumatic cylinders of opening and closing middle back door. Double electromagnetic reversing valves 2, 7 and 12 use to open or close corresponding bus door under normal circumstances. The driver uses manual shift directional valve 3, 8 and 13 to open corresponding bus door in case of emergency. The passengers use manual shift directional valve 4, 9 and 14 to open corresponding bus door in case of emergency. These manual shift directional valves are no operation state under normal circumstances.

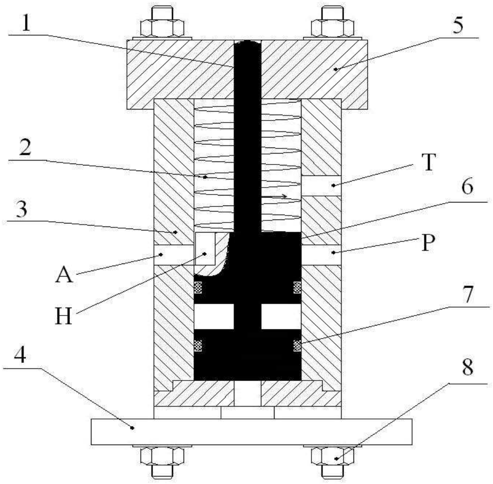
Working principle. In order to the front door as an example, Figure 1 shows the state of closing front door. The non-rod chamber of the pneumatic cylinder 5 has air pressure. The air pressure is closing the front door of the bus. If a case of emergency occurred and the front door could not open normally, the multi-manual emergency escaping system would be enabled to work. The driver may operate manual shift directional valve 3 to let its left position work. This realizes to release air pressure in the non-rod chamber of the pneumatic cylinder 5 through the valve 3. In the meantime, the manual shift directional valve 3 cuts off the air inlet pipeline. With this same, the passengers may operate manual shift directional valve 4 to let its left position work. Release air pressure is doing through the valve 4. Once the air pressure of the cylinder 5 being released, passengers or everyone may easily open the front door. The middle door and the back door have the same working states and principle.

Overall arrangement. The pneumatic circuit of multi-manual emergency escaping system must satisfy the driver and passengers to control the bus door expediently. Manual shift directional valve 3, 8 and 13 are for the driver of bus, therefore they must set in the near position of the driver's seat. Manual shift directional valve 4, 9 and 14 are for the passengers, therefore they must set in the near position of three doors. For every bus door, passengers' manual shift directional valve and driver's manual shift directional valve are in series. And pressure air must be from driver's manual shift directional valve to passengers' manual shift directional valve (see Fig.1). The overall arrangement can ensure all manual shift directional valves are non-interfering when they work.

Manual Control Device

The system has six manual control devices. Every manual control device is the key element the pneumatic circuit of multi-manual emergency escaping system. The manual control device is a kind of manual shift directional valve with special structure. Its performance decides the operation and expeditiousness of emergency escaping system.

Structure of manual control device. A manual control device consists of the following parts, a handle, a control spring, valve core, valve body, top cover, bottom cover, O-rings seal, and some connecting bolts. Figure 2 shows construction of the manual control device. Its construction is special. The valve core 6 is provided with an L shaped hole. The L shape hole is the pathway of pressure released. Its open position decides the distance of valve core travel. The top cover 5 has a rectangular orifice in its center. The handle 1 is rectangular too. And the handle 1 can move in the rectangular orifice of top cover 5. The control spring 2 is in pre-compressed state in the valve's normal conditions. In Figure 2, Port P is the air feed port. Port A is the working air port which connects the non-rod chamber of the pneumatic cylinder 5. Port T is the releasing pressure air port. Port e is the releasing air port. Hole H is L shaped hole.



1. handle 2. control spring 3. valve body 4. bottom cover 5. top cover
6. valve core 7. O-rings seal 8. connecting bolt

Fig. 2 The construction of a manual control device

Analysis of operation states of manual shift directional valve. Every manual shift directional valve has two operation states, at rest or at working. The exchange of two operation states is carried out via the rotating handle.

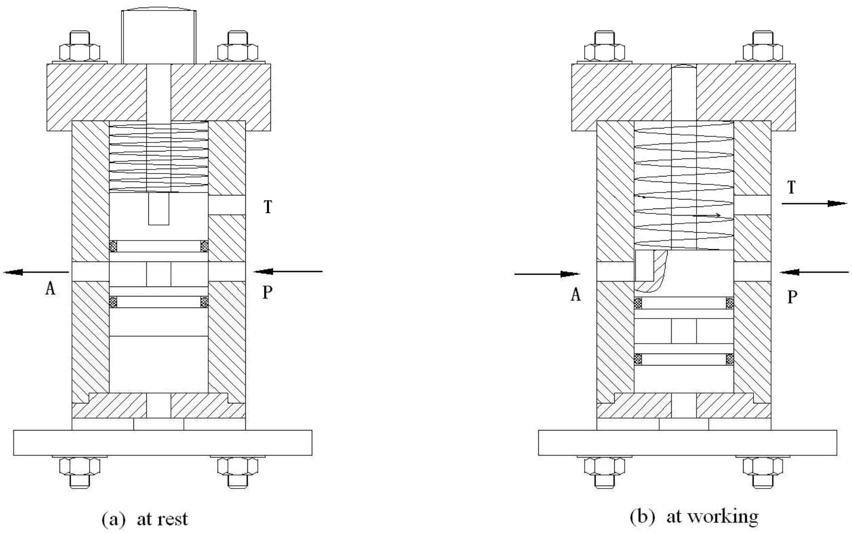


Fig. 3 Two states of a manual shift directional valve

Figure 3 shows the manual shift directional valve's two operation states. In Figure 3, (a) is at rest state, the valve core is in the upper position, the handle is in a transverse position, and the control spring is in the compressed state. Air feed pass through from inlet P to outlet A. Pressure air is not controlled by the manual shift directional valve. If the handle is rotated 90 degrees, the control spring will extend and he valve core move down to the down position. The manual shift directional valve turns into the working state.

In Figure 3, (b) is at working state. Inlet P is obstructed with outlet A by the valve core. Air feed can not enter the cylinder of bus door. In the meantime, outlet A is connective with released pressure port. The pressure air of pneumatic cylinders of opening and closing the bus door escaped through the special hole the manual shift directional valve. The door is unloading, and it may open with a little strength.

Summary

Multi-manual emergency escaping system of pneumatic bus door realizes control bus door by the driver and passenger independently under the state of emergency which pneumatic doors of a bus cannot be opened normally. The manual control devices are respectively arranged at the position of the driver's seat and the position of bus door. Two series connection manual shift directional valve ensure emergency control of one bus door. The manual shift directional valves operate conveniently, reliably and fast. It provides a way to control the bus door for driver under the state of emergency.

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