PNEUMATIC - LOGIC SYNTHESIS OF BUS DOOR FROM ASPECT OF AUTOMATION

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ABSTRACT: The paper presents a logic synthesis procedure pneumatic control of the door of the bus for suburban traffic. Minimization of pneumatic control is determined graphically by Weitz – Carnot method. It also shows all pneumatic components belonging to installations used for opening and closing the door of the bus. Finally it is shown the basic maintenance of pneumatic system of the bus door.

Keywords: Bus, Door, Pneumatic installation, Minimization, Weitz - Carnot maps, Maintenance of installations.

I. INTRODUCTION

Pneumatic systems are used in various fields of technology, for different purposes, to achieve different tasks. Used as power transmission systems to run different mechanisms, then as a management and control systems in the field of embedded systems and others. Pneumatic static systems exhibit their primary effect of pressure energy of the working fluid. Using kinetic energy to get - to do their work but also used less frequently, but the effects of the power is used in automation.

Carrier of energy and information (command, control and other signals) in pneumatic systems, is the gaseous fluid and usually compressed air.

Compressed air has long been used to drive a variety of tools: air hammers, riveting hammers steel structures, tools for downloading oxidation edges, slag after welding, polishing, drilling, transportation of loose materials, etc..

Today, in addition to the application field of application is very spread so for example: use of pneumatic brake systems and door opening to the road and rail vehicles, the use of performing various operations in construction, forestry, mining and other machinery and facilities, on vessels and aircraft for mechanization and automation of processes and machines, and the like.

II. MANAGING BUS DOORS - MINIMIZATION OF LOGIC FUNCTIONS

One possible pneumatic scheme that meets all the requirements for door control is shown in Figure 1. a) and 1. b).

Based pneumatic schemes can be concluded that the system of management of door bus for long distance transport is a system with multiple outputs. Door control on bus door for long-distance transport of a system of type (3,2). It has three input and two output signals. Each output is functionally connected to all inputs and analytical represents a logical function of three variables upon which the entire system be described by a set of logical equations:

\[ y_1 = f_1(x_1, x_2, x_3) \]
\[ y_2 = f_2(x_1, x_2, x_3) \] (1)
On pneumatic diagram we can see each other dependence of logic functions, so that we get the following dependencies:

\[ y_1 = x_1 x_2, \]
\[ y_2 = x_1 x_3. \]  
(2)

The system of equations (11) is a disjunctive normal form (DNF).

SDNF-a should look like this:

\[ y_1 = x_1 x_2 \cdot \overline{x_3 + x_3} = x_1 x_2 x_3 + x_1 x_2 x_3 \]
\[ y_2 = x_1 x_3 \cdot \overline{x_2 + x_2} = x_1 x_2 x_3 + x_1 x_2 x_3 \]  
(3)

On the basis of the SDNF-and we can put together combining table, where we will have a better view of the obtained logic functions:

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Shortened method of writing SDNF of the number of independent variables \((n = 3)\) and decimal equivalents, in which logic functions have a value of 1 will be:

\[
Y_{SDNF1} = \sum_{f_i=1}^{3} (6,7)
\]

\[
Y_{SDNF2} = \sum_{f_i=1}^{3} (5,7)
\]

In addition SDNF, a logical function can be expressed in the form of sum product and perfect subjunctive normal form (SKNF). Shortened method of writing SKNF can be used decimal notation makstermove that the value of the logical function equal to 0.

\[
Y_{SKNF1} = \prod_{f_i=0}^{4} (0,1,2,3,4,5)
\]

\[
Y_{SKNF2} = \prod_{f_i=0}^{3} (0,1,2,3,4,6)
\]

III. RELATED COMPONENTS OF INSTALLATION OPENING AND CLOSING THE DOOR ON THE BUSES

The control valve system with a safety circuit. This valve has a role to in a pneumatic signal to the valve stem is fed into a certain position and linear cylinders chamber or cylinder rotary mechanism remains without pressure (Figure 4.).

Control valve, electronically controlled system (ETS). This valve is equipped with third electromagnet that of bringing the valve stem in a position to function stops the door if the door in the direction of opening encounters an obstacle. This function is accomplished by both chambers of linear cylinders or cylinder rotary mechanism engages the air and stops the door and slowly moving in the direction of opening force due to the differences on both sides of the piston (Figure 5.).
current impulse. The first current pulse opens the door to a second current pulse closes the door (Figure 6.).

Figure 6. The control valve for the primary and backup systems

The auxiliary valve. Inoperative or repair the valve to relieve the pneumatic chamber installations and linear cylinders or cylinder rotary mechanism, which can be manually to open the door (Figure 7.).

Figure 7. The auxiliary valve

Throttle valve. This valve regulates the speed of opening and closing the door control with air flow to touching and expiration (Figure 8.).

Figure 8. Throttle valve

Push switch. Push button provides information on the required level of air pressure in the pneumatic installation (Figure 9.).

Figure 9. Push switch

Linear cylinders to open the door on the outside. For safe opening and closing the door cylinders have been developed for special requirements. The prescribed air pressure provides the force needed to open and close the door and extended damping cylinder gives, “soft” work in the final position of the door (Figure 10.).

Figure 10. Linear cylinders to open the door on the outside

Rotating mechanism to open the door. Following the trend of the world’s manufacturers of this type of equipment for opening and closing the door cylinder developed a mechanism that allows the door first open down and then rotate. To close the first cylinder mechanism rotates, and finally walks come to raising the door. If the closing occurs in disorders (eg. Passengers get stuck) stops oscillating motion and come up with the door open. The axle with helical gearing and bearings on the upper end of the exercise required torque, and the chosen material mechanical and heat treatment ensure long life and safe operation of the rotary mechanism. The swivel mechanism is possible by installing the limit switches for signaling, and switch to the reversibility of the system (Figure 11.).

Figure 11. Rotating mechanism to open the door

IV. MAINTENANCE OF PNEUMATIC SYSTEM FOR BUSES

Of the pneumatic system, regardless of which object (the technical system) are, required high reliability, maintainability and availability. Taking this into account, as
well as the requirement that maintenance costs are as low as possible, the most appropriate method of maintaining "the maintenance of the state."

The technology for this method of maintenance includes the following procedures:

- Cleaning,
- Lubrication,
- Preventive examinations (inspections),
- Repairs (emergency and planned).

The application of this method emphasizes the development and application of modern methods of diagnosing faults. Modern pneumatic components and systems management integrated with electronics in particular, favor the development of effective methods for diagnosis.

Due to the large number of different types of pneumatic components, it is difficult to make a detailed maintenance technology for each component and installation. If manufacturer has not given precise guidance for maintenance, it needs to use a universal technology used here gives the devices representing pneumatic components and installation.

4.1. Technical reliability of pneumatic systems and components

Technical reliability of pneumatic systems and components means the same feature set to perform functions within the manufacturing system, saving time in the meanings set forth exploitation indicators within the given boundaries, which correspond to the given modes and conditions of use and technical maintenance.

Usually the air technical systems and components of technological systems, and on its reliability depends on the efficiency of the manufacturing system, the profitability and cost of maintenance, repairs and downtime.

Technical reliability of pneumatic systems and components can be expressed as a unit indicator or participate in complex reliability of technological systems. Work ability, while working correctly - about the condition, deterioration, durability, serviceability limit state, preservation, overhaul fitness and so on, which are indicators of the reliability of the technical systems, pneumatic components and determines the aggregate reliability of technological systems.

The emergence of technical failure of pneumatic systems and components associated with outside and internal influences that distort the balance of energy and cause determined by the nature of the process. It is caused by objective and subjective causes of climate induced, pneumatic and mechanical factors.

4.2. Technology maintenance of pneumatic systems and components

1) Maintenance of the compressor

Wear and increased clearance in piston compressor increases the internal fluid leakage and lowering the coefficient of efficiency. Here's another interesting fluid loss due to hermetic seals, wear grooved joints, gaps in the bearings, overheating of the body and destruction of structural elements of the compressor due to vibration.

To maintain the compressor should follow the instructions for use which gives the manufacturer, because it varies by performance. Preventive periodic inspections should be organized in conjunction with other technical systems of complex technological systems, and corrective maintenance should be applied where appropriate, the diagnosis sheet.
2) Distribution network

Failures distribution network losses occur due to the air tightness. This is usually caused by aging or destruction of rubber seals for temperature deformation and vibration.

For distribution network of compressed air in addition to proper installation is very important and its tightness. It takes at least once, and it’s better two to three times a year, thoroughly check for leaks in order to find a place in a timely leak fluid.

Check the tightness of the distribution network is done by close all connections to consumers, the plant brought to the operating pressure and quantitatively measure the leakage losses from the drop in pressure in the reservoir at a specified time.

A place to collect condensate from the network should be emptied regularly. Use of automatic steam traps greatly simplifies maintenance. The correctness of the separator should be checked at least once a week, and especially pay attention to the relief valve.

3) Designing maintenance of pneumatic systems

In order to achieve better maintenance of pneumatic systems and components must be designed in advance by the system. The term design maintenance of pneumatic systems and components involves defining the system of maintenance of all essential elements and details, especially from the point of conception, organization, technology, and logistics support maintenance of technological systems.

V. CONCLUSION

This review work was an attempt to combine the logic synthesis pneumatic control in case of bus door for suburban traffic. It is given a minimization procedure management. It shows the corresponding component installation for the opening and closing of the door, and on the end it is shown the process of maintaining.

REFERENCES