Overview of Multi-Position Cylinder

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Abstract: *This paper presents aspects related to the use of a cylinder with two piston rods. Beside a multi-position cylinder, it is a pneumatic actuator. In this article two kind of circuits using a multi-position cylinder are presented: one pneumatic circuit and one electro-pneumatic circuit. The pneumatic circuit comprises the following devices: compressed air supply, a start-up valve with filter control valve, a 5/2 way solenoid valve, a 3/2 way solenoid valve and a multi-position cylinder. Furthermore, an electro-pneumatic circuit comprises: compressed air supply, an air filter, a 5/2 way solenoid impulse valve, a 3/2 way solenoid valve, a multi-position cylinder, relay, lamp and a valve solenoid. The design and simulation of both schemes from this article is done in FluidSim software from Festo.*

Keywords: *Multi-position cylinder, pneumatic circuit, electro-pneumatic circuit, electrical scheme*

1. Introduction

Actuators are constructed by connecting two cylinders of the same piston diameter but of different maximum stroke. The maximum stroke of the second piston must be larger than that of the previous one. When moving back, an intermediate stop requires a particular control. The shorter maximum stroke is half of the maximum stroke, Fig. 1.

Fig. 1. Multi-position cylinder

The main characteristics of a multi-position cylinder, [1]:

- Mounting hole pattern to ISO 21287;
- 2...5 cylinders can be combined;
- Four position settings.

Adjustable parameters and symbol of a multiple position cylinder are shown in Fig. 2, below:

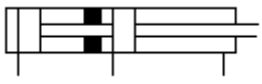
Designation	Range	Value	Unit	Symbol
Piston diameter	10^{-3}...1	$2 \cdot 10^{-2}$	m	
Piston rod diameter	10^{-3}...1	$8 \cdot 10^{-3}$	m	
Total stroke	10^{-3}...2	$2 \cdot 10^{-1}$	m	
Piston position	10^{-3}...2	0	m	
Intermediate position	10^{-3}...1	0	m	

Fig. 2. Adjustable parameters and symbol

2. The circuits with multi-position cylinder

A pneumatic installation is an interconnected set of devices that convert compressed air into mechanical work, [2].
In the table below the component devices used in the pneumatic scheme are presented.

Table 1: The devices of the first pneumatic scheme

Description	Number of components
Compressed air supply	1
Start-up valve with filter control valve	1
5/2 way solenoid valve	1
3/2 way solenoid valve	1
Multi-position cylinder	1

The first pneumatic circuit studied has one cylinder with two piston rods, Fig. 3.

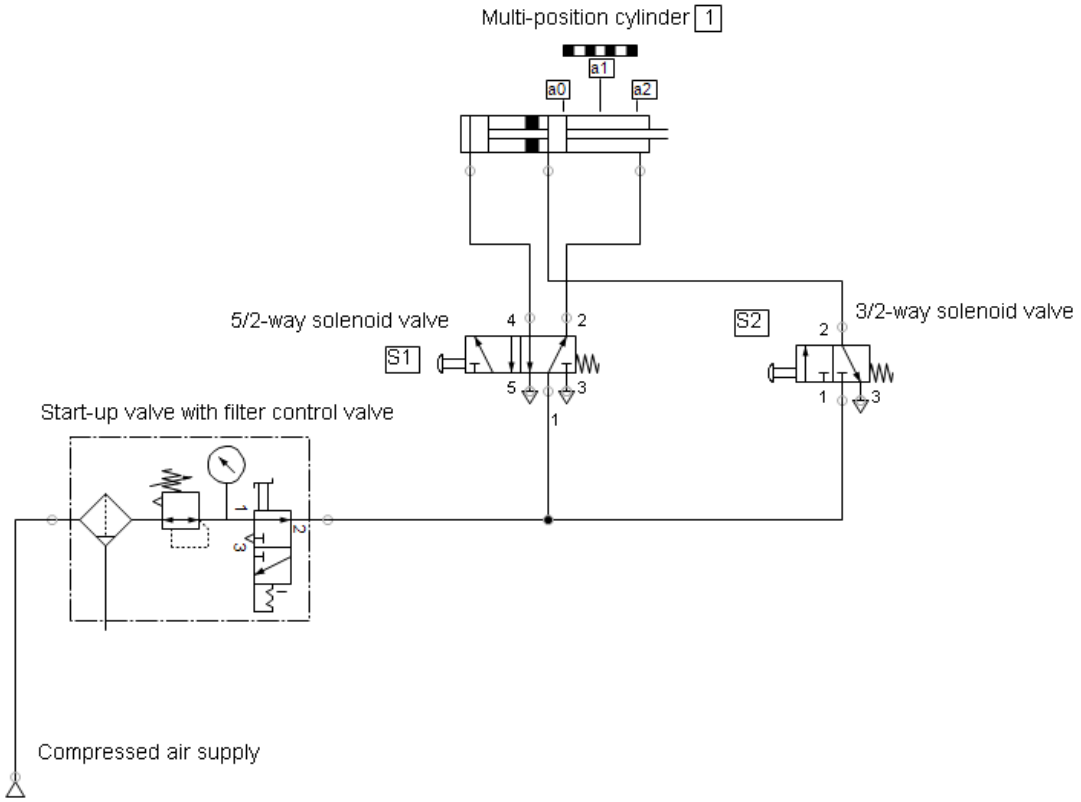


Fig. 3. Pneumatic circuit using multi-position cylinder

Operator presses the S1 button belonging to the 5/2 way solenoid valve with spring, [3].
Both piston rods move from point a0 to point a1. After that, both piston rods return from point a1 to point a0, because the 5/2 way valve has a spring, Fig. 4.

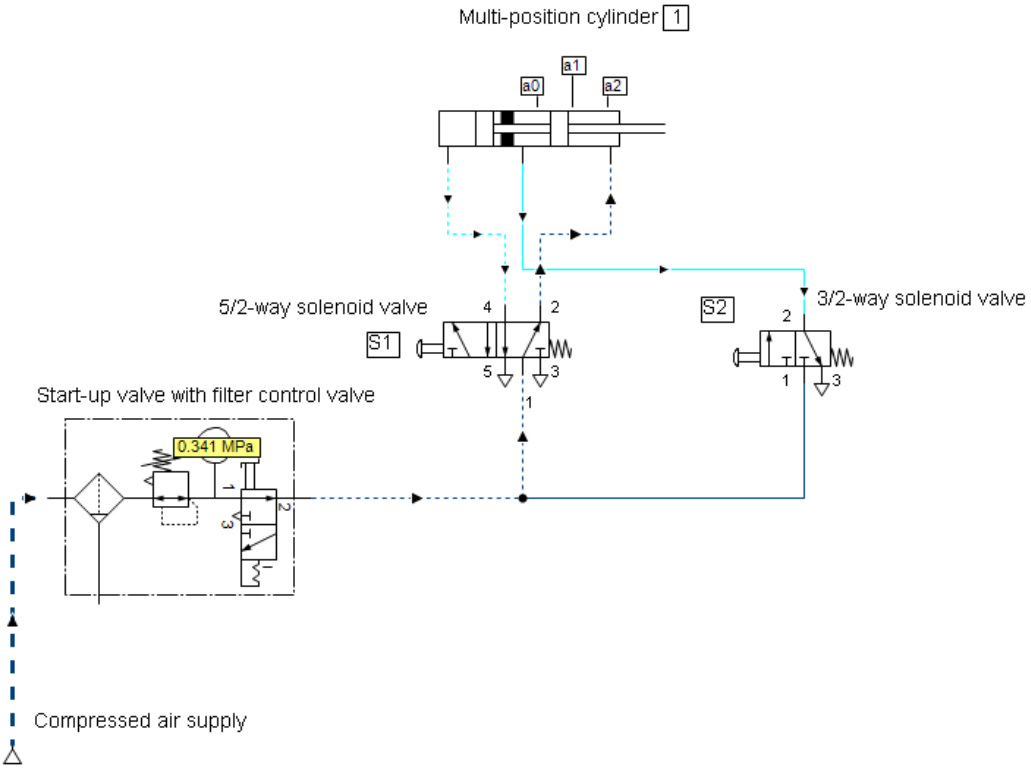


Fig. 4. Pneumatic scheme with multi-position cylinder. Simulation I

If operator presses S2 button belonging to the 3/2 way solenoid valve with spring, [4], the piston rod moves from point a0 to point a2. After that, this piston rod returns from point a2 to point a0, because of the spring of this 3/2 way solenoid valve, Fig. 5.

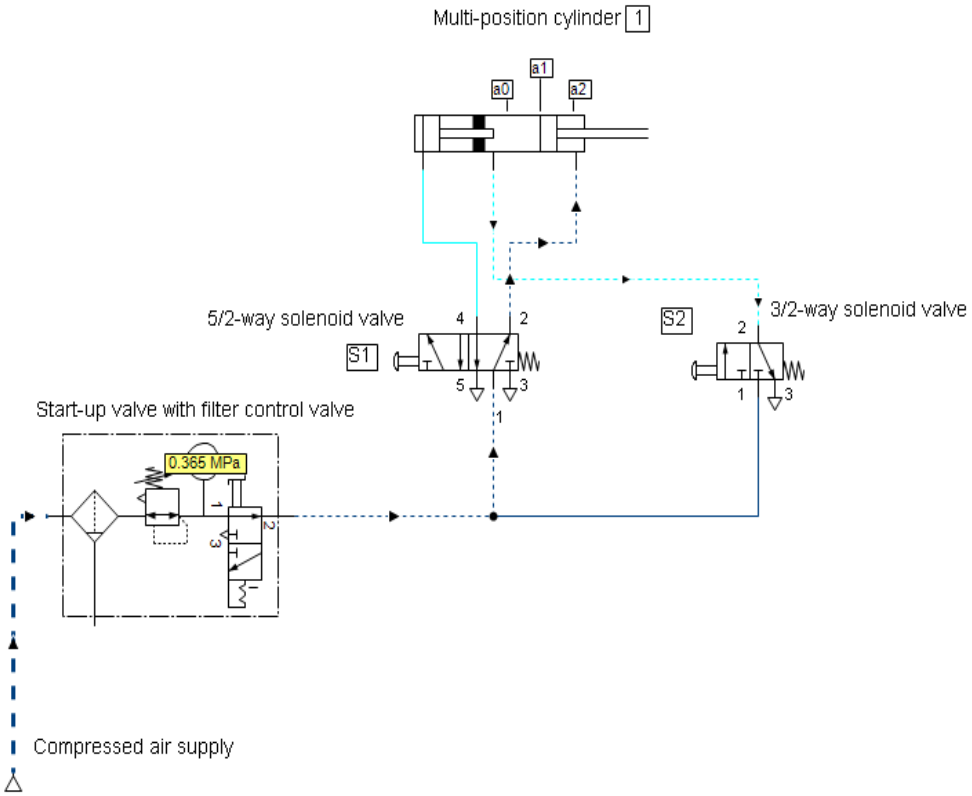


Fig. 5. Pneumatic scheme with multi-position cylinder. Simulation II

The diagrams given show variation of the following functional parameters of the multi-position cylinder 1 (Multi-cyl 1-1), Fig. 6:

- Position 1 – x1 [mm];
- Velocity 1 – v1 [m/s];
- Position 2 – x2 [mm];
- Velocity 2 – v2 [m/s].

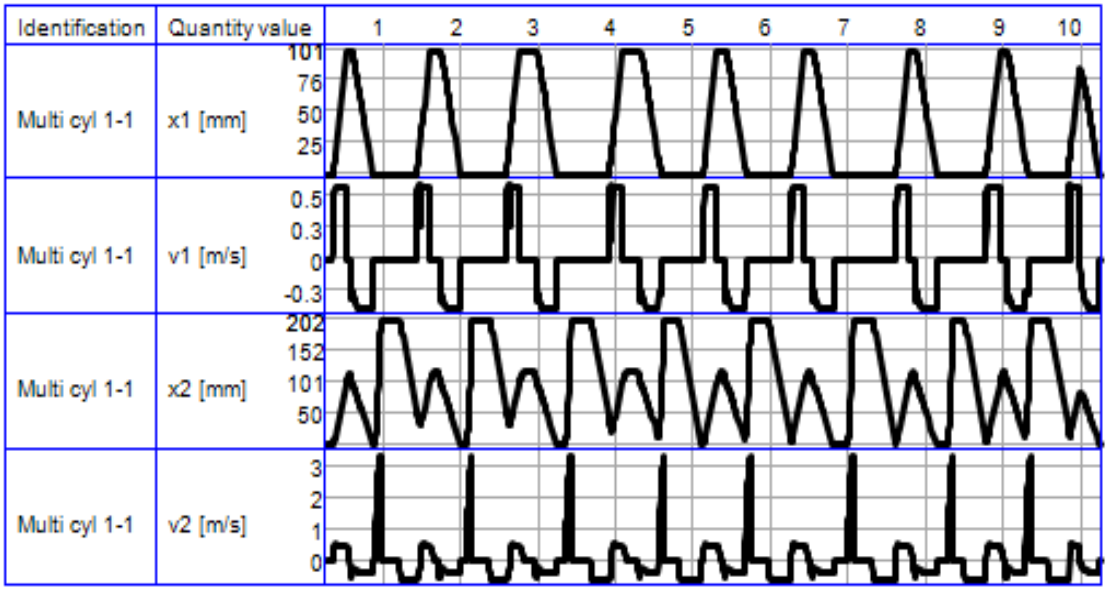


Fig. 6. Diagrams of parameters variations from the multi-cyl 1-1

Furthermore, an electro-pneumatic circuit with multi-position cylinder is studied, as in Fig. 7.

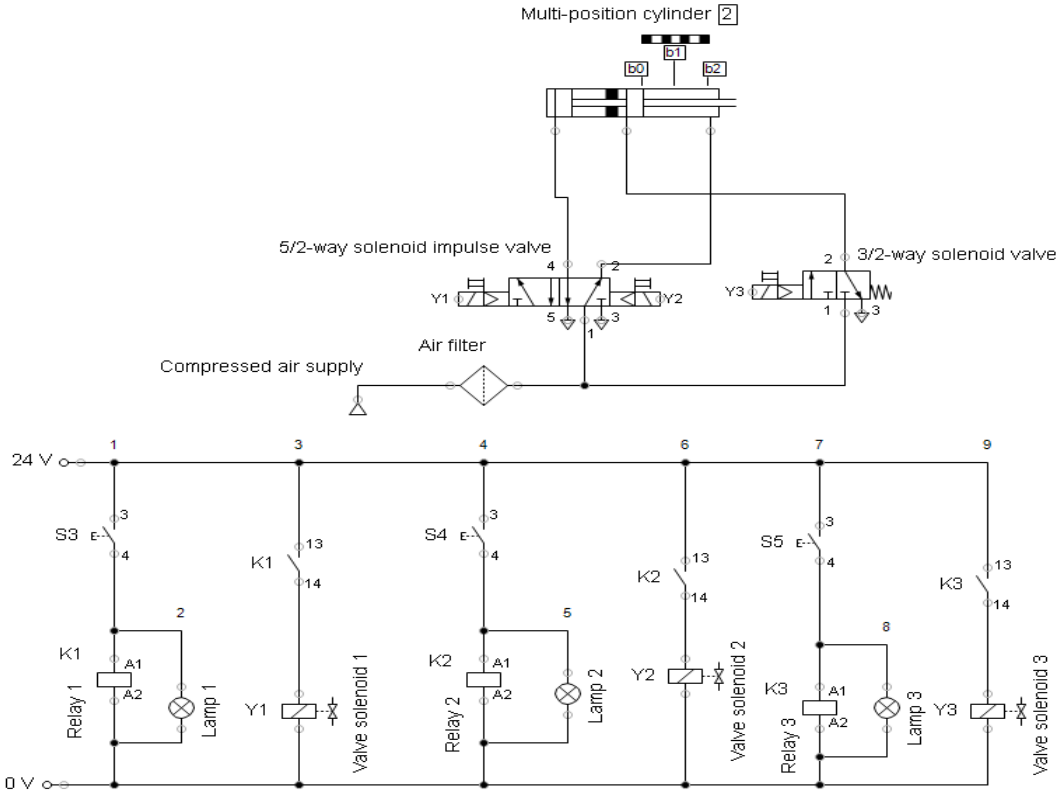


Fig. 7. Electro-pneumatic circuit using multi-position cylinder

Table 2 below shows the component devices used in the pneumatic scheme, [5].

Table 2: The devices of the electro-pneumatic scheme

Description	Number of components
Compressed air supply	1
Air filter	1
5/2 way solenoid impulse valve	1
3/2 way solenoid valve	1
Multi-position cylinder	1
Relay	3
Lamp	3
Valve solenoid	3

If operator presses S3 button, both piston rods of the multi-position cylinder (2) move from point b0 to point b1 and lamp 1 shows a yellow signal, Fig. 8.

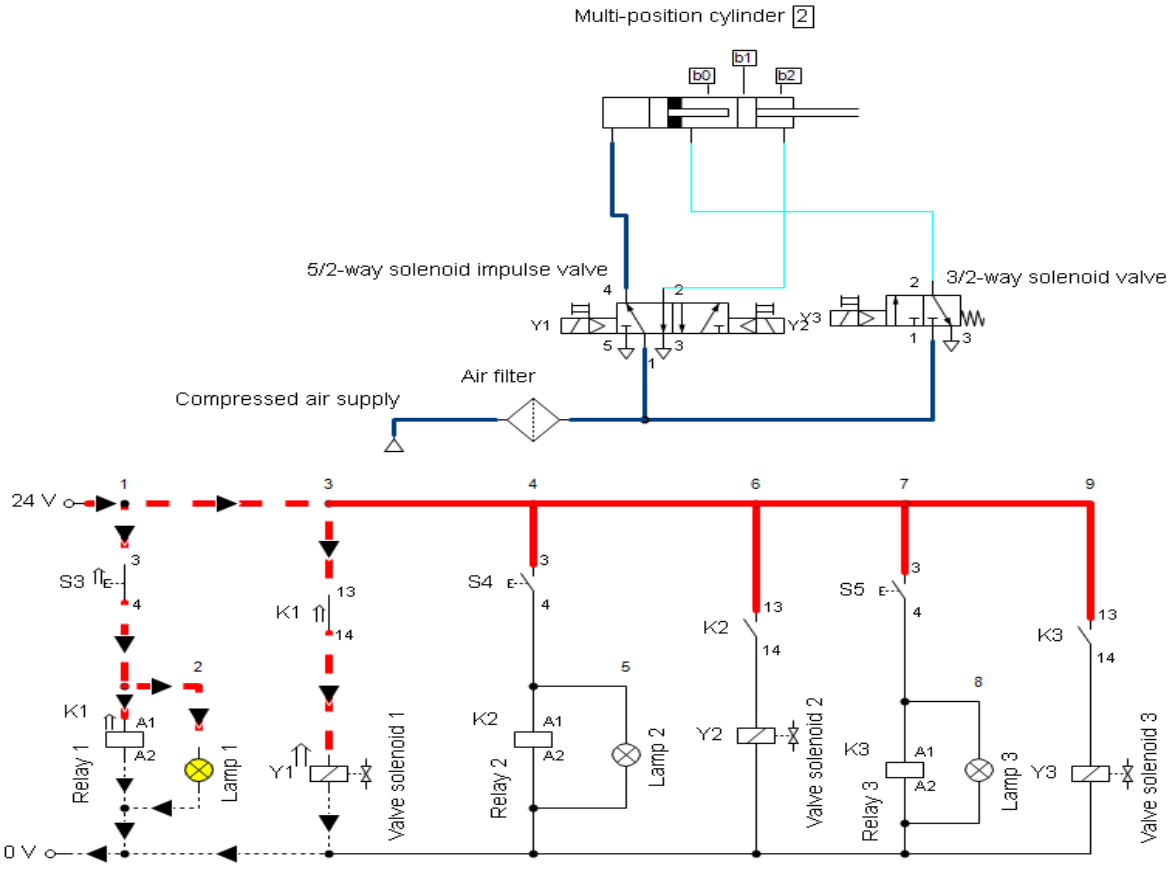


Fig. 8. Electro-pneumatic circuit using multi-position cylinder. Simulation I

If operator presses S4 button, both piston rods of the multi-position cylinder (2) move from point b1 to point b0 and lamp 2 shows green signal, Fig. 9.

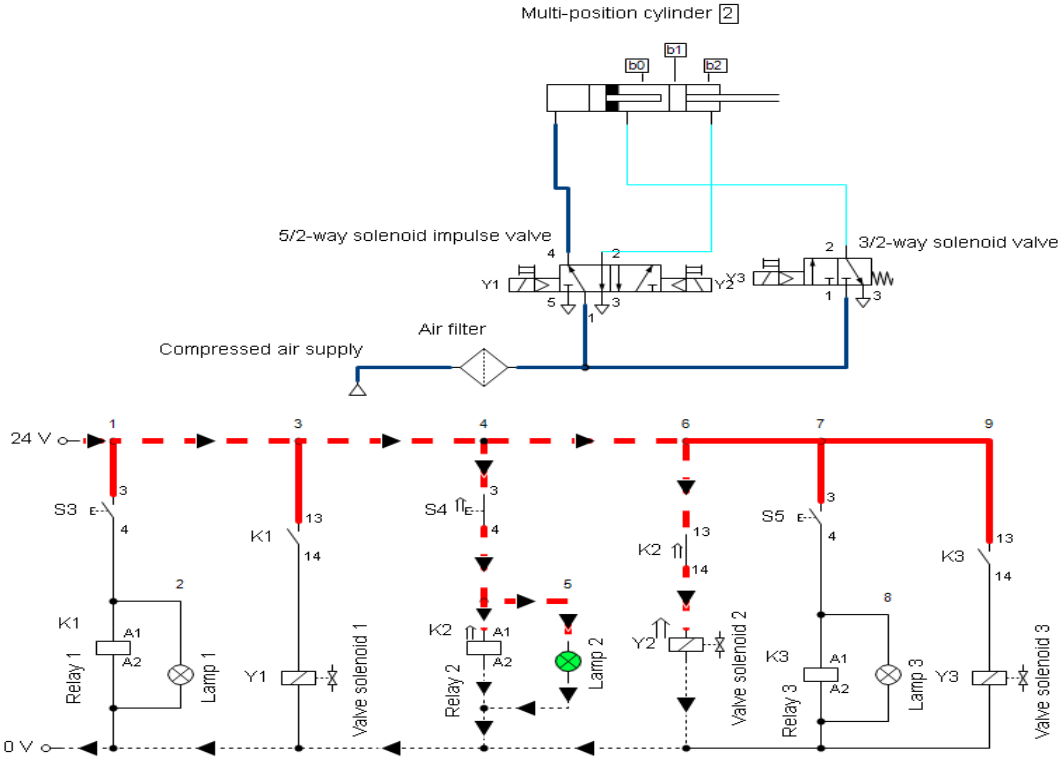


Fig. 9. Electro-pneumatic circuit using multi-position cylinder. Simulation II

Finally, if operator presses S5 button, the second piston rod of the multi-position cylinder (2) moves from point b1 to point b2. After that, this piston rod returns from point b2 to point b0, because of the spring of the 3/2 way solenoid valve and lamp 3 shows red signal, Fig. 10.

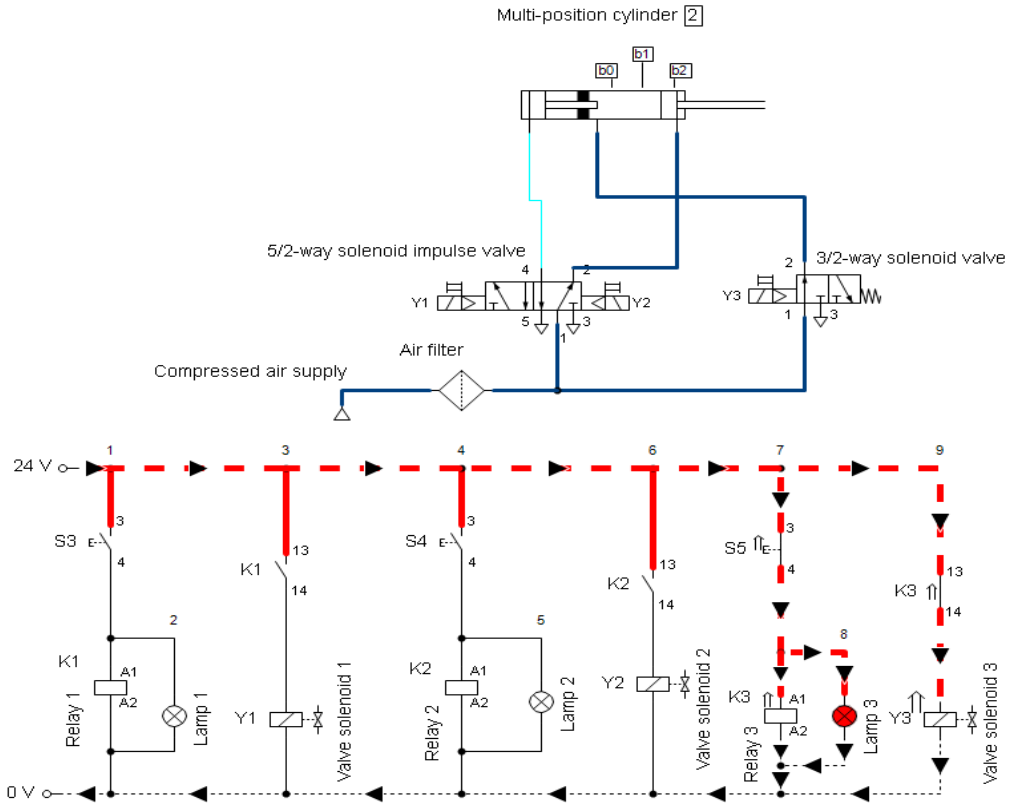


Fig. 10. Electro-pneumatic circuit using multi-position cylinder. Simulation III

3. Conclusions

The circuit schemes presented allow experimental verification of a multi-position cylinder. The main advantage of a multi-position cylinder is that this type of cylinder can use either one piston rod or both pistons rods. Using a single piston rod a small force is obtained in a reciprocating linear motion, but if a higher force is needed, then both pistons rods are used.
The presented pneumatic scheme has two simulations and the electro-pneumatic scheme has three simulations.
For a better choice of a multi-position cylinder in the design of pneumatic and electro-pneumatic installations, it is recommended that simulation methods should be used beforehand.

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