

Efficacy of Using the Double-Acting Hydraulic Cylinder

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Abstract: In this paper, the authors present aspects related to the use of a double-acting cylinder with return spring. Three circuits using a double-acting cylinder with return spring are presented in this manuscript, that is, a hydraulic circuit and two electro-pneumatic circuits. Thereby, the hydraulic scheme contains the following devices: double-acting cylinder with return spring (Doub 1-1), two throttle valves, 4/2-way hand lever valve, pump unit, and tank. Likewise, first electro-hydraulic circuit has the following devices: double-acting cylinder (Doub 2-1), two throttle check valves, pump unit, and tank. Second electro-hydraulic circuit has the following devices: double-acting cylinder (Doub 3-1 and Doub 3-2), pressure relief valve, 4/3-way solenoid valve, two lamps, pump unit, relay, and solenoid valves.

Keywords: Hydraulic, cylinder, spring, circuit, button

1. Introduction

In hydraulic circuits several actuators can be used. The main hydraulic actuators are: single-acting, double-acting, loading unit, hydraulic motor and semi-rotary motor.

The double-acting hydraulic cylinders can be equipped with return spring; these return spring are to left or to right, Fig. 1.

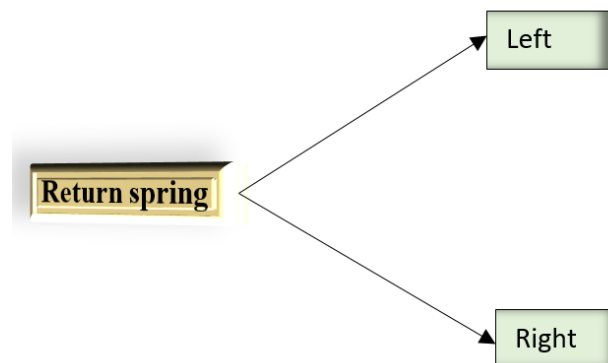


Fig. 1. Return spring

In this manuscript, all hydraulic cylinders are equipped with return springs right, [1].

In specialized literature, a double-acting hydraulic cylinder with return spring right has a specific symbol, Fig. 2.

Double-acting hydraulic cylinder with return spring

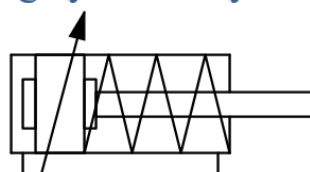


Fig. 2. Symbol of double-acting cylinder with return spring

In practice, different types of double-acting cylinder with cushioning are used. But, in our case we use some double-acting cylinders with cushioning type DNG-50-80-PPV-A, Fig. 3.



Fig. 3. Hydraulic cylinder with return spring

Anyway, the pneumatic cylinders DNG-50-80-PPV-A are in accordance with standard ISO 15552, [2].

Parameters of double-acting cylinder DNG-50-80-PPV-A are shown in the table below.

Table 1: Double-acting cylinder with cushioning specification

Parameters	Value	Unit
Bore	$50 \cdot 10^{-3}$	m
Stroke	$80 \cdot 10^{-3}$	m
P_{max}	10^6	Pa
Basic weight	1.4	kg

2. Study of hydraulic circuits with a double-acting cylinder

In practice, simple hydraulic circuits use a single double-acting cylinder, [3].

That is why the first studied hydraulic scheme has a single double-acting cylinder with spring return, Fig. 4.

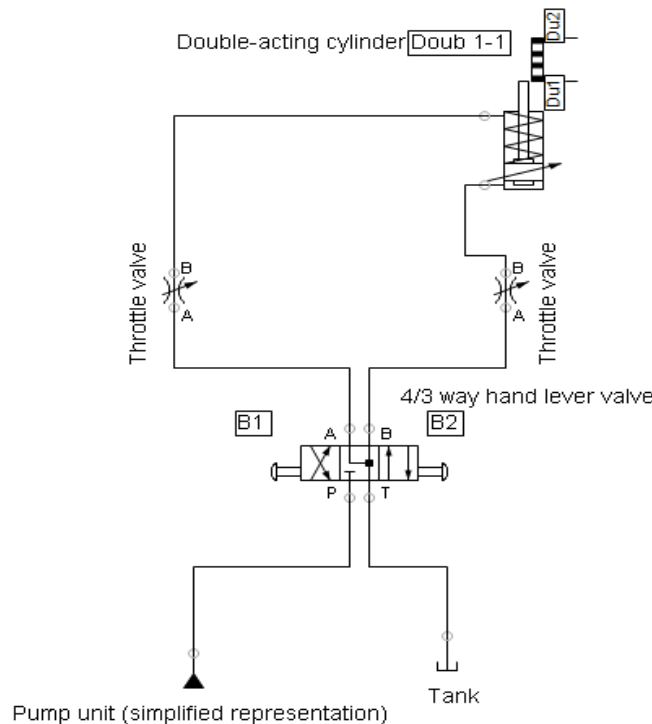


Fig. 4. Hydraulic circuit using double-acting cylinder (Doub 1-1)

Table 1 below shows six component devices used in the hydraulic scheme [4].

Table 2: The devices of the hydraulic circuit

Description	Number of components
Double-acting cylinder with return spring (Doub 1)	1
Throttle valve	2
4/3-way hand lever valve	1
Pump unit	1
Tank	1

In the first circuit, operator presses the B1 button to the 4/2-way hand lever valve. Then, the piston rod moves from point Du1 to point Du2, Fig. 5.

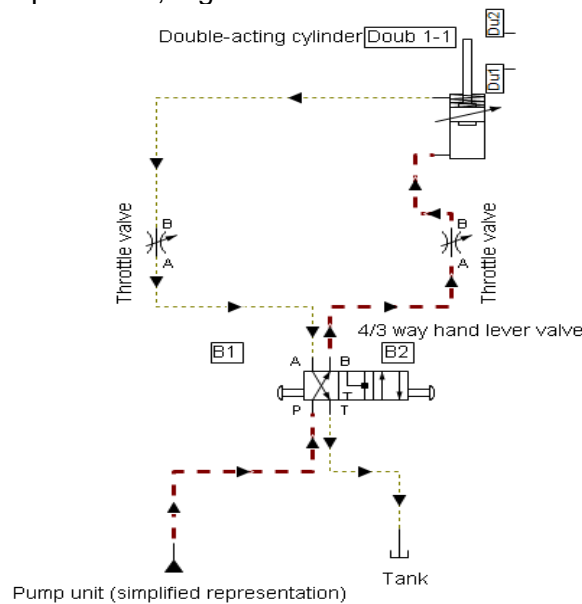


Fig. 5. Hydraulic circuit with double-acting cylinder (Doub 1-1). Simulation I.

If operator presses B2 button belonging to the 4/2-way hand lever valve, as in second simulation, the piston rod moves from point Du2 to point Du1, Fig. 6.

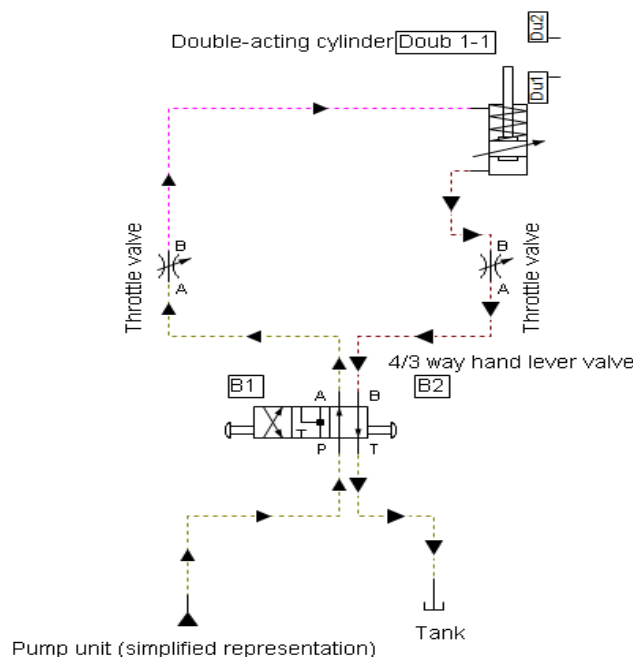


Fig. 6. Hydraulic circuit with double-acting cylinder (Doub 1-1). Simulation II.

The diagrams give show variation of the following functional parameters of the double-acting cylinder with return spring (Doub 1-1), Fig. 7.

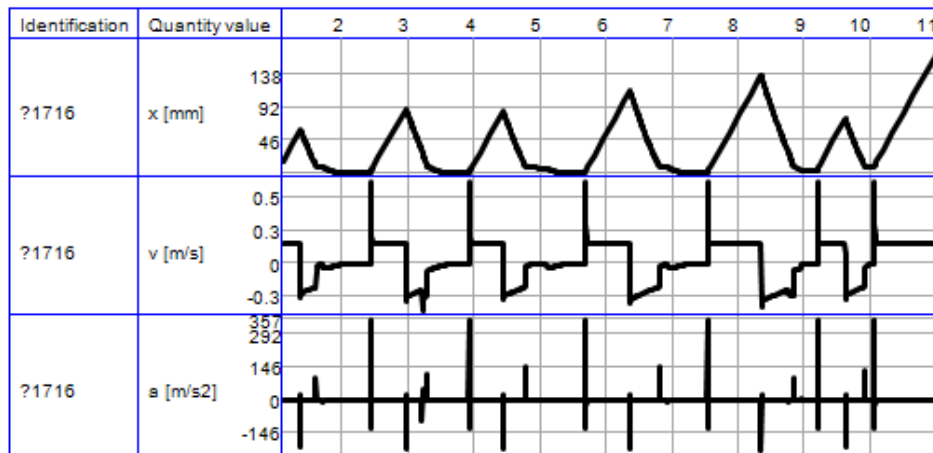


Fig. 7. Diagrams of parameters variations from the hydraulic cylinder (Doub 1-1)

Furthermore, an electro-hydraulic circuit has a double-acting pneumatic cylinder (Doub 2-1) with return spring [5].

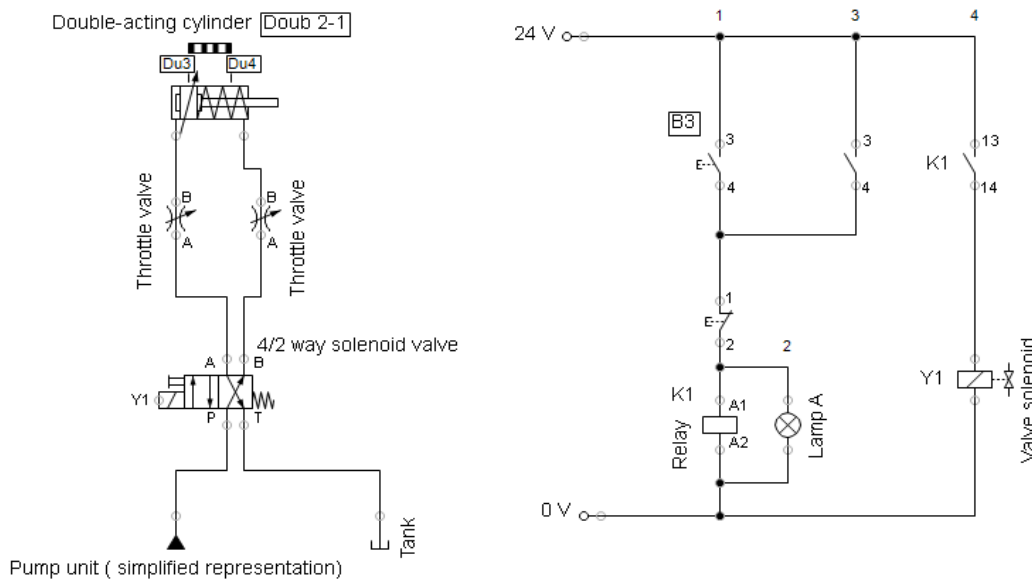


Fig. 8. Electro-hydraulic circuit using cylinder (Doub 2-1)

Table 3 below shows nine component devices used in the electro-pneumatic circuit [6].

Table 3: The devices of the electro-hydraulic circuit

Description	Number of components
Double-acting cylinder (Doub 2-1)	1
Throttle valve	2
4/2-way solenoid valve	1
Pump unit (simplified representation)	1
Tank	1
Lamp A	1
Relay	1
Solenoid valve	1

If operator presses B3 button, the piston rod of the double-acting cylinder (Doub 2-1), moves from point Du3 to point Du4, and a lamp shows a green signal. After that, the piston rod returns from point Du4 to point Du3, because the 4/2-way solenoid valve has a spring, Fig. 9.

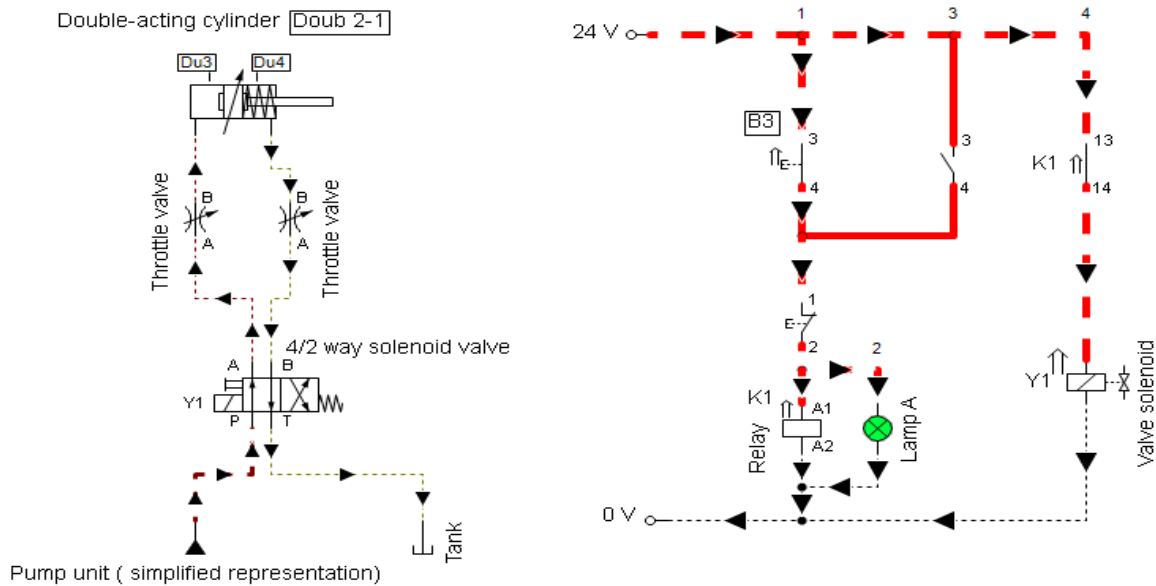


Fig. 9. Electro-hydraulic circuit using cylinder (Doub 2-1). Simulation.

Finally, the last electro-hydraulic circuit is equipped with two hydraulic cylinders, Fig. 10.

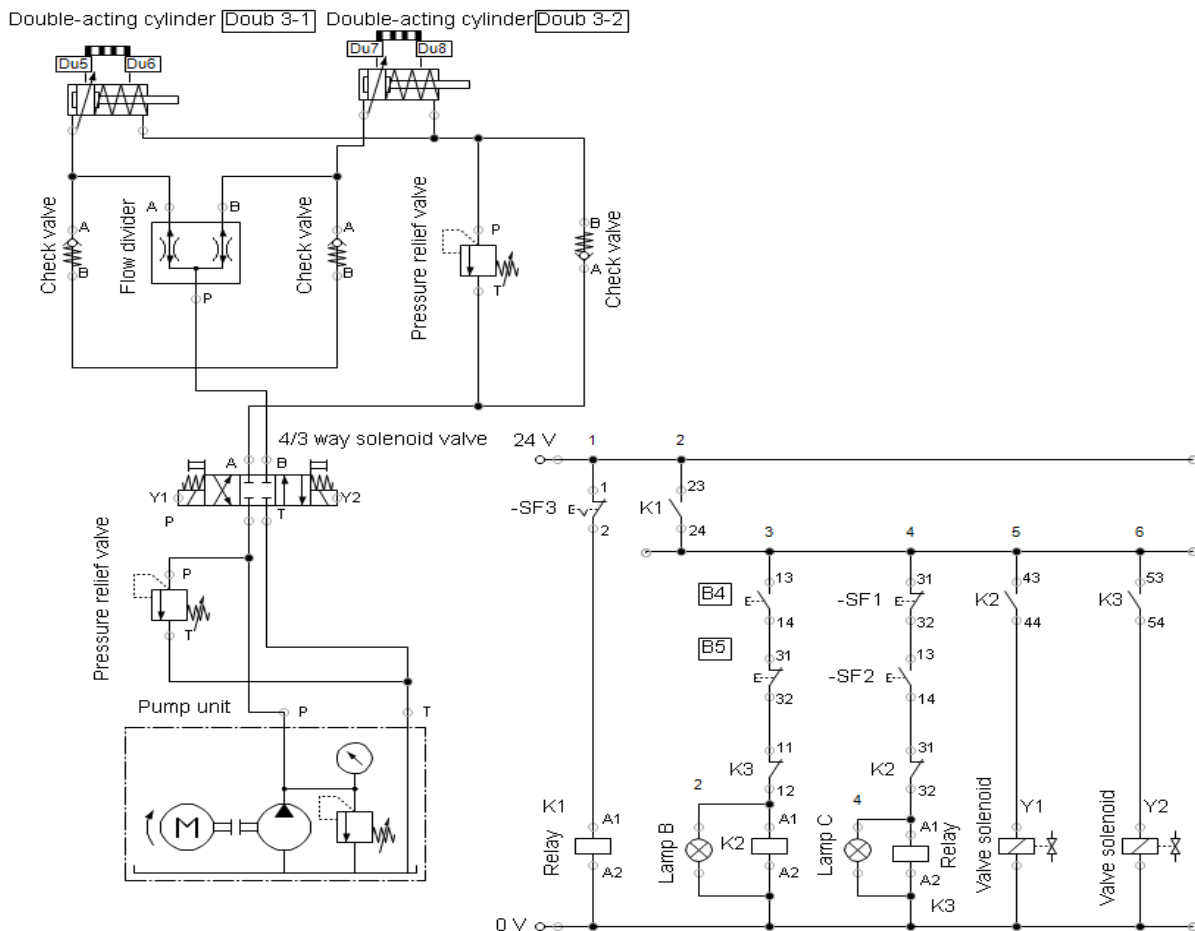


Fig. 10. Electro-hydraulic circuit using two hydraulic cylinders

After that, if operator presses the B5 button, the piston rod of the double-acting cylinder (Doub 3-1) returns from point Do6 to point Do5, and the piston rod of the double-acting cylinder (Doub 3-2) returns from point Do8 to point Do7. In this case, the lamp C shows blue signal, Fig. 12.

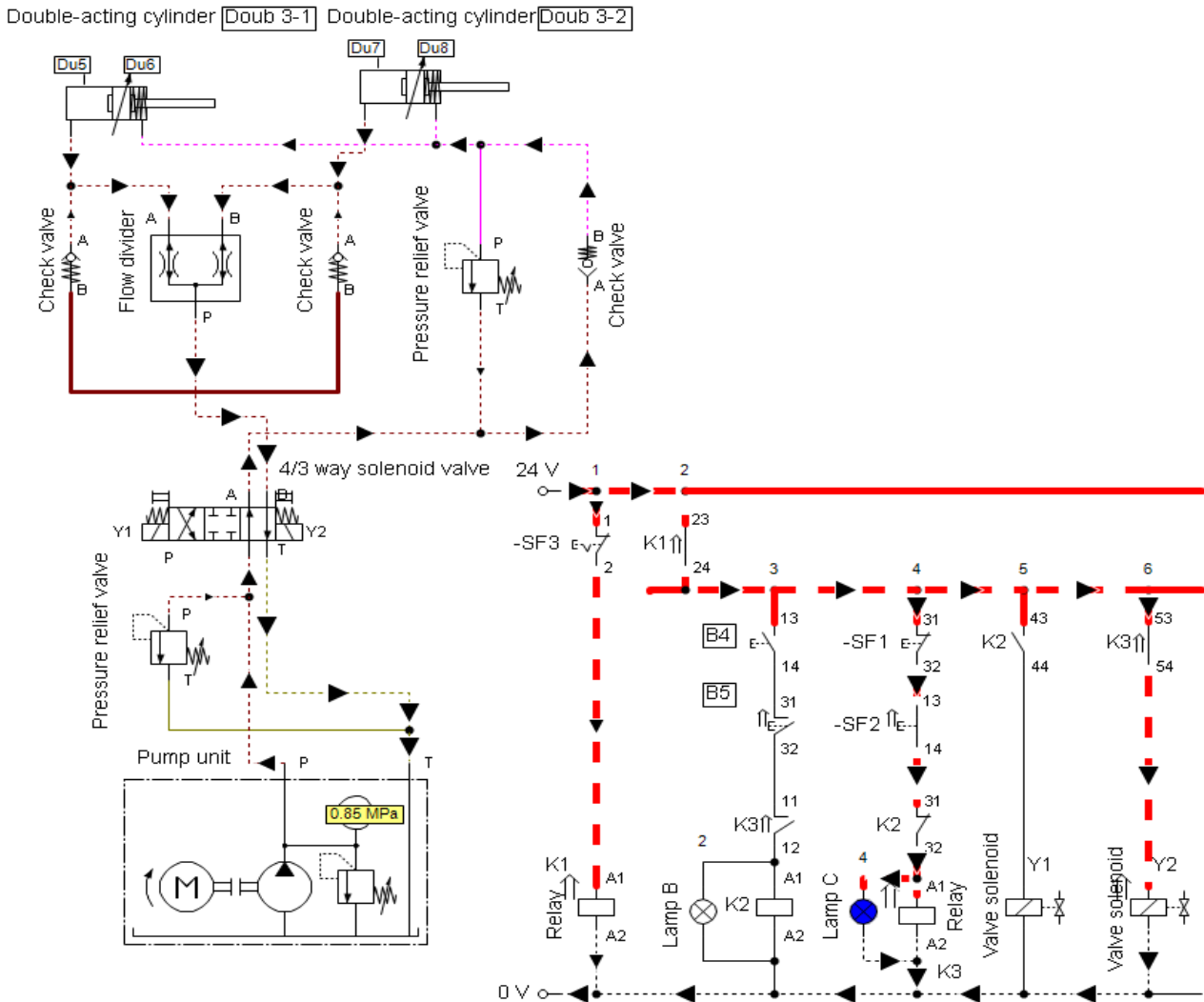


Fig. 12. Electro-hydraulic circuit using two hydraulic cylinders. Simulation II.

3. Conclusions

Hydraulic and electro-hydraulic circuits equipped with double-acting cylinders are used in many fields of industry.

Advantages of the double-acting cylinders with return springs in the hydraulic and electro-hydraulic circuits are:

- Accuracy
- Precision
- Energy-saving capability
- Push and pull motions.

The future papers on this topic will focus on the implementation in hydraulic circuits with double-acting cylinders together with several actuators (hydraulic motor, semi-rotary drive, loading unit, etc.).

Acknowledgments

We wish to thank Professor dr. eng. Nastasescu Vasile of the Military Technical Academy "Ferdinand I", for his unwavering guidance and support in the preparation of this manuscript.

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