ISSN 1454 - 8003
Proceedings of 2017 International Conference on Hydraulics and Pneumatics - HERVEX
November 8-10, Băile Govora, Romania

USING LOGIC GATES IN FLUID POWER SYSTEMS CONTROL (Part 1)

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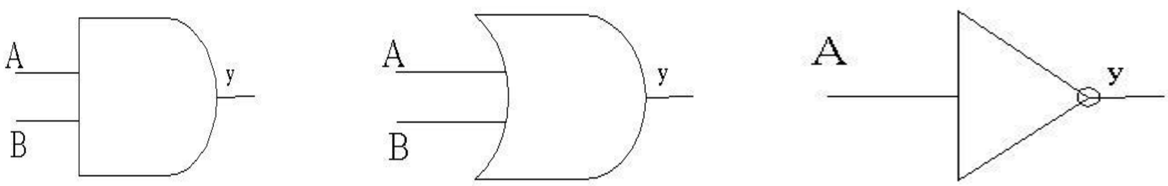
Abstract: *The control of fluid power systems refers especially to flow (speed) and pressure (force) and is realized by several methods, from mechanical to electro-electronic-mechanic solutions. In this paper we present the possibility to use hydraulic components to simulate logic gates (logic functions) in order to control fluid power systems.*

Keywords*: Fluid, power, logic, gate, automation.*

1. Elementary logic gates

A logic gate (function) is an elementary block, having at least one input (gate) (named in the following “A”, “B”,) and one output (named “y”. At this moment, we will consider login gates having two inputs.
At any gate should have one of the two Boolean conditions: zero (0) – meaning no signal – 1 (one) – meaning existence of a signal.
For the beginning, will take into consideration the most three common logic gates: AND, OR and NOT.
In figure 1 are presented this logic gates, their representation, the truth tables and the hydraulic representations.

AND OR NOT



A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Ā	y
0	1
1	0

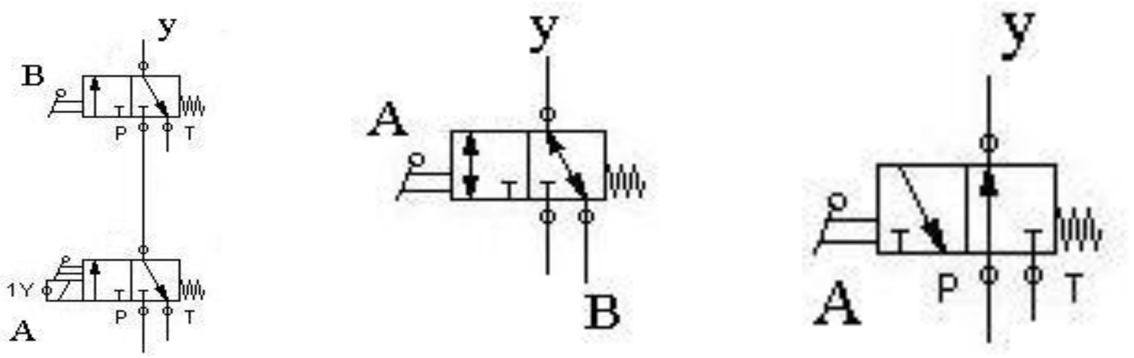


Fig. 1. Basic logic gates

ISSN 1454 - 8003
Proceedings of 2017 International Conference on Hydraulics and Pneumatics - HERVEX
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2. The use of OR logic gate

In figure 4 there is presented an example of using the OR logic gate. As can be observed, the fluid parameters – pressure, i.e. the force at the cylinder - will be modified by acting the pressure relief valves. In case that in circuit is placed a throttle valve, the flow could be modified, i.e. the speed of the cylinder rod.

In figure 2 is presented a hydraulic circuit containing an OR logic gate. In figures 3 there are presented the hydraulic circuit, and the truth table for logic gate OR.

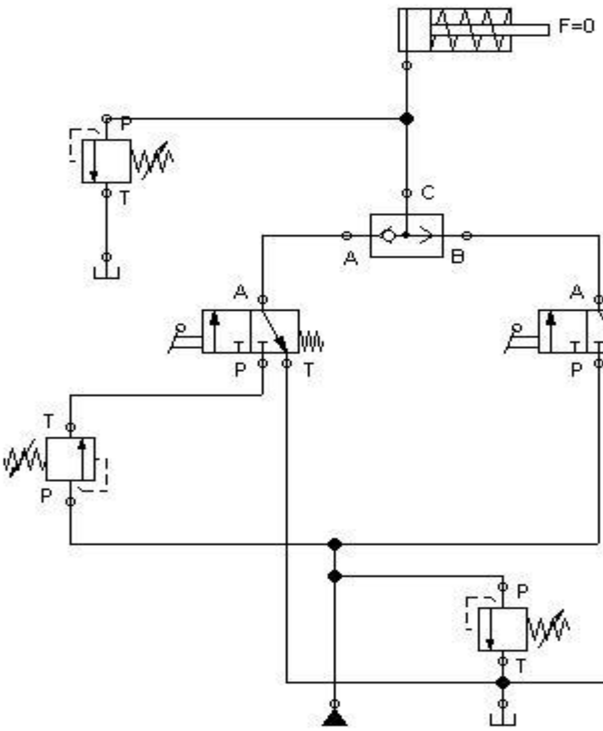


Fig. 2. The hydraulic circuit for OR gate

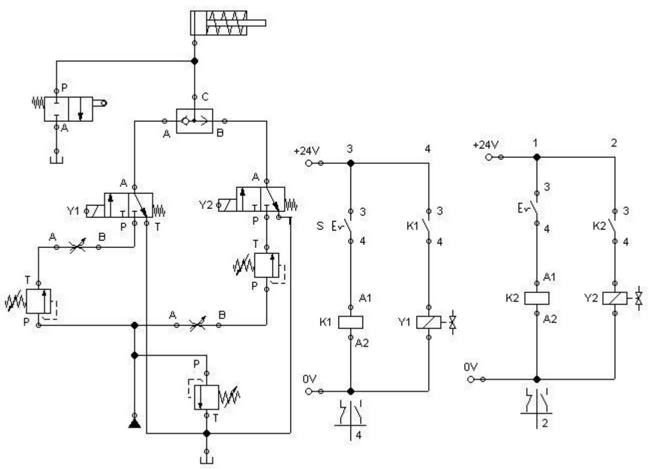


Fig. 3.a. OR truth table : A = 0, B = 0, y = 0

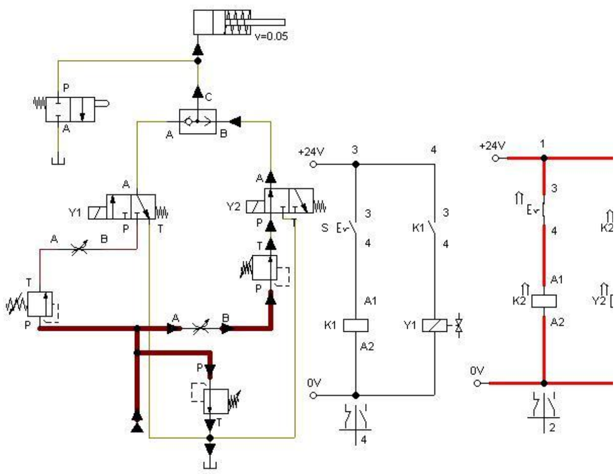


Fig. 3.b. OR truth table : A = 0, B = 1, y = 1

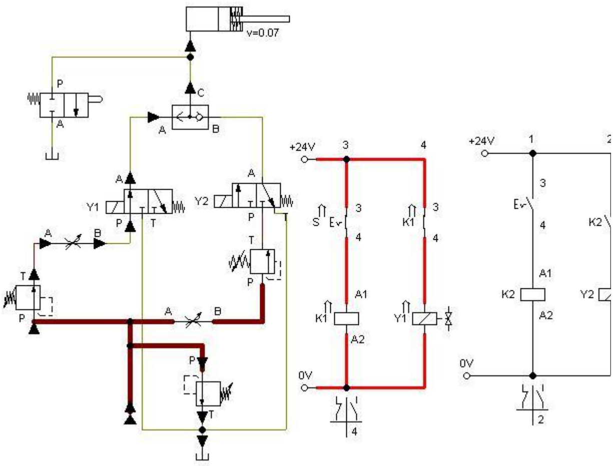


Fig. 3.c. OR truth table : A = 1, B = 0, y = 0

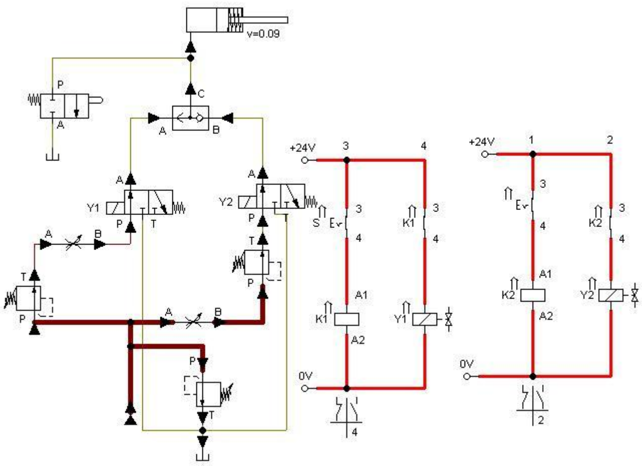


Fig. 3.d. OR truth table : A = 1, B =1, y = 1

3. The use of AND logic gate

Figure 4 presents the use of AND logic gate. Figures 5 there are presented the hydraulic circuit, and the truth table for logic gate AND.

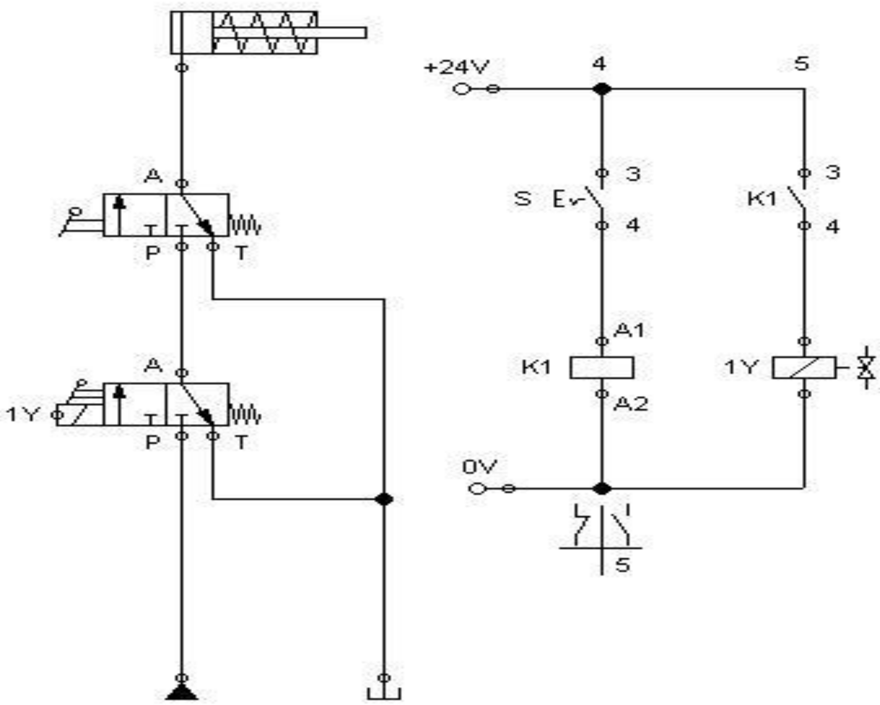


Fig. 4. The hydraulic circuit for AND gate

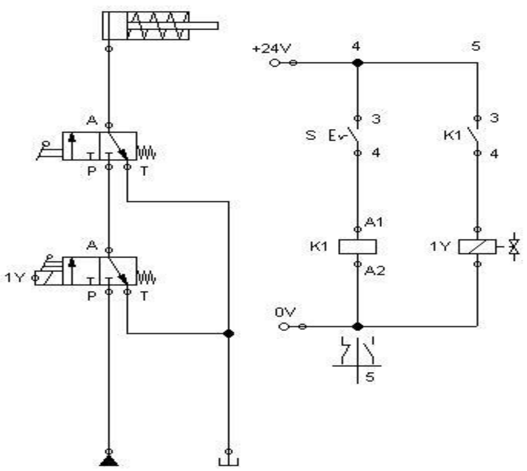


Fig. 5.a. AND truth table : A = 0, B = 0, y = 0

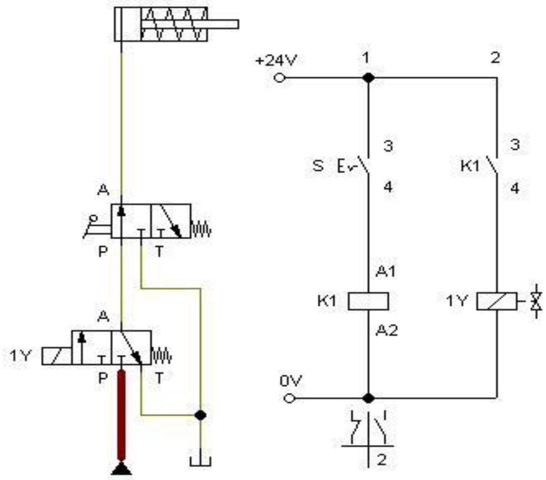


Fig. 5.b. AND truth table : A = 0, B = 1, y = 0

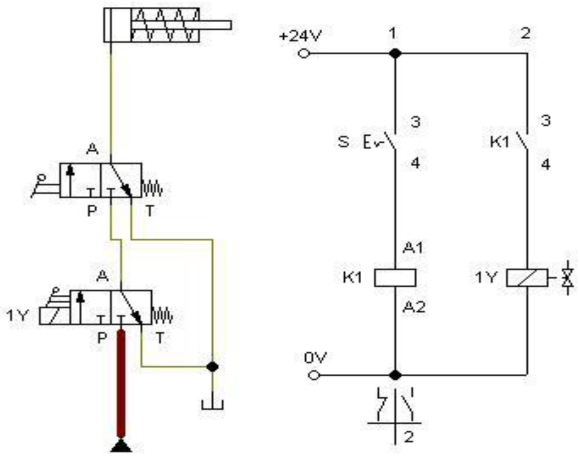


Fig. 5.c. AND truth table : A = 1, B = 0, y = 0

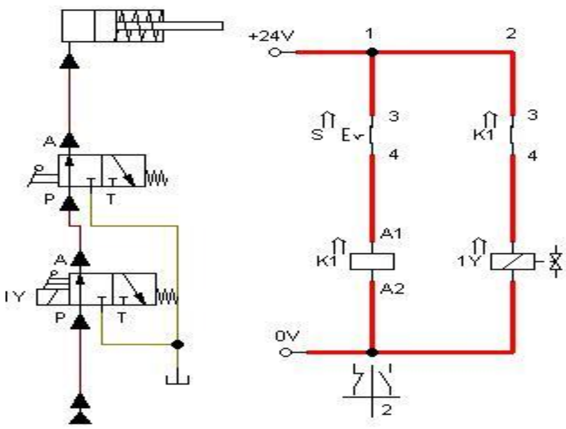


Fig. 5.d. AND truth table : A = 1, B =1, y = 1

4. The use of NOT logic gate

Figure 6 presents the use of NOT logic gate. Figures 7 there are presented the hydraulic circuit, and the truth table for logic gate NOT.

5. Combined logic gates

Logical gates can be, also combined in order to obtain more complex functions.
So, if gates NOT and OR are combined, will be obtained NOR logic gate. Figure 8 presents the use of NOR logic gate, the correspondent hydraulic circuit, and the truth table.
If gates NOT and AND are combined, will be obtained NAND logic gate. Figure 9 presents the use of NOR logic gate, the correspondent hydraulic circuit, and the truth table.

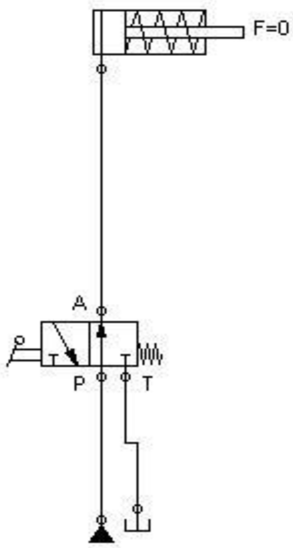


Fig. 6. The hydraulic circuit for NOT gate

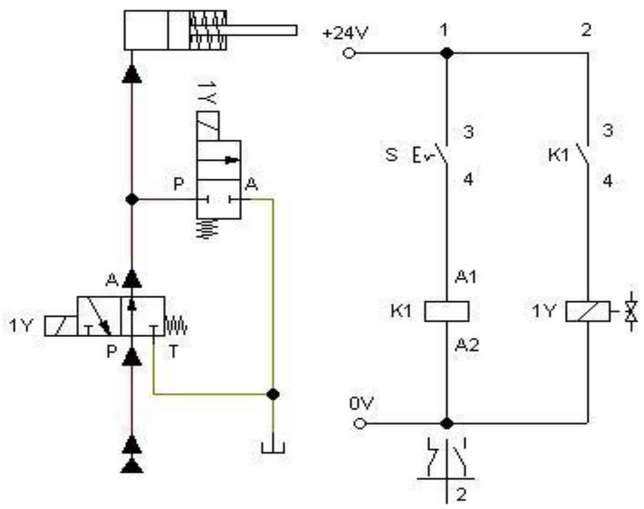


Fig. 7.a. NOT Truth table : Ā = 0, y = 1

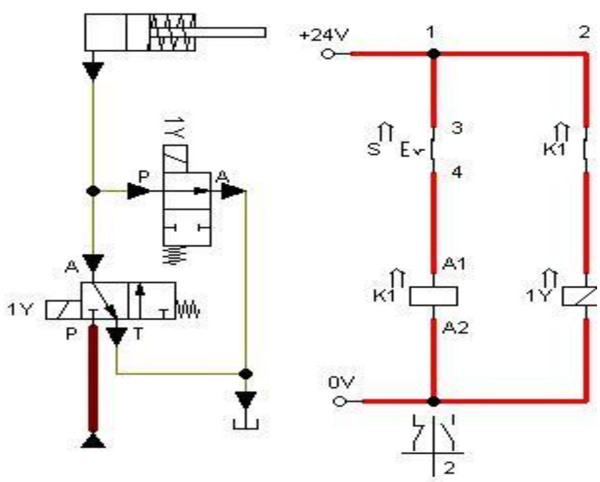
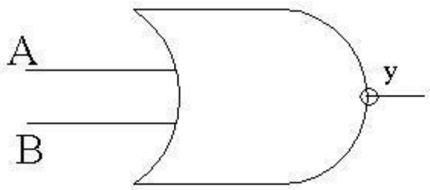


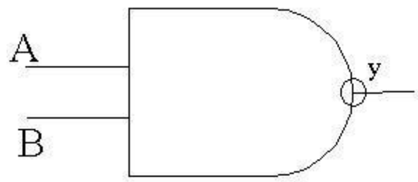
Fig. 7.b. NOT Truth table : Ā = 1, y = 0

NOR (= NOT + OR)



A	*B*	*y*
0	*0*	*1*
0	*1*	*0*
1	*0*	*0*
1	*1*	*0*

NAND (= NOT + AND)



A	*B*	*y*
0	*0*	*1*
0	*1*	*1*
1	*0*	*1*
1	*1*	*0*

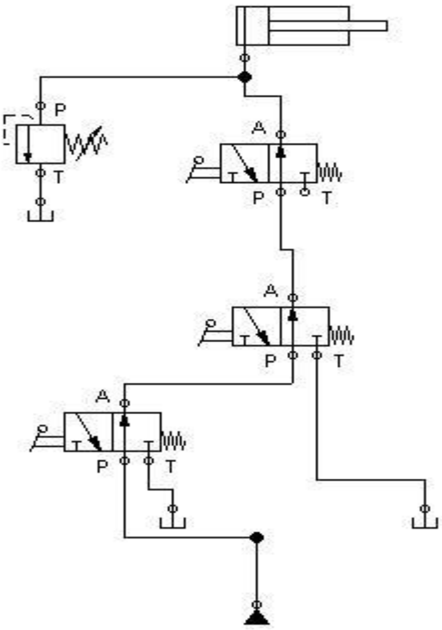


Fig. 8. NOR gate representations

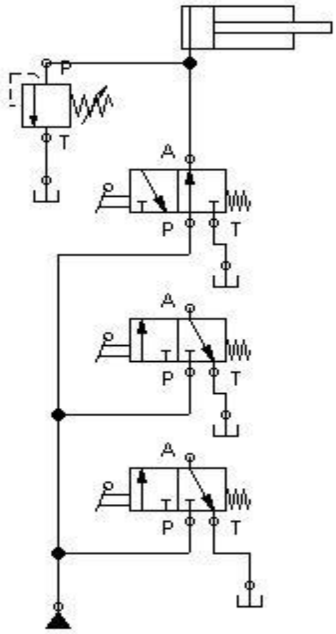


Fig. 9. NAND gate representations

6. Conclusions

The paper presented the possibility to generate logic gates, using fluid power components.
There are presented the hydraulic scheme equivalents of logic gates in correspondence with truth tables.

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