

ELECTRO-PNEUMATIC CONTROL TECHNOLOGY EXERCISES

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Electro-Pneumatic Control Technology

Experiment 1: Control of single acting cylinder using pilot circuit

Objective:

Using single acting cylinder, understand the working principle of the control circuit.

Equipment and Parts:

1. Single acting cylinder
2. 3/2-way, single solenoid / spring return valve
3. Electrical Distributor module
4. Electrical Input switches module

Experiment:

(A) Normally opened pilot circuit

- a. Connect the air supply from the air manifold to the valve.
- b. Set the pressure to 4 or 5 bar.
- c. Connect the electrical circuit diagram with the modules as shown.



Figure 1.1: Electrical diagram, normally opened pilot circuit

- d. Connect the cylinder to a normally closed 3/2 way valve as shown.

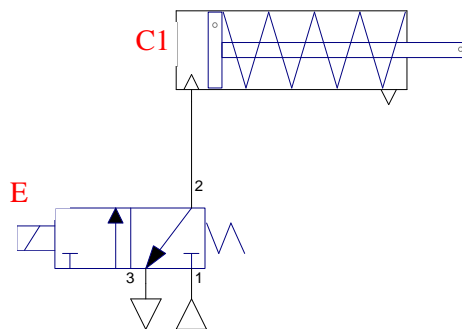


Figure 1.2: Fluid diagram, normally opened pilot circuit

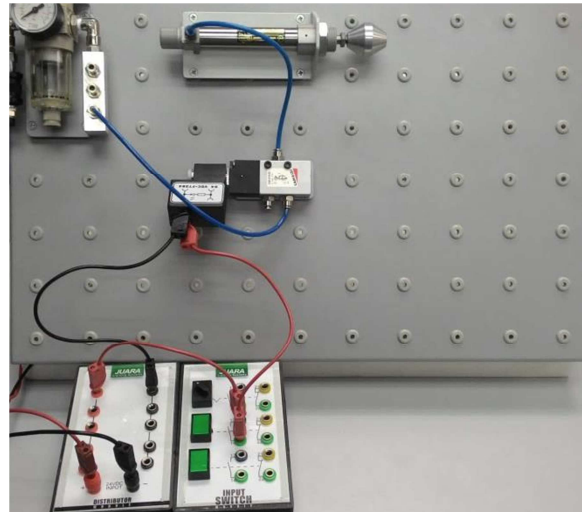


Figure 1.3: Actual diagram, normally opened pilot circuit

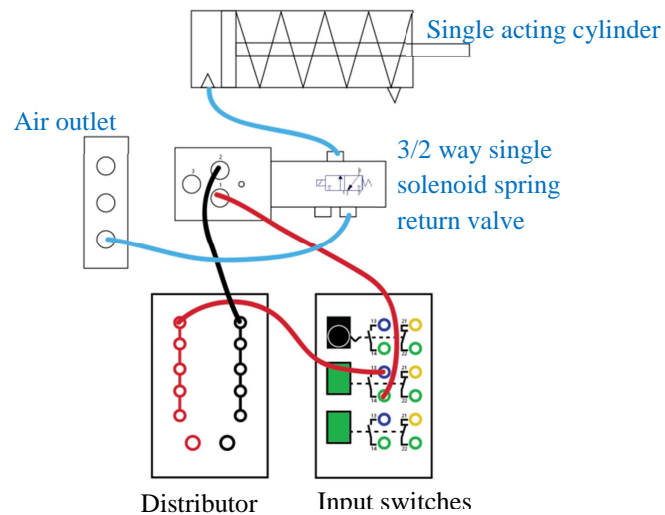


Figure 1.4: Connection of normally opened pilot circuit

- e. Push button S1 and observe the cylinder movement.
- f. Release the push button and observe the movement of the cylinder.
- g. Describe briefly what happened to the 3/-way solenoid valve and the cylinder.

(B) Normally closed pilot circuit

- a. Connect the electrical circuit with the modules as shown.



Figure 1.5: Electrical diagram, normally closed pilot circuit

- b. Connect the cylinder to a normally closed 3/2-way valve as shown.
(Note that the switch contact is now changed from normally opened to normally closed)

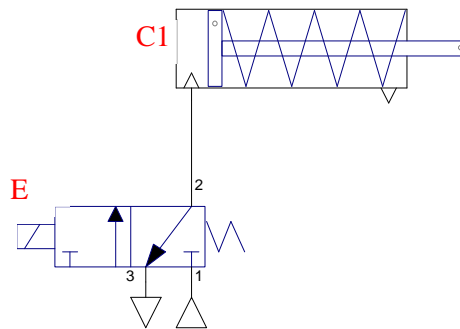


Figure 1.6: Fluid diagram, normally closed pilot circuit

(Notice that in the fluid diagram, the valve is shown in its unactuated position)

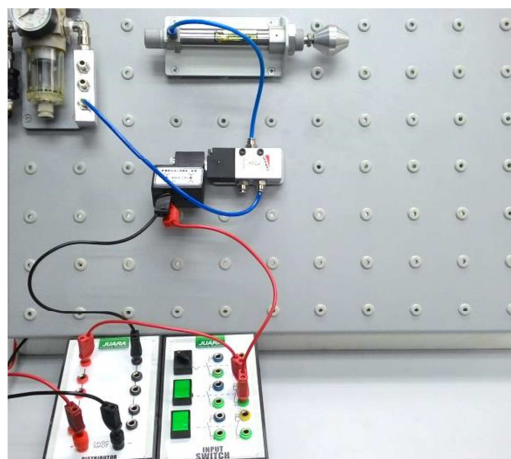


Figure 1.7: Actual diagram, normally closed pilot circuit

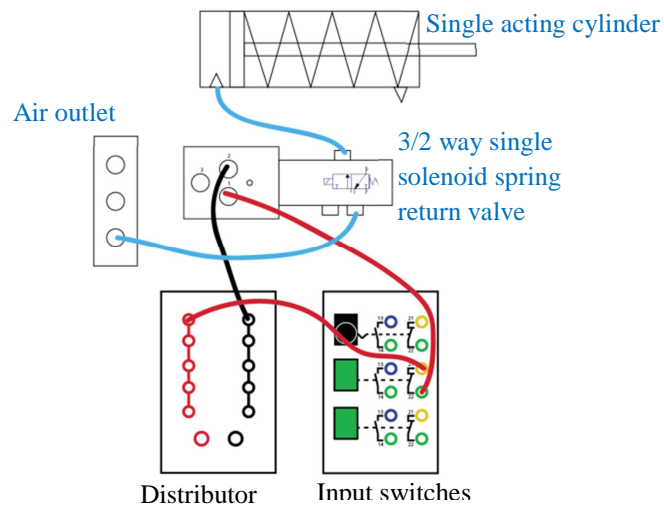


Figure 1.8: Connection of normally closed pilot circuit

- c. Push the button S1 and observe the cylinder motion.
- d. Describe briefly what happened to the 3/2-way single solenoid valve and the cylinder.

Experiment 2: Control of a single acting cylinder using logic functions with switches

Objective:

Using single acting cylinder, understand the working principle and specificity logic functions in electro-pneumatic control.

Equipment and Parts:

1. Single acting cylinder
2. 3/2-way, single solenoid / spring return valve
3. Electrical Distributor module
4. Electrical Input switches module

Experiment:

(A) AND function with switches

- a. Connect the electrical diagram with the modules as shown.

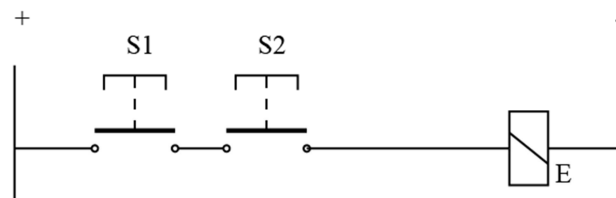


Figure 2.1: Electrical diagram, AND function

- b. Connect the cylinder to the 3/2 way valves as shown:

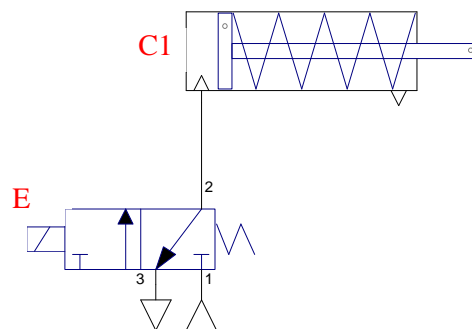


Figure 2.2: Fluid diagram, AND function

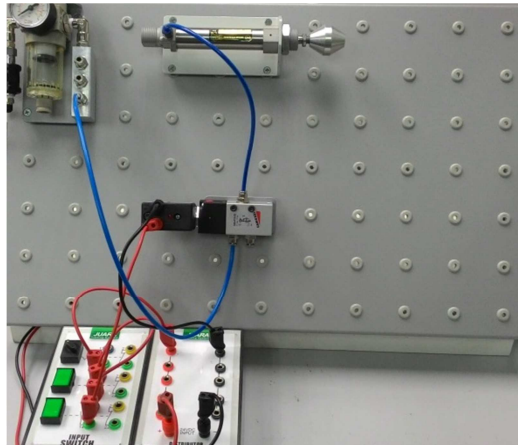


Figure 2.3: Actual diagram, AND function

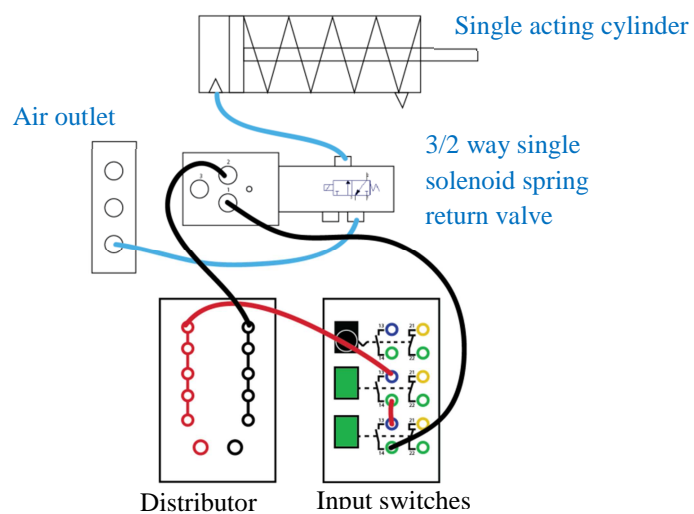


Figure 2.4: Connection of AND circuit

- c. Push the buttons S1 and S2 according to the truth table sequence used previously in the Electrical Control Technology exercises and observe the cylinder movement.

(0 = cylinder at minus position, 1 = cylinder at plus position).

- d. Describe briefly what happened to the 3/2-way solenoid valve and the cylinder.

(B) NOR function with switches

- a. Connect the electrical circuit diagram with the modules as shown.

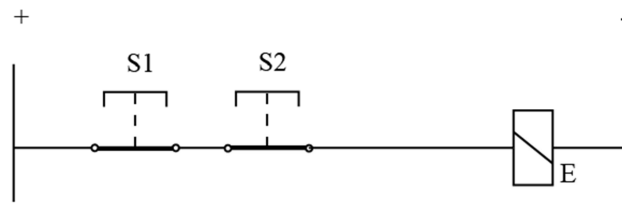


Figure 2.5: Electrical diagram, NOR function

- b. Connect the cylinder to the a 3/2-way solenoid valves as shown:

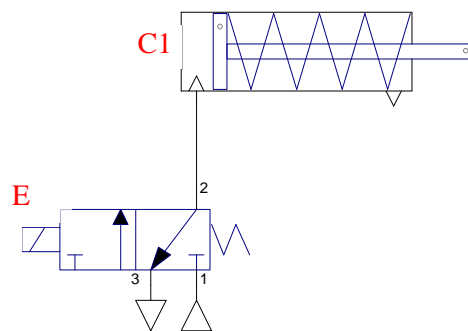


Figure 2.6: Fluid diagram, NOR function

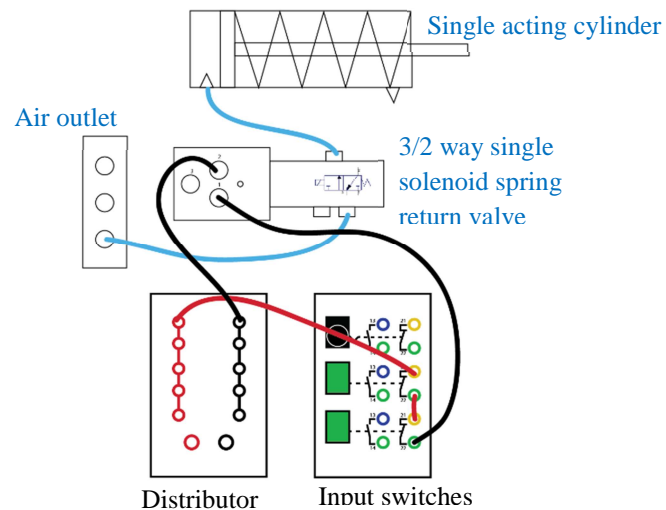


Figure 2.7: Connection of NOR circuit

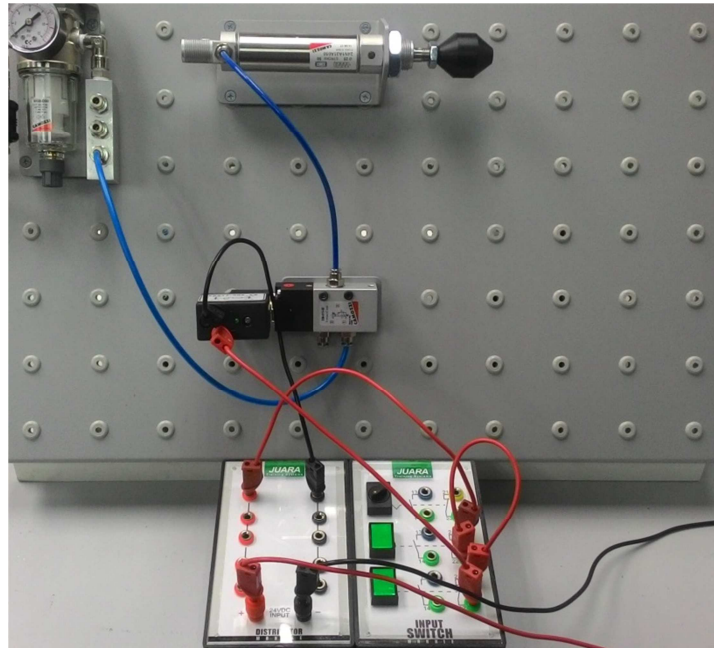


Figure 2.8: Actual diagram of NOR circuit

- a. Push the buttons S1 and S2 according to the truth table sequence used previously in the Electrical Control Technology exercises and observe the cylinder movement.
(0 = cylinder at minus position, 1 = cylinder at plus position).
- b. Describe briefly what happened to the 3/2-way solenoid valve and the cylinder.

Experiment 3: Control of double acting cylinder using a single solenoid 5/2-way valve

Objective:

Using double acting cylinder, understand the working principle of a 5/2-way valves.

Equipment and Parts:

1. Double acting cylinder
2. 5/2-way, single solenoid / spring return valve
3. 5/2 way, double solenoid valve
4. Electrical Distributor module
5. Electrical Input switches module

Experiment:

(A) Unistable control function

- a. Connect the electrical circuit diagram with the modules as shown.



Figure 3.1: Electrical diagram, unistable control

- b. Connect the cylinder to the 5/2-way single solenoid valve as shown:

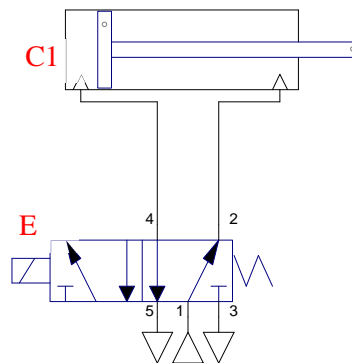


Figure 3.2: Fluid diagram, unistable control

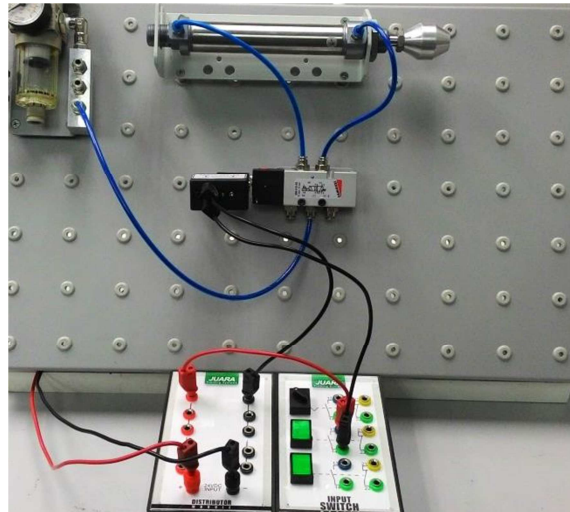


Figure 3.3: Actual diagram, unstable control

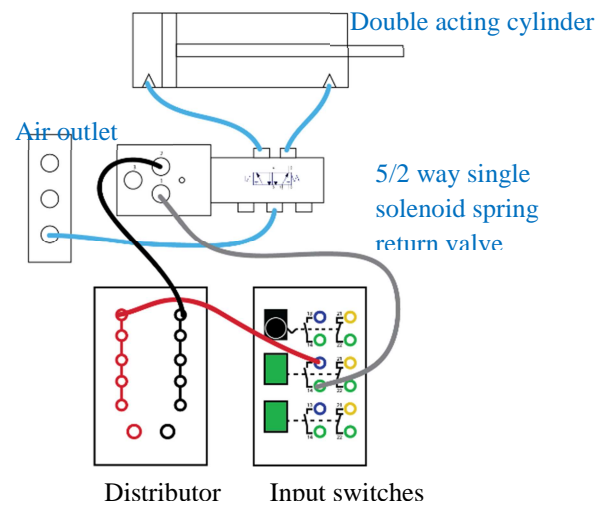


Figure 3.4: Connection of unstable control

- c. Push button S, observe the cylinder motion.
- d. Release the button S, observe the cylinder motion.
- e. Describe briefly what happened on the 5/2-way solenoid valve and the cylinder.

(B) Bistable control with OR function for the cylinder plus movement

- a. Connect the electrical circuit with the modules as shown.

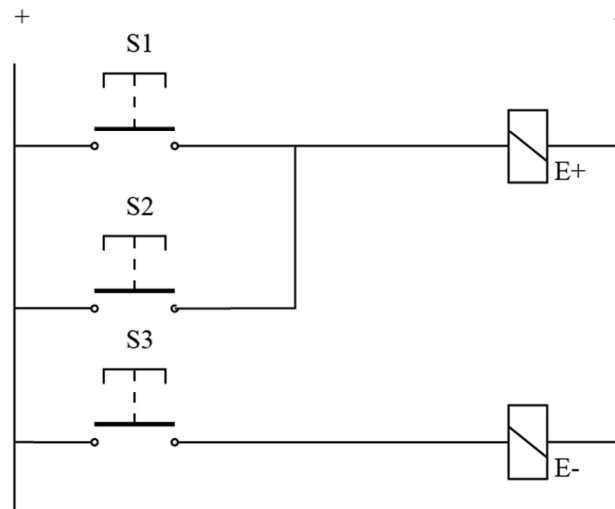


Figure 3.5: Electrical diagram, bistable control

- b. Connect the cylinder to the 5/2-way valve as shown:

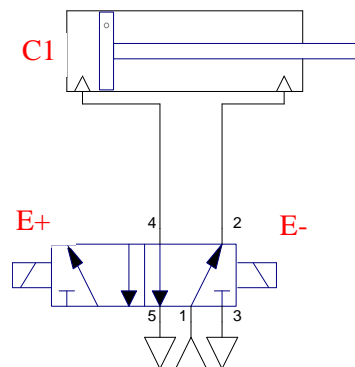


Figure 3.6: Fluid diagram, bistable control

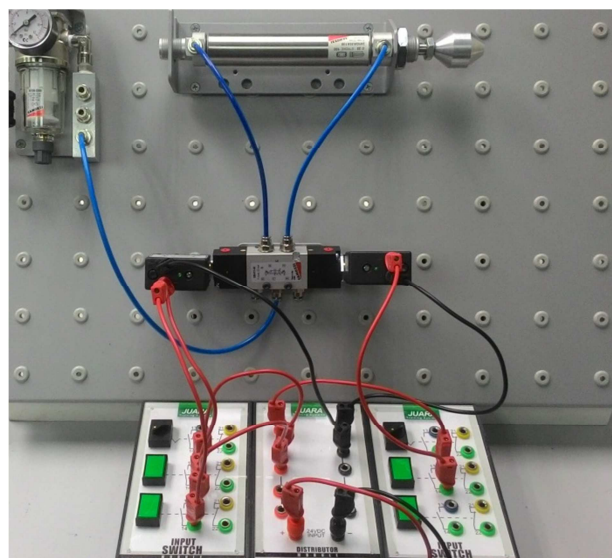


Figure 3.7: Actual diagram, bistable control

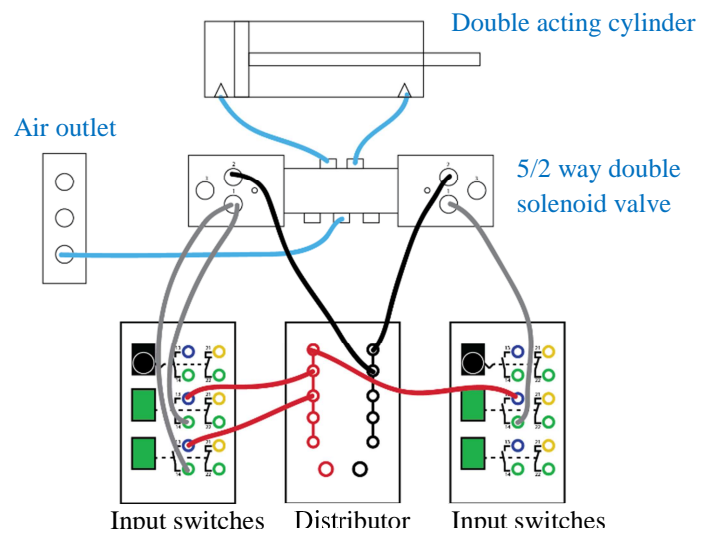


Figure 3.8: Connection of bistable control

- c. Push button S1, S2 and S3 respectively and observe the cylinder movement
- .
- d. Describe briefly what happened on the 5/2-way double solenoid valve and the cylinder.

Experiment 4: Memory (Latching / Holding circuit) function with double acting cylinder

Objective:

Using double acting cylinder, understand the working principle of memory function with unstable valve.

Equipment and Parts:

1. Double acting cylinder
2. 5/2 way, single solenoid / spring return valve
3. Non-return throttle valve
4. Electrical Distributor module
5. Electrical Input switches module
6. Relay module
7. Emergency module

Experiment:

(A) ON-dominant latching circuit

- a. Connect the electrical modules as shown.

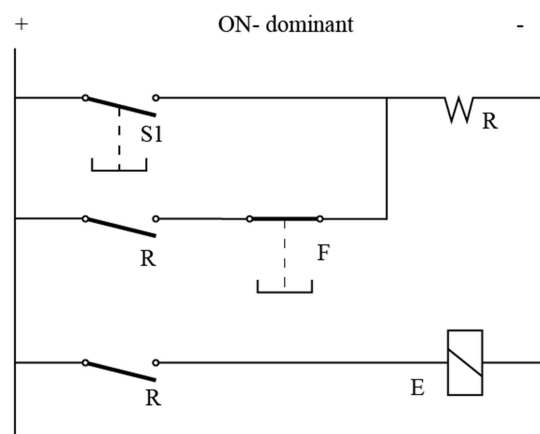


Figure 4.1: Electrical diagram, ON-dominant latching circuit

(Note that F is the emergency button)

- b. Connect the cylinder to the 5/2 way valve as shown:

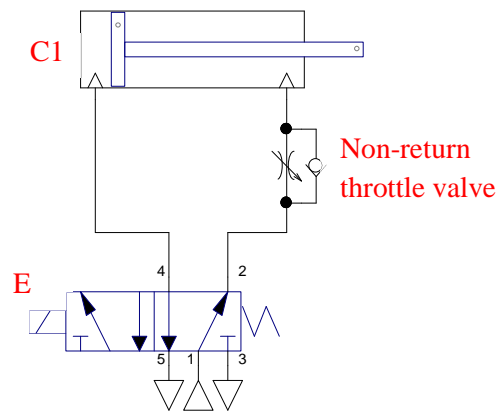


Figure 4.2: Fluid diagram, ON-dominant latching circuit

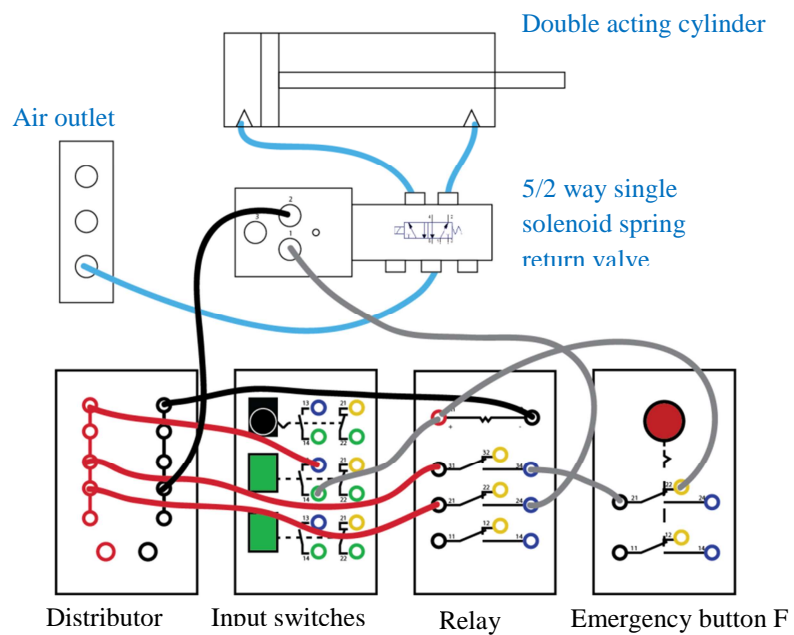


Figure 4.3: Connection of ON-dominant latching circuit

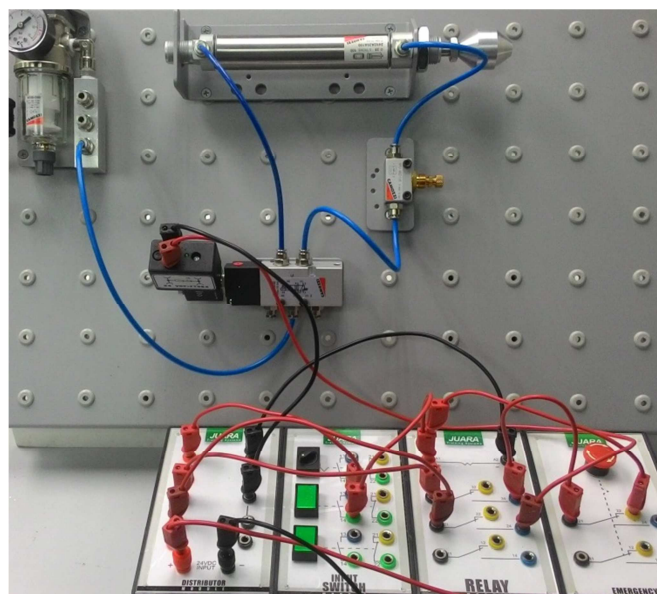


Figure 4.4: Actual diagram of ON-dominant latching circuit

- c. Push button S1 and then release.
- d. Observe and describe briefly what happened to the cylinder movement.
- e. Push the emergency button and describe briefly what happened to the cylinder.
- f. Push the button S1 now and release. Describe briefly what happened to the cylinder.
- g. Release the emergency button by turning the button clockwise. Now push button S1 and describe briefly what happened to the cylinder.

(B) OFF-dominant latching circuit

- a. Connect the electrical circuit with modules as shown.

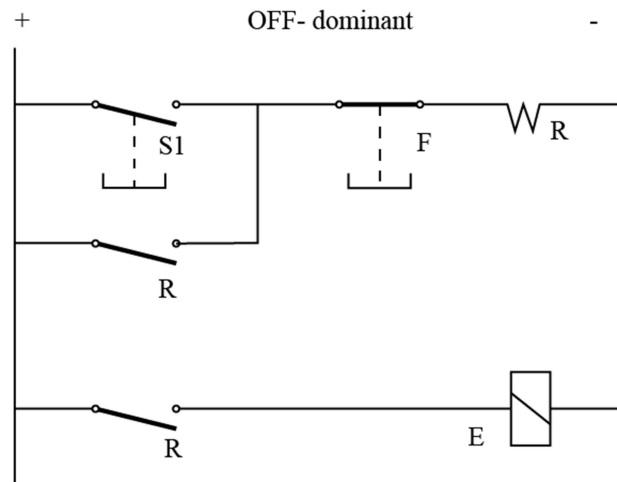


Figure 4.5: Electrical diagram, OFF-dominant latching circuit

(Note that F switch is the emergency button)

- b. Connect the cylinder to the 5/2-way solenoid valve as shown:

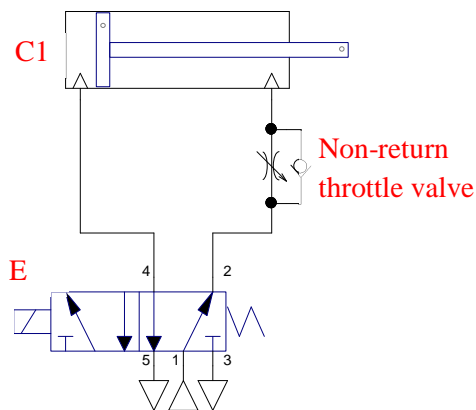


Figure 4.6: Fluid diagram, OFF-dominant latching circuit

(Note that the pneumatic component connection is the same as ON-dominant latching circuit, only the electrical circuit connection of emergency switch contact changes.)

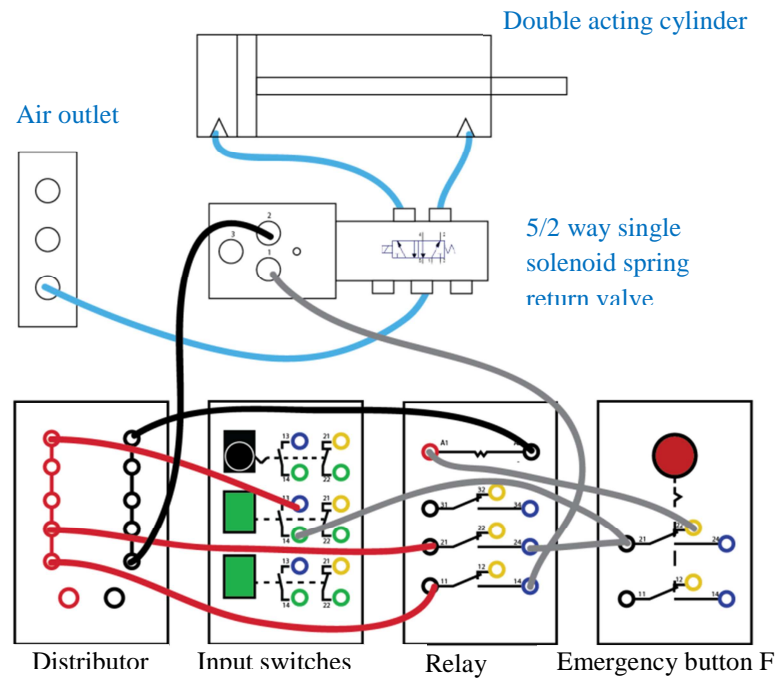


Figure 4.7: Connection of OFF-dominant latching circuit

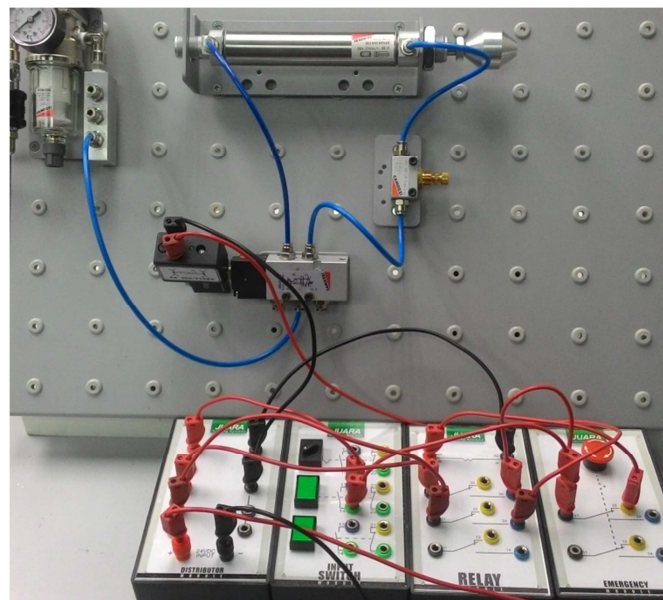


Figure 4.8: Actual diagram of OFF-dominant latching circuit

- Push button S1 and release.
- Observe and describe briefly what happened to the cylinder.
- Push the emergency button and describe briefly what happened to the cylinder.
- Push the button S1 now and release. Describe briefly what happened to the cylinder.
- Release the emergency button by turning the button clockwise. Now push button S1 and describe briefly what happened to the cylinder.
- Explain the differences between ON-dominant and OFF-dominant latching circuit based on your observation.

Experiment 5: Automatic control of double acting cylinder

Objective:

Using electrical roller limit switches, understand the working principle of automatic sequence function by using electrical circuit control.

Equipment and Parts:

1. Double acting cylinder
2. 5/2-way, double solenoid valve
3. Electrical roller limit switches
4. Electrical Distributor module
5. Electrical Input switches module

Experiment:

(A) Automatic work cycle with start/stop button

- a. Connect the electrical modules as shown.

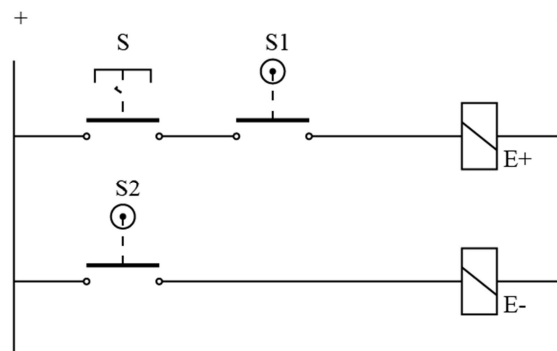


Figure 5.1: Electrical diagram, automatic work cycle with start / stop button

(Notice that S1 contact is drawn in the unactuated position)

- b. Connect the double acting cylinder with a 5/2-way double solenoid valve, a start/stop switch and two roller limit switches as shown.

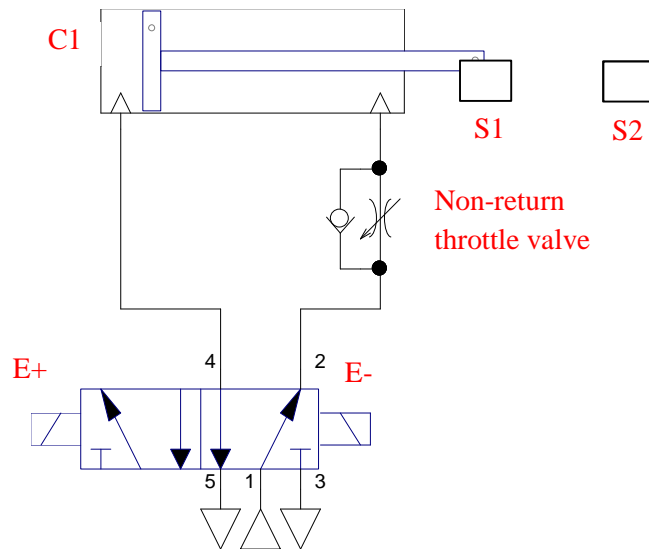


Figure 5.2: Fluid diagram, automatic work cycle with start / stop button

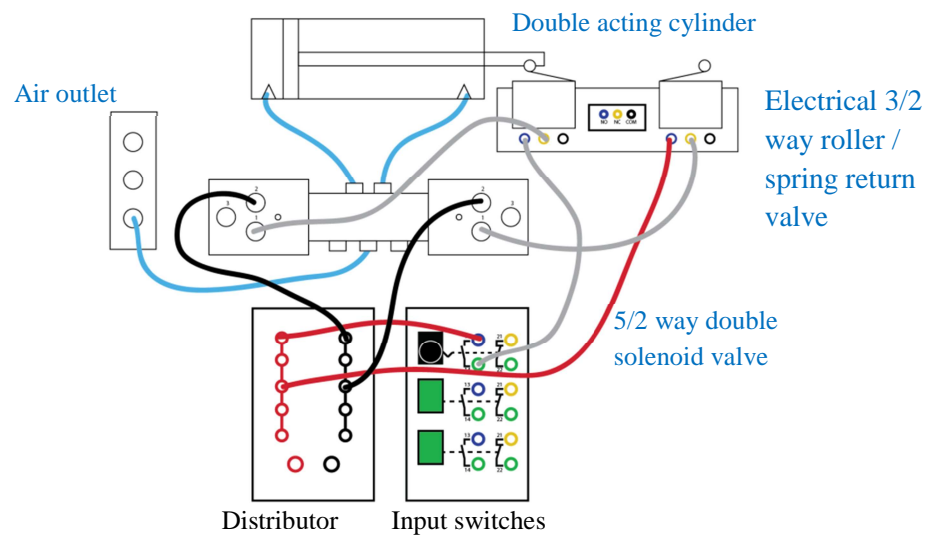


Figure 5.3: Connection of automatic work cycle with start / stop button

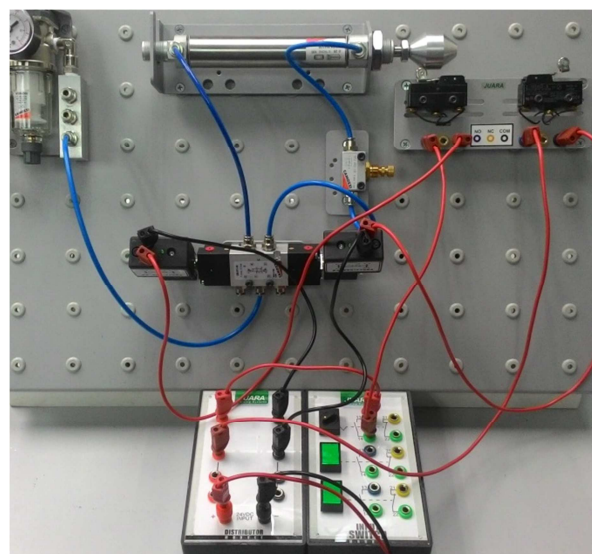


Figure 5.4: Actual diagram, automatic work cycle with start / stop button

- c. Turn Start/stop switch to start the automatic cycle.
- d. Observe and describe what happen to the cylinder and the roller limit switch.
- e. Turn off the switch S and describe what happen.

Experiment 6: Timer

Objective:

Using timer module, understand the working principle of time delay in plus motion by using electrical control.

Equipment and Parts:

1. Input switches module
2. Electrical Distributor module
3. Electrical Timer Relay module
4. Relay module
5. Double acting cylinder
6. 5/2 way, single solenoid / spring return valve
7. Electrical roller limit switches

Experiment:

(A) Delay in minus motion

- a. Connect the electrical circuit with the module as shown below.

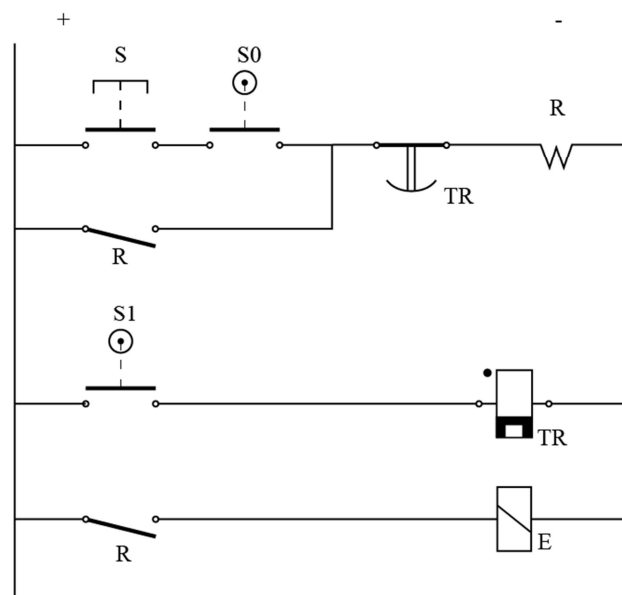


Figure 6.1: Electrical diagram of timer delay circuit

- b. Connect a 5/2 way single solenoid / spring return valve with two roller limit switches and the timer relay as shown.

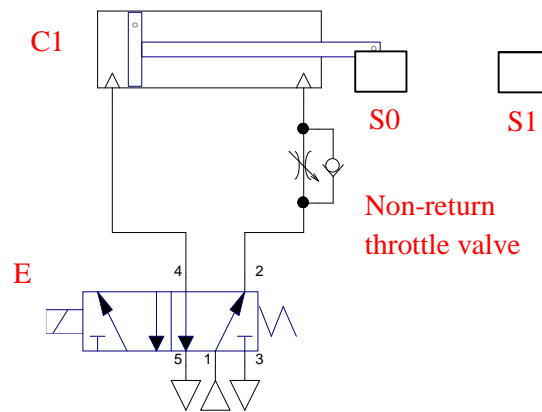


Figure 6.2: Fluid diagram of timer delay circuit

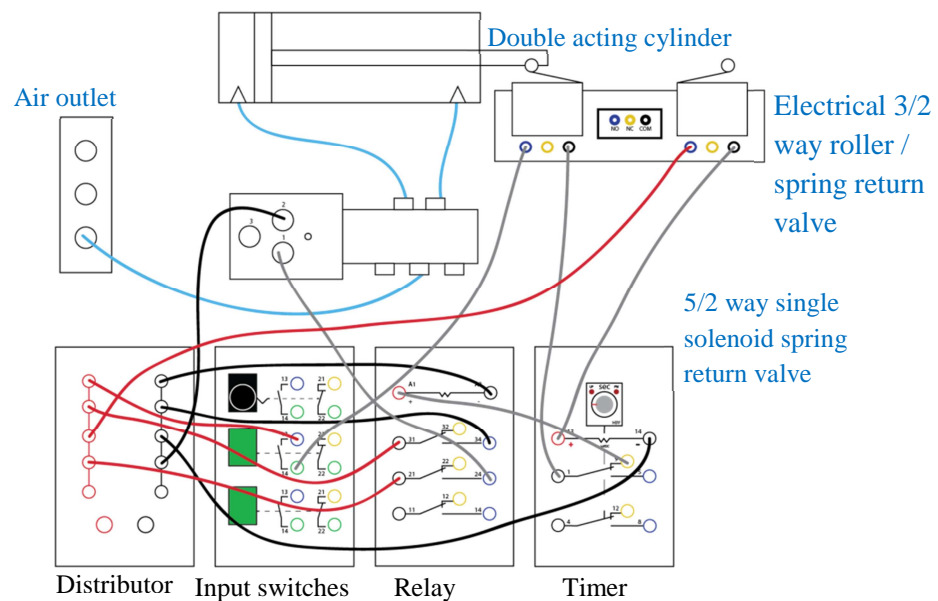


Figure 6.3: Connection of timer delay circuit

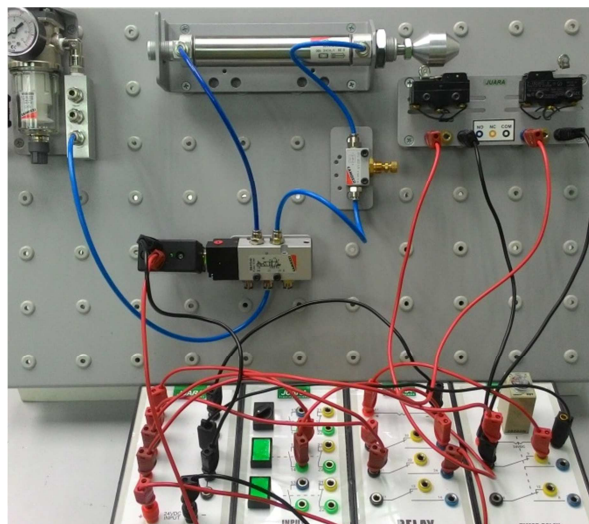


Figure 6.4: Actual diagram of timer delay circuit

- c. Push and release the push button S1 and observe the cylinder motion.
- d. Describe briefly what happened to the cylinder.