ELECTRO-PNEUMATIC

Push button switches

- A push button is a switch used to close or open an electric control circuit.
- They are primarily used for starting and stopping of operation of machinery.
- This causes set of contacts to open or close.

Push buttons are of two types

i) Momentary push button

ii) Maintained contact or detent push button

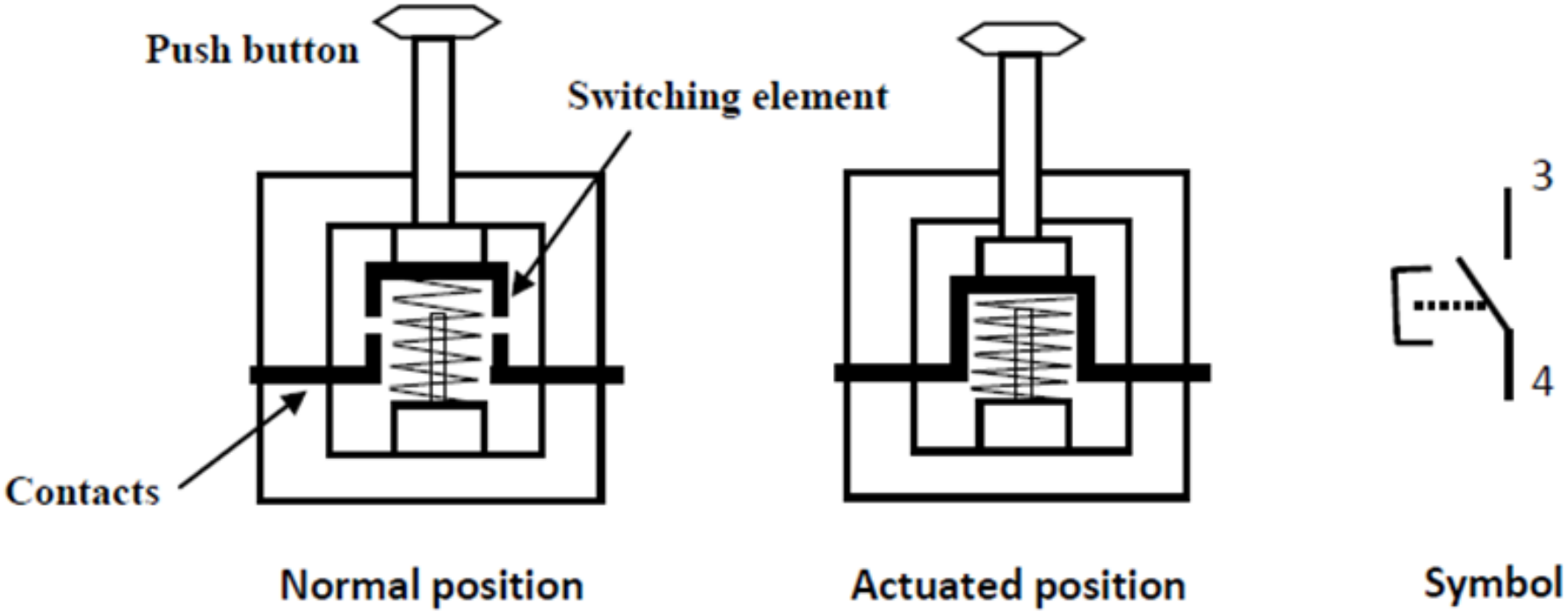
Push button switches

- Momentary push buttons return to their unactuated position when they are released.
- Maintained (or mechanically latched) push buttons has a latching mechanism to hold it in the selected position.

- The contact of the push buttons, distinguished according to their functions,
- i) Normally open (NO) type
- ii) Normally closed (NC) type
- iii) Change over (CO) type.

Normally open (NO) type

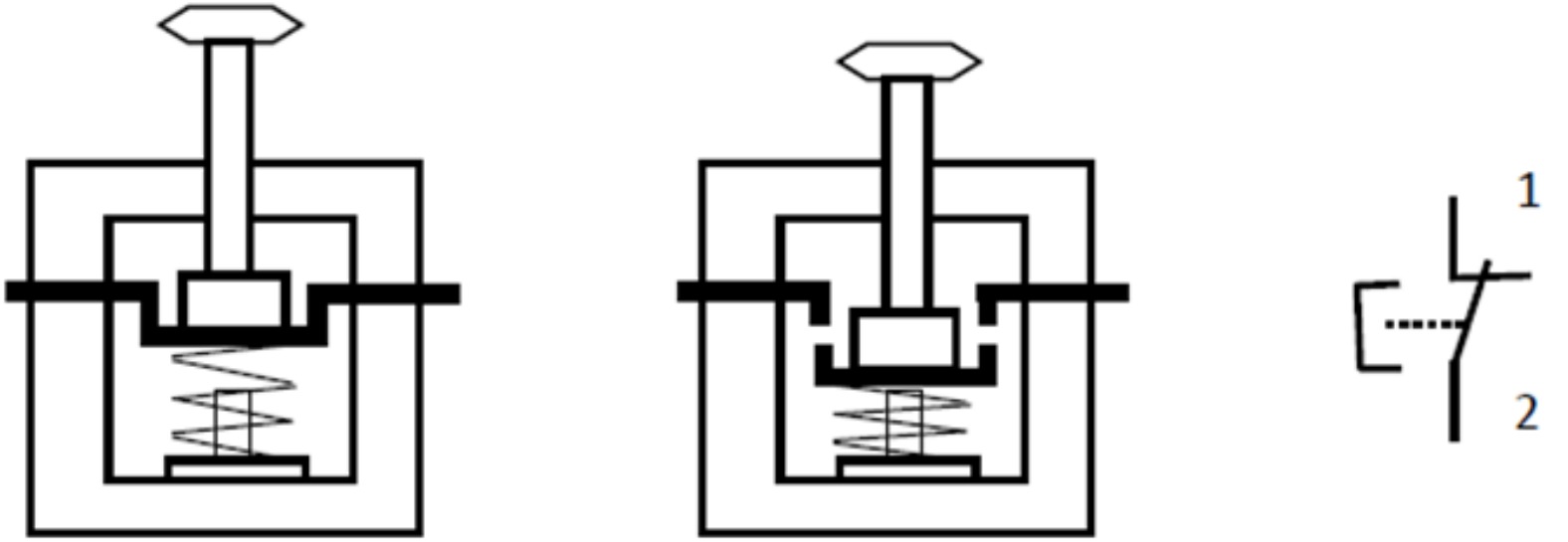
- In the NO type, the contacts are open in the normal position, inhibiting the energy flow through them.
- But in the actuated position, the contacts are closed,



Normally Open (NO)

Normally closed (NC) type

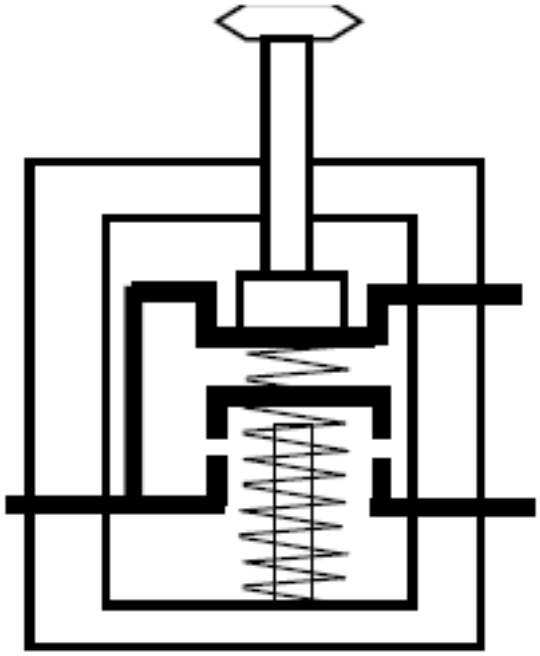
- In the NC type, the contacts are closed in the normal position, permitting the energy flow through them.
- And, the contacts are open in the actuated position, inhibiting the energy flow through them.



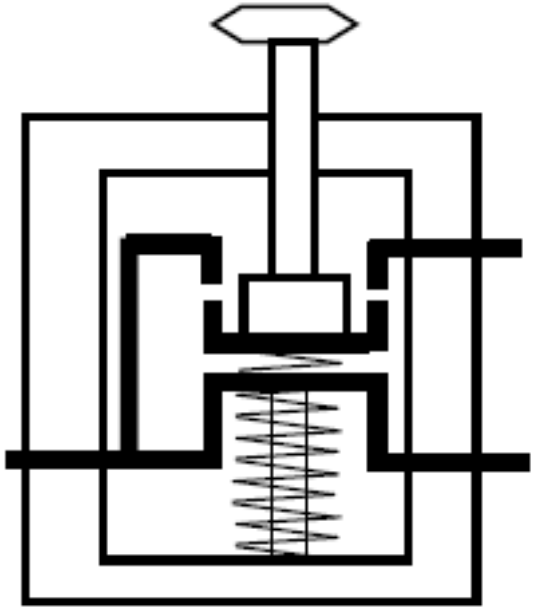
Normally closed (NC)

Changeover contact

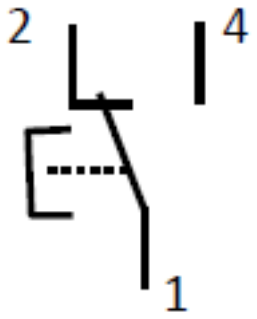
- A changeover contact is a combination of NO and NC contacts.



Normal position



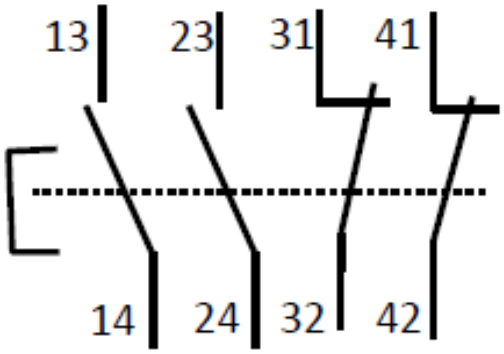
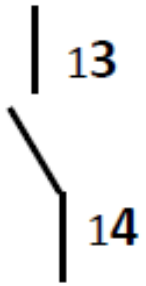
Actuated position



Symbol

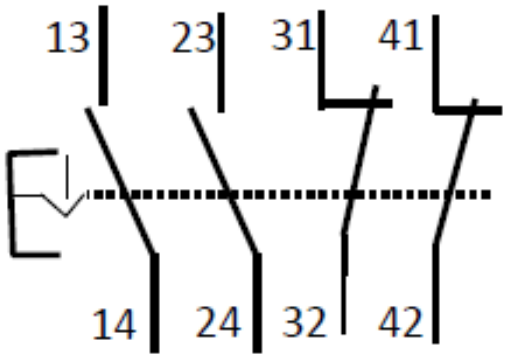
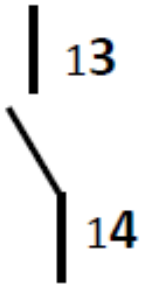
Change Over (CO)

Designation of the pushbuttons

Type of contact	Designation
Momentary contact type PB station (2 NO +2 NC)  	First digit indicates the function of contact. Second digit represents a serial ordering. 3 and 4 represents **NO** contacts and 1 is the serial no. 

Type of devices	***Terminal Numbers***	
	Normally closed contacts	**Normally open contacts**
Push buttons and Relays	1 and 2	3 and 4
Timers and Counters	5 and 6	7 and 8

Designation of the pushbuttons

Type of contact	Designation
Maintained Contact type PB station (2NO+2 NC) 	First digit indicates the function of contact. Second digit represents a serial ordering. 3 and 4 represents **NO** contacts and 1 is the serial no. 

Type of devices	***Terminal Numbers***	
	Normally closed contacts	**Normally open contacts**
Push buttons and Relays	1 and 2	3 and 4
Timers and Counters	5 and 6	7 and 8

Direct and Indirect Control:

Direct Control:

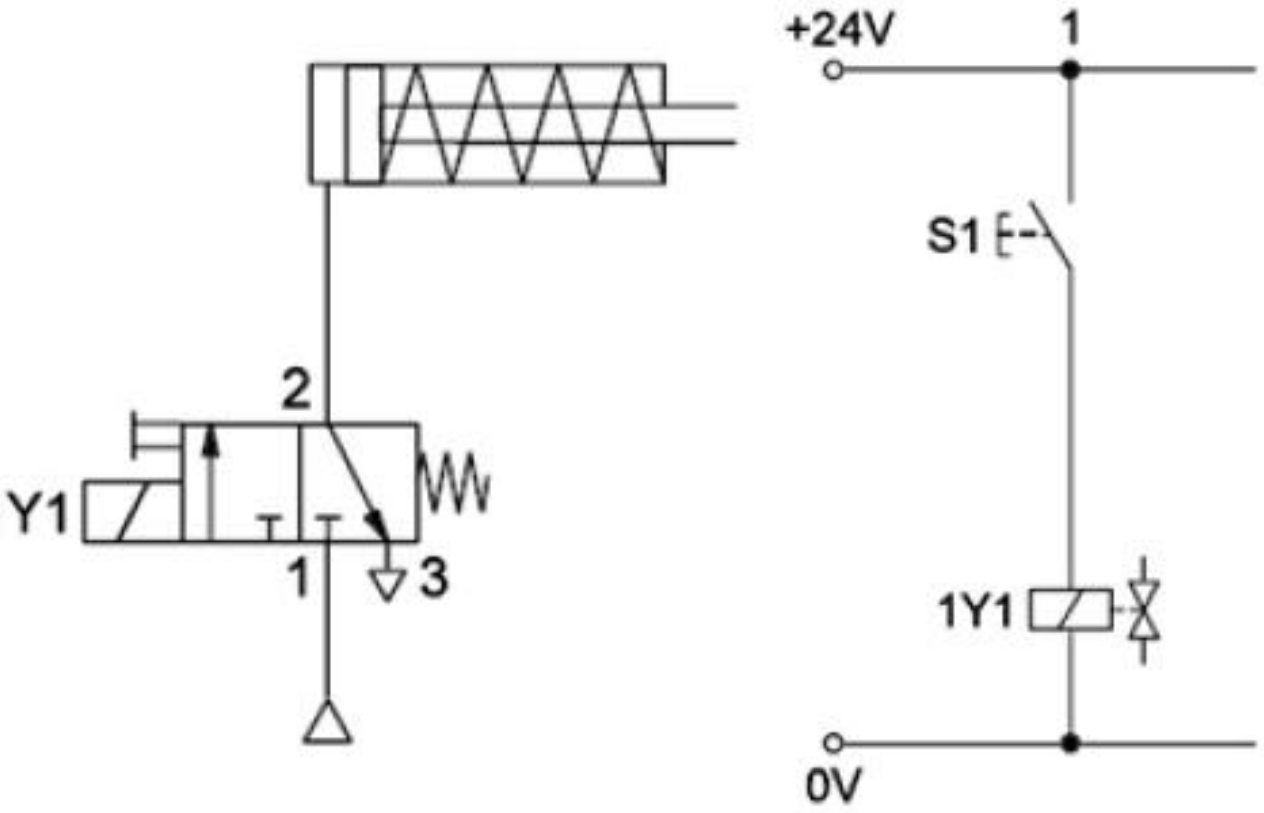
• The piston rod of a single-acting cylinder is to be extended when pushbutton S1 is pressed and retracted when the pushbutton is released.

Indirect Control:

- If the pushbutton is pressed in an indirect control system, current flows through the relay coil.
- Contact K1 of the relay closes, and the directional control valve switches.
- The piston rod advances.

Direct Control of Single Acting Cylinder:

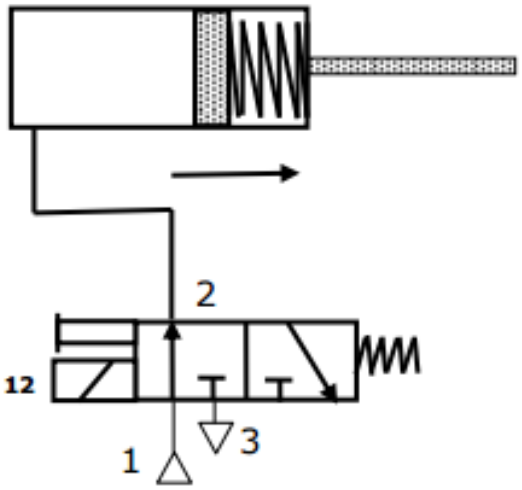
The electrical circuit diagram for direct control of a single-acting cylinder is shown in Figure.



Direct Control of Single Acting Cylinder:

Forward stroke:

- The circuit is closed when push button PB closes.
- Magnetic field is produced in the coil Y.
- Armature in the coil opens the passage for the compressed air.
- The compressed air flows from 1 to 2 of the 3/2 DCV to cylinder, which travels to the final forward position.

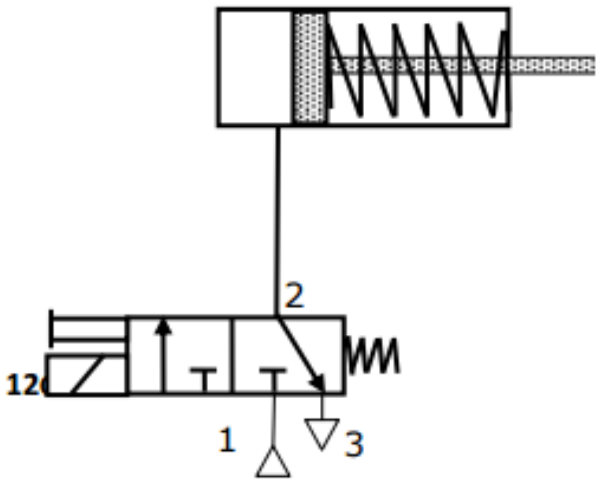


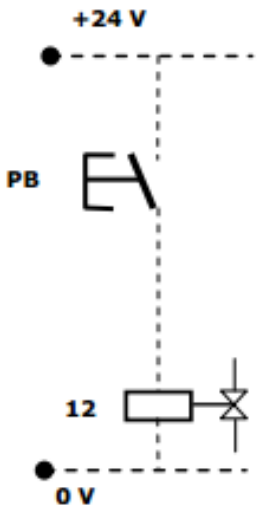
Position when cylinder is extended

Direct Control of Single Acting Cylinder:

Return stroke:

- When the push button PB is released, circuit is interrupted.
- Magnetic field at coil Y collapses, the 3/2 way valve switches back to its original position.
- The compressed air in the cylinder then exhausts through port 3 of the DCV and the cylinder travel to the final rear position.

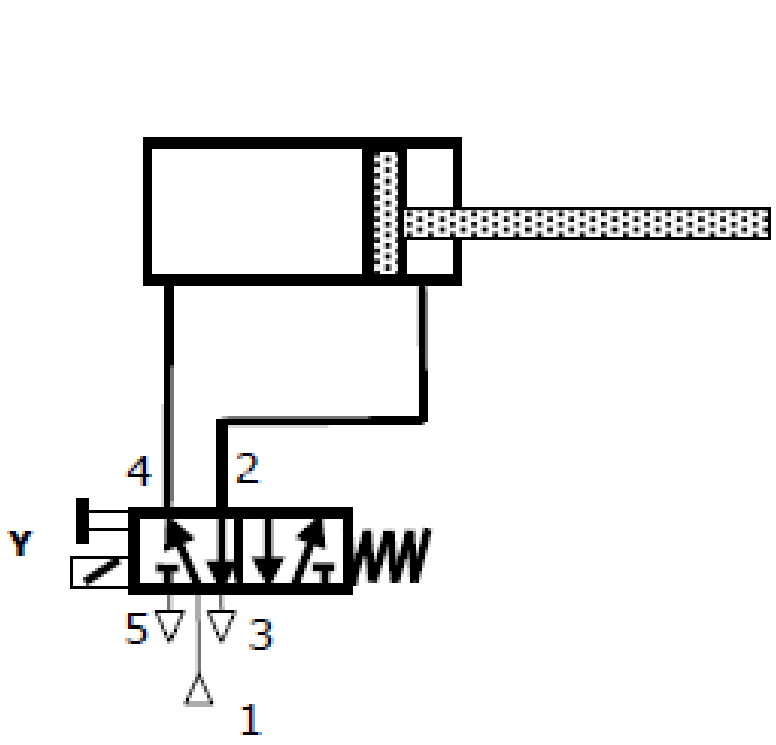




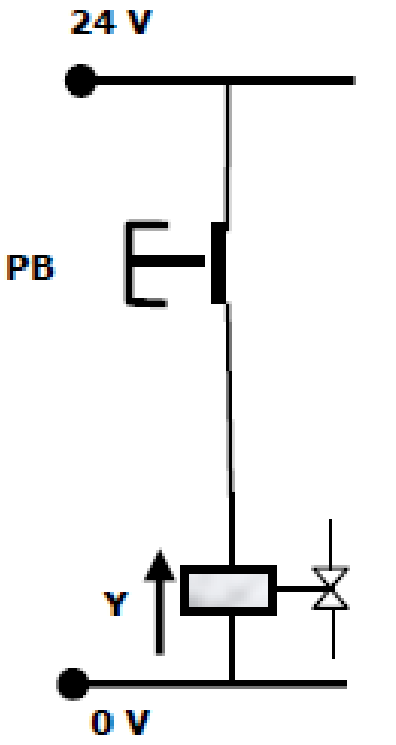
Position when cylinder is retracted

Direct Control of Double Acting Cylinder (extended):

The electrical circuit diagram for direct control of a double-acting cylinder is shown in Figure.



Pneumatic Circuit



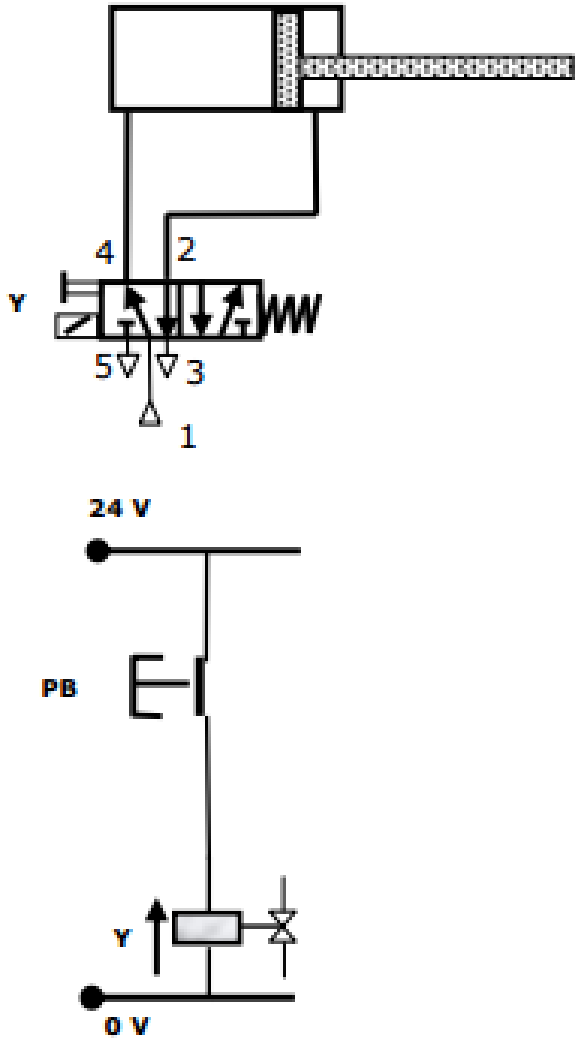
Electrical Circuit

Position when cylinder is extended

Direct Control of Double Acting Cylinder (extended):

Forward stroke:

- The double acting cylinder is controlled by 5/2 way valve.
- When the pushbutton PB is pressed, coil Y is energised and the directional control valve is activated by compressed air via pilot control.
- The piston travels to the final forward position.

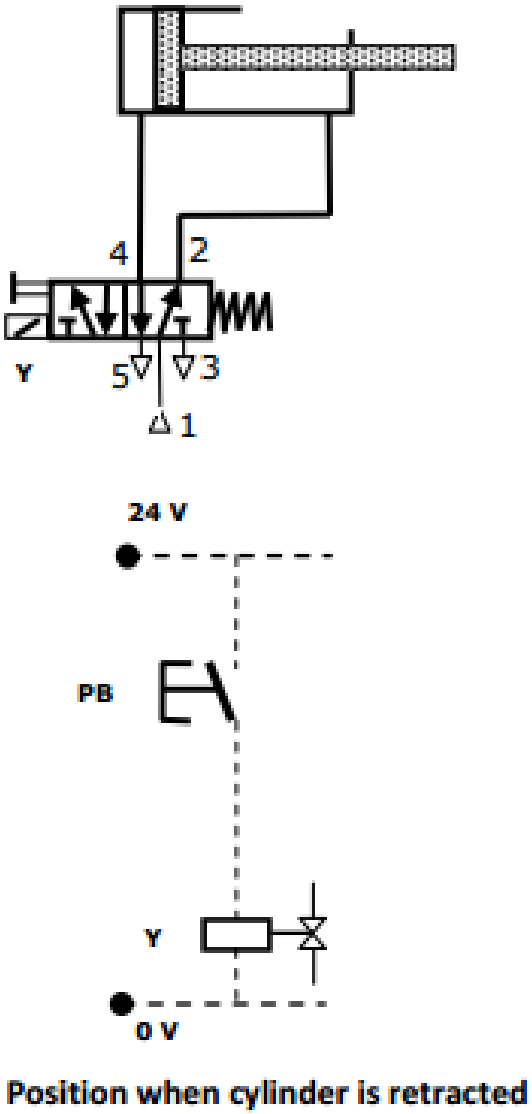


a) Position when cylinder is extended

Direct Control of Double Acting Cylinder (retracted):

Return stroke:

- On release of PB, circuit is interrupted.
- Magnetic field at coil Y collapses, the return spring of 5/2 becomes active and the 5/2 way valve switches back to its original position.
- The compressed air in the cylinder then exhausts through port 5 of the 5/2 DCV and the cylinder travel to the final rear position.

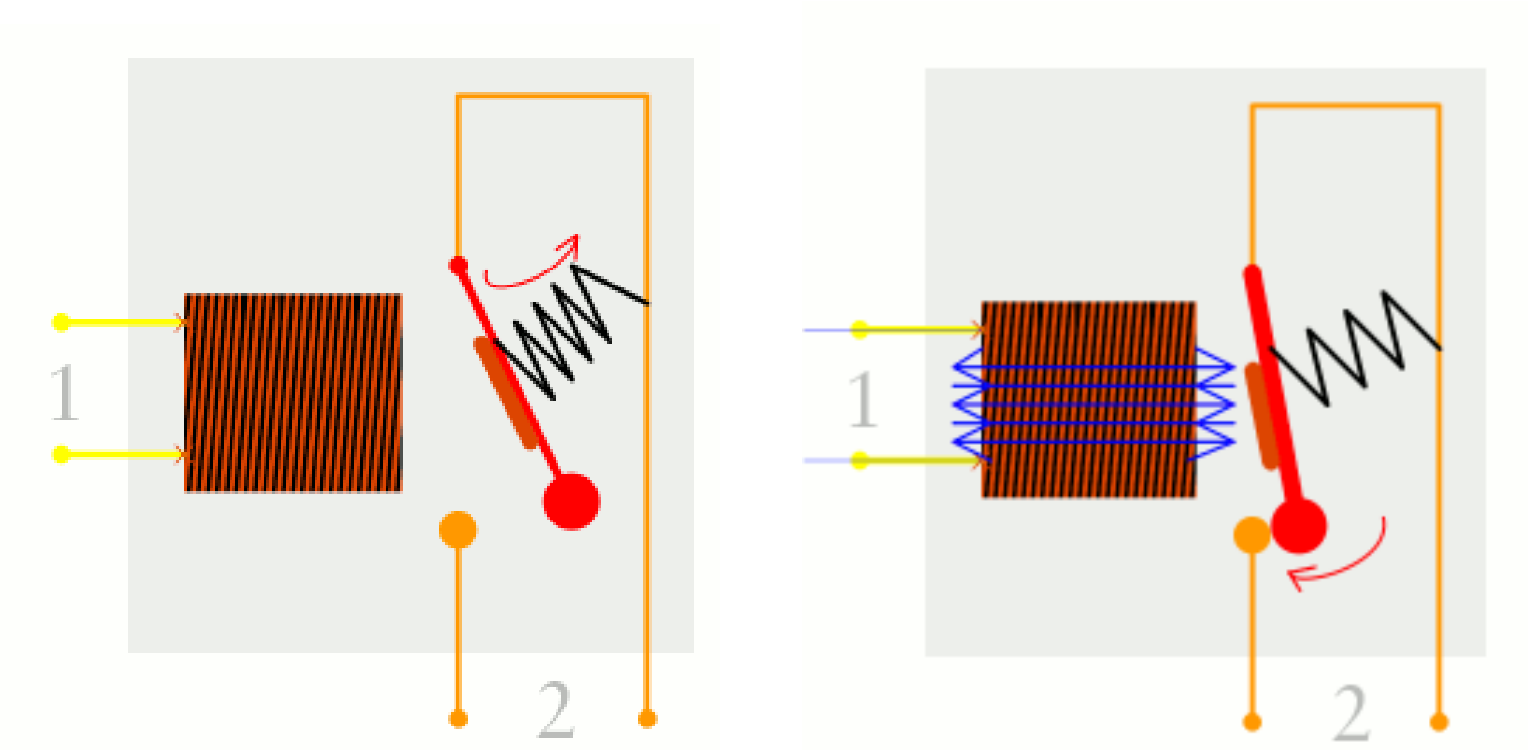


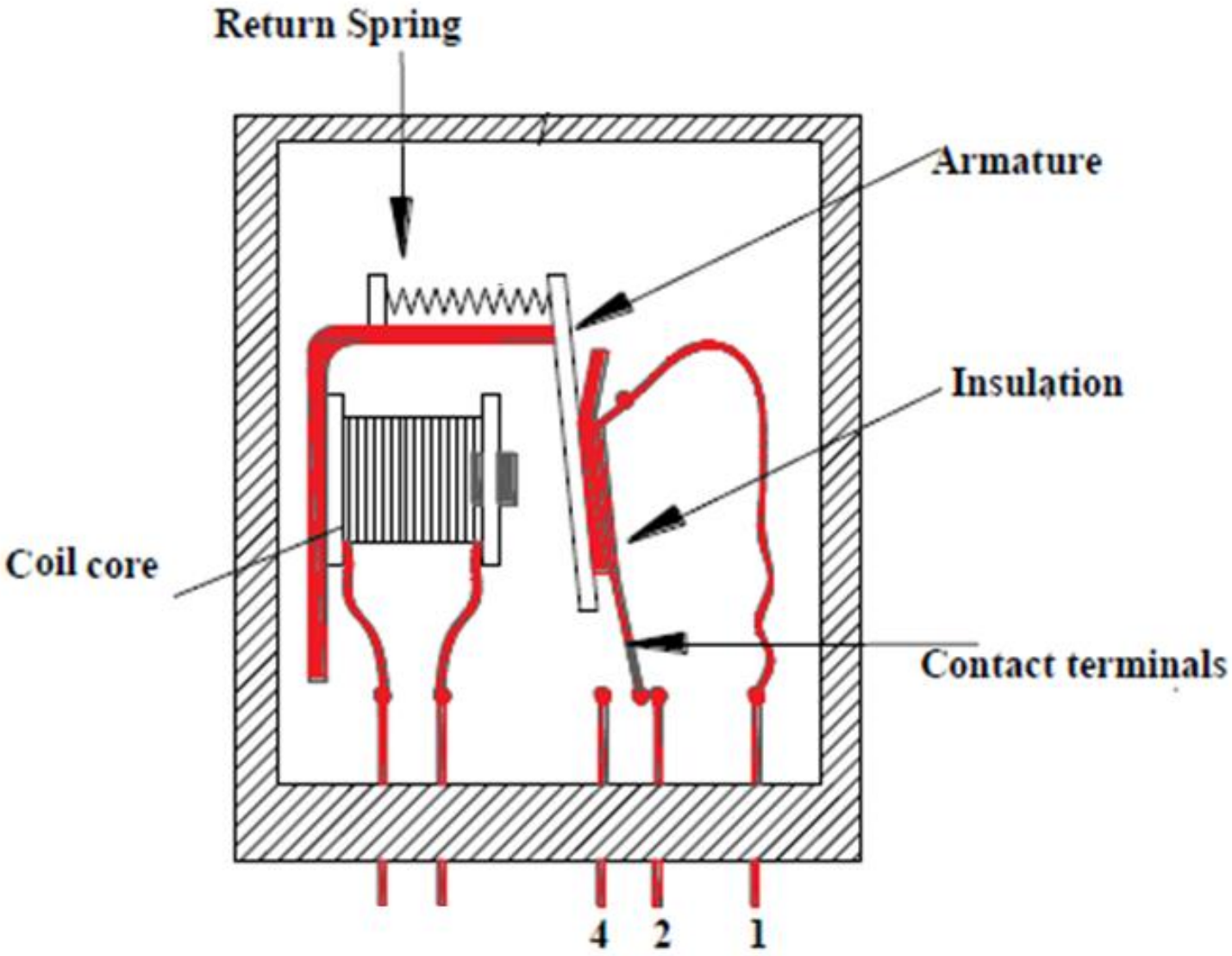
Position when cylinder is retracted

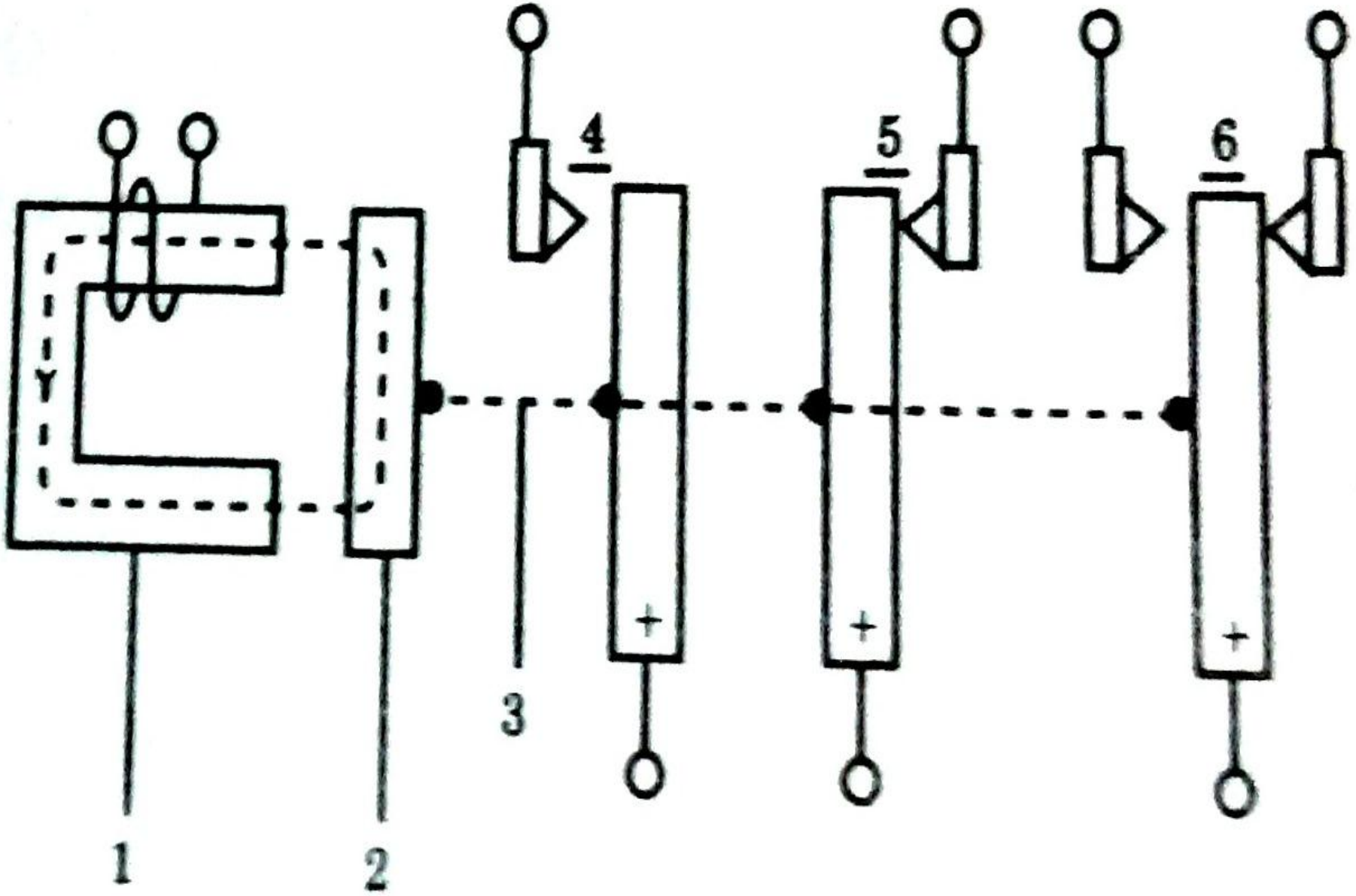
RELAY

- A relay is an electro magnetically actuated switch.
- It is a simple electrical device used for signal processing.
- Relays are designed to withstand heavy power surges and harsh environment conditions.

- When a voltage is applied to the solenoid coil, an electromagnet field results.
- This causes the armature to be attracted to the coil core.
- The armature actuates the relay contacts, either closing or opening them, depending on the design.
- A return spring returns the armature to its initial position when the current to the coil is interrupted.

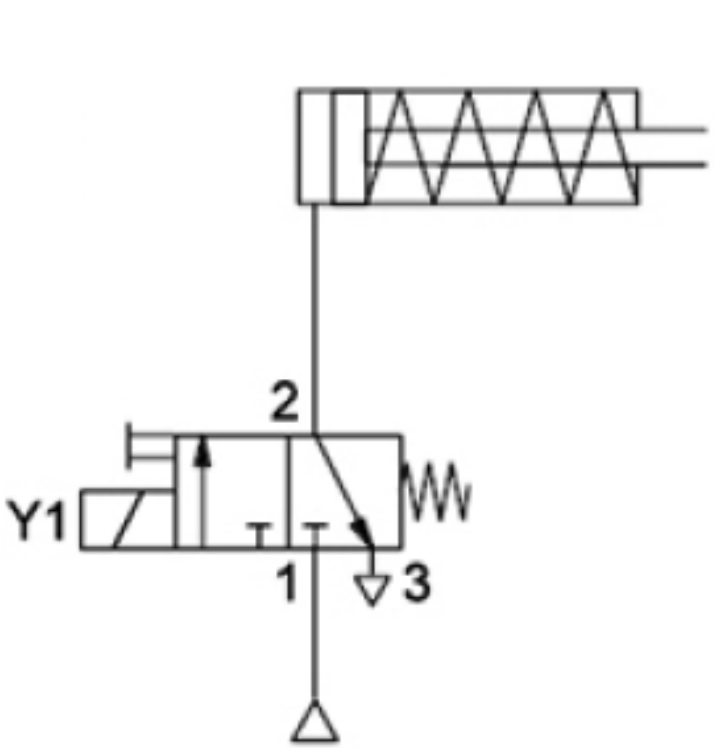



Return Spring
Armature
Insulation
Coil core
Contact terminals
4
2
1

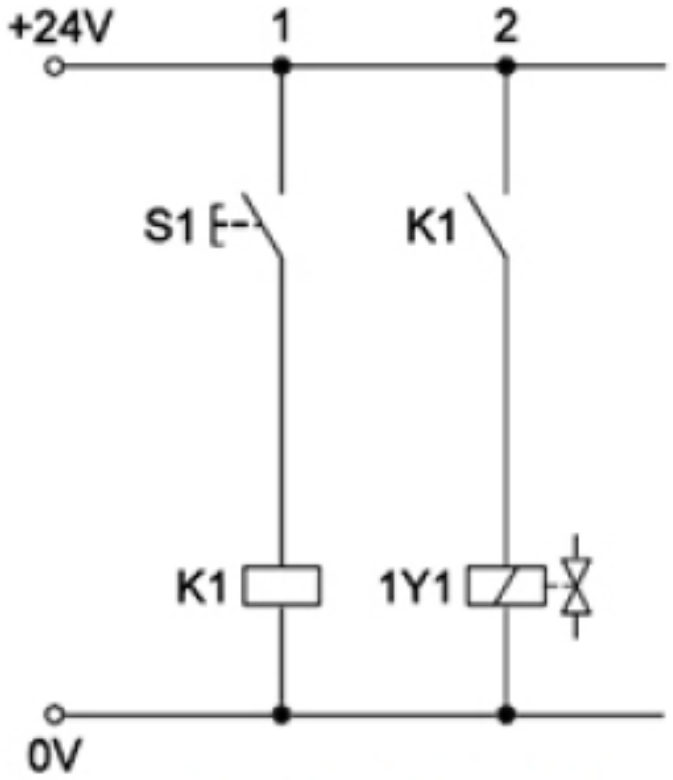

4
5
6
1
2
3
+
+
+

Indirect Control of Single Acting Cylinder

The electrical circuit diagram for indirect control of a single-acting cylinder is shown in Figure.



Pneumatic Circuit

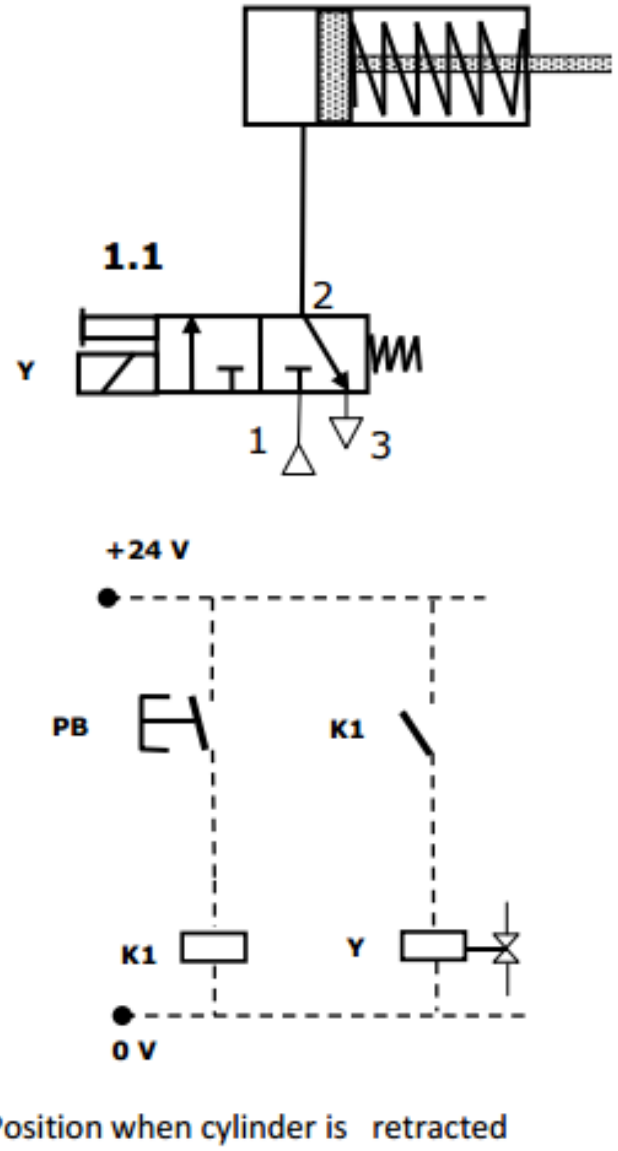


Electrical Circuit

Indirect Control of Single Acting Cylinder

Return stroke:

- On release of PB, circuit is interrupted.
- This de-energises a relay K1.
- The magnetic field at coil Y is collapses due to the opening of contact K1 the 3/2 way valve switches back to its original position.
- The compressed air in the cylinder ther exhausts through port 3 of the DCV and the cylinder travel to the final rea position.

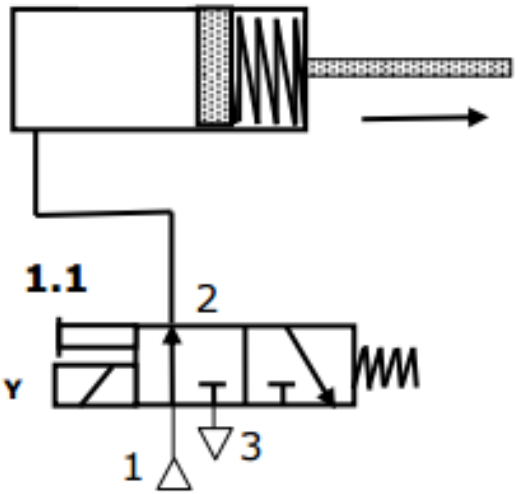


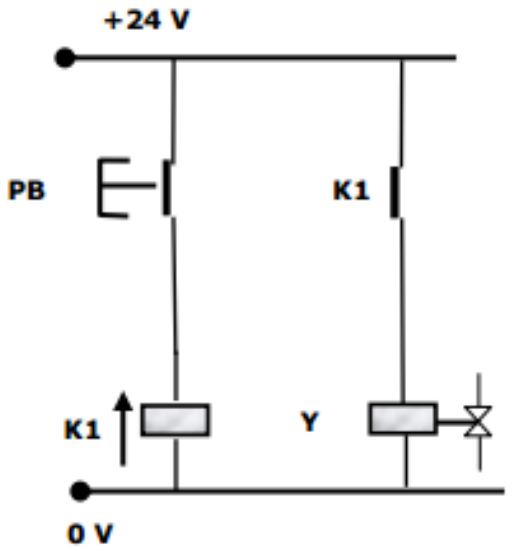
Position when cylinder is retracted

Indirect Control of Single Acting Cylinder

Forward stroke:

- The circuit is closed when push button PB closes.
- Closing of PB energises a relay K1.
- The coil Y is energised via normally open contact K1 (indirect energising).
- A magnetic field is produced in armature of the coil Y opens the passage for the compressed air.
- The compressed air flows from 1 to 2 of the 3/2 DCV to cylinder, which travels to the final forward position.

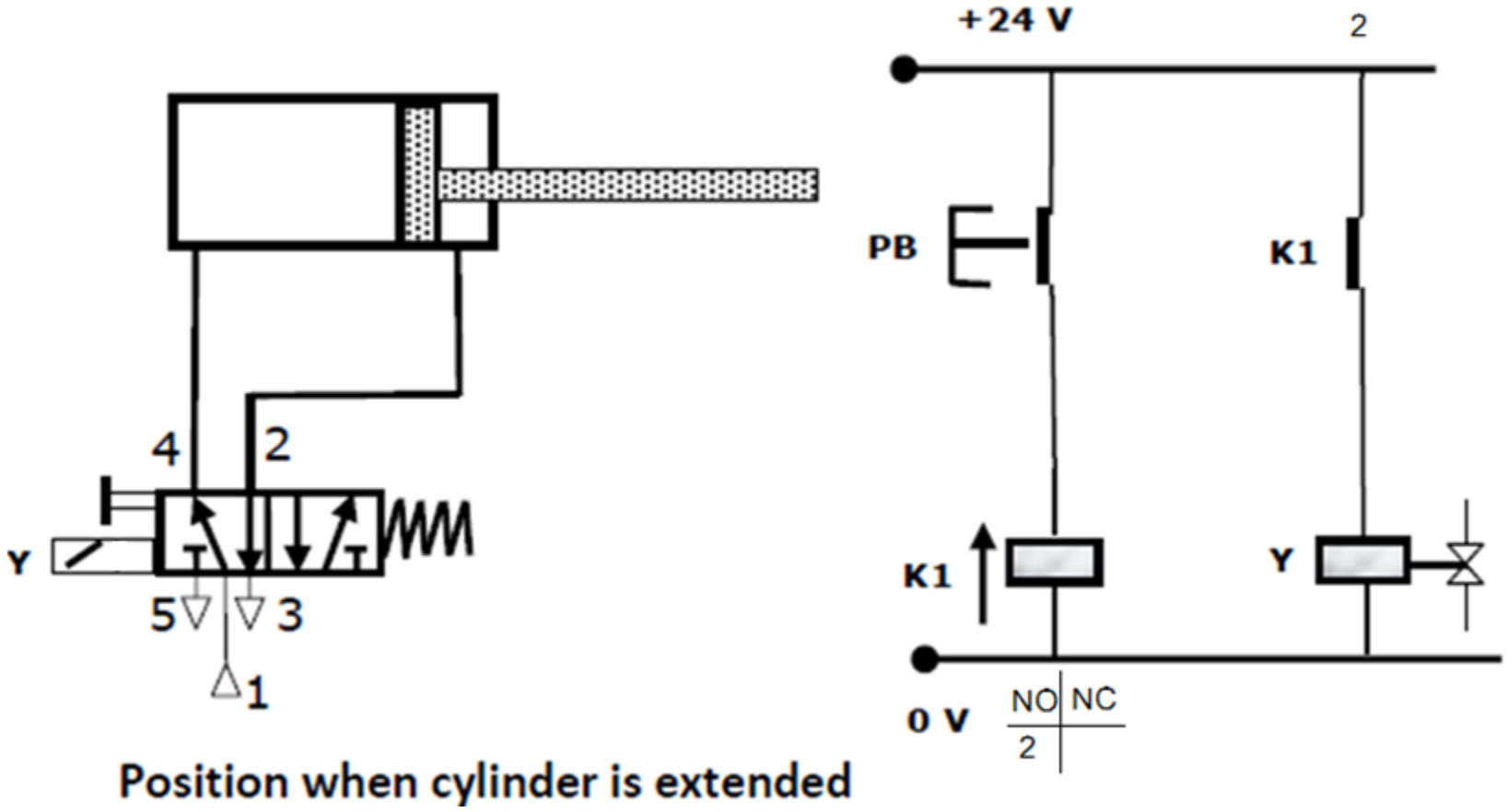




Position when cylinder is extended

In-direct Control of Double Acting Cylinder (extended):

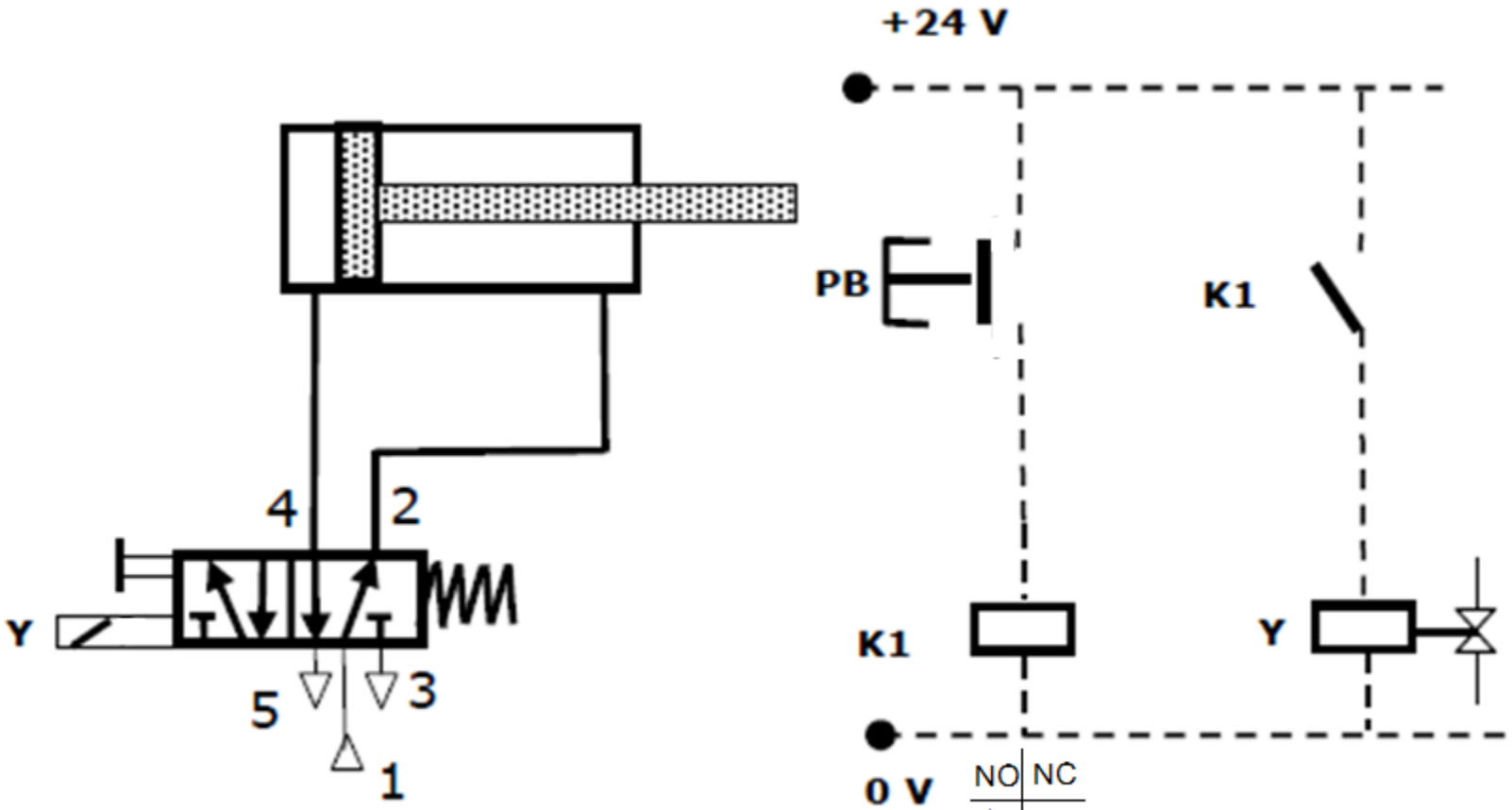
The electrical circuit diagram for in-direct control of a double-acting cylinder is shown in Figure.



Position when cylinder is extended

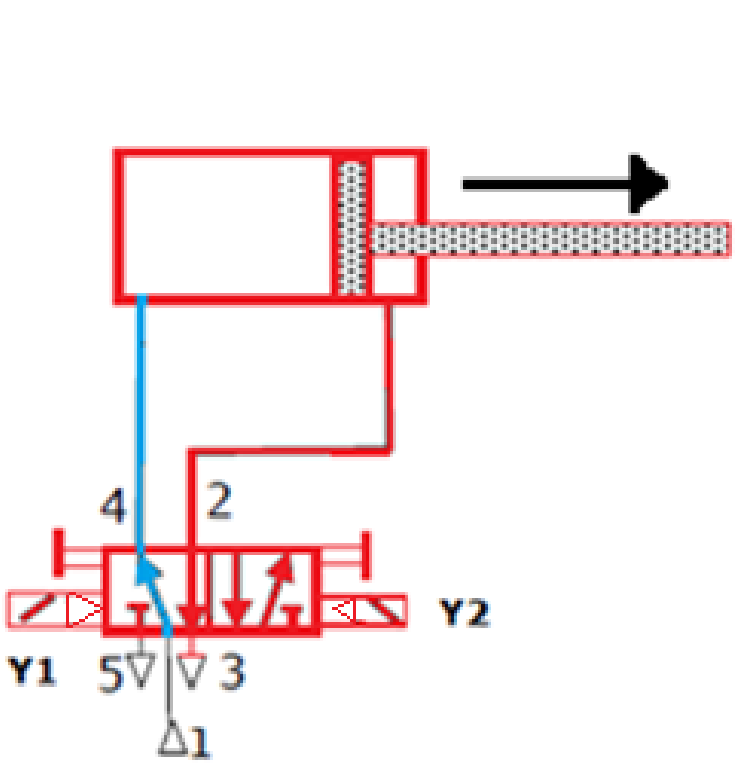
In-direct Control of Double Acting Cylinder: (retracted)

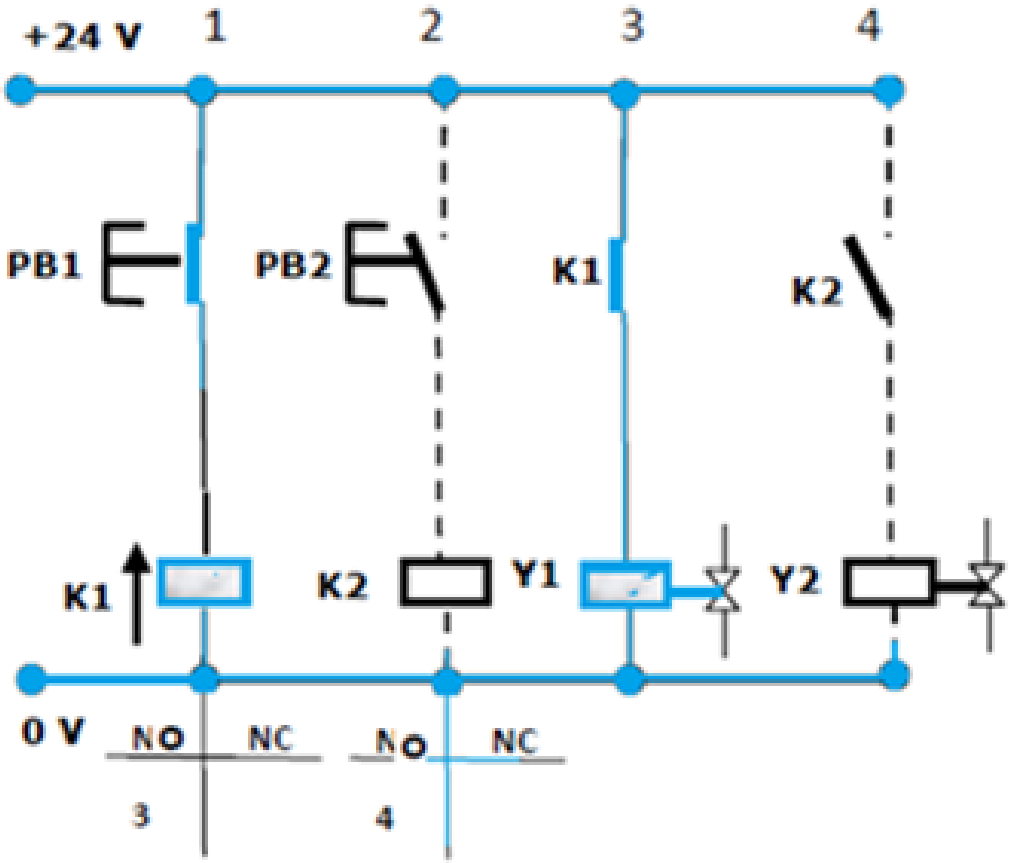
The electrical circuit diagram for in-direct control of a double-acting cylinder is shown in Figure.



Position when cylinder is retracted

Indirect Control of double acting cylinder (using 5/2 way, double solenoid)

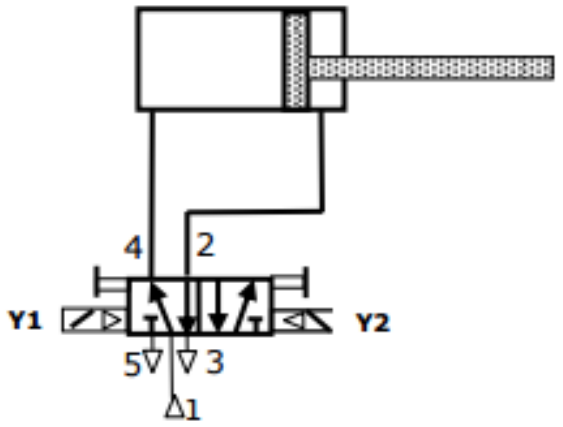


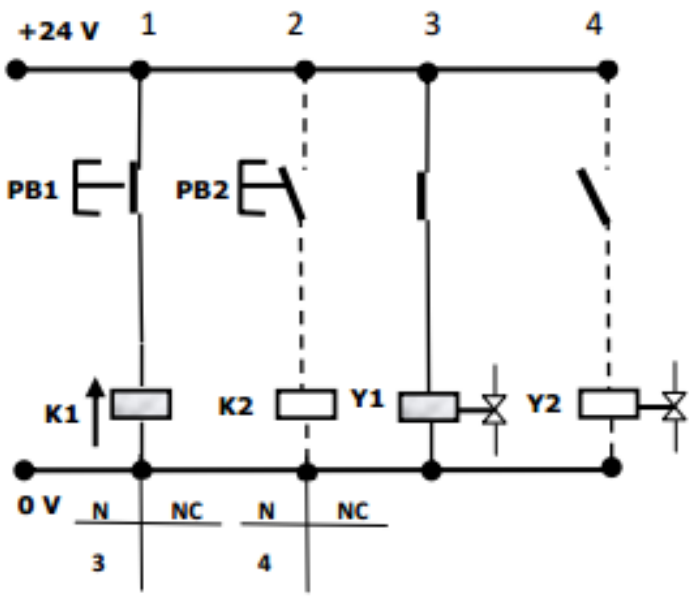


Indirect Control of double acting cylinder (using 5/2 way, double solenoid)

Forward stroke:

- When PB1 is pressed, coil Y1 is energised and 5/2 way DCV changes over.
- Piston travels out and remains in the final forward position until a signal is applied to coil Y2.
- The 5/2 DCV will remain in the last position because it is double solenoid valve and has no return spring.



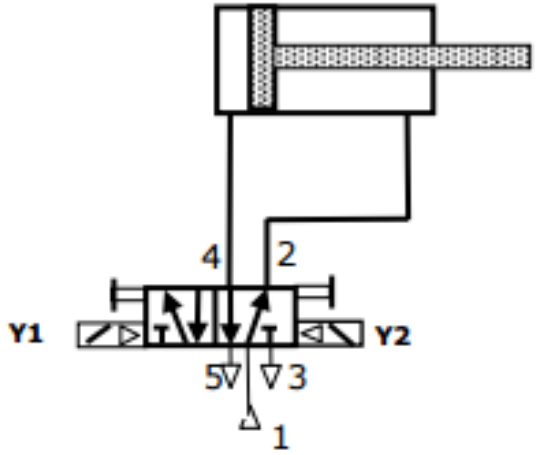


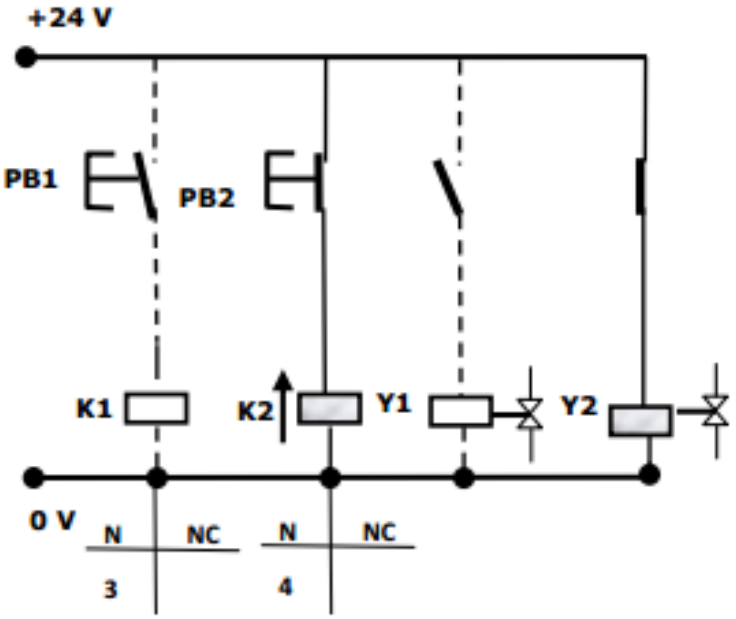
a) Position when cylinder is extended

Indirect Control of DAC (using double solenoid)

Return stroke:

- When the push button PB1 is released and PB2 is pressed.
- Opening of Push button PB1 de-energises a relay K1.
- Magnetic field at coil Y1 is collapses due to opening of contact K1.
- Closing of PB2 energises Y2 and the piston returns to its original position as a result of changeover of the 5/2 way valve.



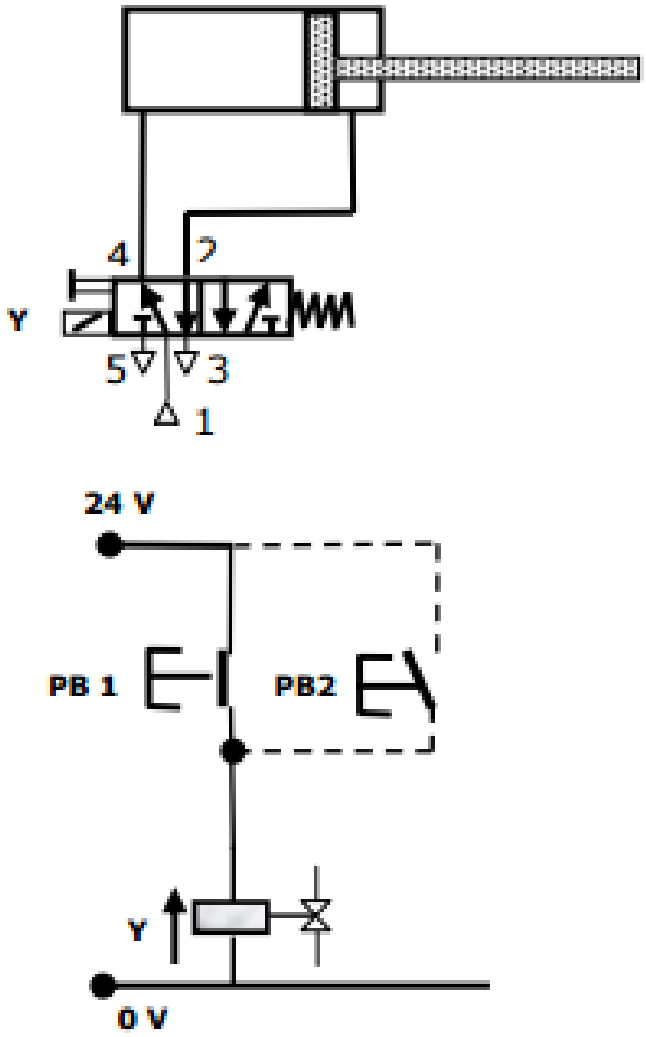


b) Position when cylinder is

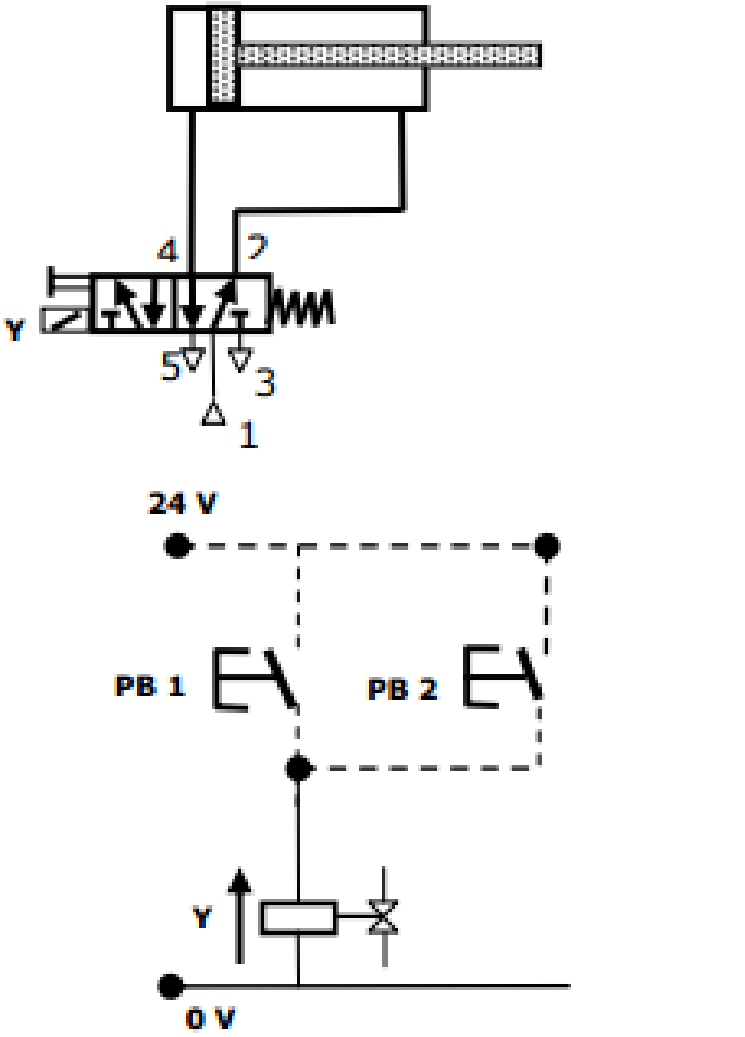
Control of double acting cylinder OR logic (Parallel circuit)

- The piston of a DAC is to travel out when either one of two pushbutton switch is pressed.
- It is to return when both are released.
- When PB1 or PB2 are pressed coil Y1 is energised.
- The DCV switches over and the piston travels to the final forward position.
- When both the PB switches are released, the signal is removed from Y1 and the cylinder travels back to its original position.

Control of double acting cylinder OR logic (Parallel circuit)



a) Cylinder is extended using PB1

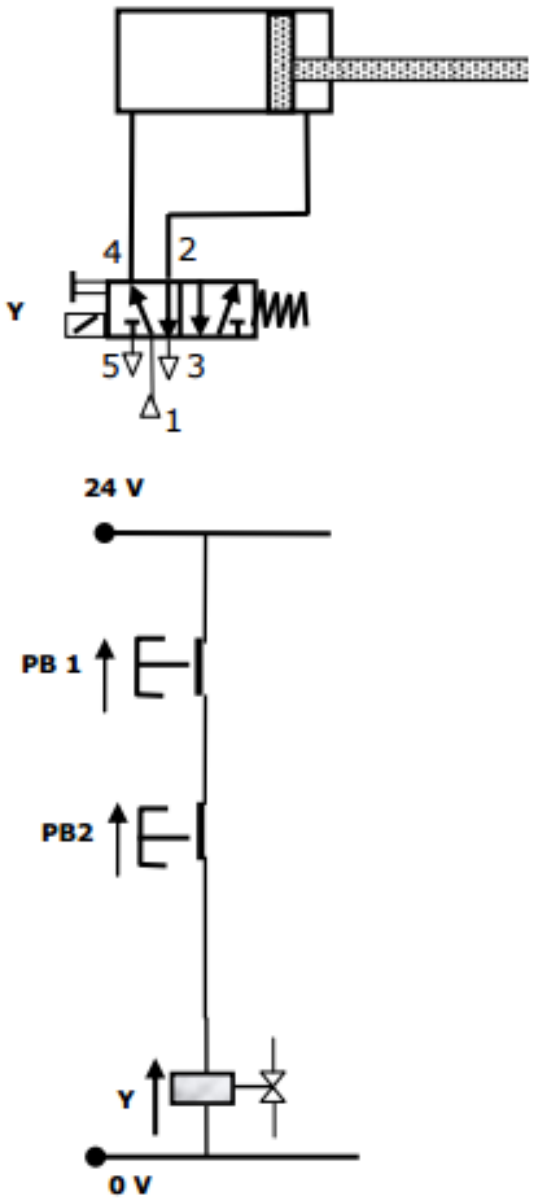


b) Cylinder is retracted (both PB released)

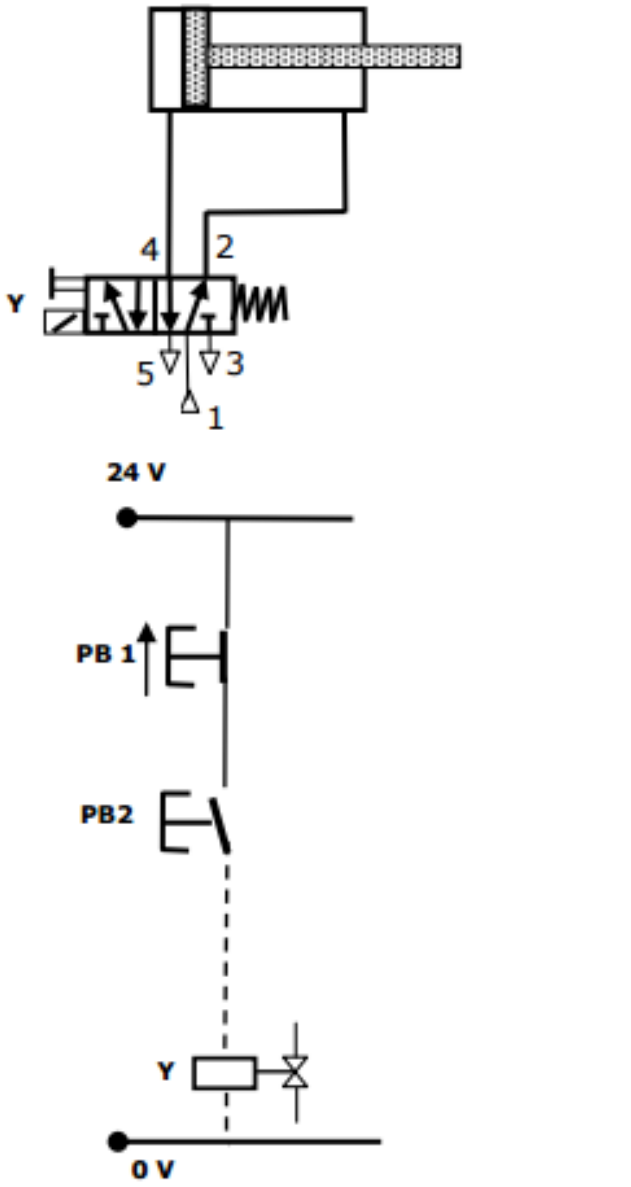
Control of double acting cylinder AND logic (Series circuit)

- The piston of a DAC is to travel out when both push button switch is pressed.
- If only one PB is pressed, there is no movement.
- When PB1 or PB2 are pressed coil Y1 is energised.
- The DCV switches over and the piston travels to the final forward position.
- When one of the PB switches are released, the signal is removed from Y1 and the cylinder travels back to its original position.

Control of double acting cylinder AND logic (Series circuit)

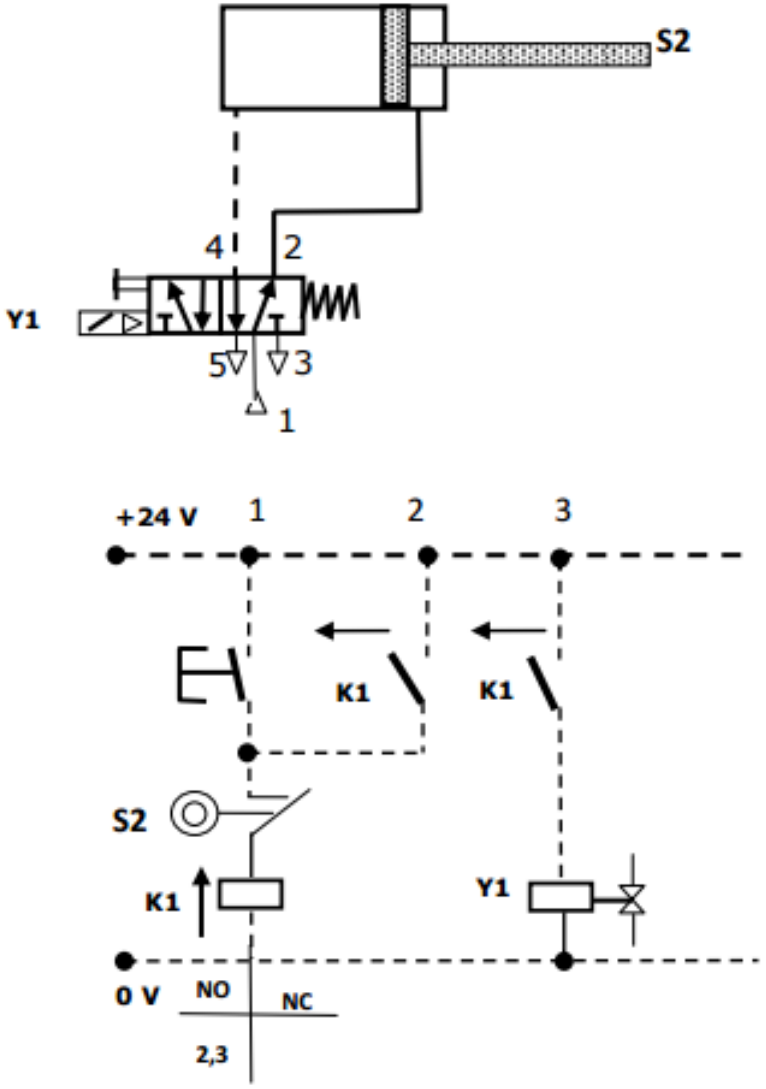


a) Cylinder is extended using PB1



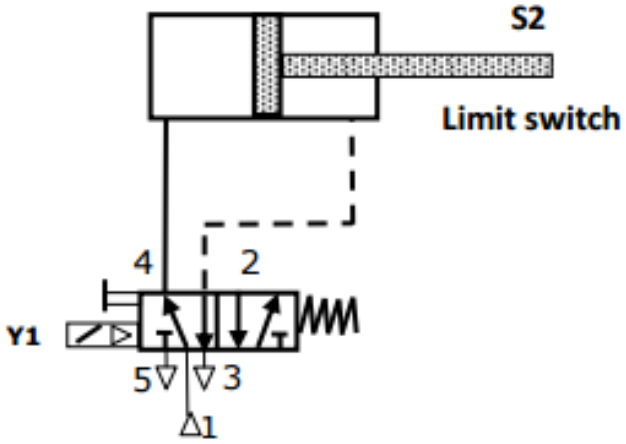
b) Cylinder is retracted (both PB released)

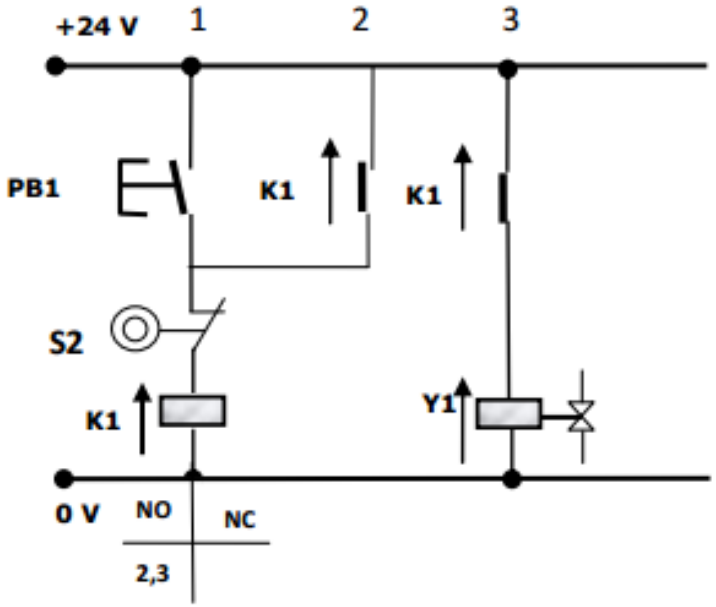
Automatic control of DAC (spring return)



b) Position when S2 just pressed

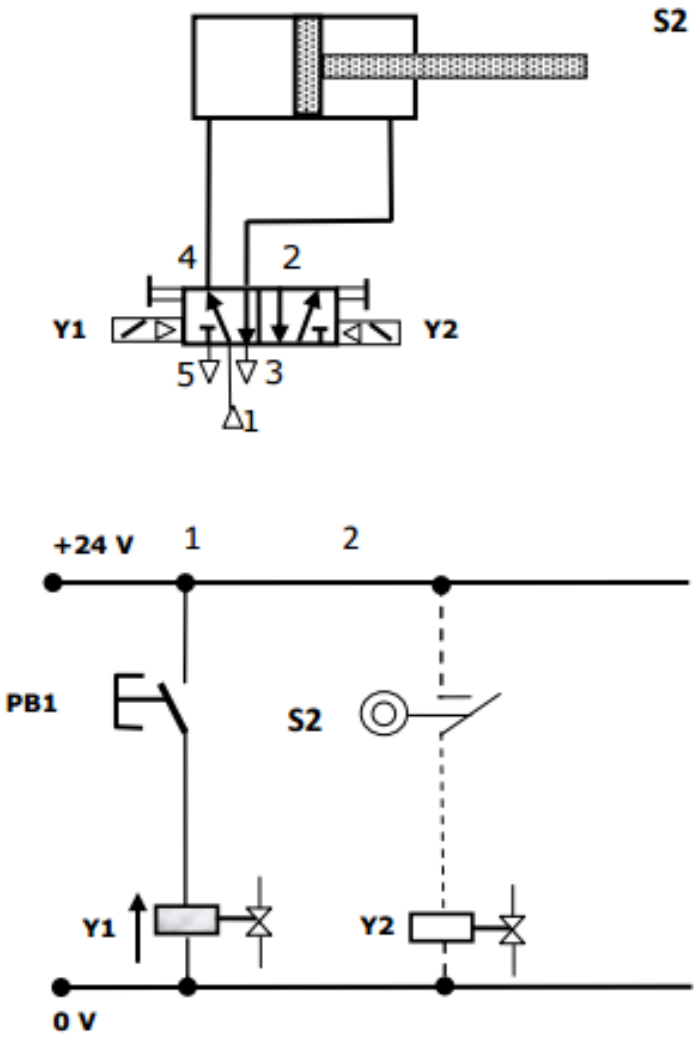
Automatic control of DAC (spring return)





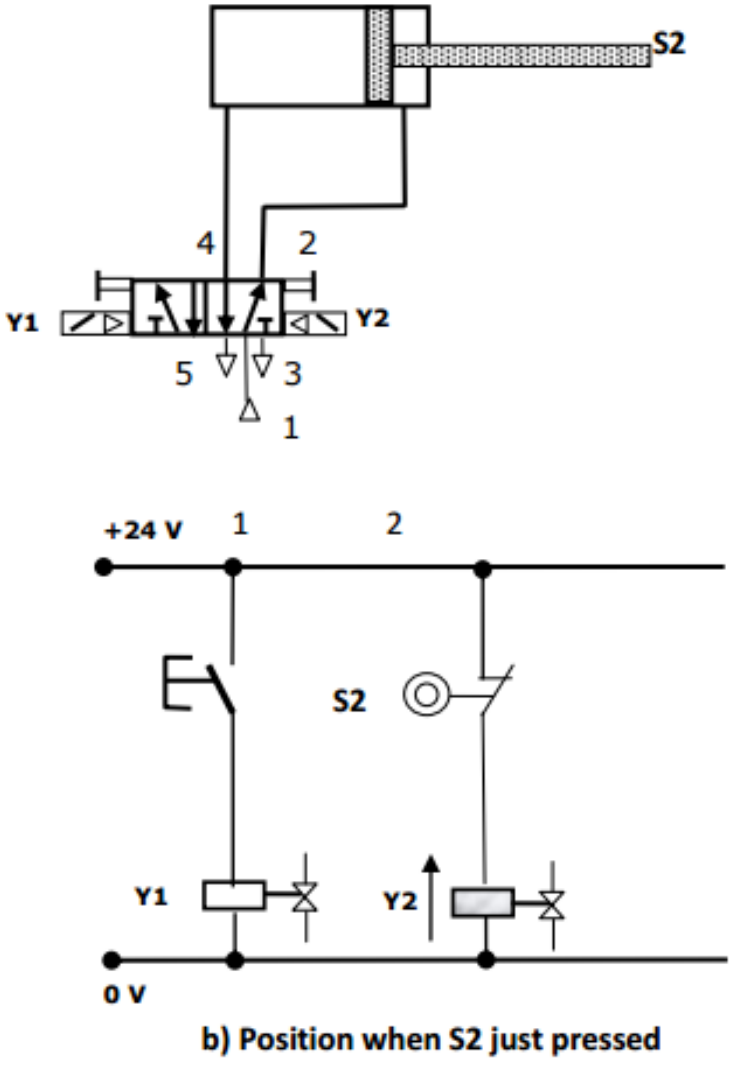
a) Cylinder while extending

Direct control of automatic control of DAC (double solenoid)



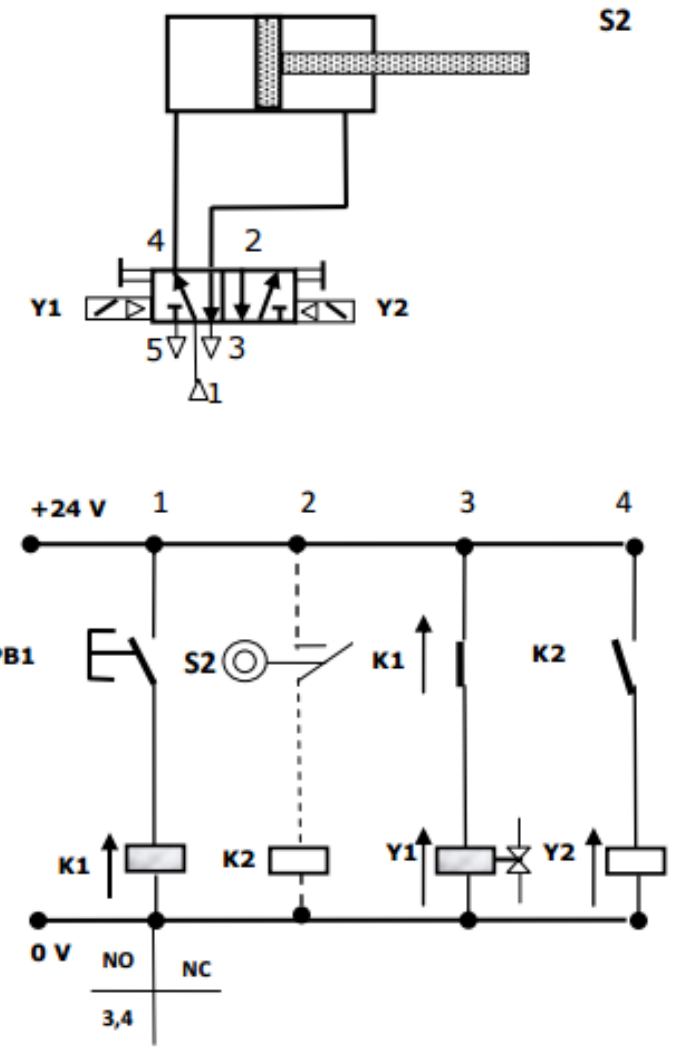
a) Cylinder while extending

Direct control of automatic control of DAC (double solenoid)



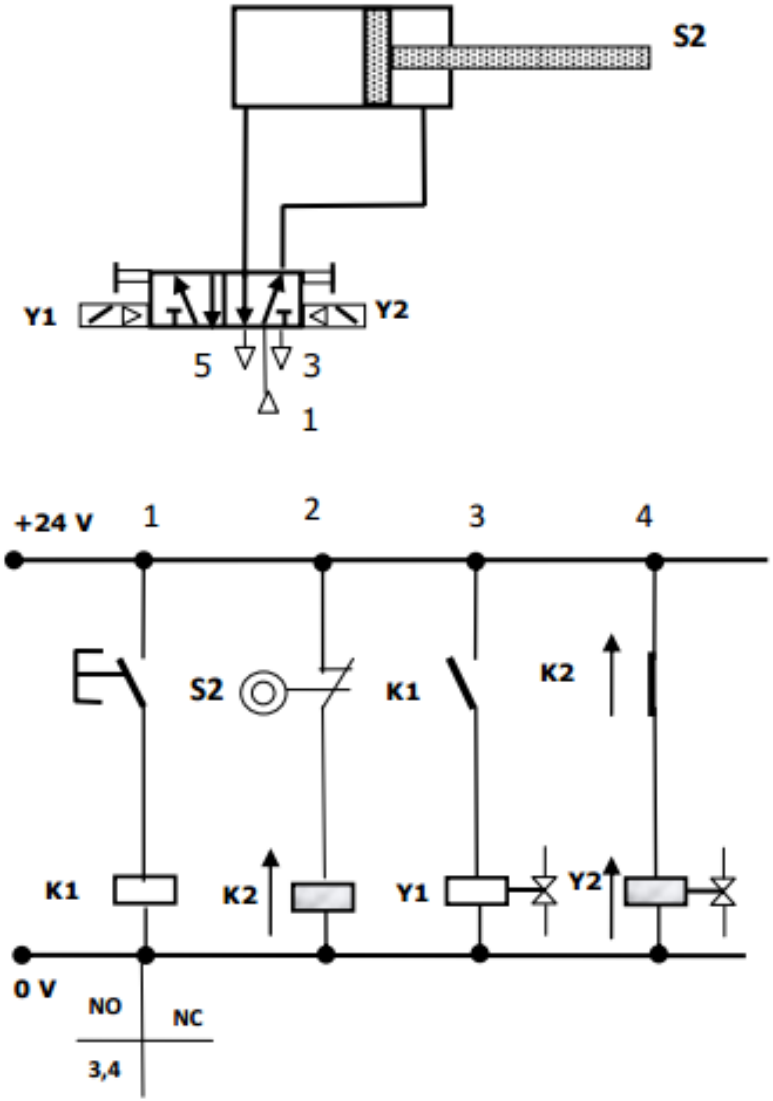
b) Position when S2 just pressed

Indirect control of automatic control of DAC (double solenoid)



a) Cylinder while extending

Indirect control of automatic control of DAC (double solenoid)



b) Position when S2 just pressed


YUASA
NP4-12 12V,4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V,4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V,4Ah
valve regulated
sealed lead-acid type
rechargeable battery
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V,4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V,4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V,4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
YUASA CORPORATION


YUASA
NP4-12 12V,4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION
NO
POWER

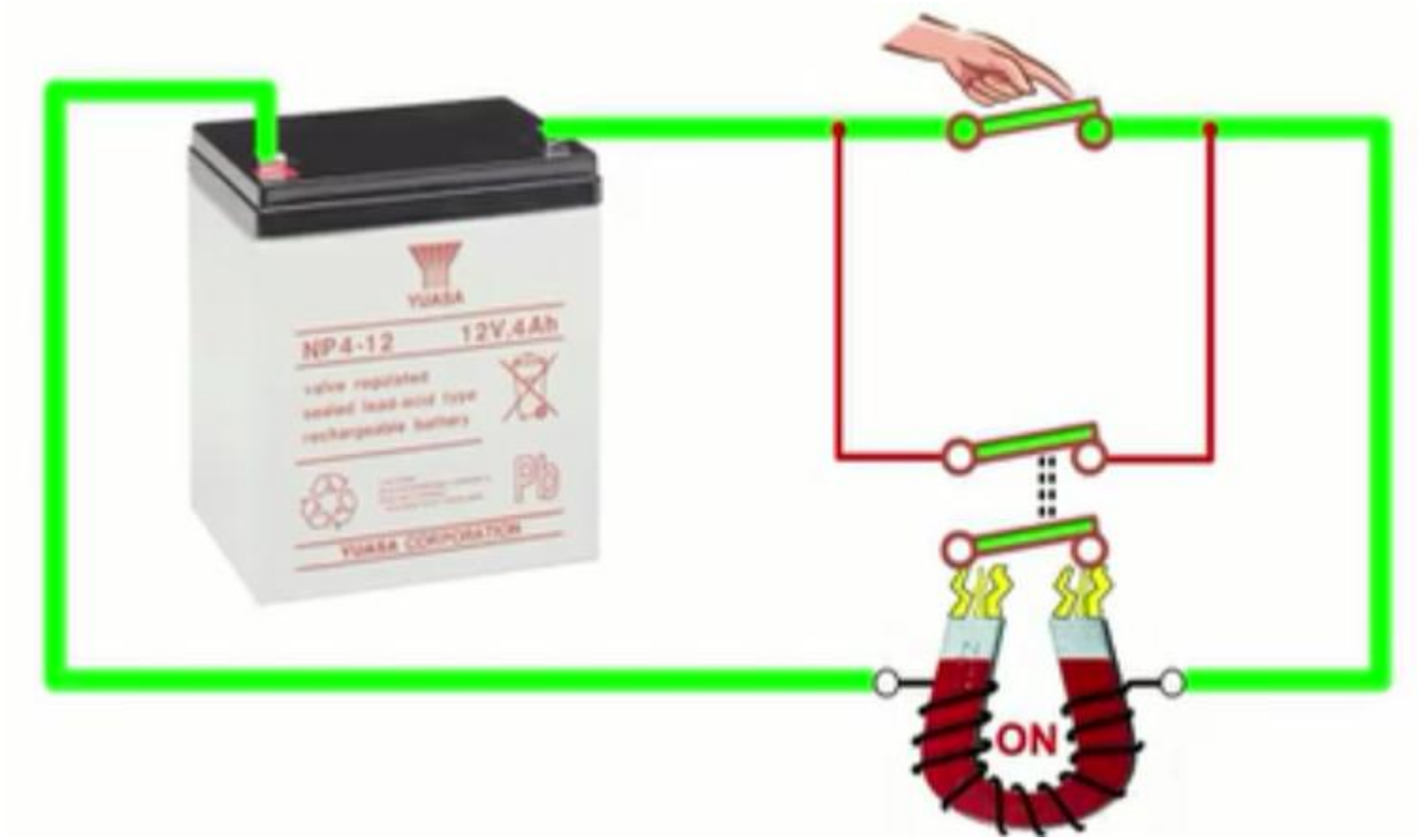

YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION
ON


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION
N
NO
POWER


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION
NO
POWER


YUASA
NP4-12 12V,4Ah
valve regulated
sealed lead-acid type
rechargeable battery
YUASA CORPORATION


YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
YUASA CORPORATION
ON

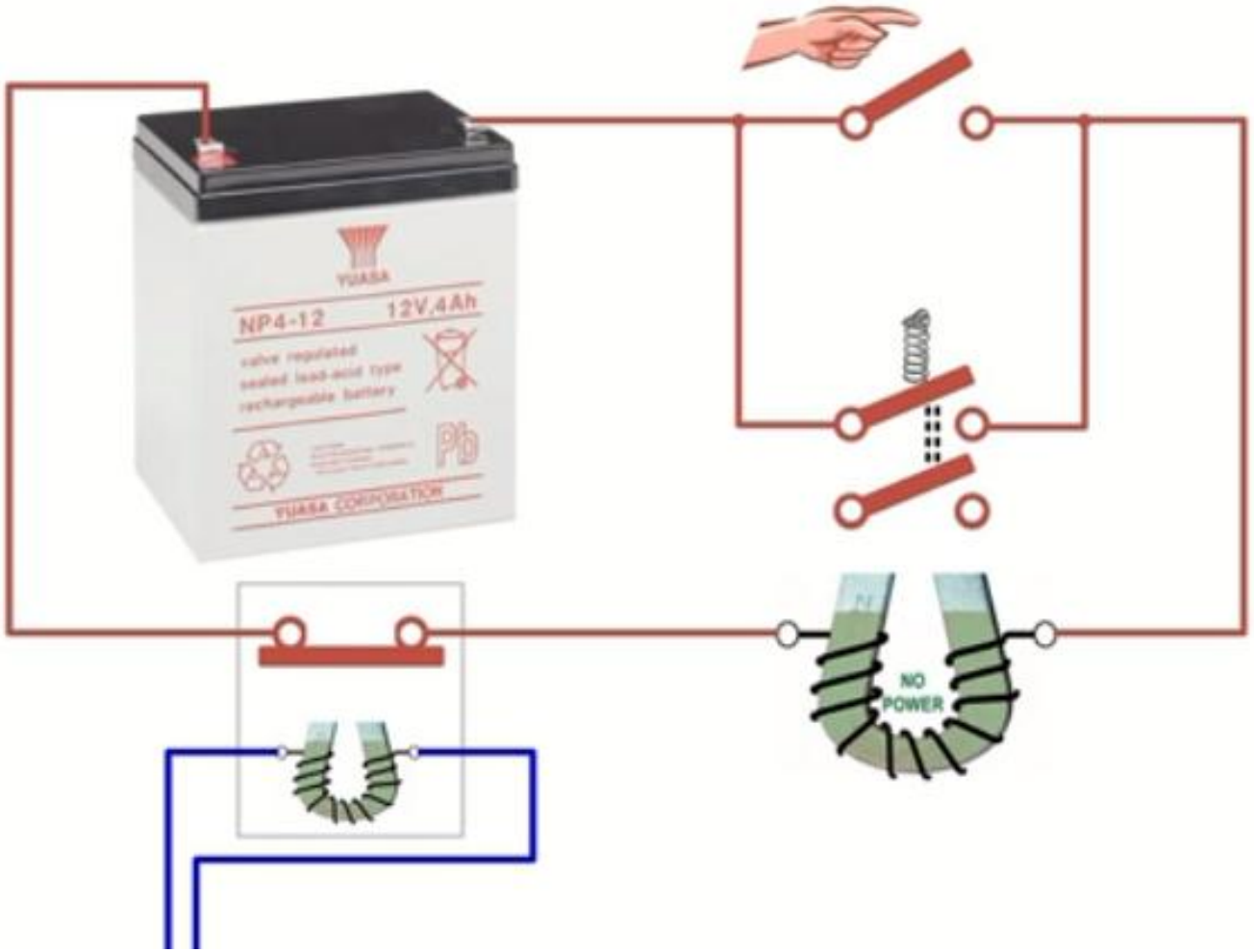
The switch on the relay has now bypasses the push switch.

This is called as latching relay

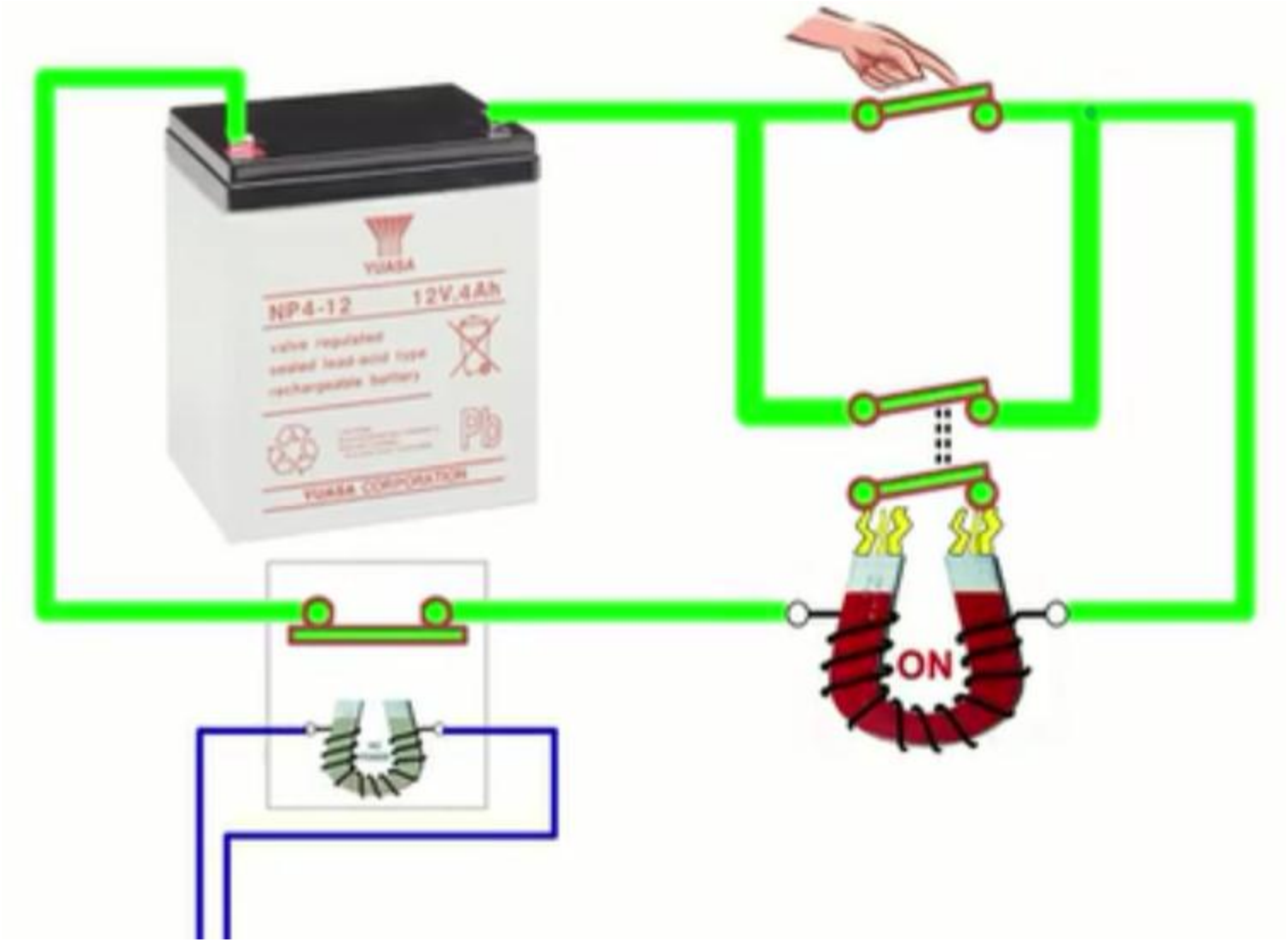

YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
YUASA CORPORATION
ON

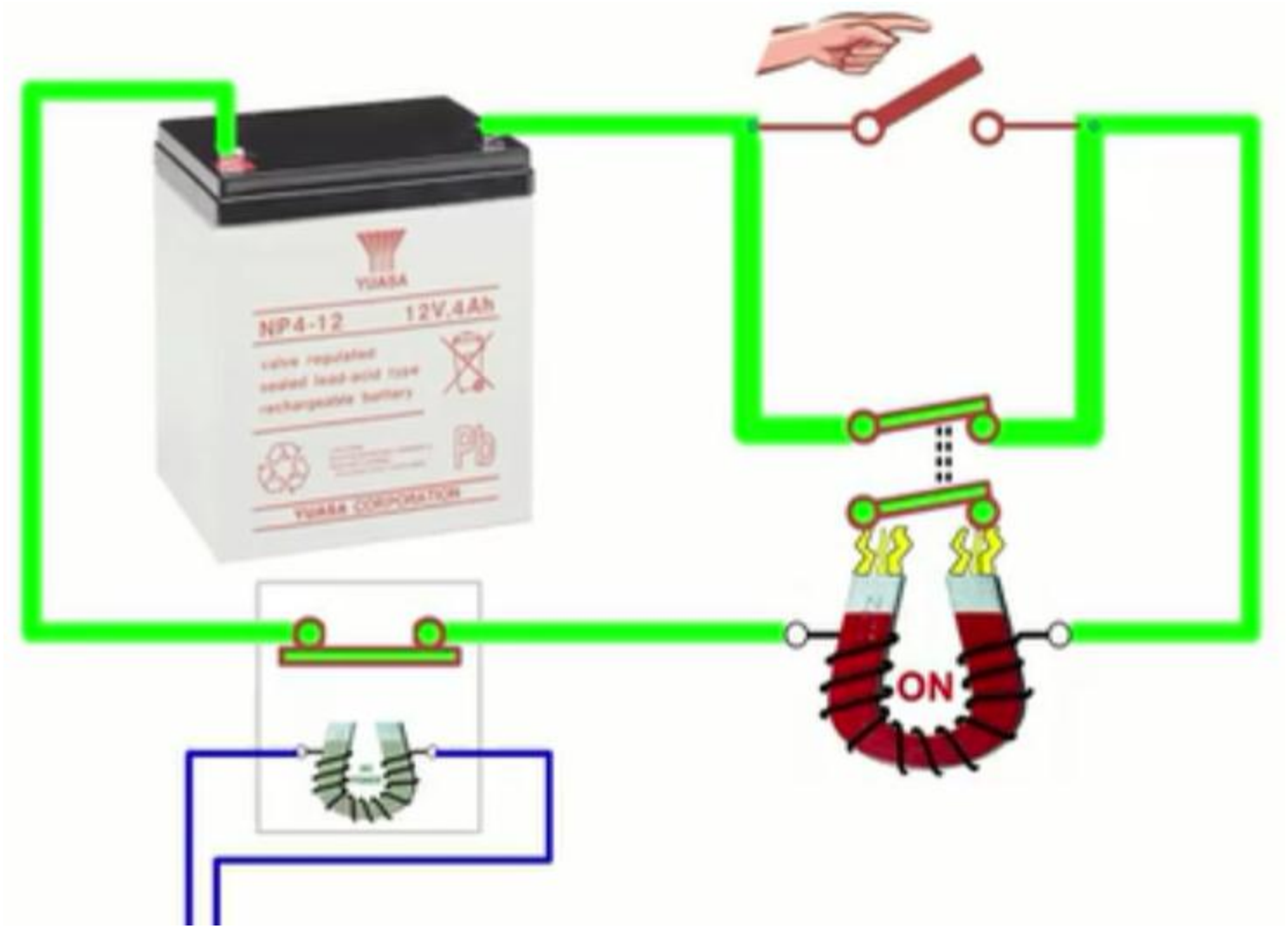

YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION
ON

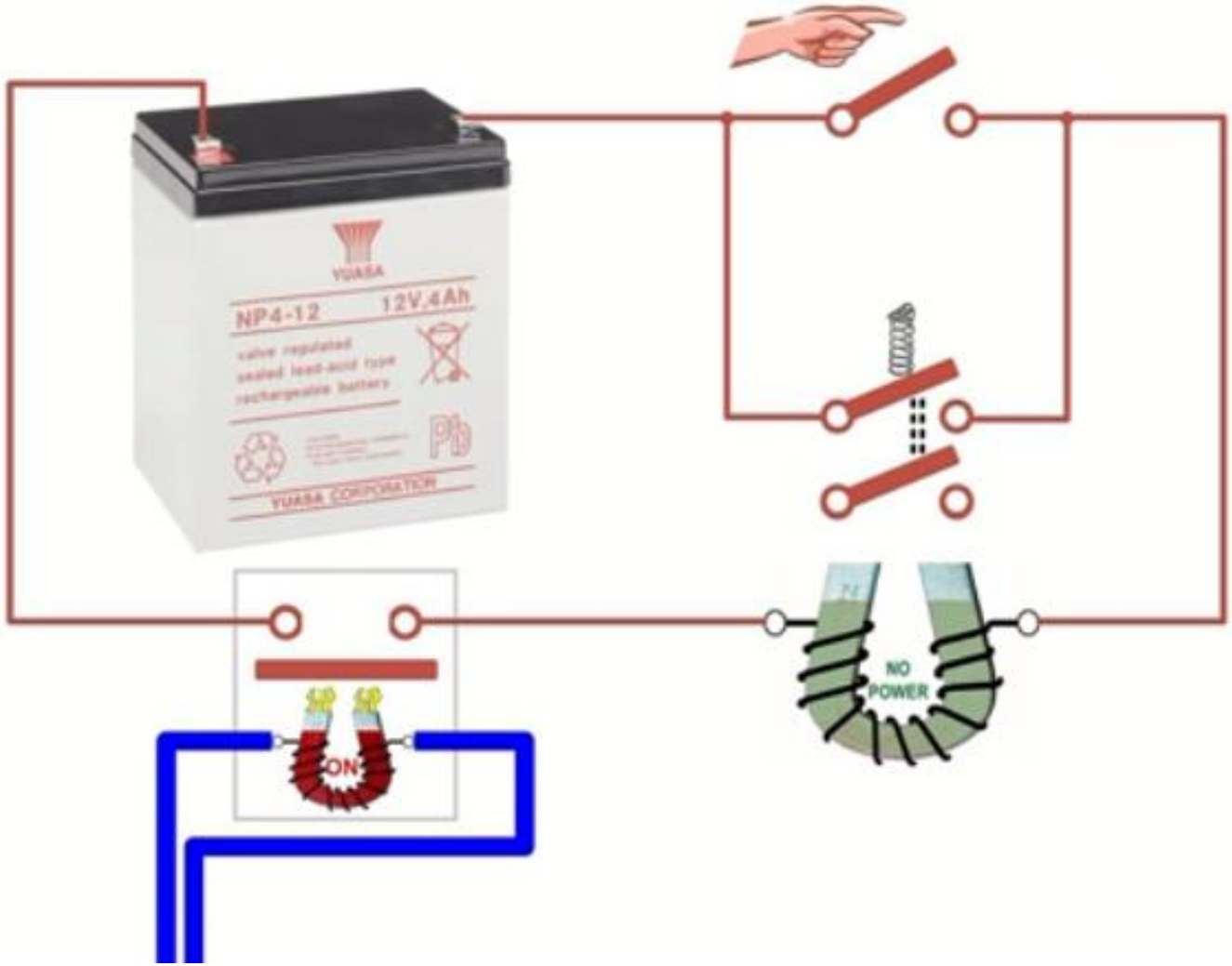

YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION
NO
POWER



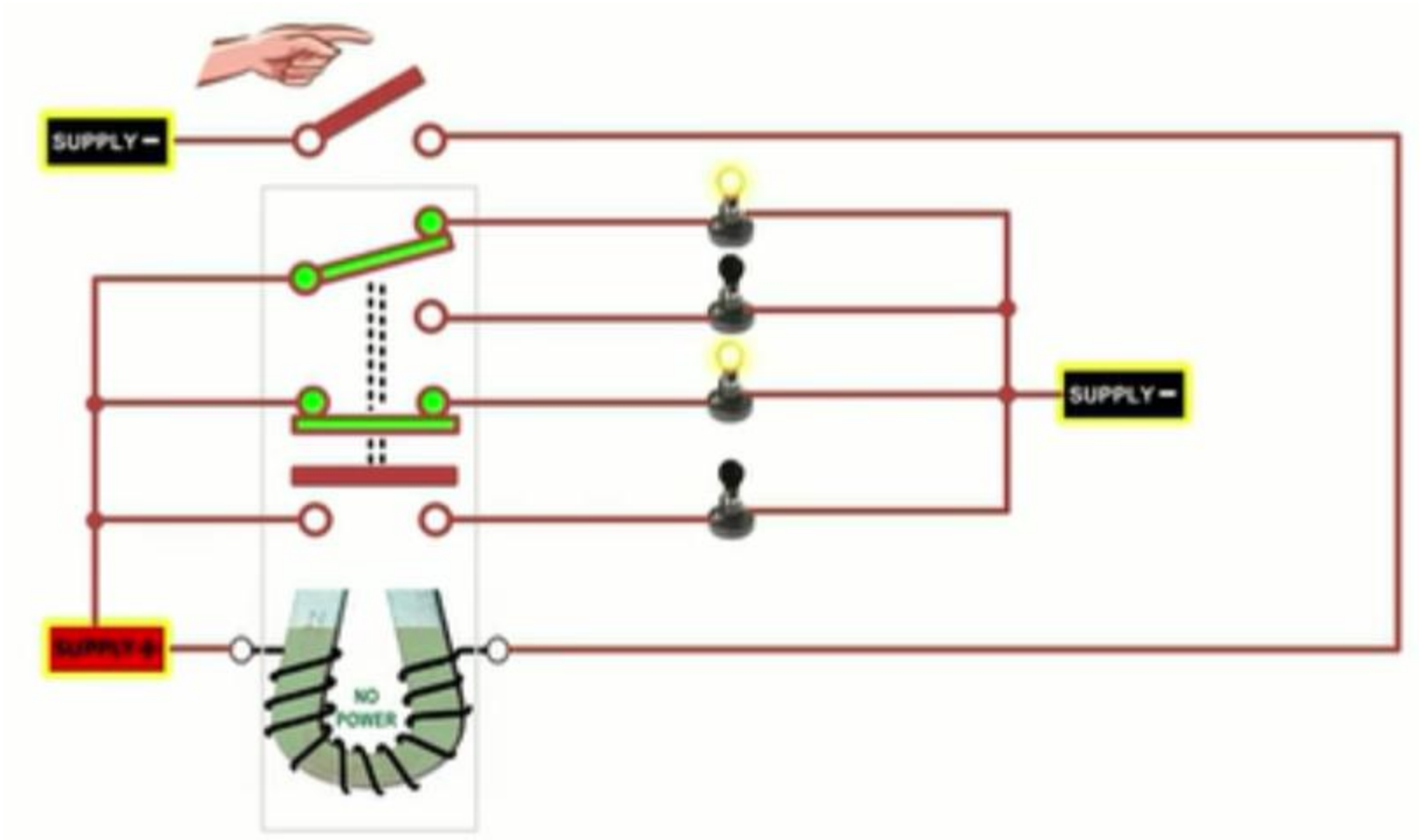
A separate relay circuit to unlatch the earlier relay

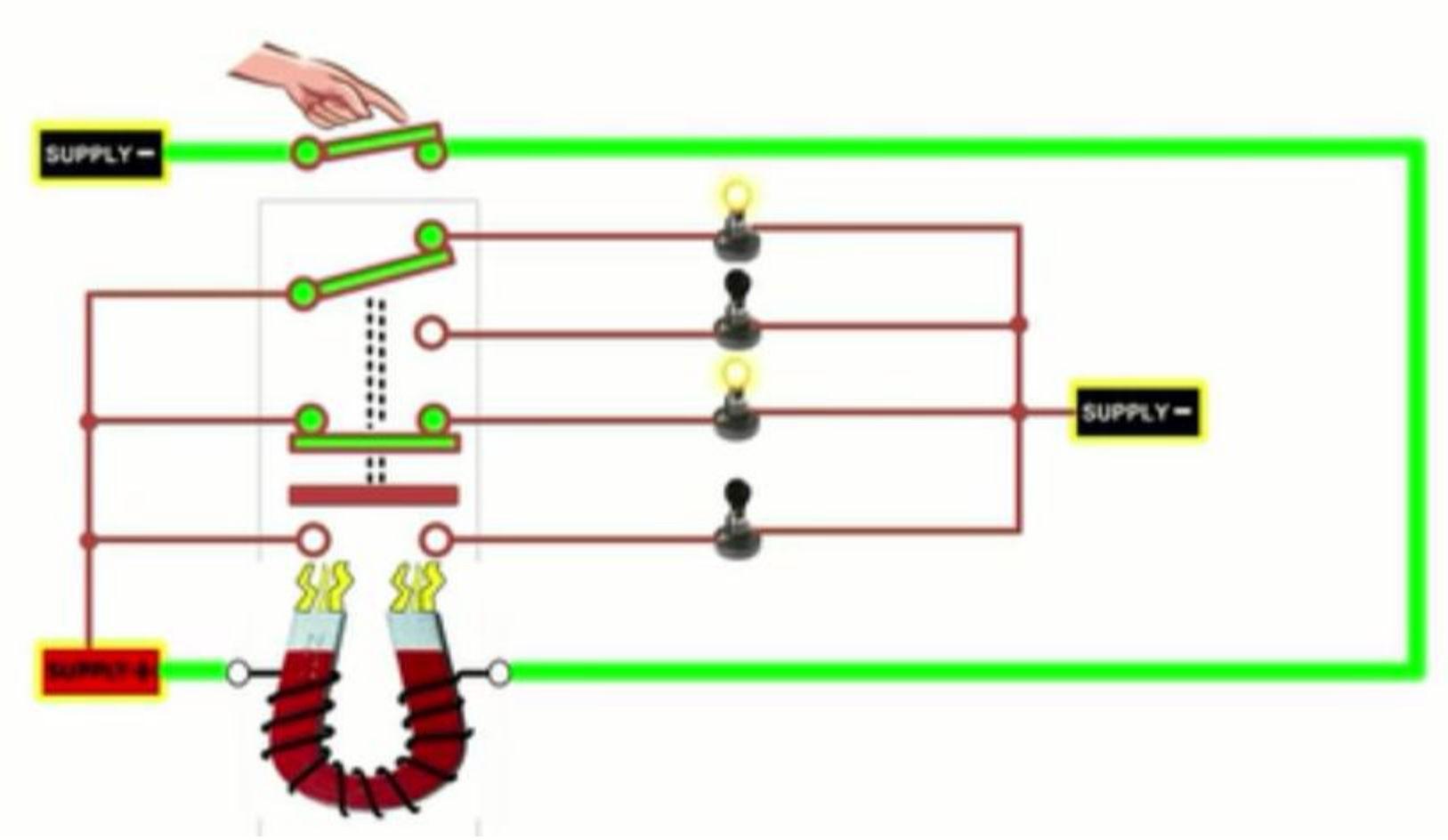

YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION
ON

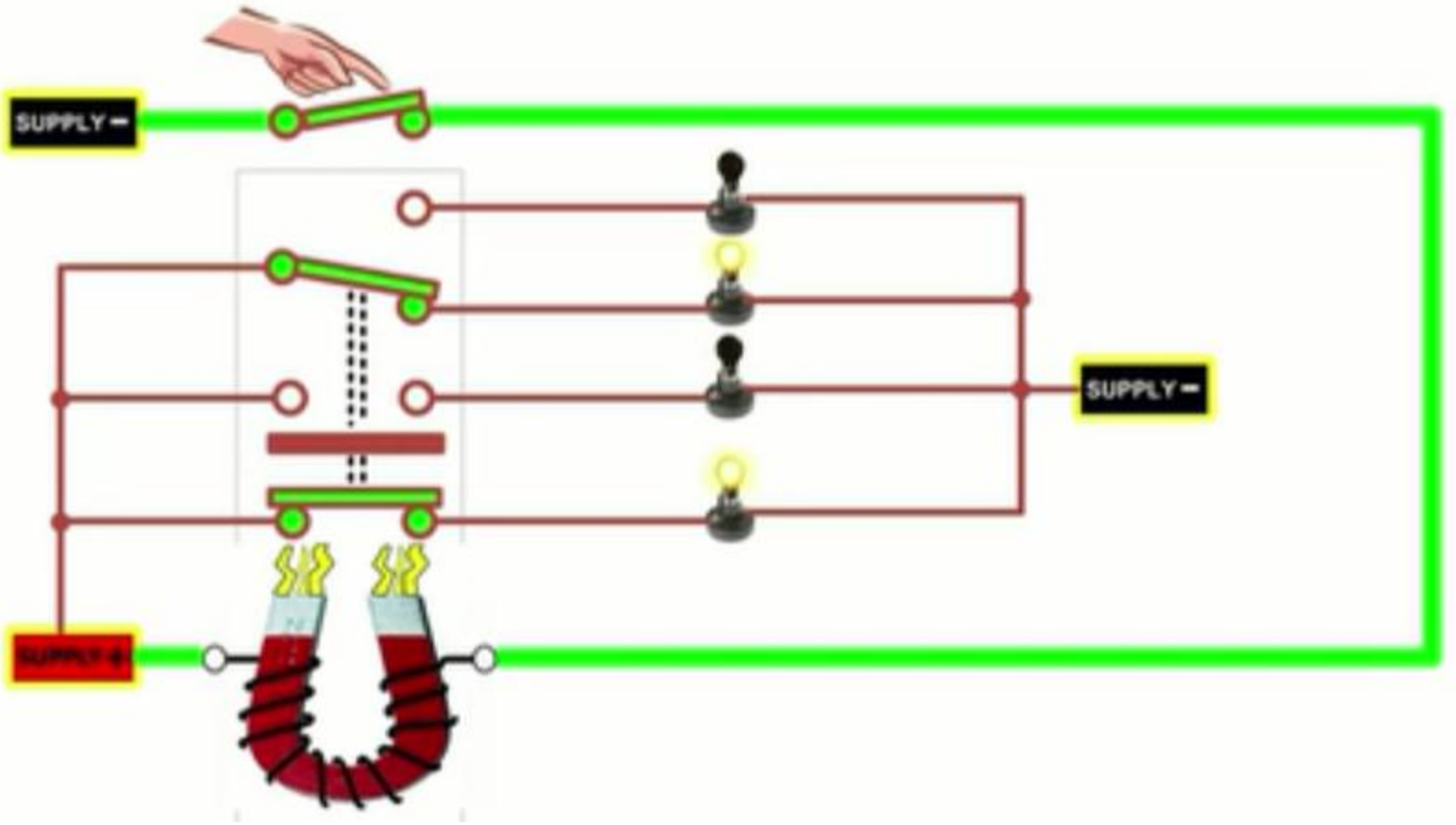

YUASA
NP4-12 12V.4Ah
valve regulated
sealed lead-acid type
rechargeable battery
Pb
YUASA CORPORATION
ON

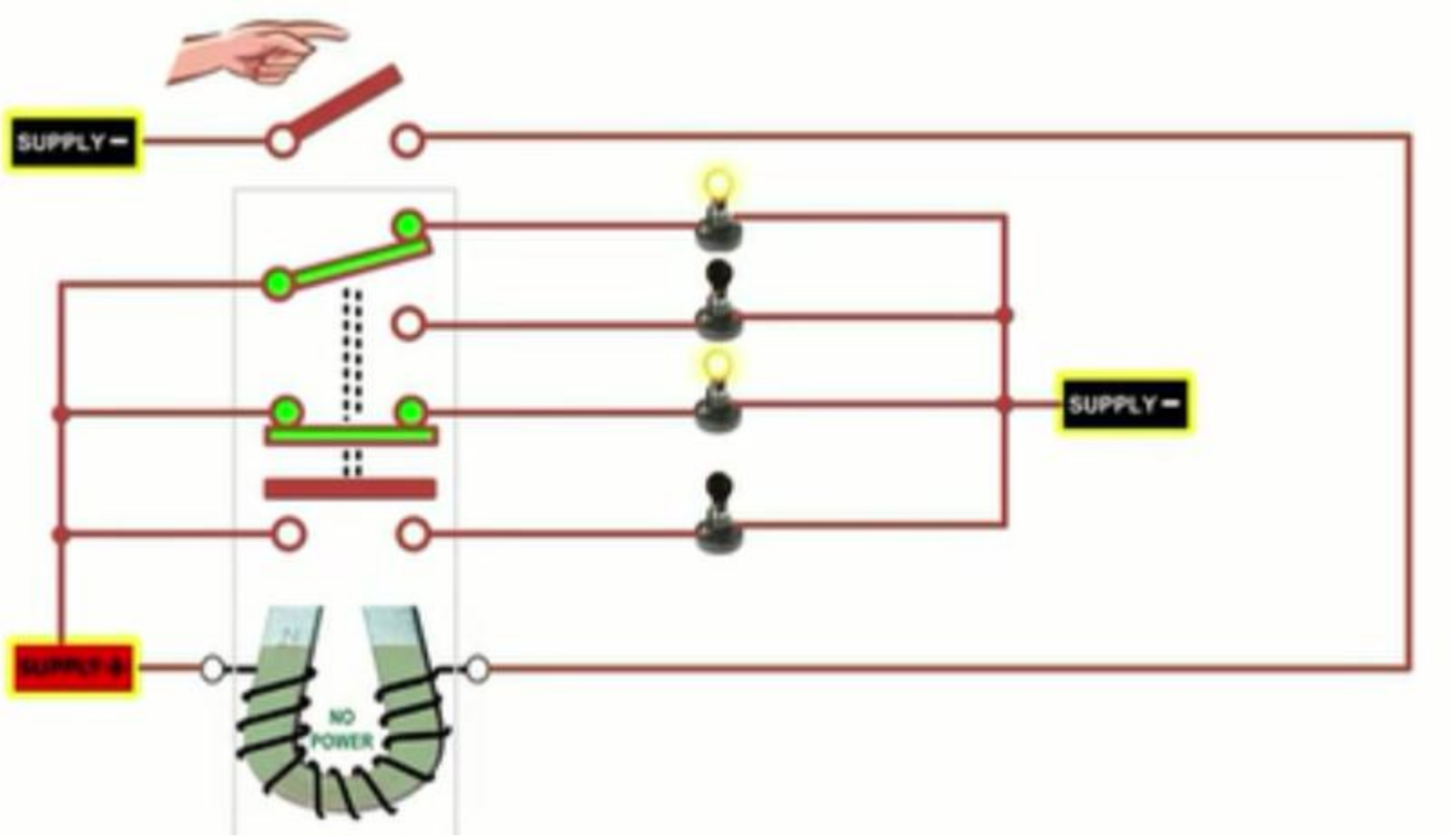


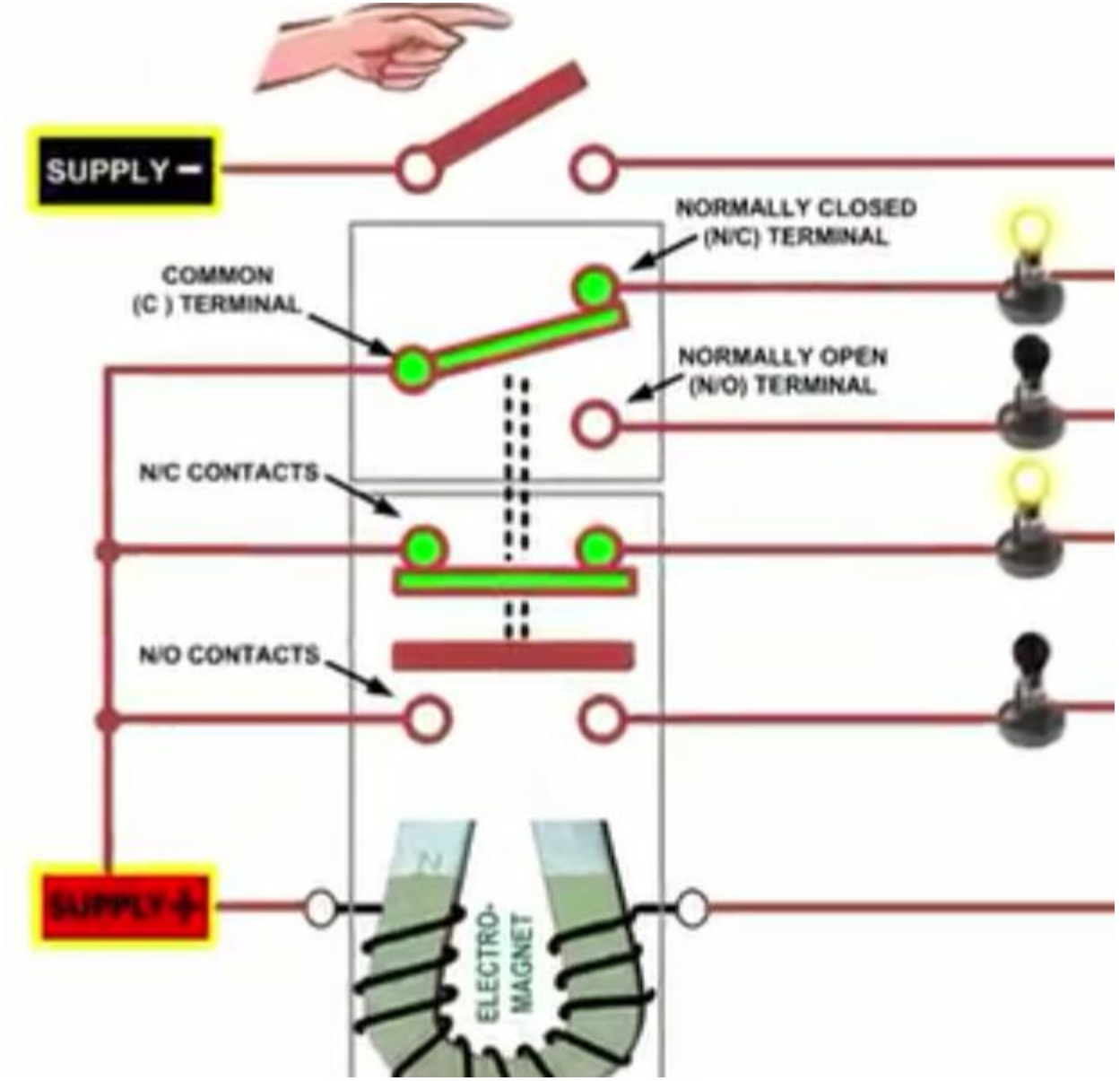
When second relay is energized, the first one is de-energised.


SUPPLY −
SUPPLY −
SUPPLY +
NO
POWER


SUPPLY −
SUPPLY −
SUPPLY +


SUPPLY −
SUPPLY −
SUPPLY +


SUPPLY –
SUPPLY –
NO
POWER


SUPPLY −
NORMALLY CLOSED
(N/C) TERMINAL
COMMON
(C) TERMINAL
NORMALLY OPEN
(N/O) TERMINAL
N/C CONTACTS
N/O CONTACTS
SUPPLY +
ELECTRO-
MAGNET

Latching circuits

- A *latch* is an electronic circuit that has two inputs and one output.
- Latching circuit can be dominant ON or dominant Off.
- Dominant position refer to status of relay coil (circuit) when both the start and stop signals are applied simultaneously

Latching circuit with Dominant OFF

When Start button (PB1) and Stop button (PB2) are pressed simultaneously, if the circuit goes to OFF position , then such a circuit is called Dominant OFF latching circuit.

Latching circuit with Dominant OFF

When we press START push button PB1 is pressed and released , following operations occurs:

- Relay coil K1 in branch 1 (vertical) is energised. All Contact of K1 closes.

- A NO contact of K1 in branch 2, is connected parallel to PB1. This NO contact of K1 latches the start push button. Therefore even if the PB1 is released, NO contact of K1 in branch 2 keeps coil K1 energised.

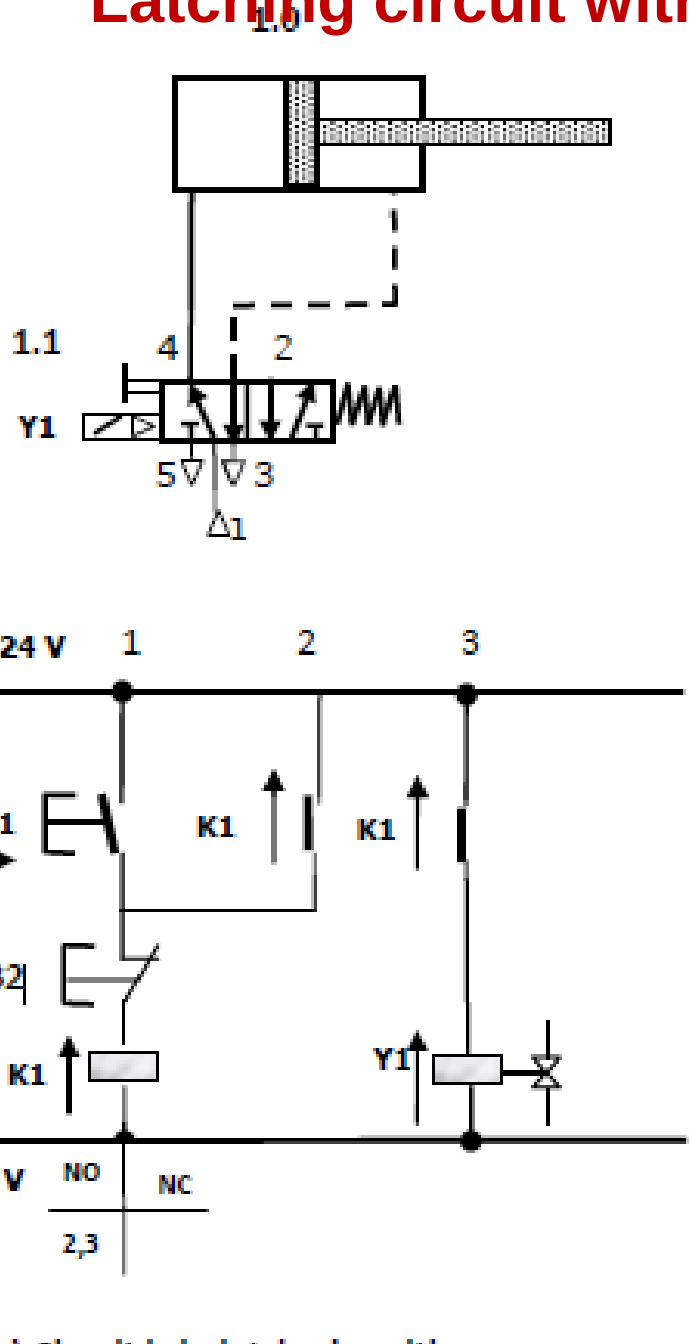
- There is another NO contact in branch 3, which is connected to Y1. When push button PB1 is pressed this also remain closed, as a result cylinder moves forward and remains there until stop button PB2 is pressed.

Latching circuit with Dominant OFF

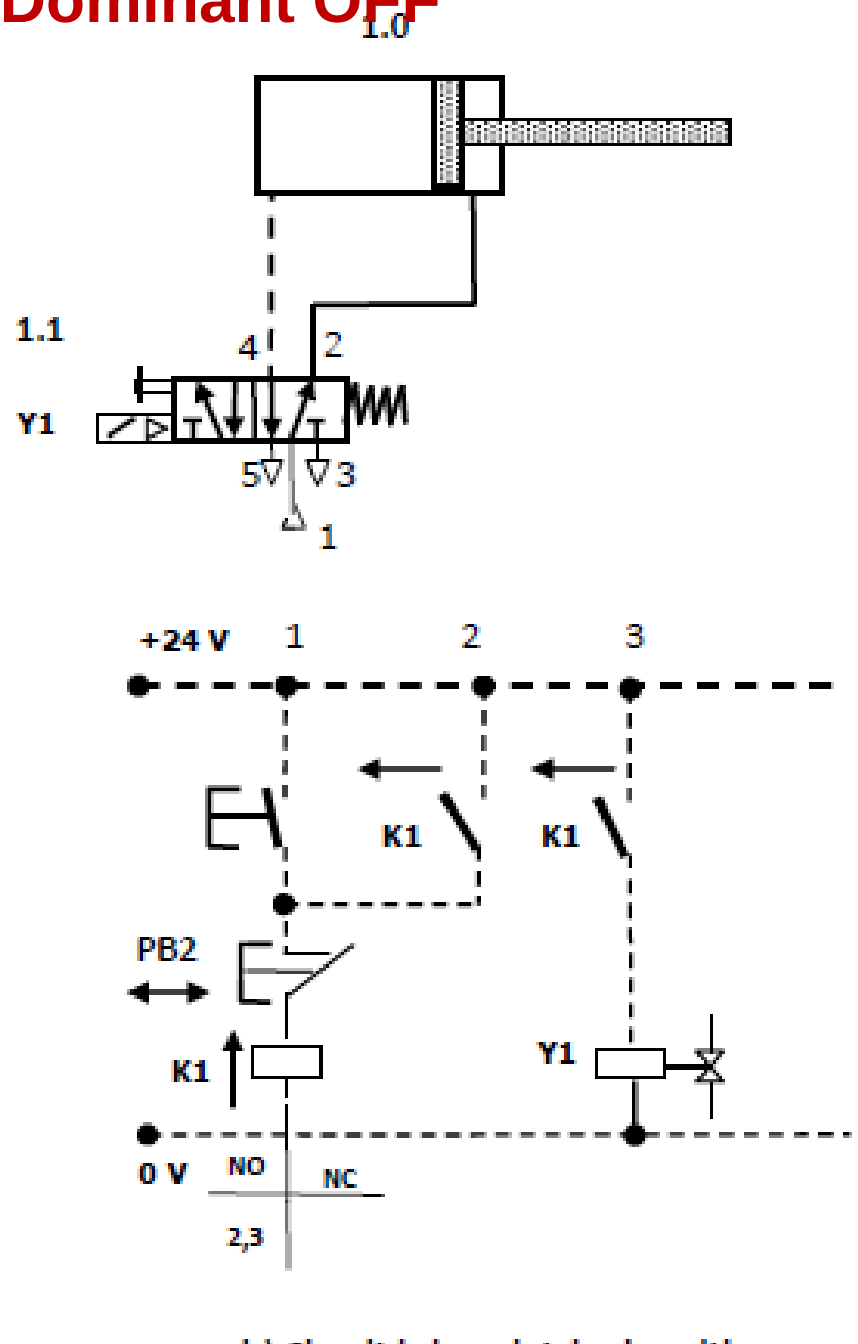
When we press STOP push button PB2 is pressed momentarily and released , following operations occurs:

- Relay coil K1 in branch 1 (vertical) is de-energised. All contact of K1 opens.
- NO contact of K1 in branch 2 , which is connected parallel to PB1 is now open. This NO contact of K1 no more latches the start push button.

Latching circuit with Dominant OFF



a) Circuit is in latched position



b) Circuit is in unlatched position

Latching circuit with Dominant ON

- When Start button (PB1) and Stop button (PB2) are pressed simultaneously, if the circuit goes to ON position , then such a circuit is called Dominant ON latching circuit.

Latching circuit with Dominant ON

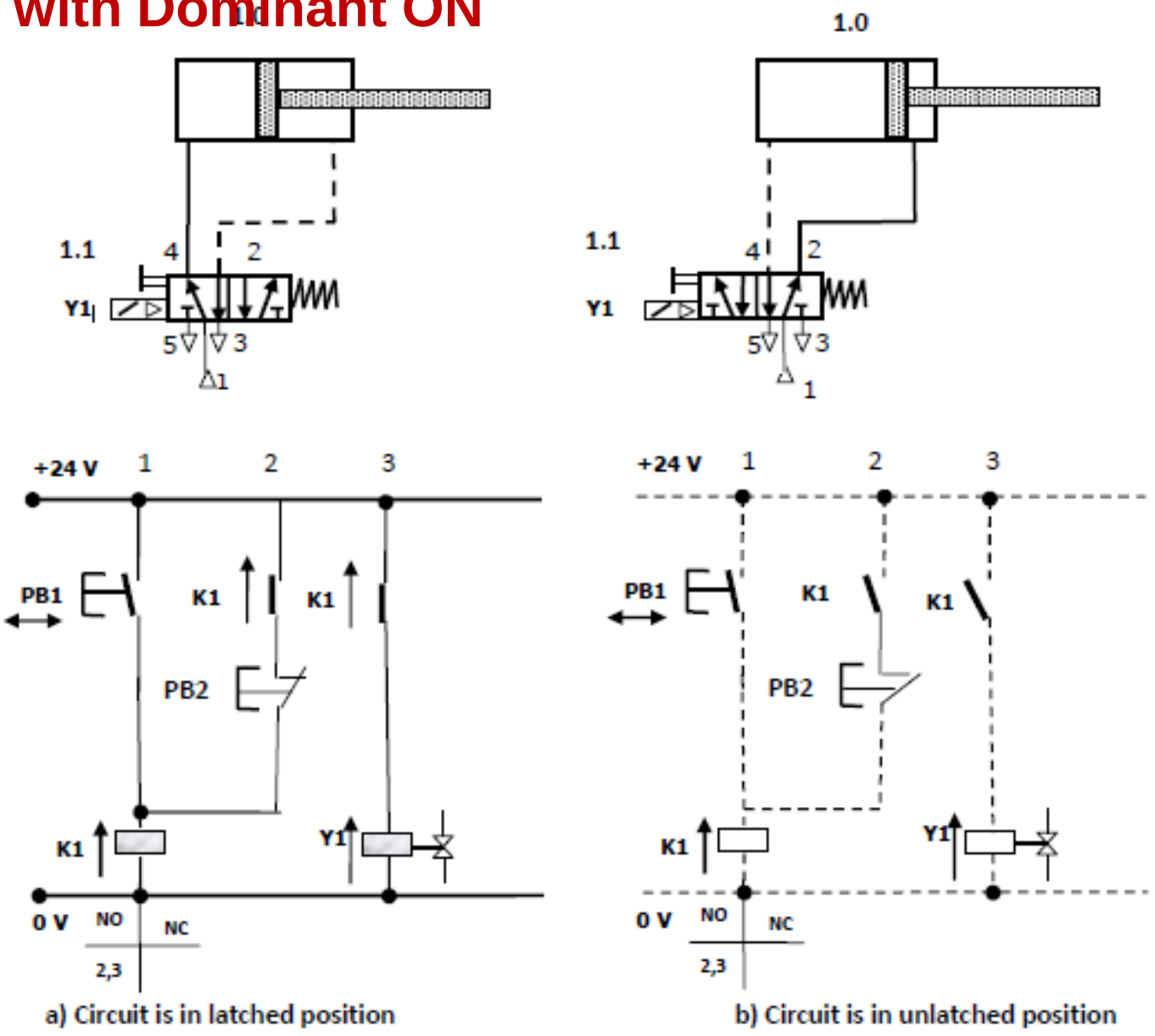
- When we press START push button PB1 is pressed and released , following operations occurs:
- Relay coil K1 in branch 1 (vertical) is energised. All Contact K1 closes
- Notice that there is a NO contact of K1 in branch 2 , which is connected parallel to PB1 and in series with PB2. This NO contact of K1 latches the start push button. Therefore even if the PB1 is released, NO contact of K1 in branch 2 keeps coil K1 energised.
- There is another NO contact in branch 3, which is connected to Y1. When push button PB1 is pressed this also remain closed, as a result cylinder moves forward and remains there until stop button PB2 is pressed.

Latching circuit with Dominant ON

- When we press STOP push button PB2 is pressed momentarily and released , following operations occurs:

- Relay coil K1 in branch 1 (vertical) is de-energised. All Contact K1 opens
- NO contact of K1 in branch 2 , which is connected parallel to PB1 is now open. This NO contact of K1 no more latches the start push button.
- NO contact in branch 3 is also open now, which is denergises. As a result cylinder moves back to its home position and remains in home position until start button PB1 is pressed again.

Latching circuit with Dominant ON

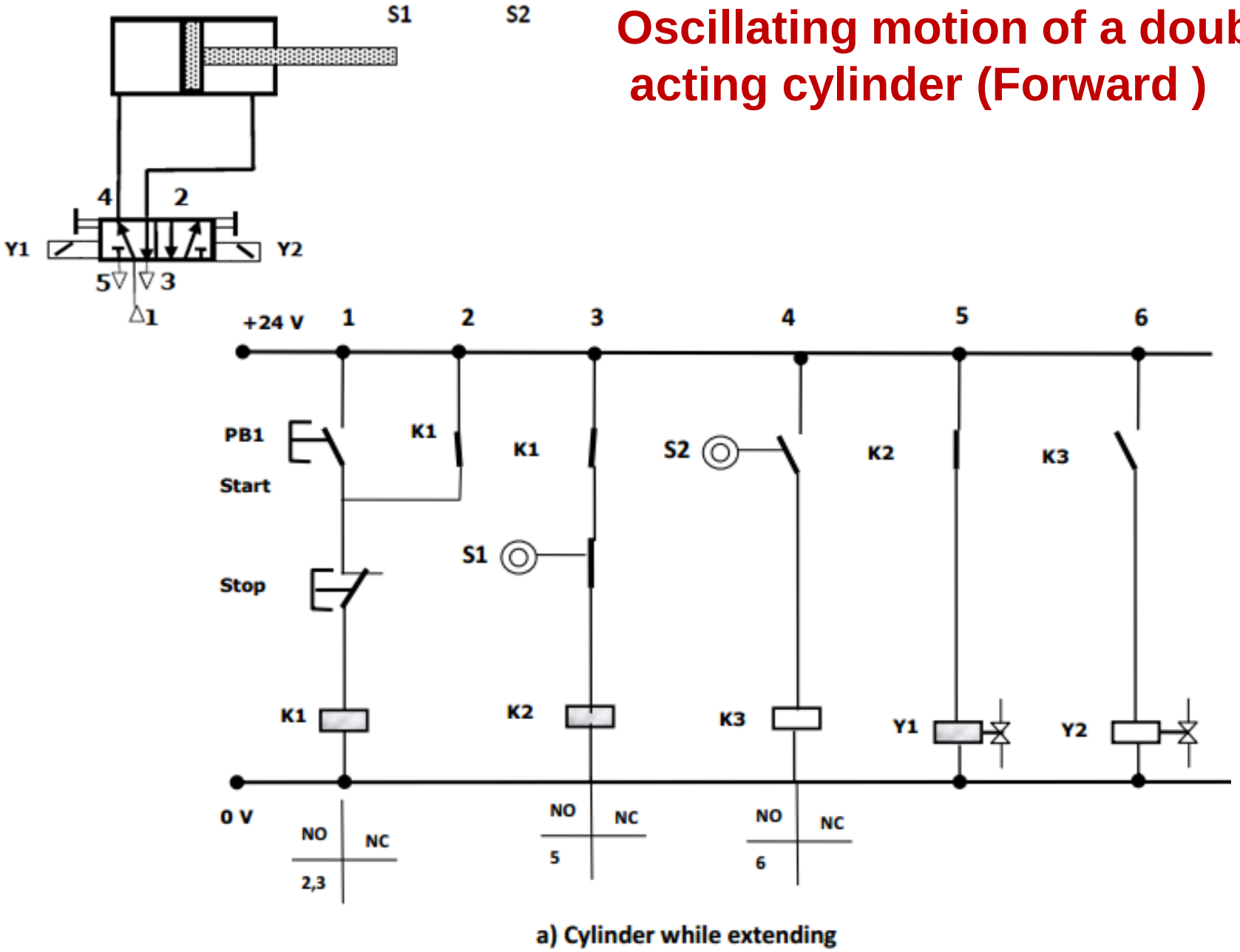


a) Circuit is in latched position

b) Circuit is in unlatched position

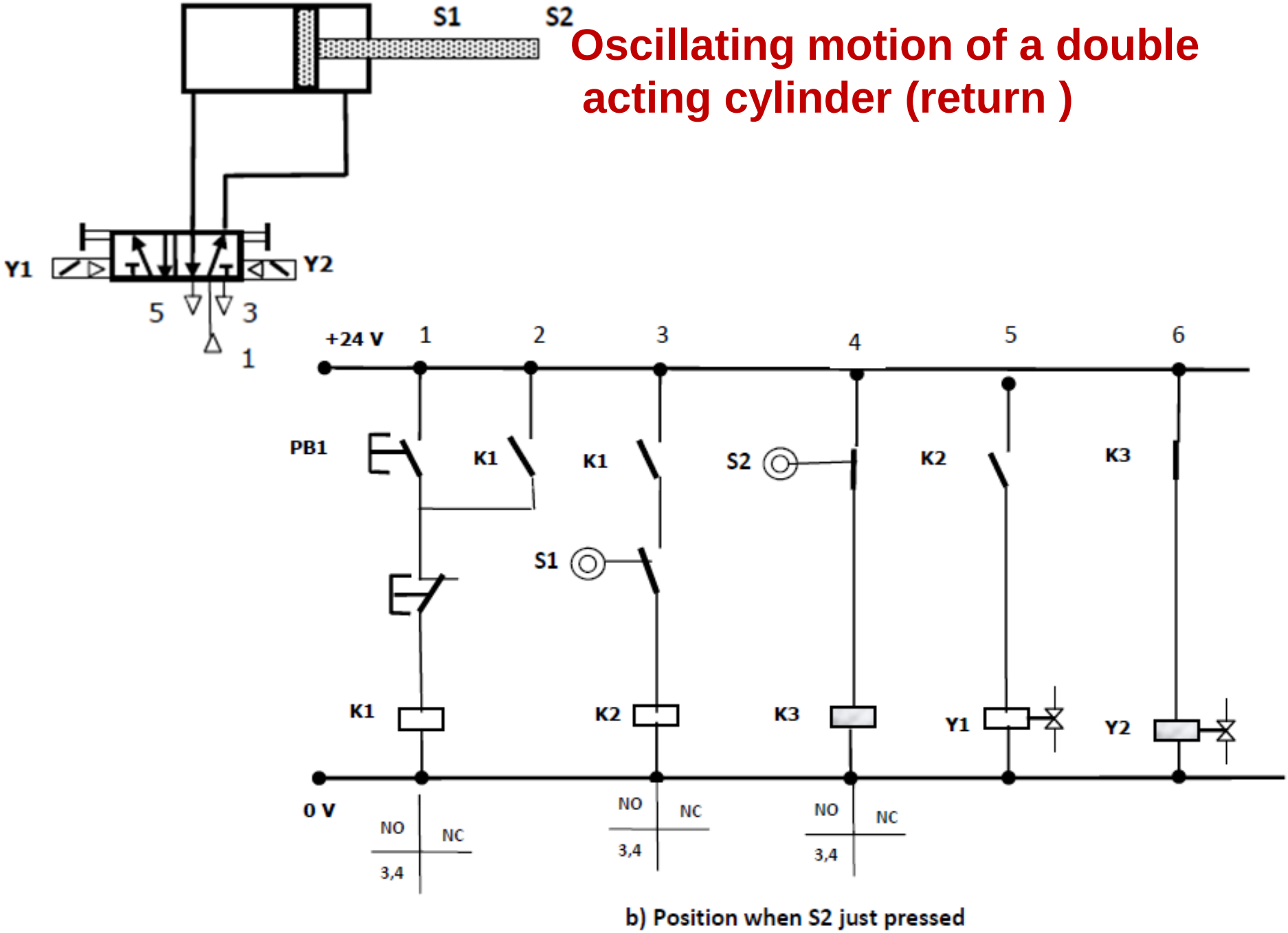
Dominant ON circuit

Oscillating motion of a double acting cylinder (Forward)



a) Cylinder while extending

Oscillating motion of a double acting cylinder (return)



b) Position when S2 just pressed

TIME DELAY VALVES

- In many pneumatic/hydraulic systems, deliberate time delays are required to be introduced between specific operations.
- It is achieved using time delay valves.
- Such valve either generate or cancel an output signal after a specified interval of time with reference to the application or removal of the time signal.

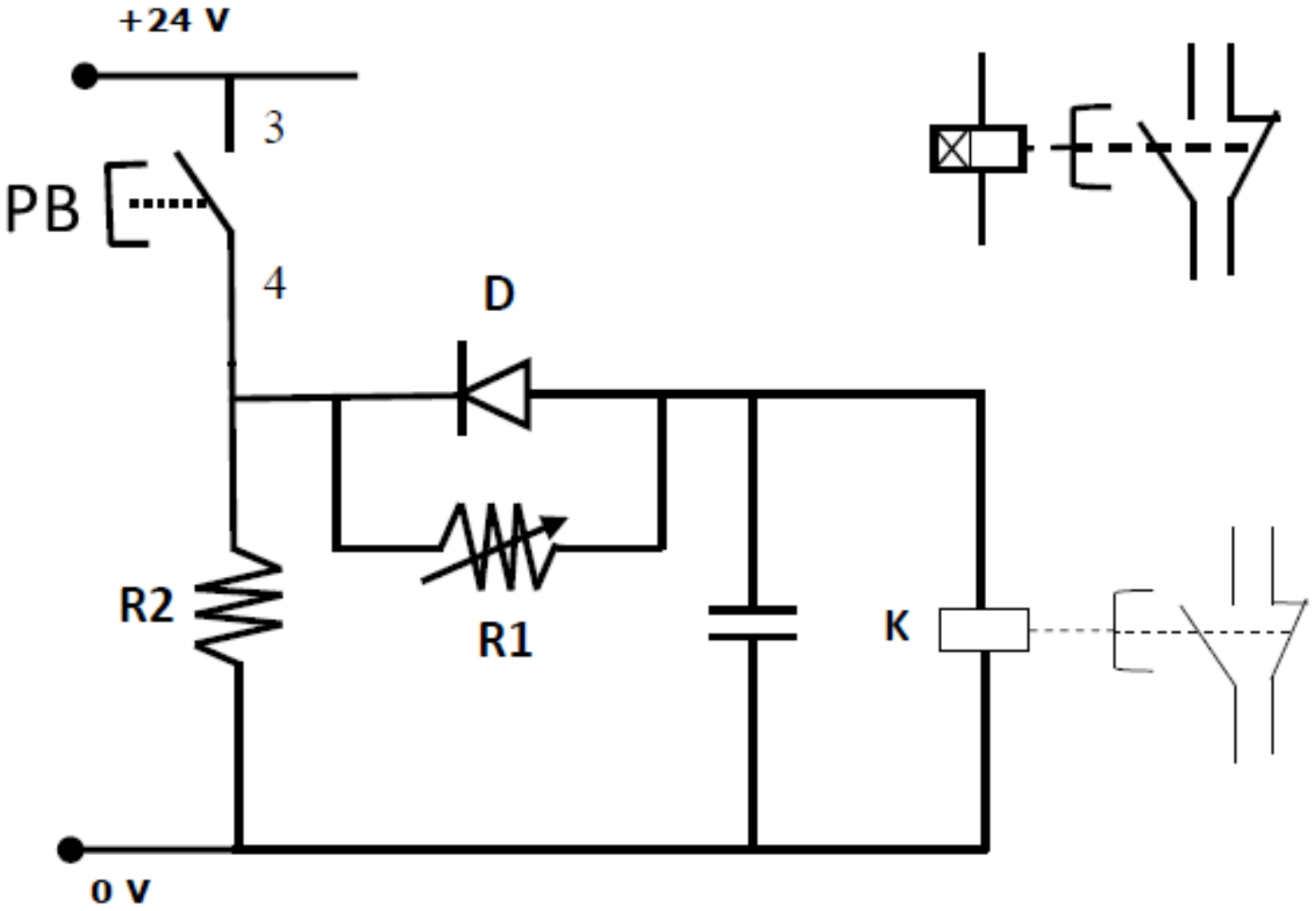
Time delay valves are classified as :

1. On delay timers
2. Off delay timers

On-delay timer

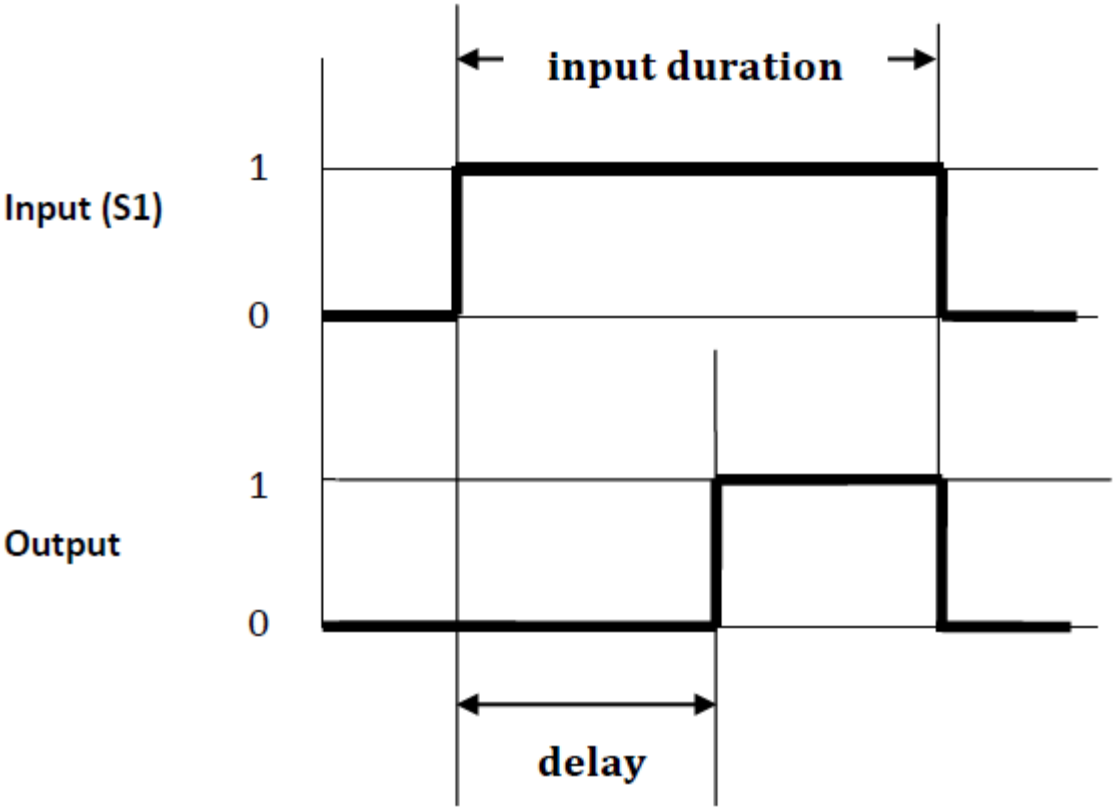
- When push button PB is pressed (ON), capacitor C is charged through potentiometer R1 as diode D is reverse –biased.
- The time taken to charge the capacitor, depends on the resistance of the potentiometer (R1) and the capacitance(C) of the capacitor.
- By adjusting the resistance of the potentiometer, the required time delay can be set.
- When the capacitor is charged sufficiently, coil K is energised, and its contacts are operated after the set time delay.
- When the push button is released (OFF), the capacitor discharges quickly through a small resistance (R2) as the diode by passes resistor R1, and the contacts of relay (K) return to their normal position without any delay.

On-delay timer

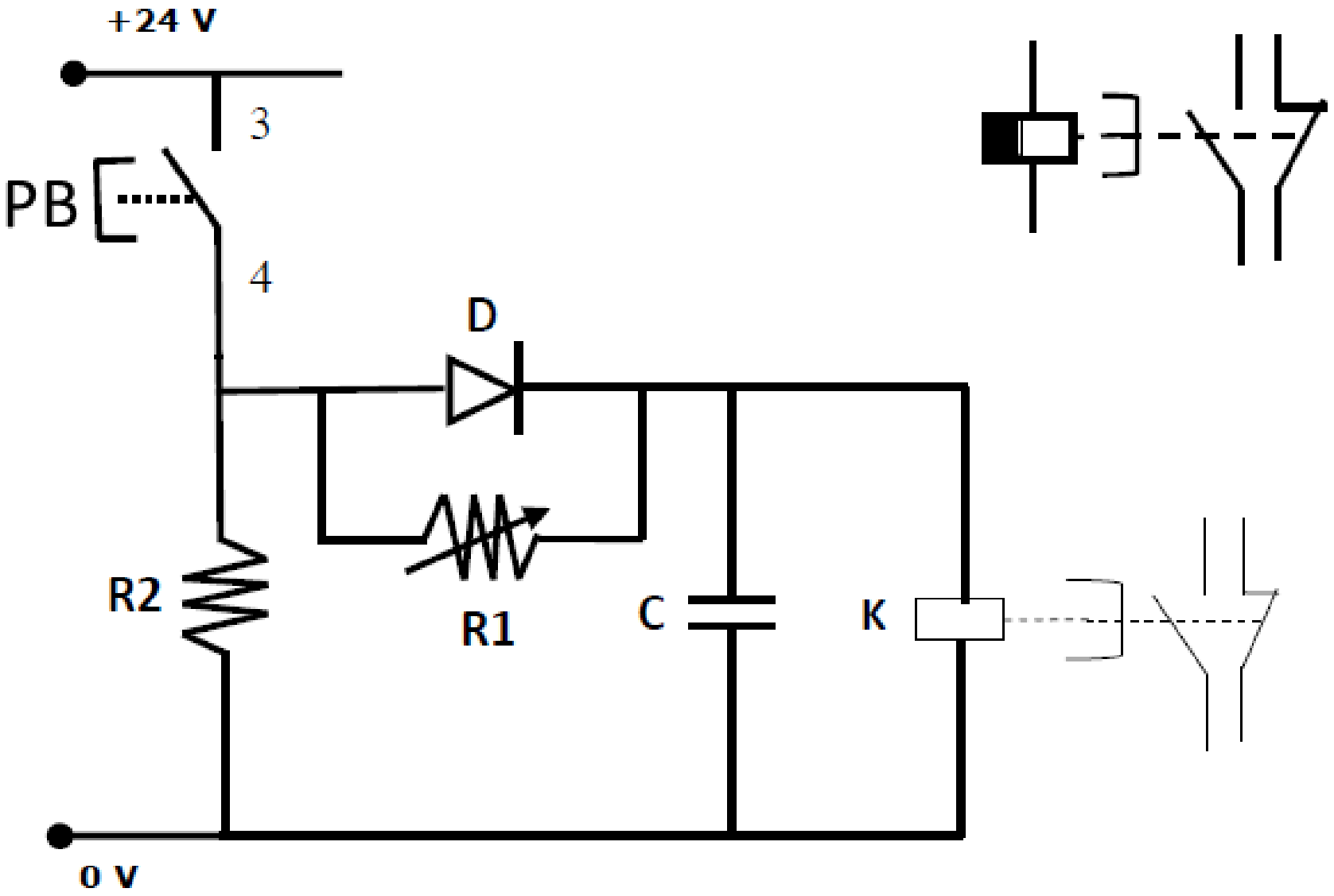


Pull in delay (on –delay timer)

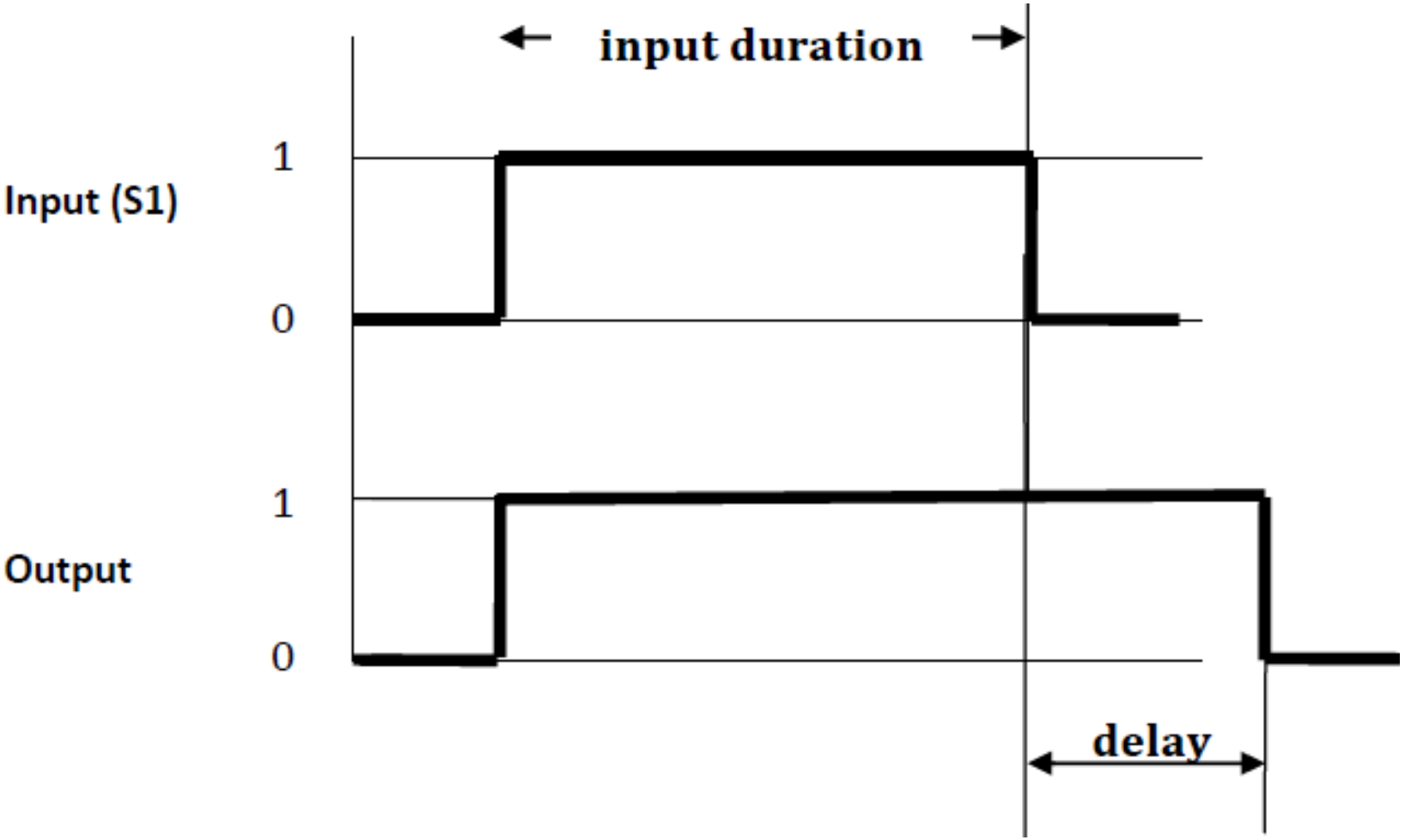
On-delay timer

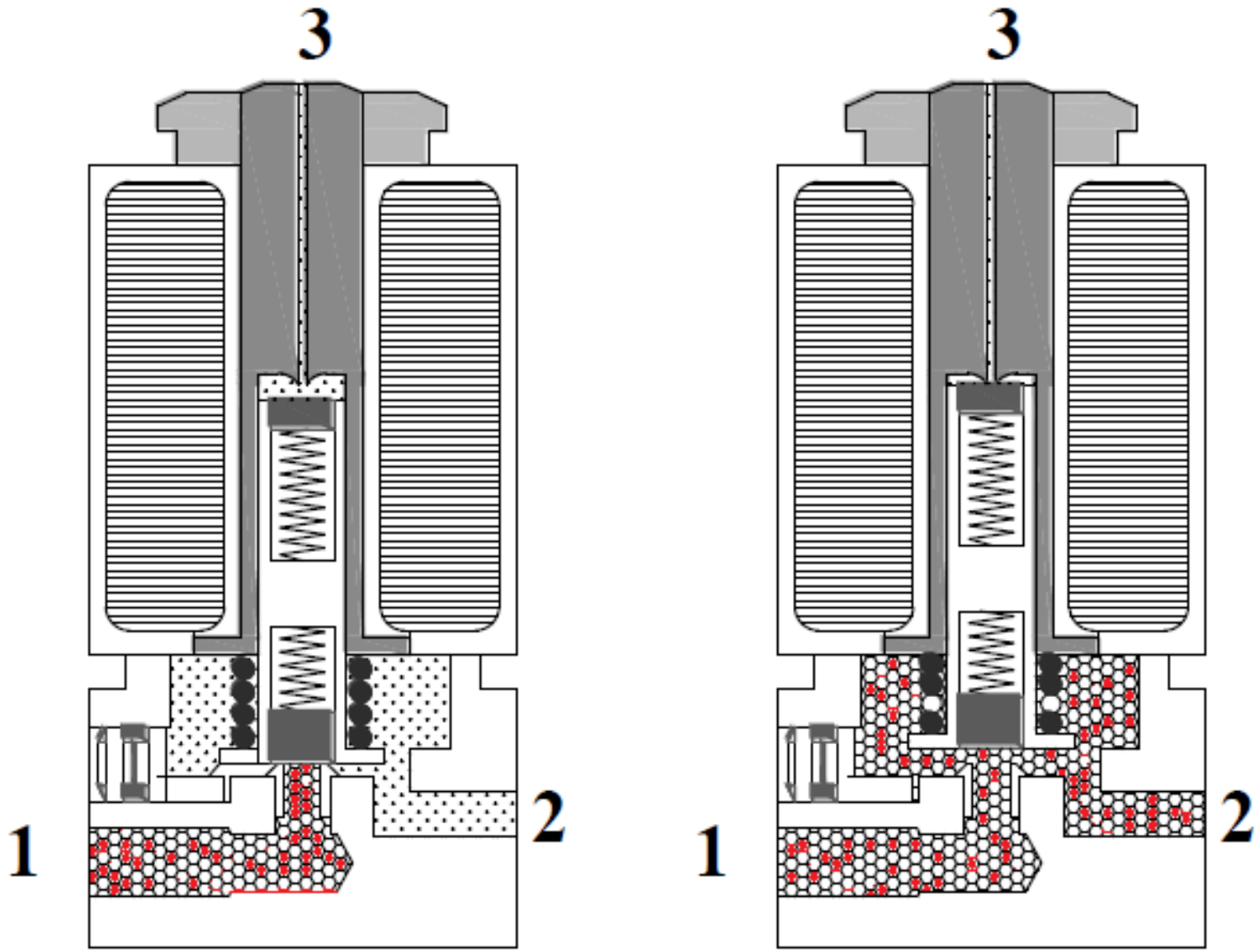


Off-delay timer



Off-delay timer





Cross sectional view of a 3/2 single solenoid valve