Control of Motion

- Discrete Motion
    - On/off control
    - Simple logic
- Proportional Motion
    - Trajectories, velocities, acceleration
   - Open loop or closed loop

Digital Logic Expressions

oPICK = (iPARTRDY • iCYLRETRACT +
    oPICK • /iCYLEXTEND) • /iESTOP

- Pickup when part is ready, and cylinder is retracted, and emergency stop is not on, or while cylinder is not fully extended and emergency stop is not on.

Pneumatic Logic Elements

- Directional control valve
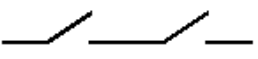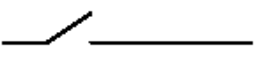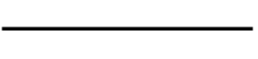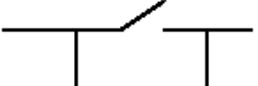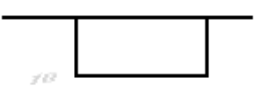
- Shuttle valve - OR function

- Twin pressure valve - AND function

- Other functions
  - Check valve
  - Speed control valve
  - Time delay valve
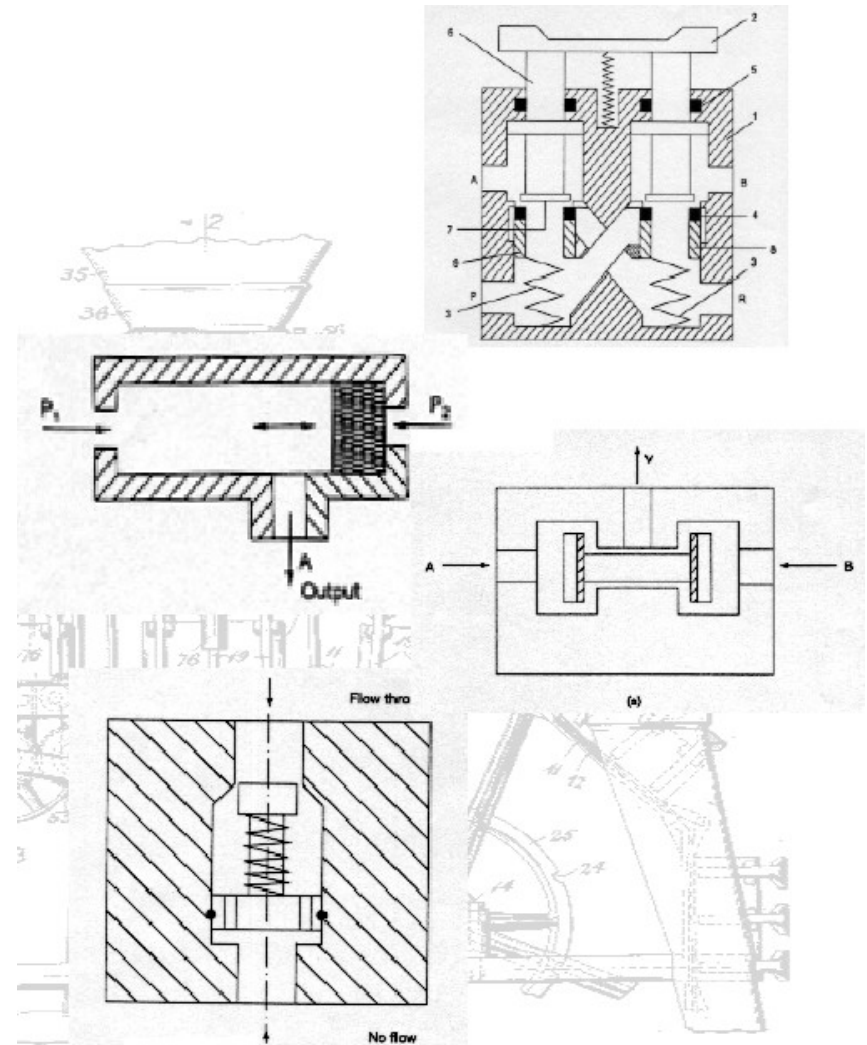
Electric Logic Elements

- wired in series = AND
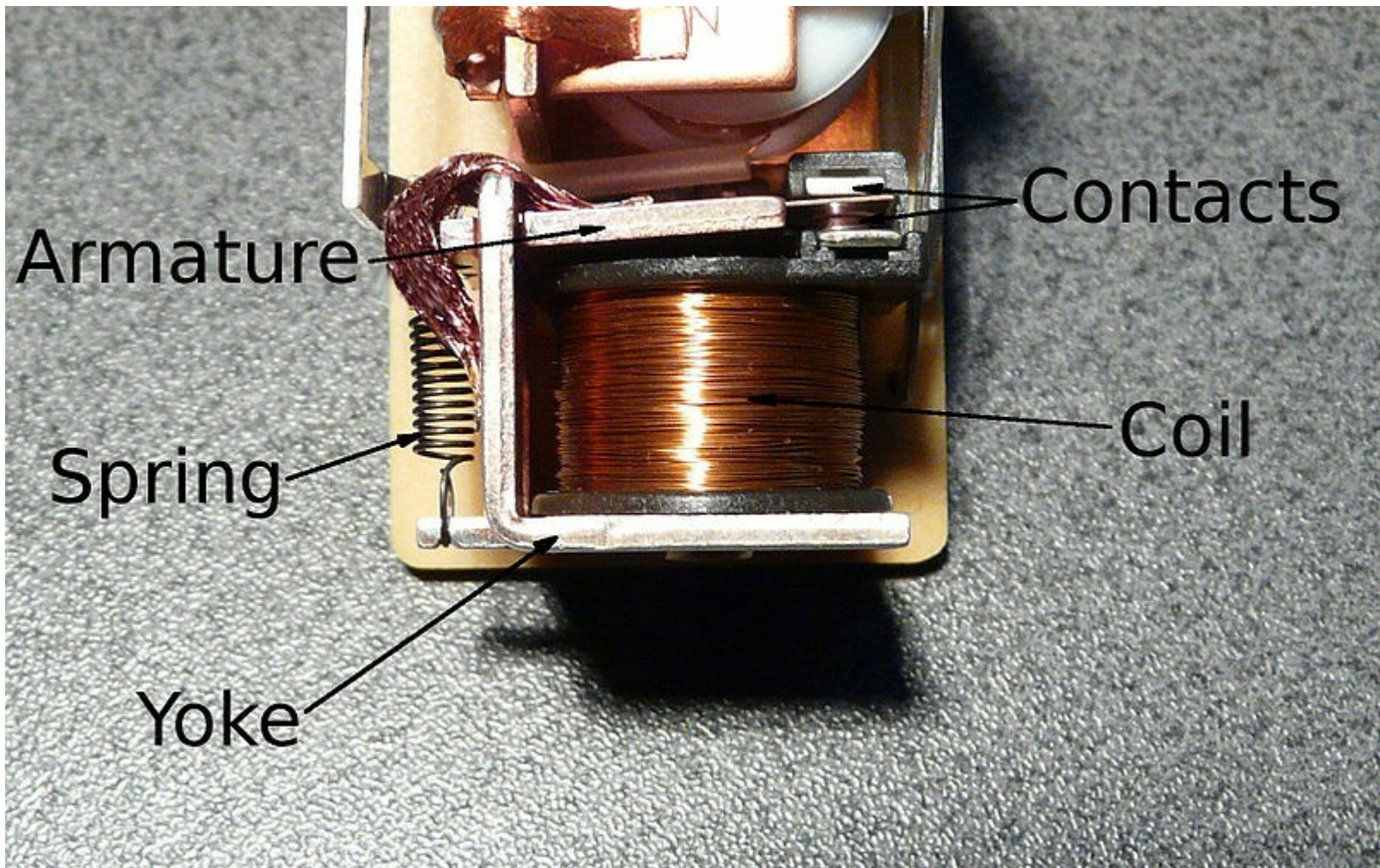- wired in parallel = OR
- Relay = NOT

Boolean Arithmetic

- 0 and 0 = 0   (0 · 0 = 0)
- 0 and 1 = 0   (0 · 1 = 0)
- 1 and 1 = 1   (1 · 1 = 1)
- 0   or 0 = 0   (0 + 0 = 0)
- 0   or 1 = 1   (0 + 1 = 1)
- 1   or 1 = 1   (1 + 1 = 1)
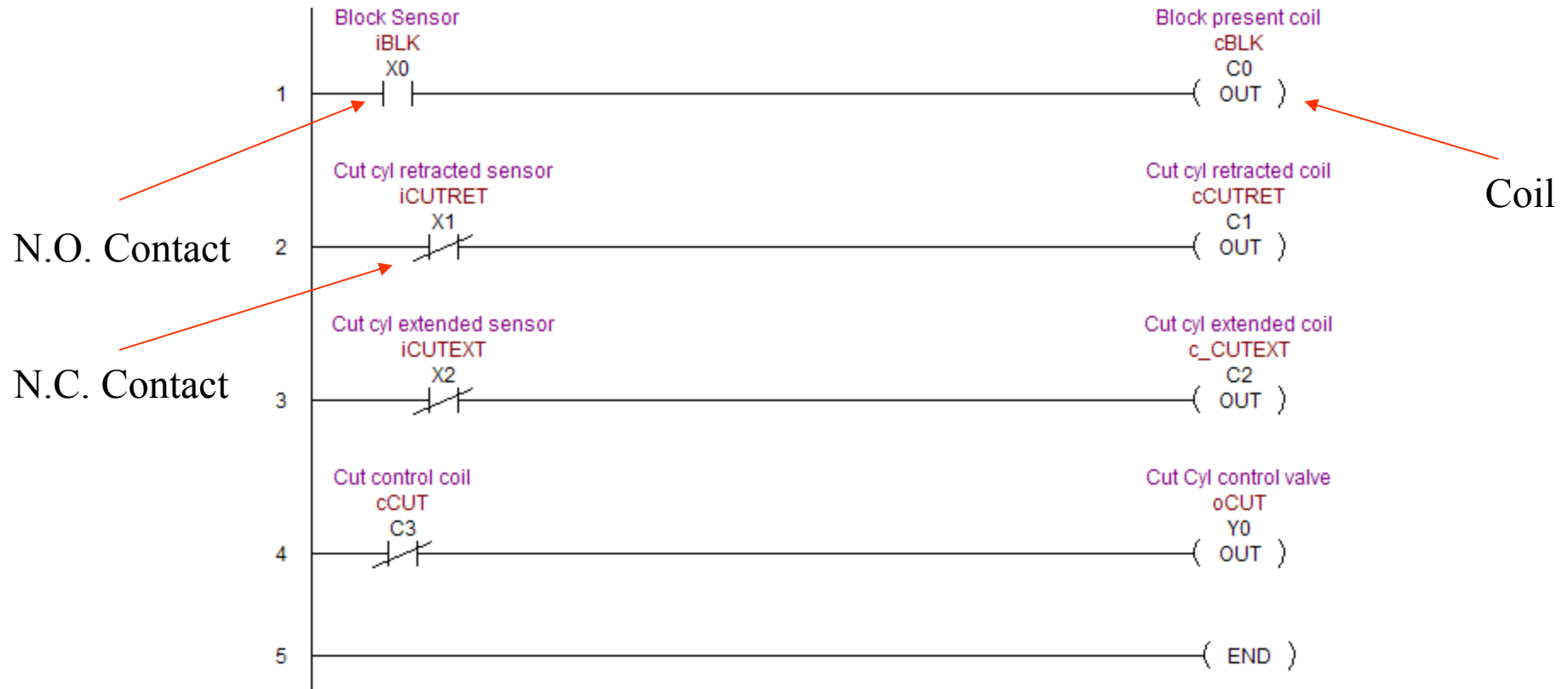- not 0 = 1   (/0 = 1)

$$A + /A = 1$$

$$A \cdot B = B \cdot A$$

$$A \cdot B + A \cdot C = A \cdot (B+C)$$

Relays

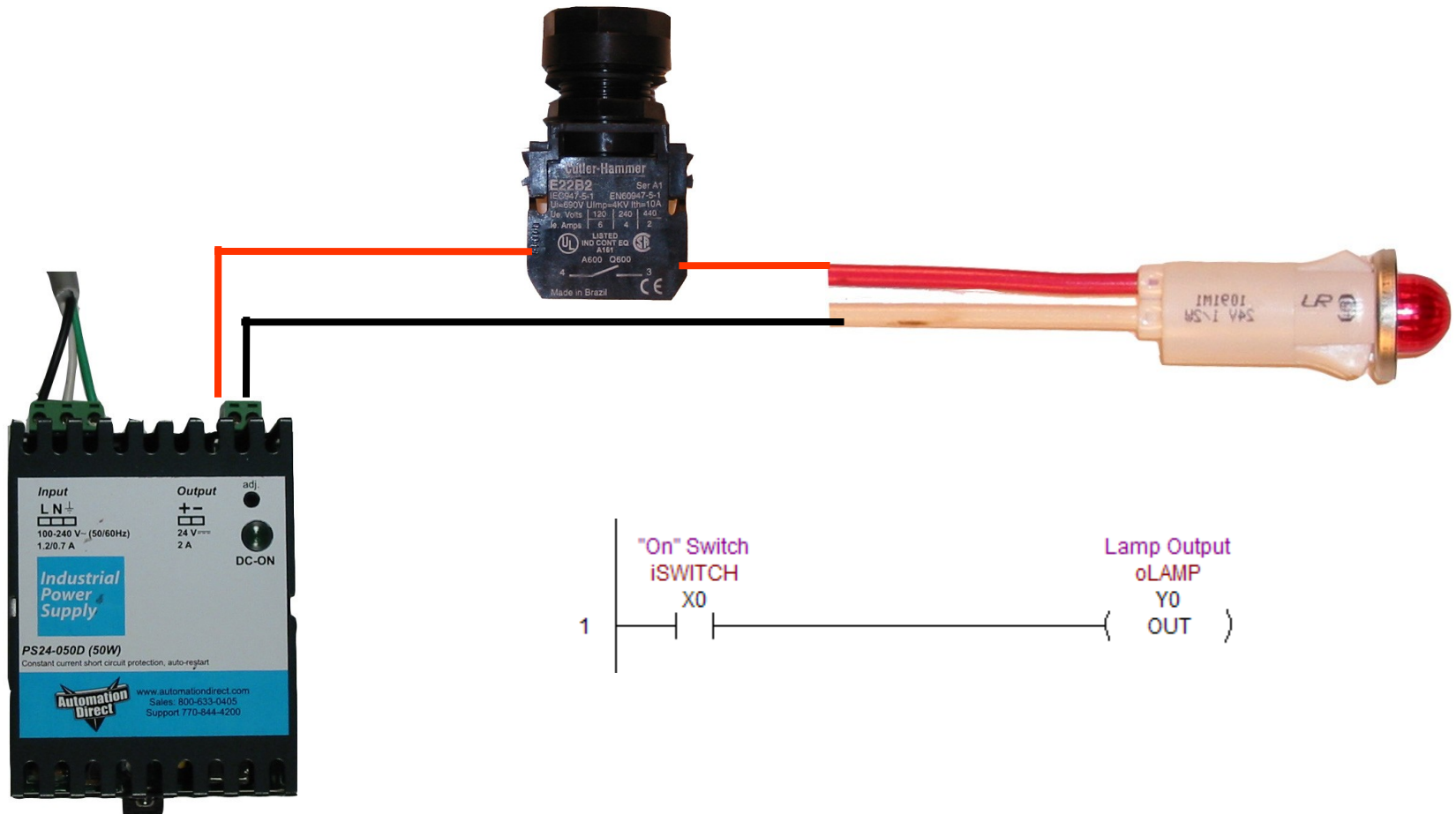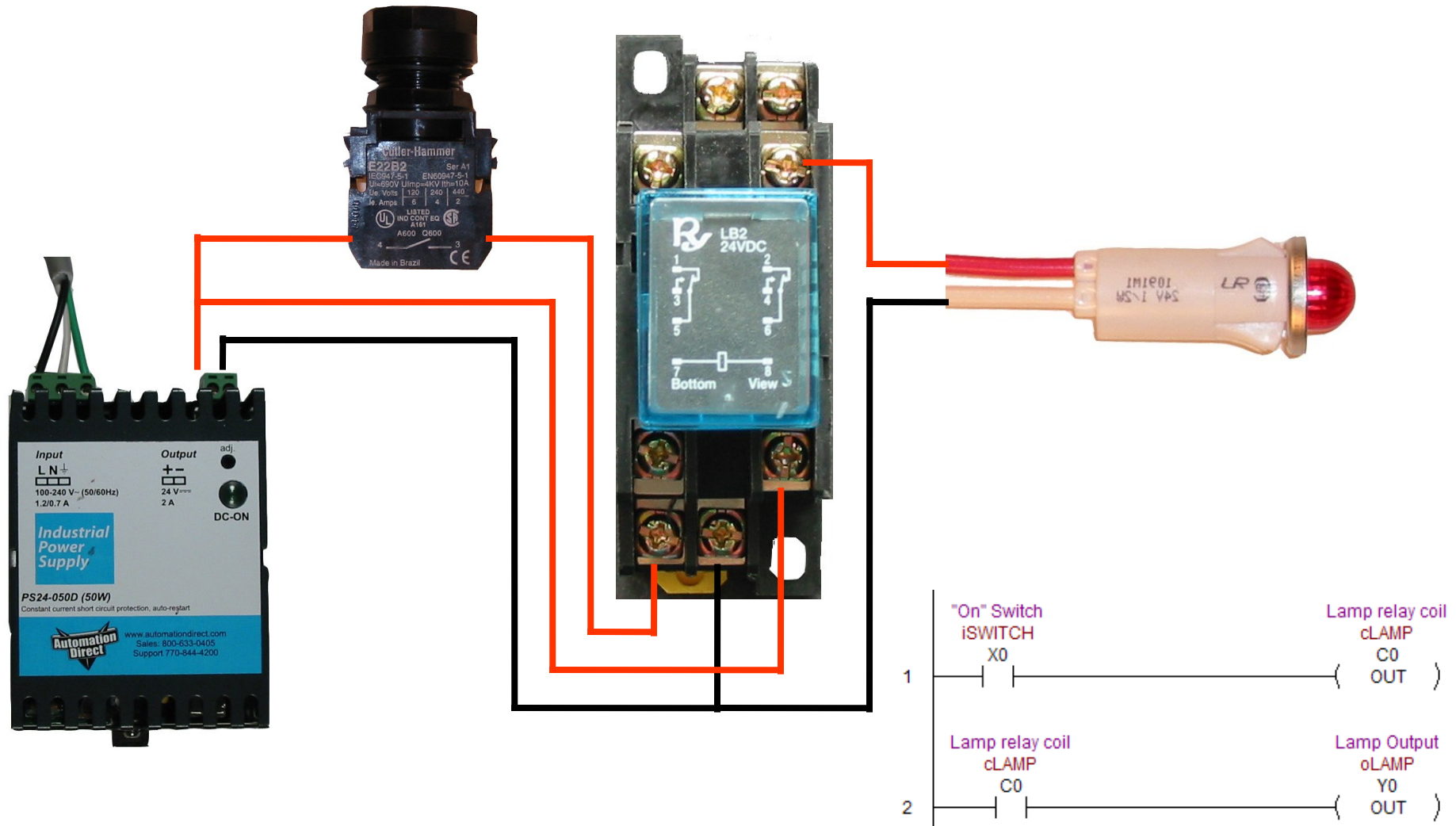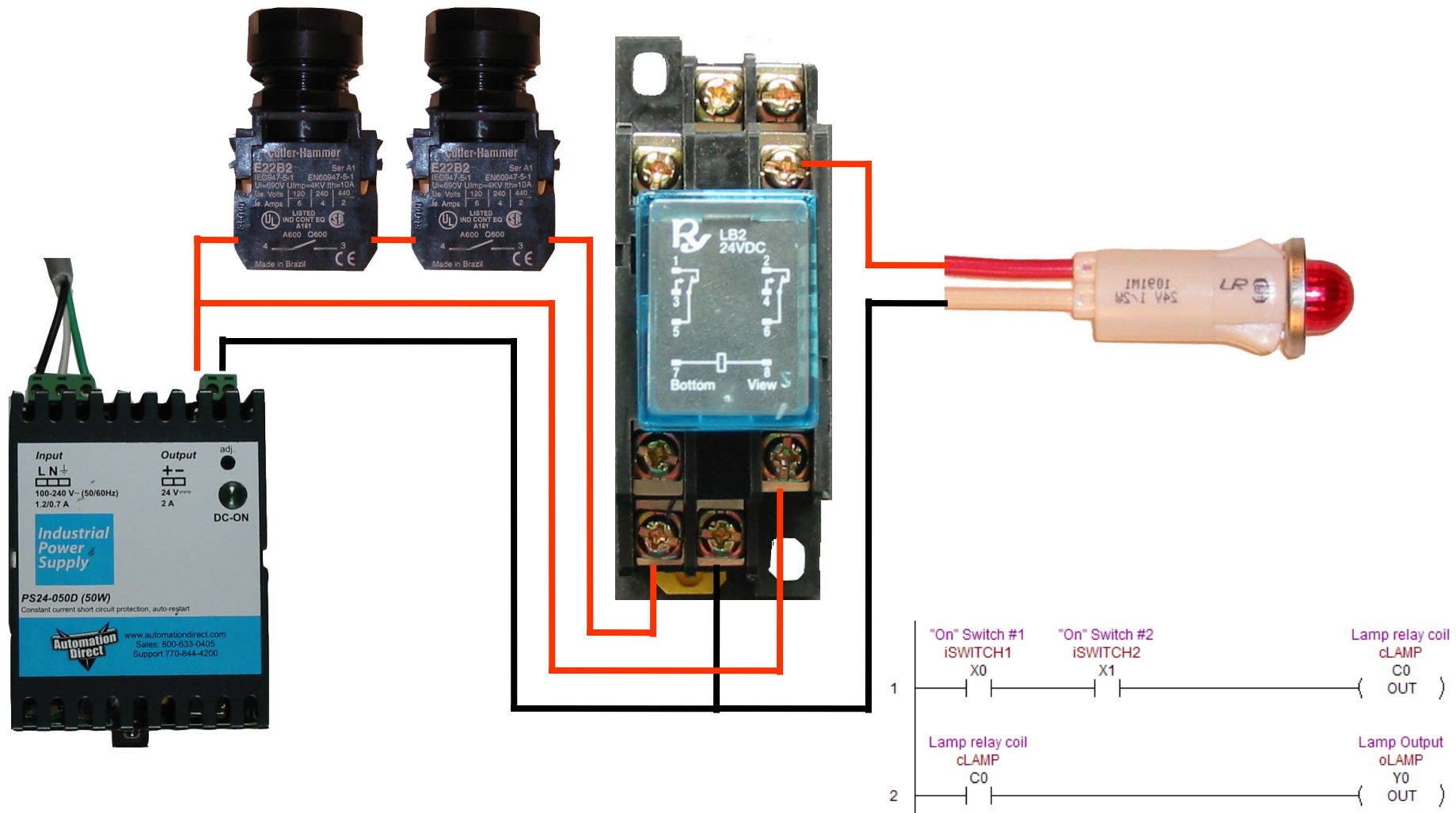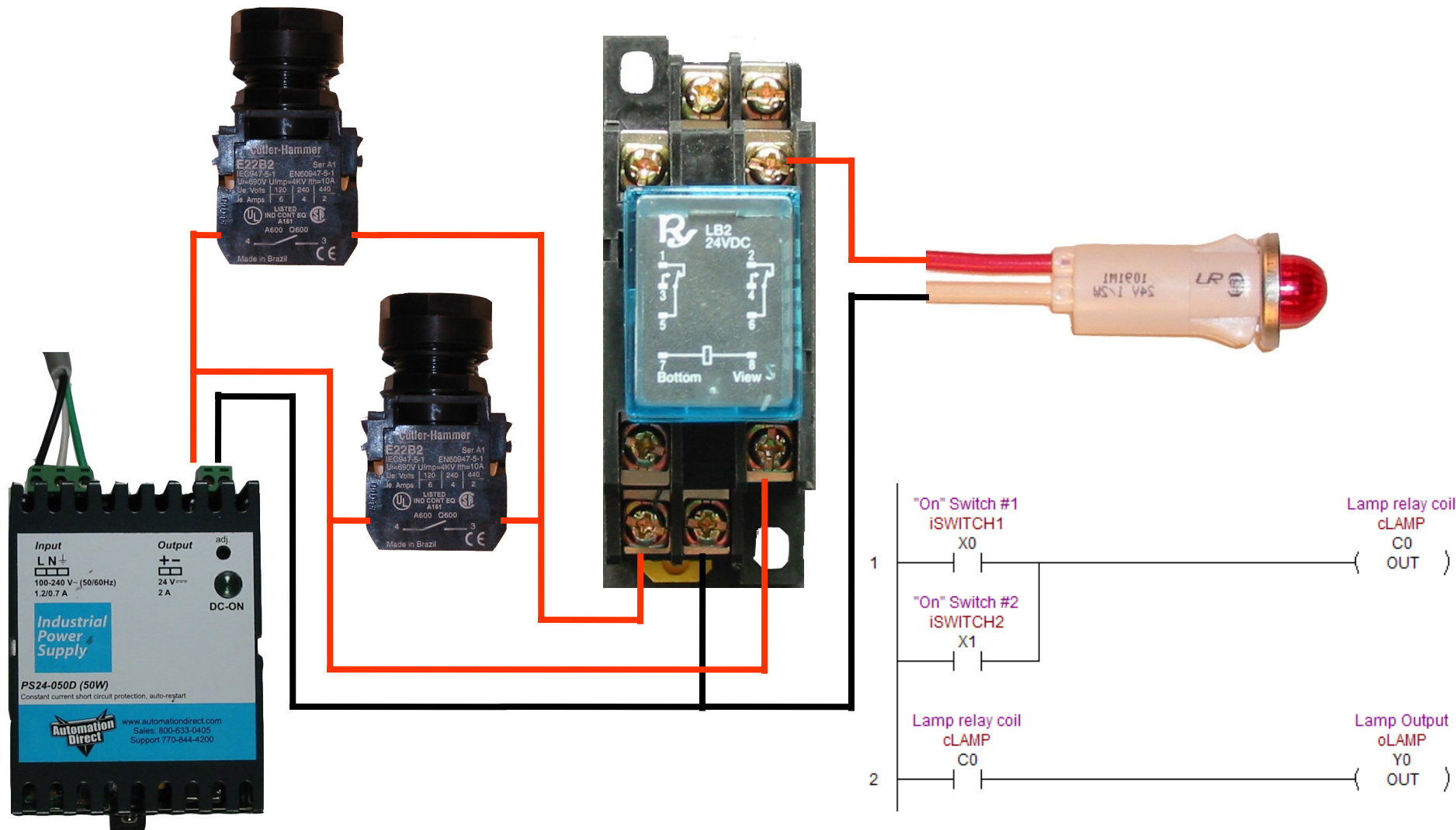# Ladder Diagrams

Example – Light Switch

"On" Switch
iSWITCH
X0

Lamp Output
oLAMP
Y0
OUT

1 |—| |——————————————————————————————( )—

Example – Light Relay

"On" Switch
iSWITCH

Lamp relay coil
cLAMP

X0 ──| |──────────────────(OUT)── C0

1

Lamp relay coil
cLAMP

Lamp Output
oLAMP

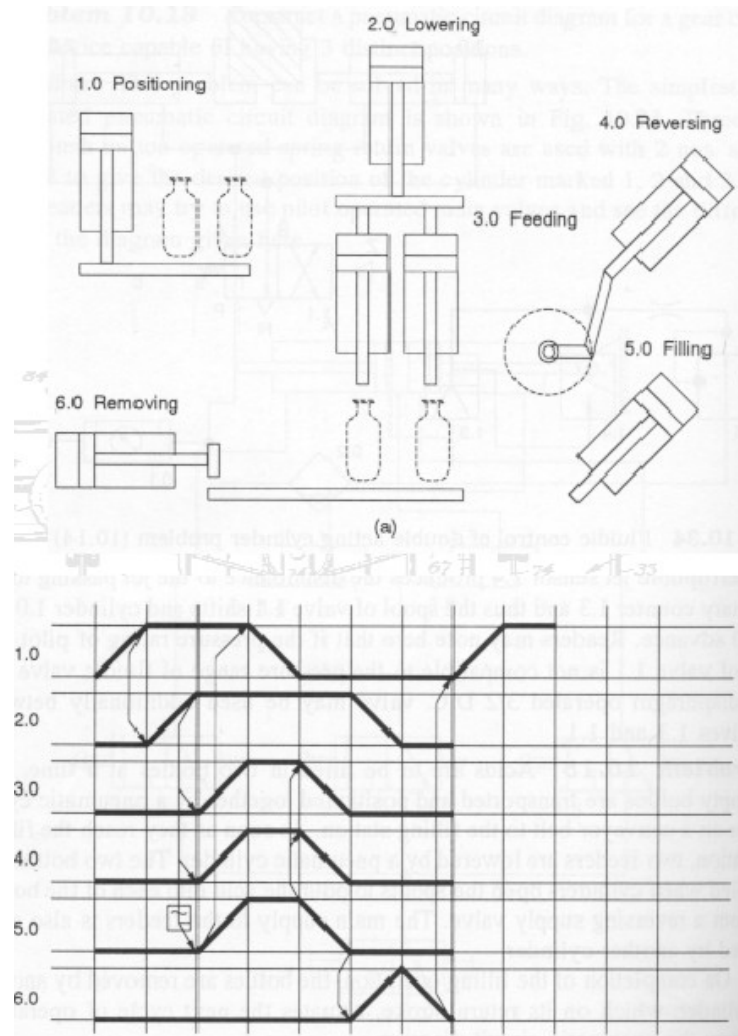C0 ──| |──────────────────(OUT)── Y0
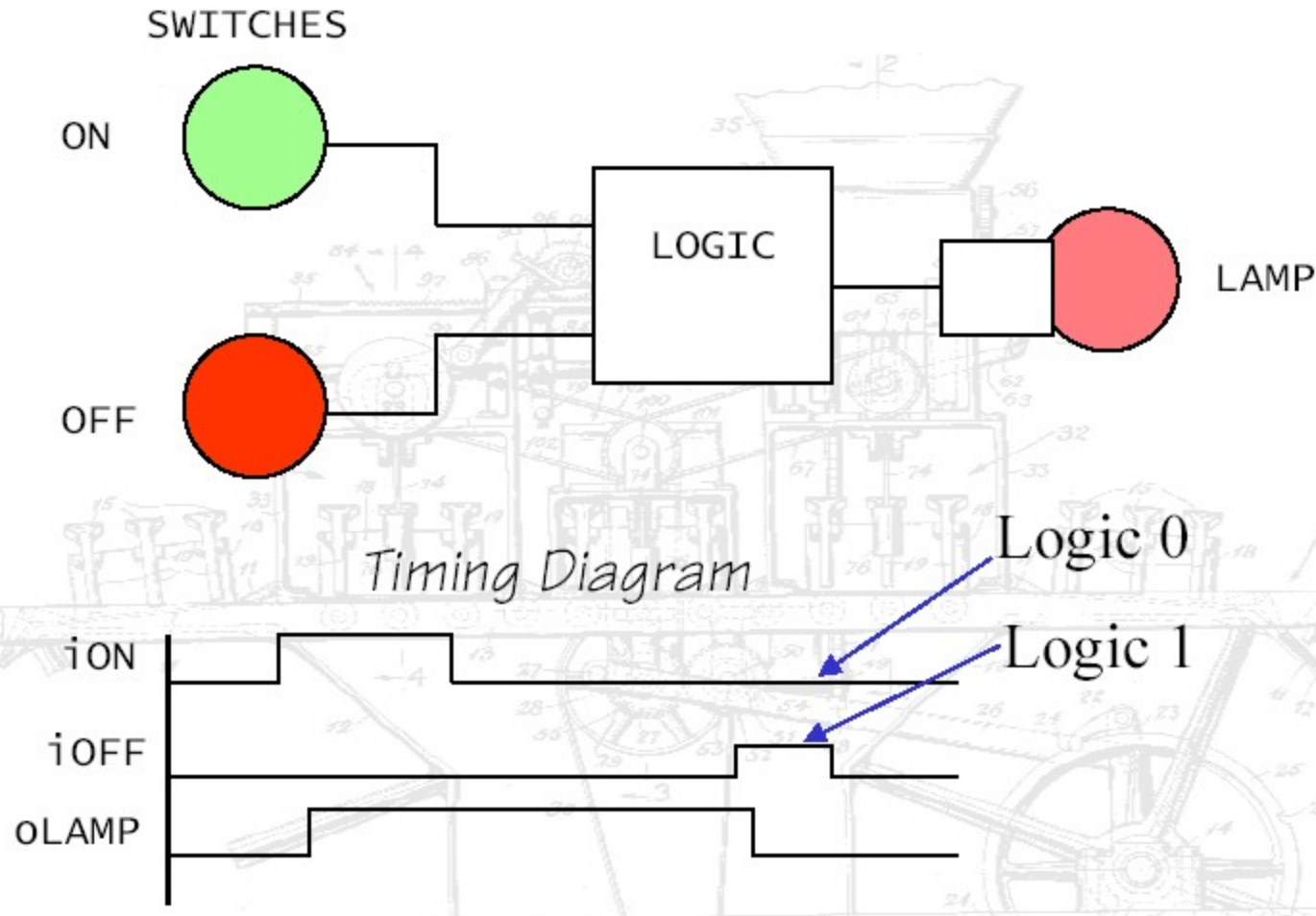
2

Example – Light Relay, "And" Logic

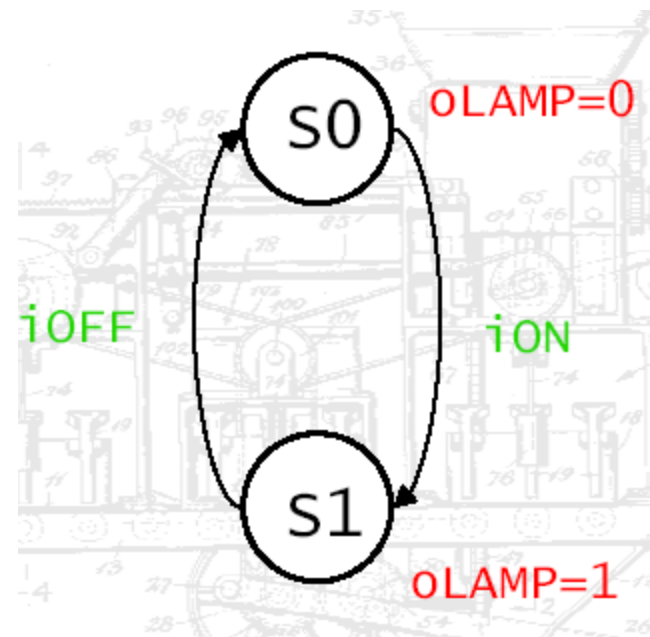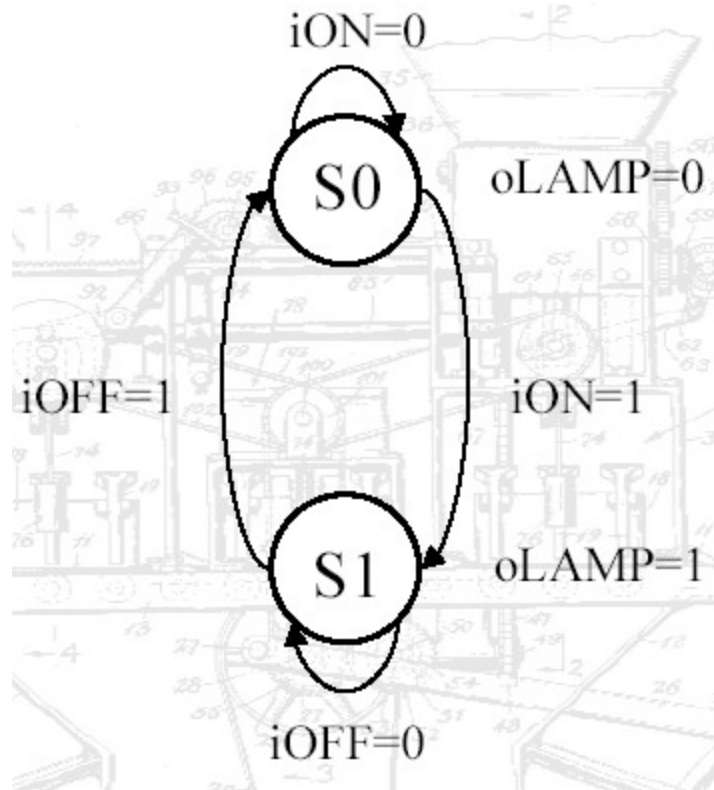# Example – Light Relay – "OR" Logic
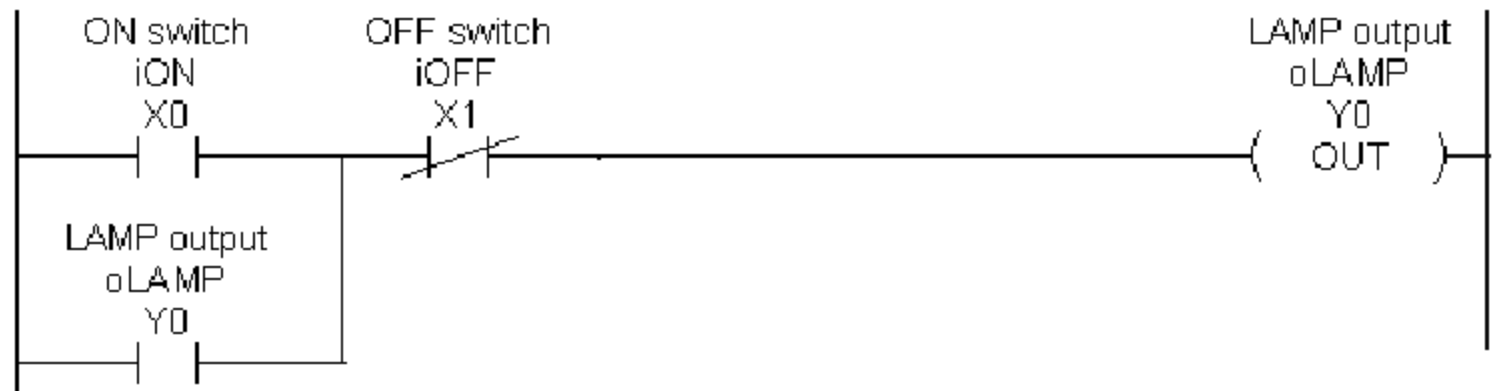
Timing Diagrams

State Machines

State Diagram

Logic Equation and Ladder Diagram

$$oLAMP = /iOFF \cdot (iON + oLAMP)$$

Example – Latching Relay Logic