

CONTROL OF MOTION

- On/Off Control (bang-bang)
- Proportional Control
 - open loop
 - closed loop

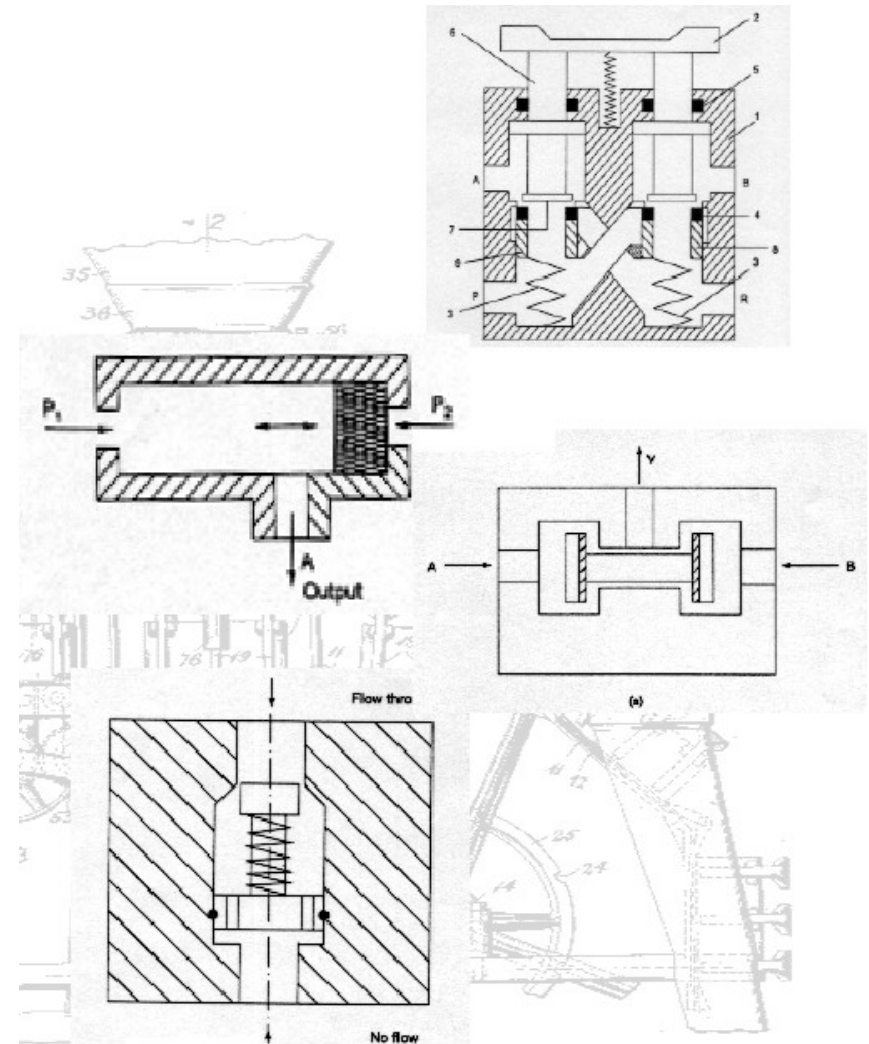
DIGITAL LOGIC EXPRESSIONS

$$oPICK = (iPARTRDY \cdot iCYLRETRACT + oPICK \cdot /iCYLEXTEND) \cdot /iESTOP$$

- 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

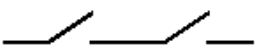
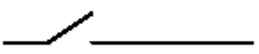
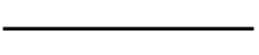
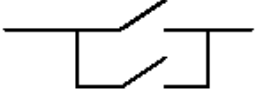
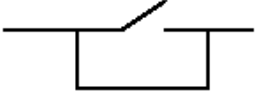
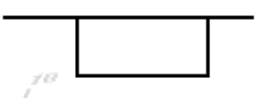
- Directional control valve
- Shuttle valve - OR function
- Twin pressure valve - AND function
- Other functions
 - Check valve
 - Speed control valve
 - Time delay valve



ELECTRIC LOGIC ELEMENTS

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

BOOLEAN ARITHMETIC

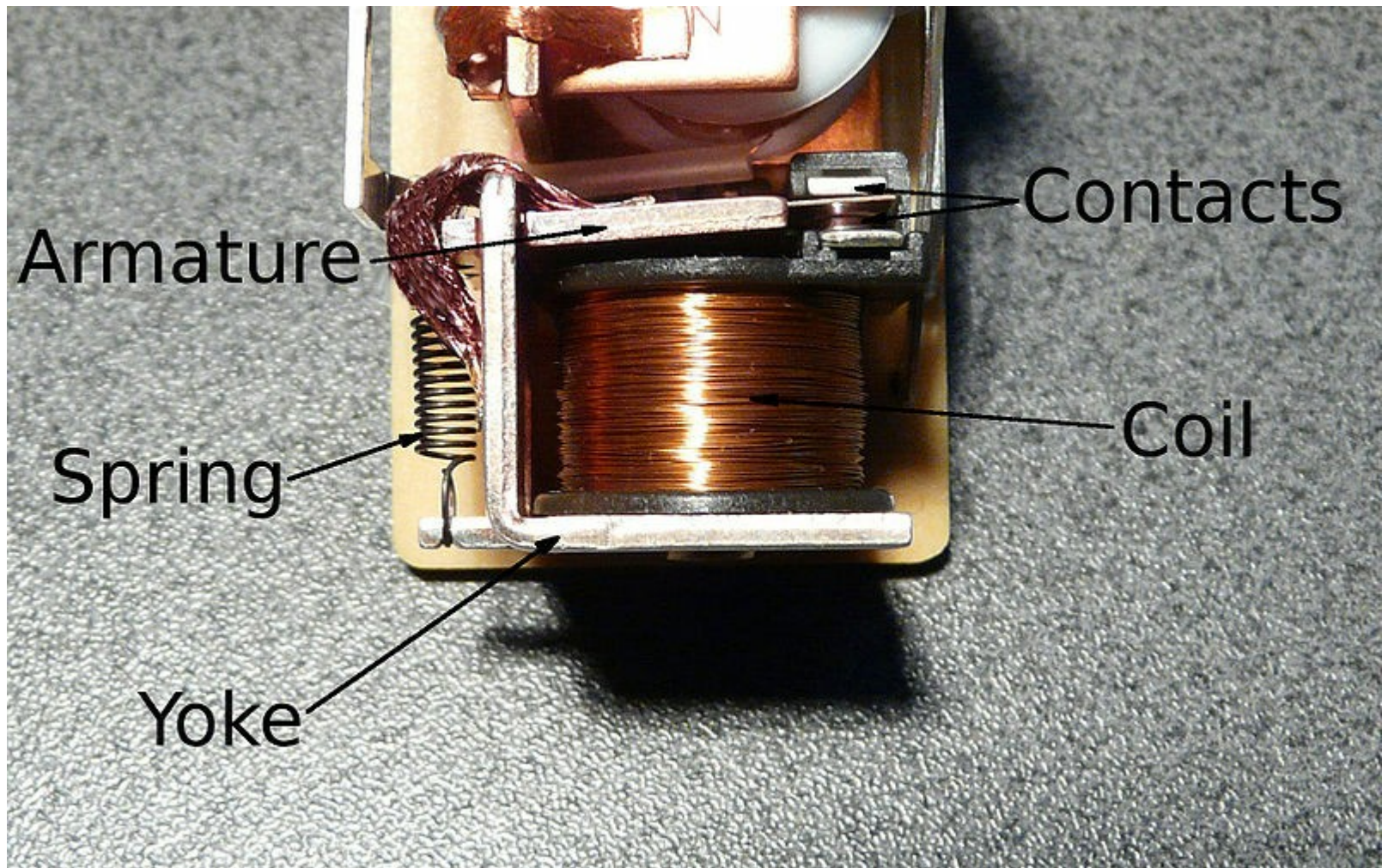
- $0 \text{ and } 0 = 0$ ($0 \cdot 0 = 0$) 
- $0 \text{ and } 1 = 0$ ($0 \cdot 1 = 0$) 
- $1 \text{ and } 1 = 1$ ($1 \cdot 1 = 1$) 
- $0 \text{ or } 0 = 0$ ($0 + 0 = 0$) 
- $0 \text{ or } 1 = 1$ ($0 + 1 = 1$) 
- $1 \text{ or } 1 = 1$ ($1 + 1 = 1$) 
- $\text{not } 0 = 1$ ($/0 = 1$) 

$$A + /A = 1$$

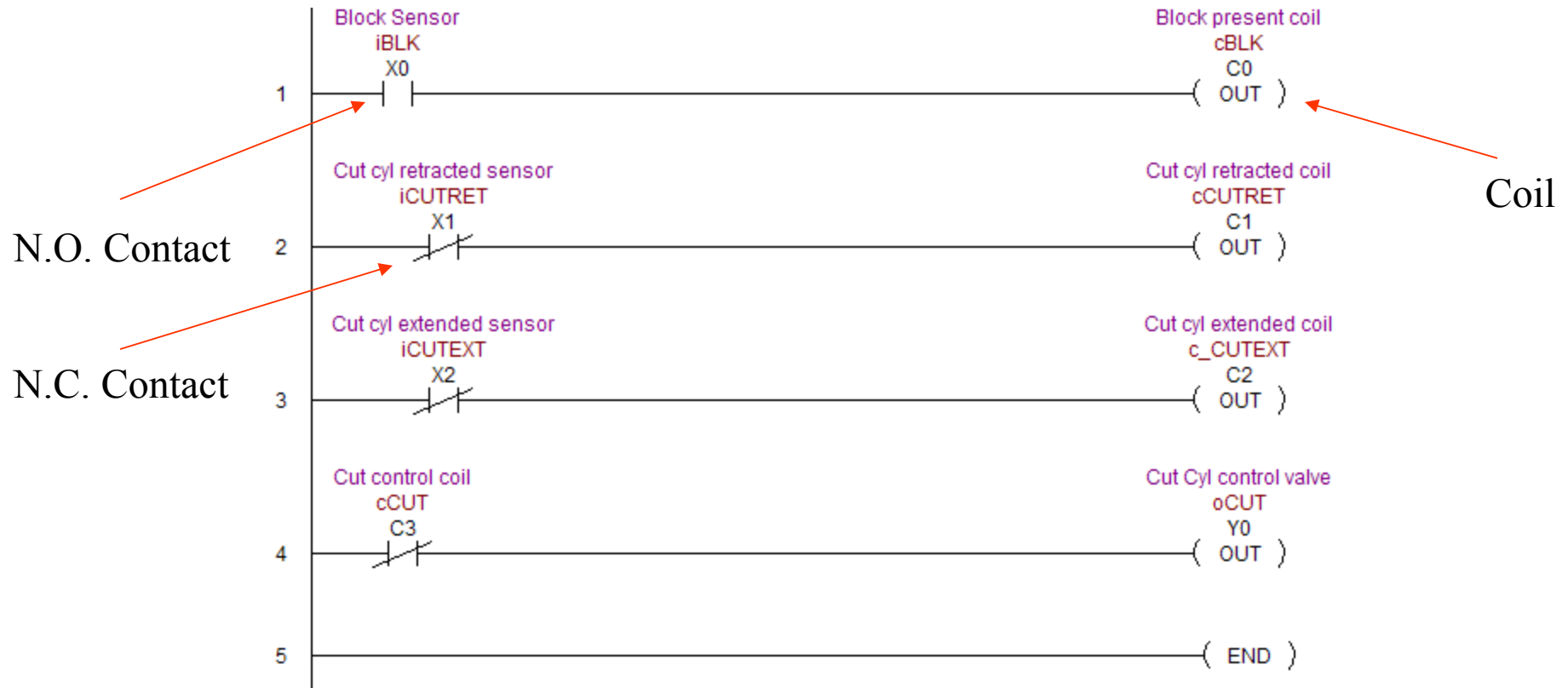
$$A \cdot B = B \cdot A$$

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

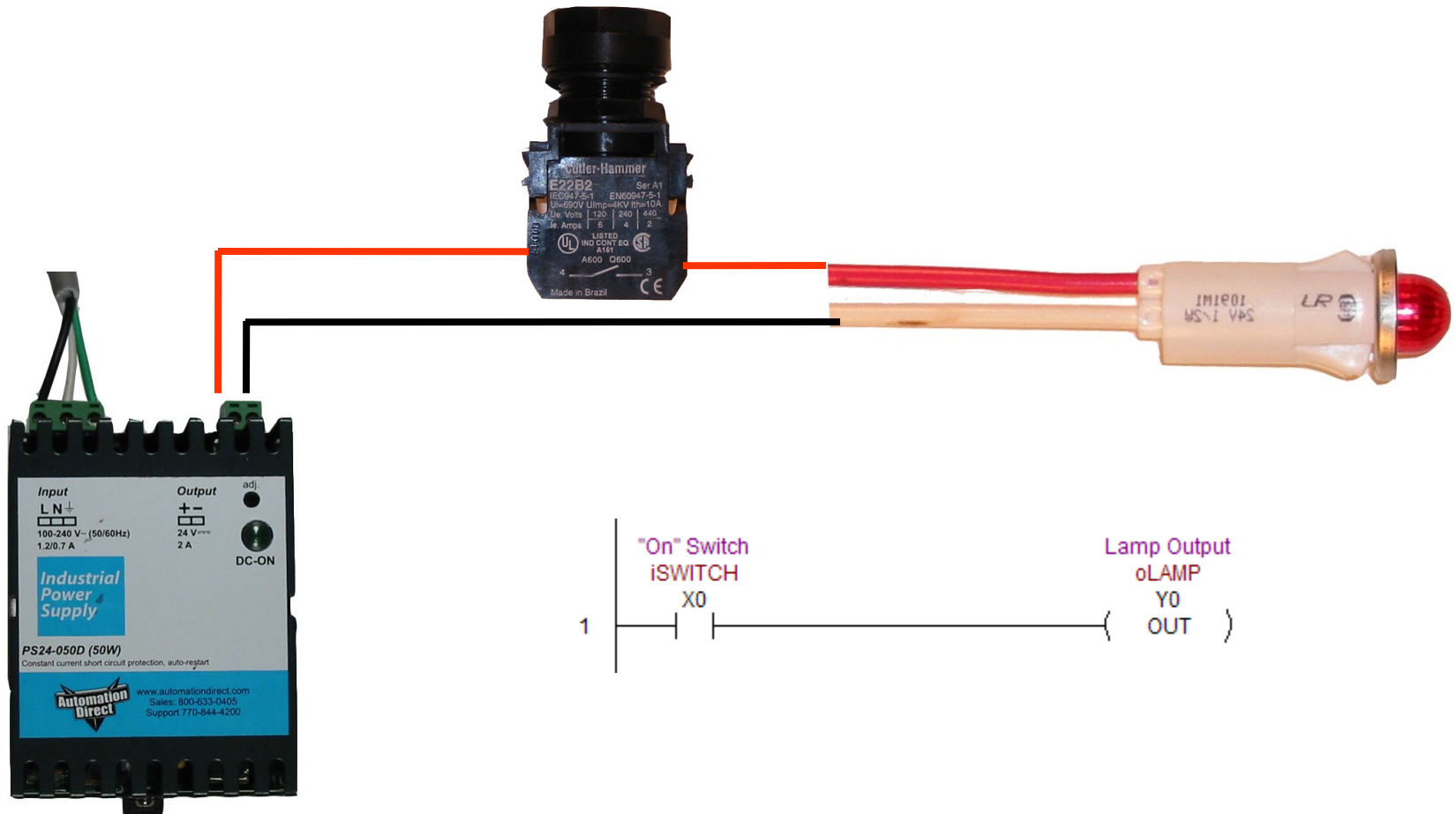
RELAYS



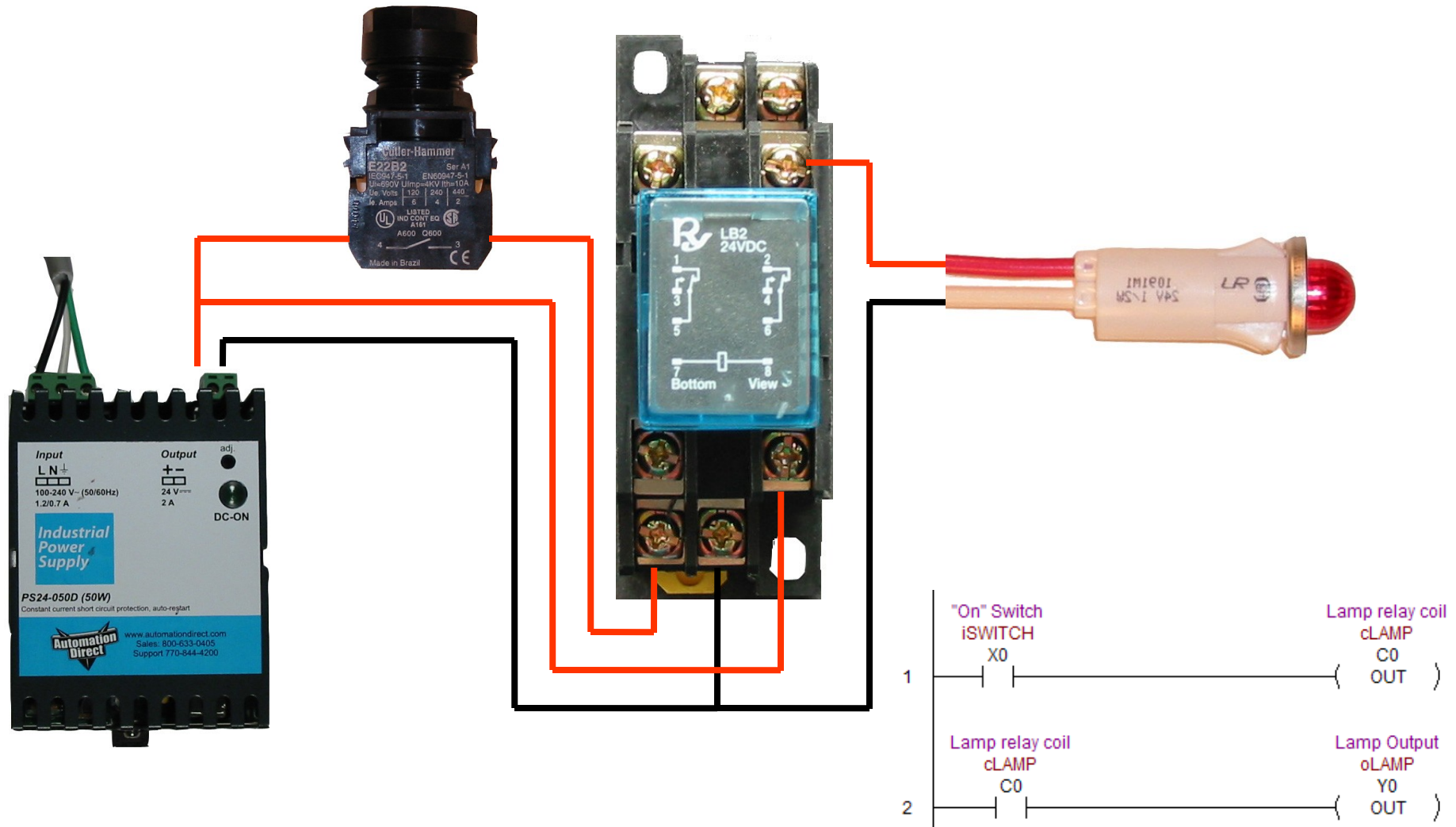
LADDER DIAGRAMS



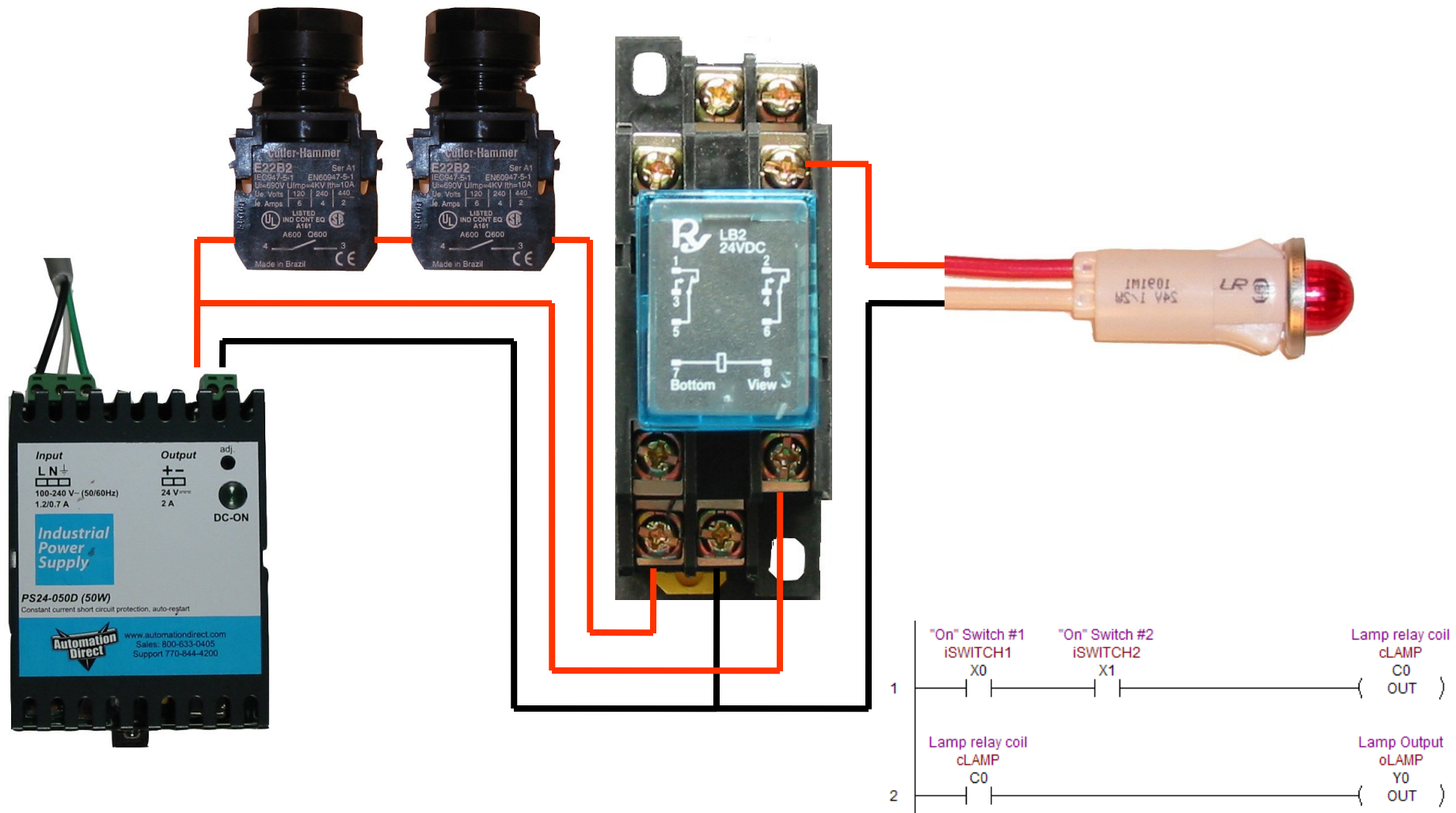
EXAMPLE – LIGHT SWITCH



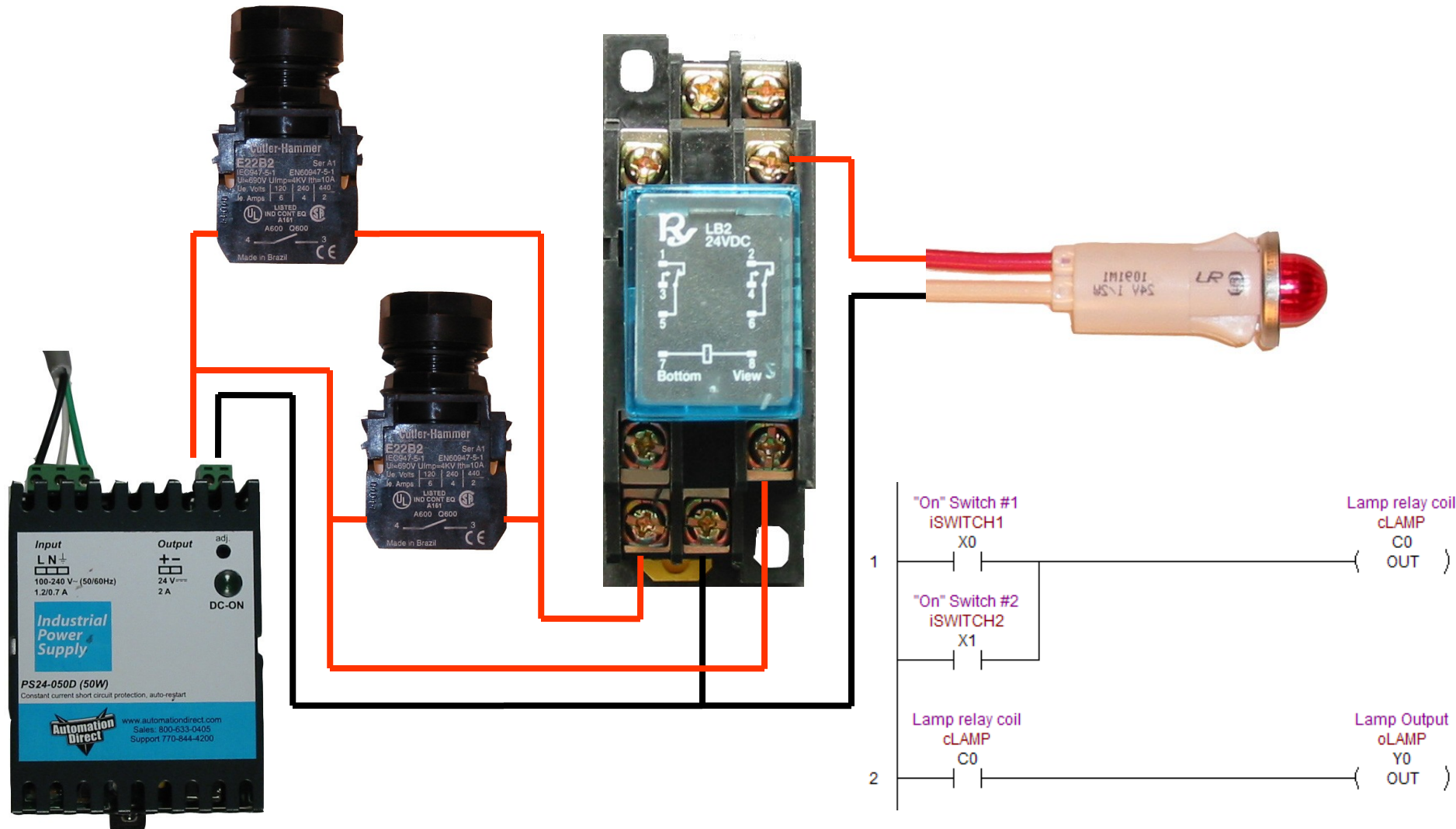
EXAMPLE – LIGHT RELAY



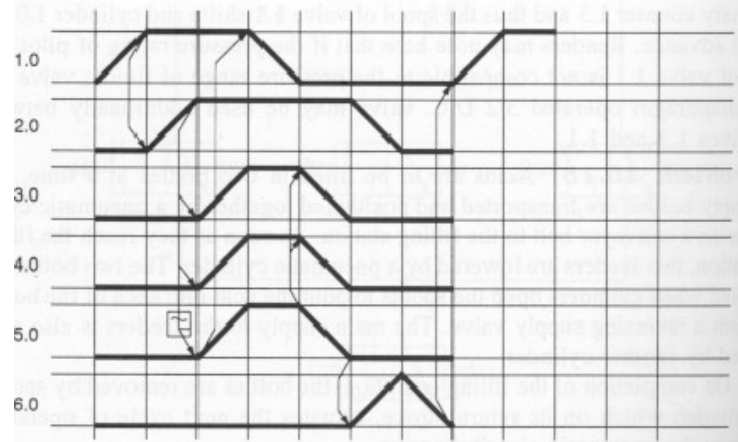
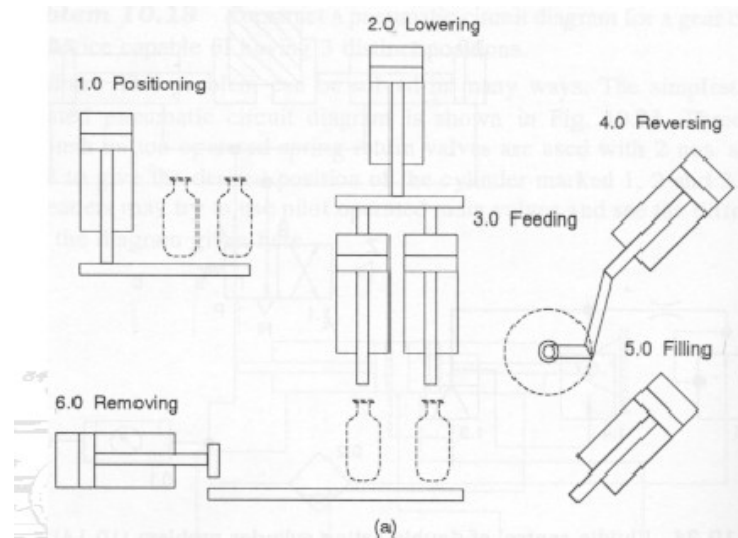
EXAMPLE – LIGHT RELAY, “AND” LOGIC



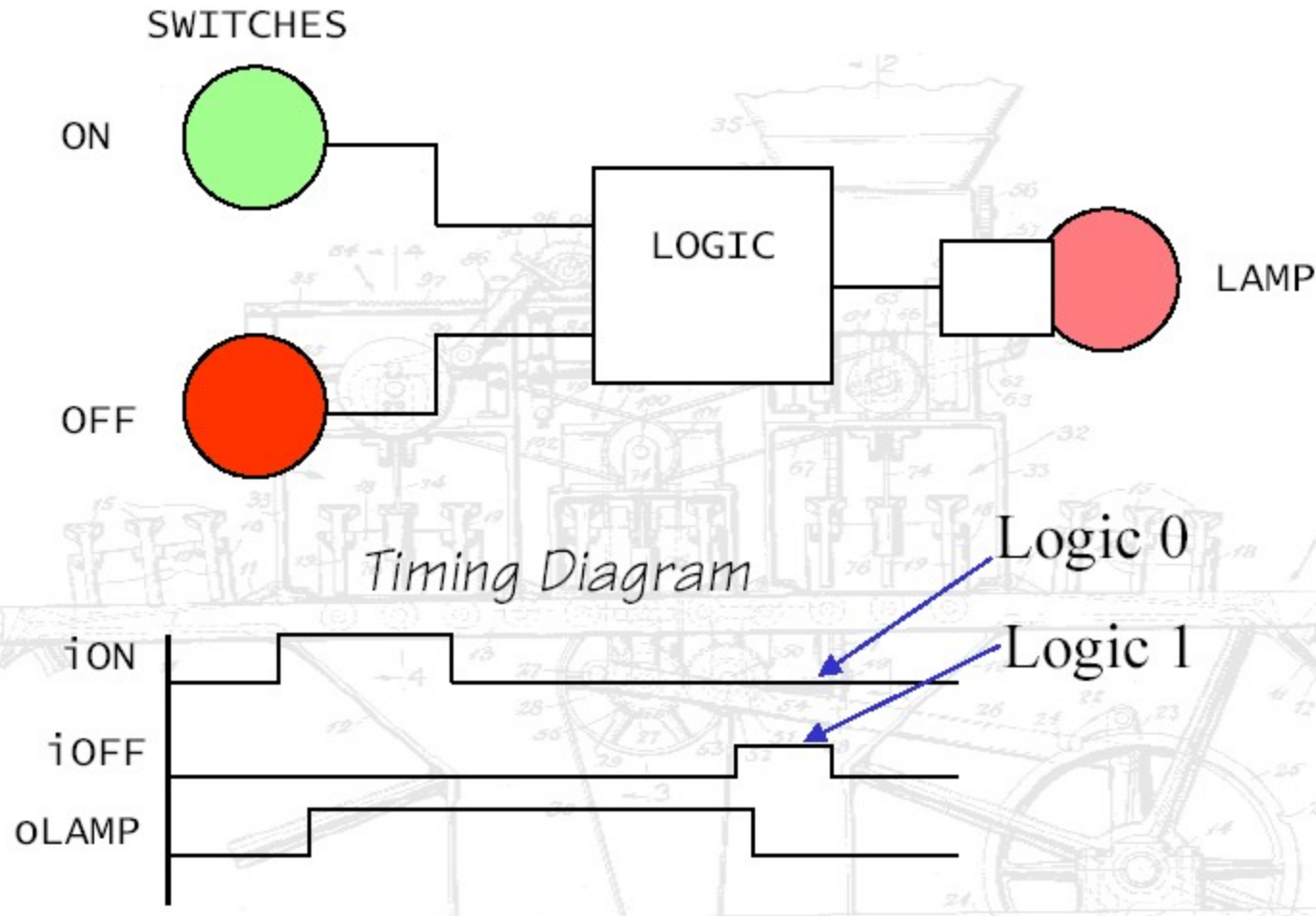
EXAMPLE – LIGHT RELAY – “OR” LOGIC



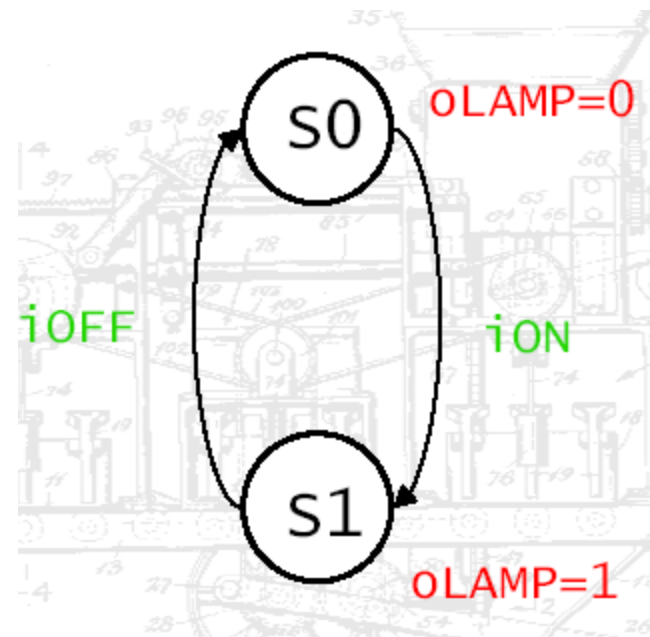
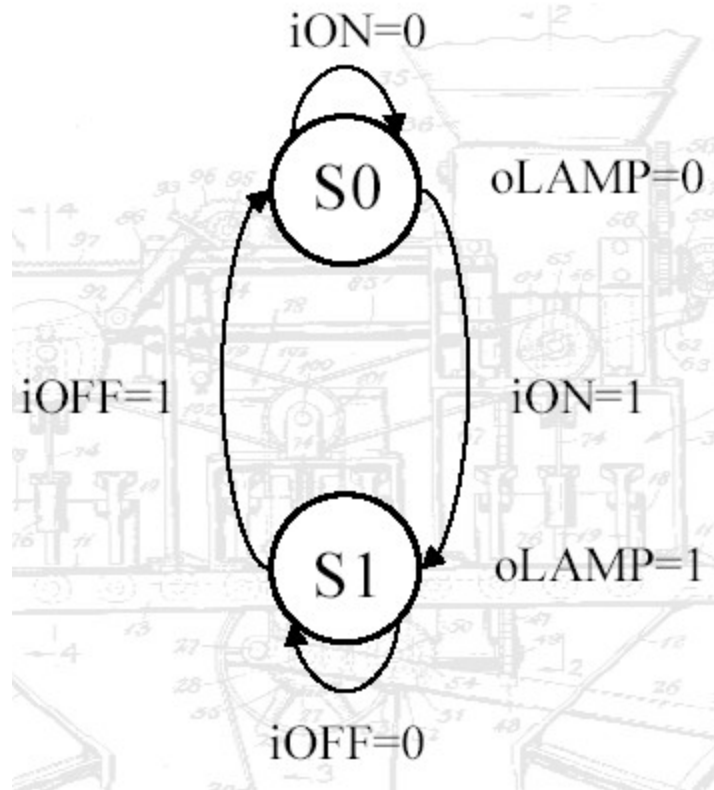
TIMING DIAGRAMS



STATE MACHINES

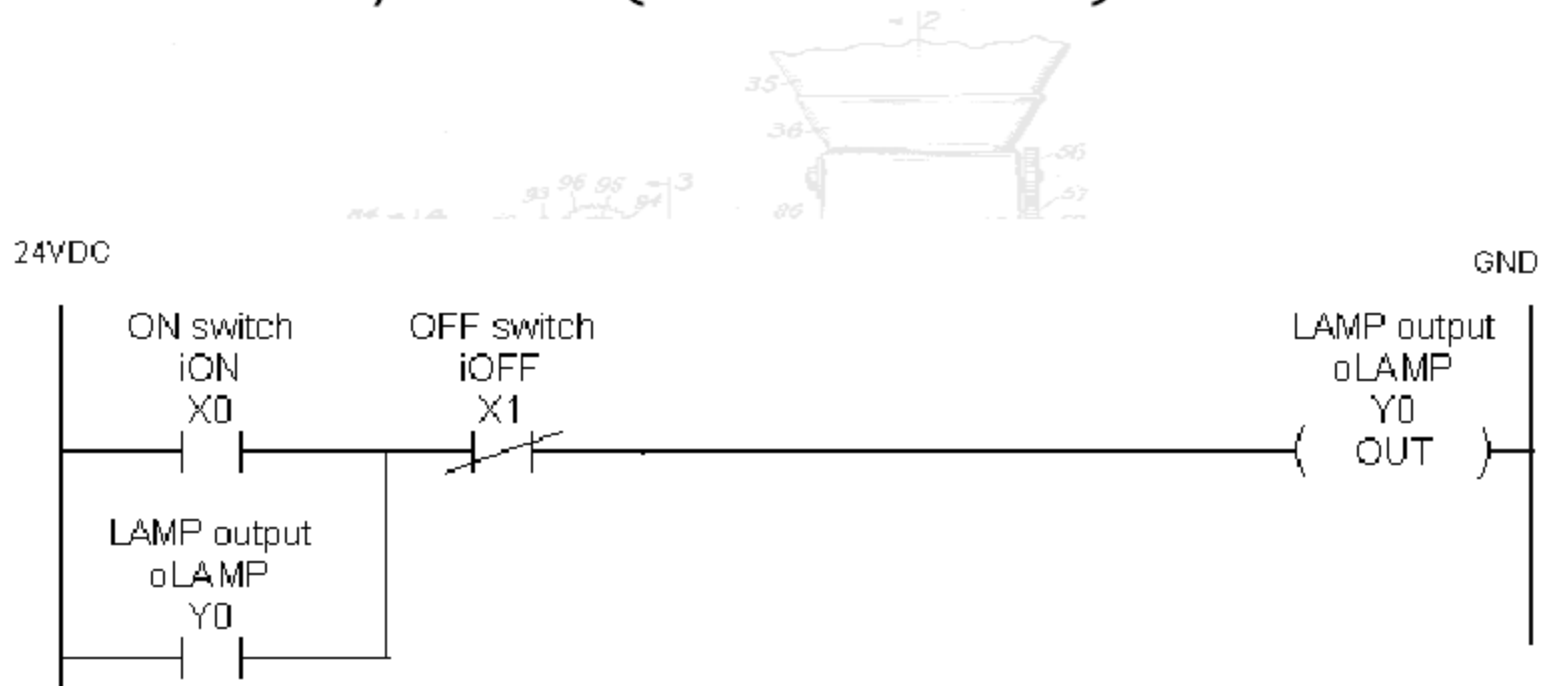


STATE DIAGRAM



LOGIC EQUATION AND LADDER DIAGRAM

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



EXAMPLE — LATCHING RELAY LOGIC

