Basic Mechatronics Workshop
Module 1:Introduction to Mechatronics

LAB-2 (Practice)

Basic concepts of control systems
(Pilot & Memory, Sequence, Time Schedule)

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LAB-2

Basic concepts of control systems
(Pilot & Memory, Sequence, Time Schedule)
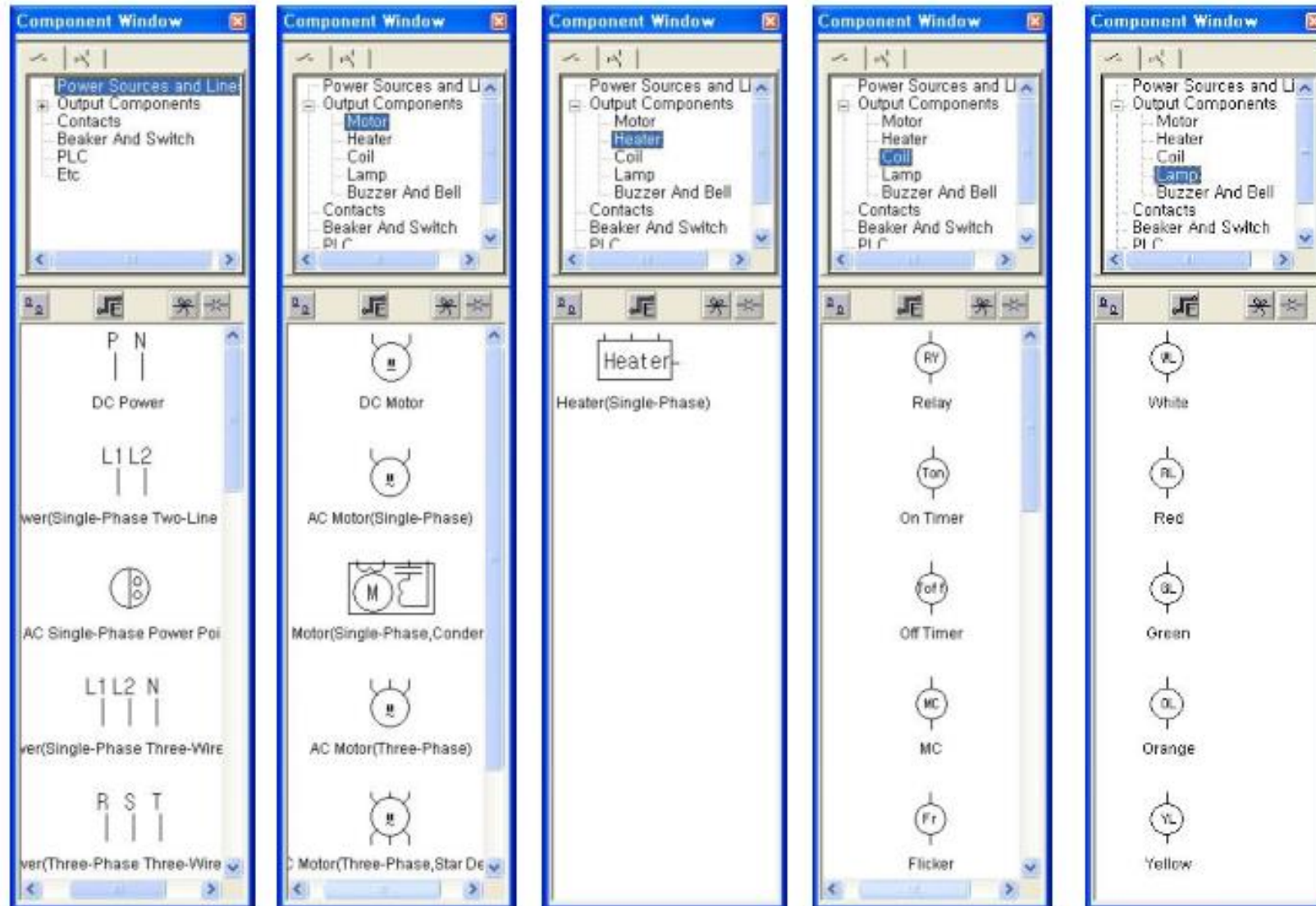### (Practice)

Tasks

Use ELCO Lab to simulate and implement the following control circuits that explained in Module 1 Chapter 2 .

1. Describe the devices, symbols, and control circuits

2. Design Pilot and Memory control circuits.

3. Describe the operation of a hand-off-automatic control switch.

4. Connect a hand-off-automatic control circuit.

5. Read and interpret sequence control schematics.

6. Convert a sequence control schematic into a wiring diagram.

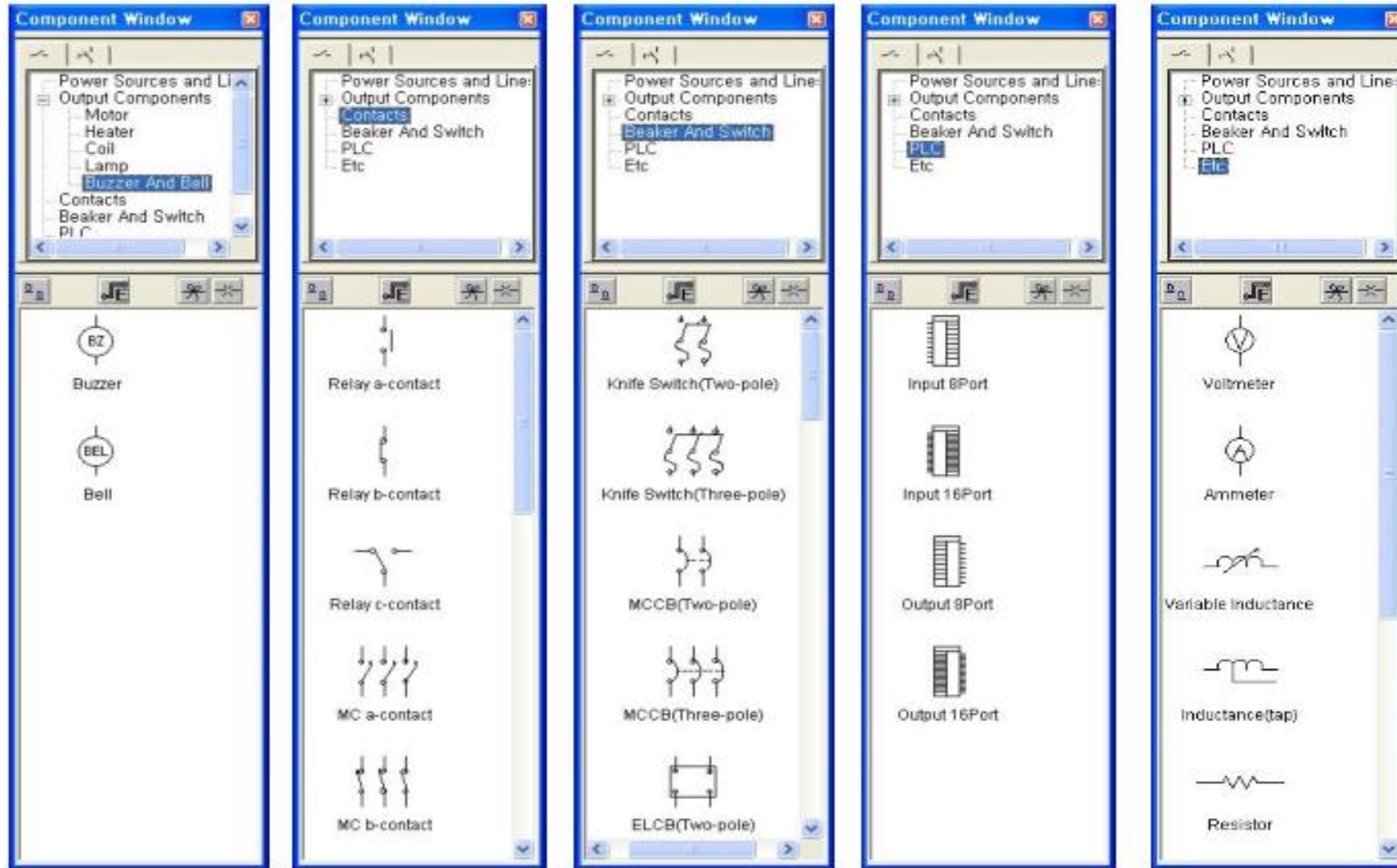7. Connect a sequence control circuit.

Devices, symbols, and circuits

Electric Sequence Components

⊙ Electric component list(KS)
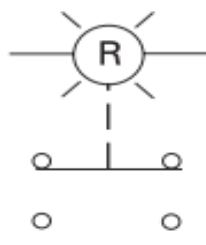
Electric Sequence Components

Devices and symbols
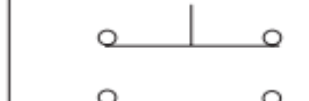

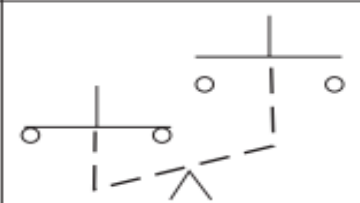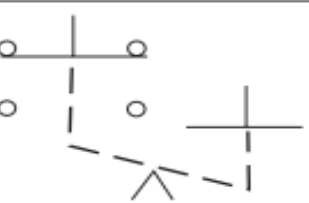| Switches				
Disconnect	Circuit Interrupter	Circuit Breaker W/Thermal O.L.	Circuit Breaker W/Magnetic O.L.	Circuit Breaker W/Thermal and Magnetic O.L.

Limit Switches		Foot Switches	Pressure and Vacuum Switches		Liquid Level Switches	
Normally Open	Normally Closed	NO	NC	NO	NC	NO
Held Closed	Held Open	NC	Temperature Actuated Switches		Flow Switches (Air, Water, Etc.)	

Speed (Plugging)		Anti-Plug	Selector			
F	F	F	2 Position	3 Position	2 Pos. Sel. Pushbutton	
R	R		J K	J K L	A B	

2 Position

J ↘ K

o ─── o A1

o ─── o A2

	J	K
A1	X	
A2		X

X - Contact Closed

3 Position

J   K   L

o ─── o A1

o ─── o A2

	J	K	L
A1		X	
A2			X

X - Contact Closed

2 Pos. Sel. Pushbutton

A ↘ B

1o ─── o2

3o   o4

Contacts	Selector Position			
	A		B	
	Button		Button	
	Free	Depres'd	Free	Depres'd
1-2	X			
3-4		X	X	X
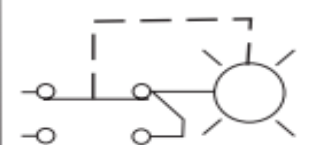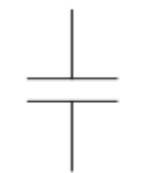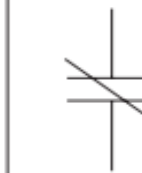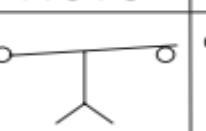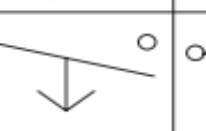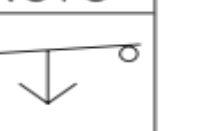
Devices and symbols

Pushbuttons

Momentary Contact				Maintained Contact		Illuminated
Single Circuit		Double Circuit	Mushroom Head	Wobble Stick	Two Single Circuit	One Double Circuit
NO	NC	NO & NC				

Pilot Lights / Contacts
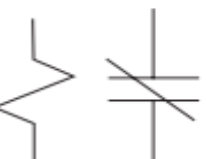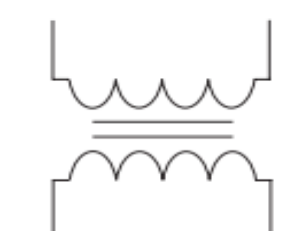
Indicate Color by Letter		Instant Operating				Timed Contacts – Contact Action
Non Push-to-Test	Push-to-Test	With Blowout		Without Blowout		Retarded After Coil Is:
		NO	NC	NO	NC	Energized	Deenergized

Timed Contacts columns: NOTC | NCTO | NOTO | NCTC

Coils / Overload Relays / Inductors / Transformers
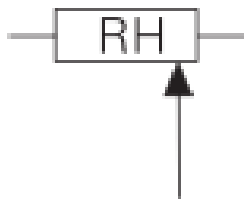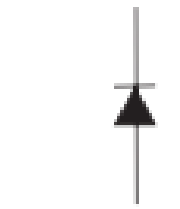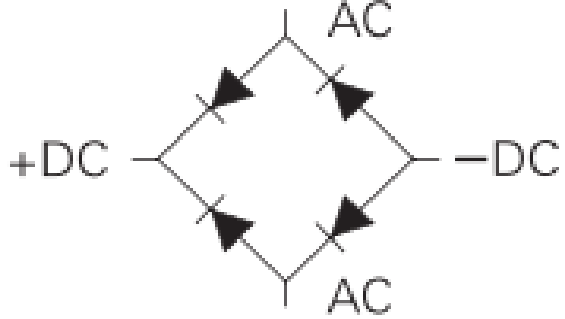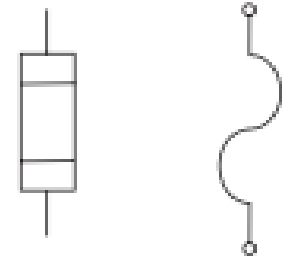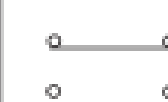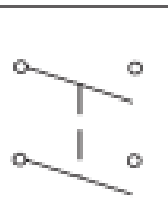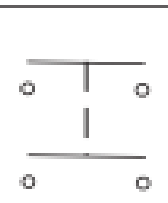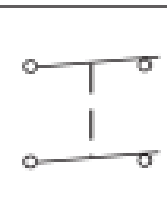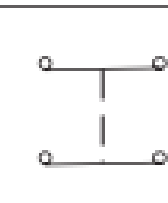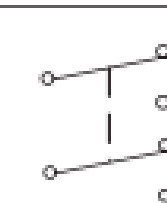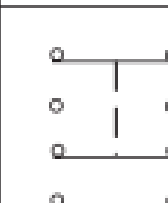
Coils	Overload Relays		Inductors		Transformers			
Shunt	Thermal	Magnetic	Iron Core	Auto	Iron Core	Air Core		Dual Voltage
Series			Air Core	Current				

Devices and symbols

AC Motors			Schematic Wiring				Battery
Single Phase	Three-Phase Squirrel Cage	Wound Rotor	Not Connected	Connected	Power	Control	

DC Motors				Meter	Meter Shunt	Wiring Terminal	Connections
Armature	Shunt Field	Series Field	Comm. or Compens. Field	Indicate Type by Letter			Mechanical
	(Show 4 Loops)	(Show 3 Loops)	(Show 2 Loops)		Ground		Mechanical Interlock
Annunciator	Bell	Buzzer	Horn Siren, Etc.				
					Capacitors		
					Fixed		Adjustable

Devices and symbols

Resistors				Half Wave Rectifier	Full Wave Rectifier	Fuse
Fixed	Heating Element	Adj. By Fixed Taps	Rheostat Pot Or Adj. Tap			Power or Control
─[RES]─	─[H]─	─[RES]─	─[RH]─	◄ (diode)	AC / +DC ◇ −DC / AC (bridge)	(fuse symbols)

Supplementary Contact Symbols

SPST NO		SPST NC		SPDT		Terms	
Single Break	Double Break	Single Break	Double Break	Single Break	Double Break	SPST	Single-Pole Single-Throw
(contact)	(contact)	(contact)	(contact)	(contact)	(contact)	SPDT	Single-Pole Double-Throw
DPST 2 NO		**DPST 2 NC**		**DPDT**		DPST	Double-Pole Single-Throw
Single Break	Double Break	Single Break	Double Break	Single Break	Double Break	DPDT	Double-Pole Double-Throw
(contact)	(contact)	(contact)	(contact)	(contact)	(contact)	NO	Normally Open
						NC	Normally Closed

Hard-wired control systems
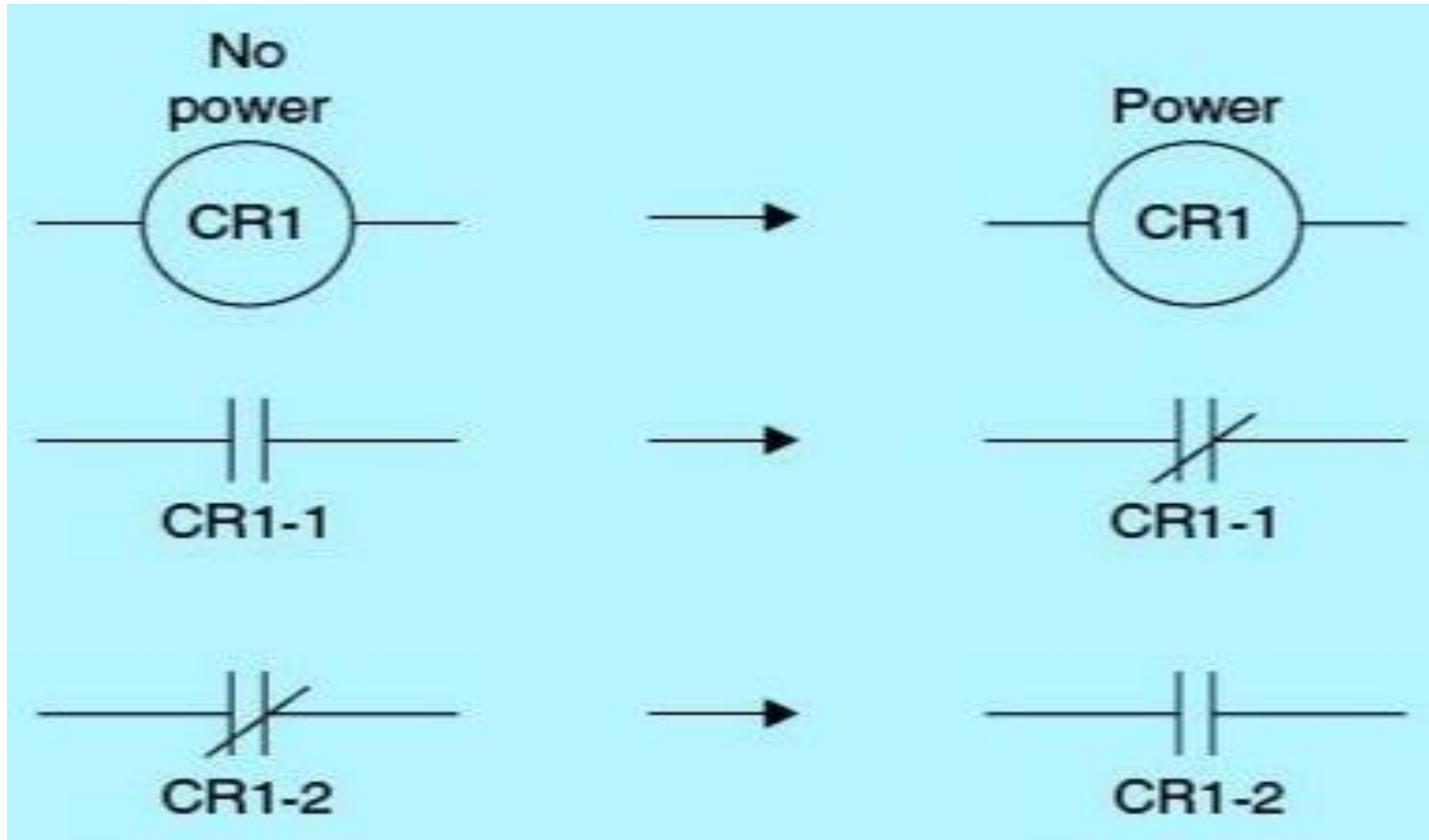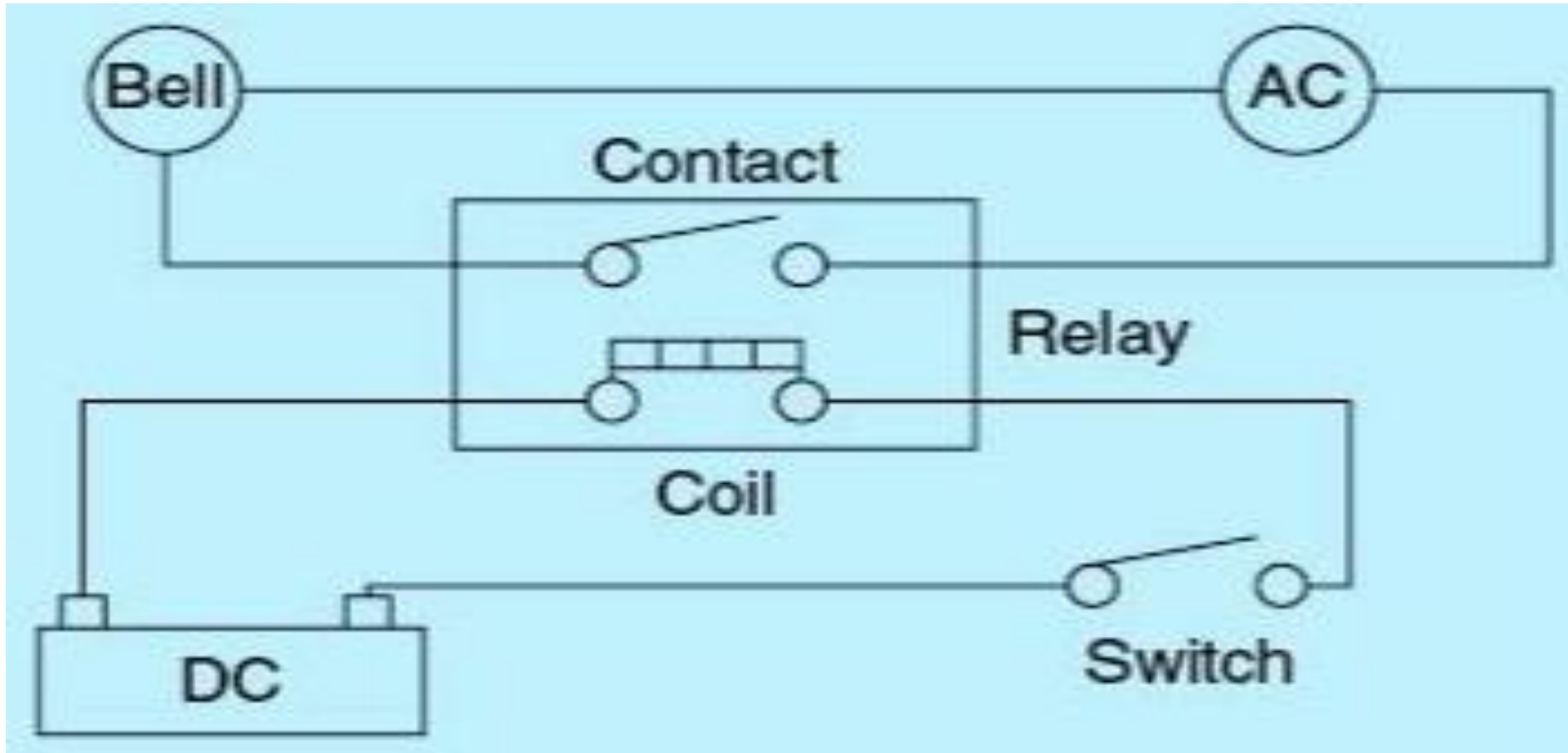
Conventional Relays
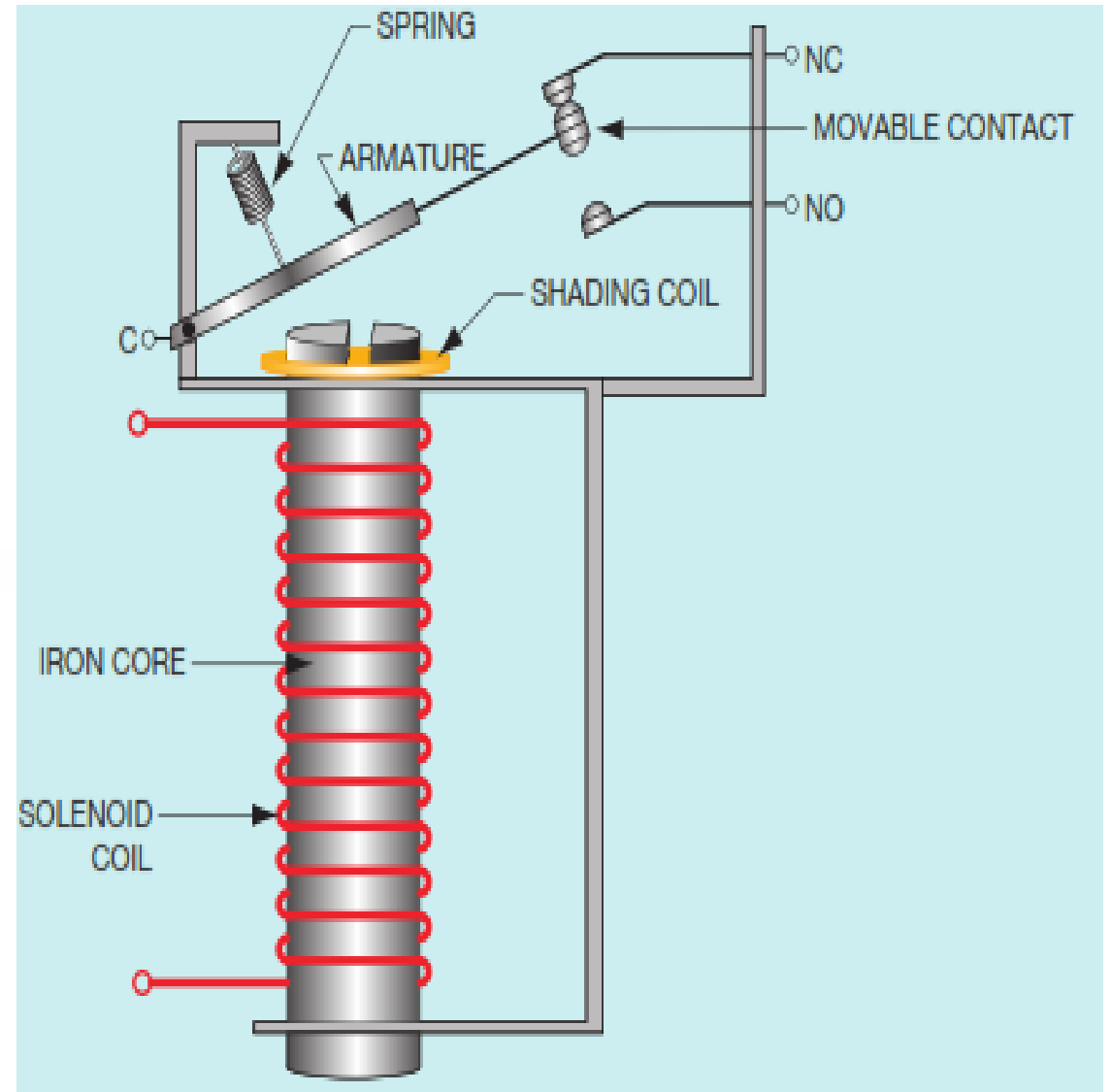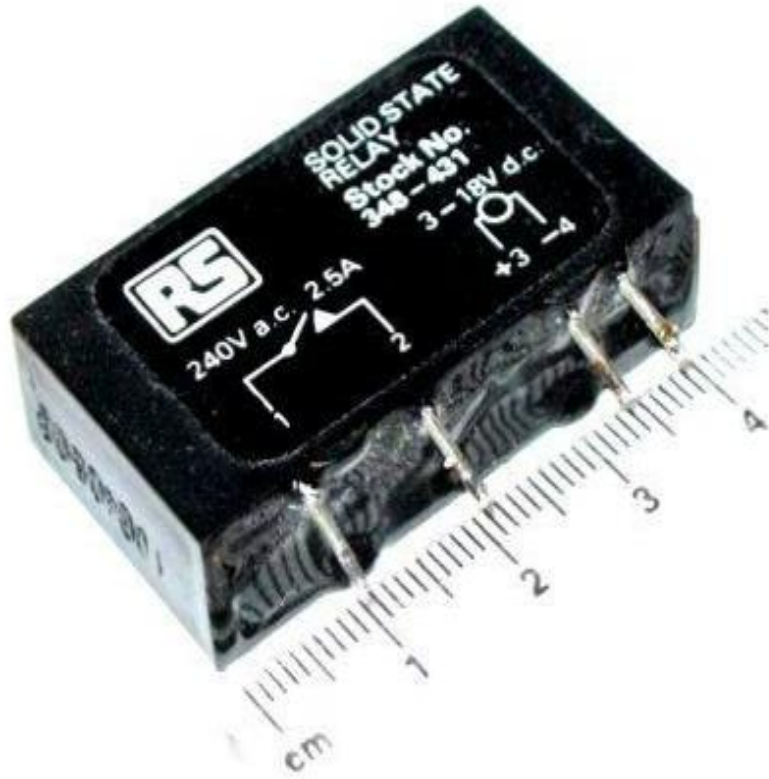
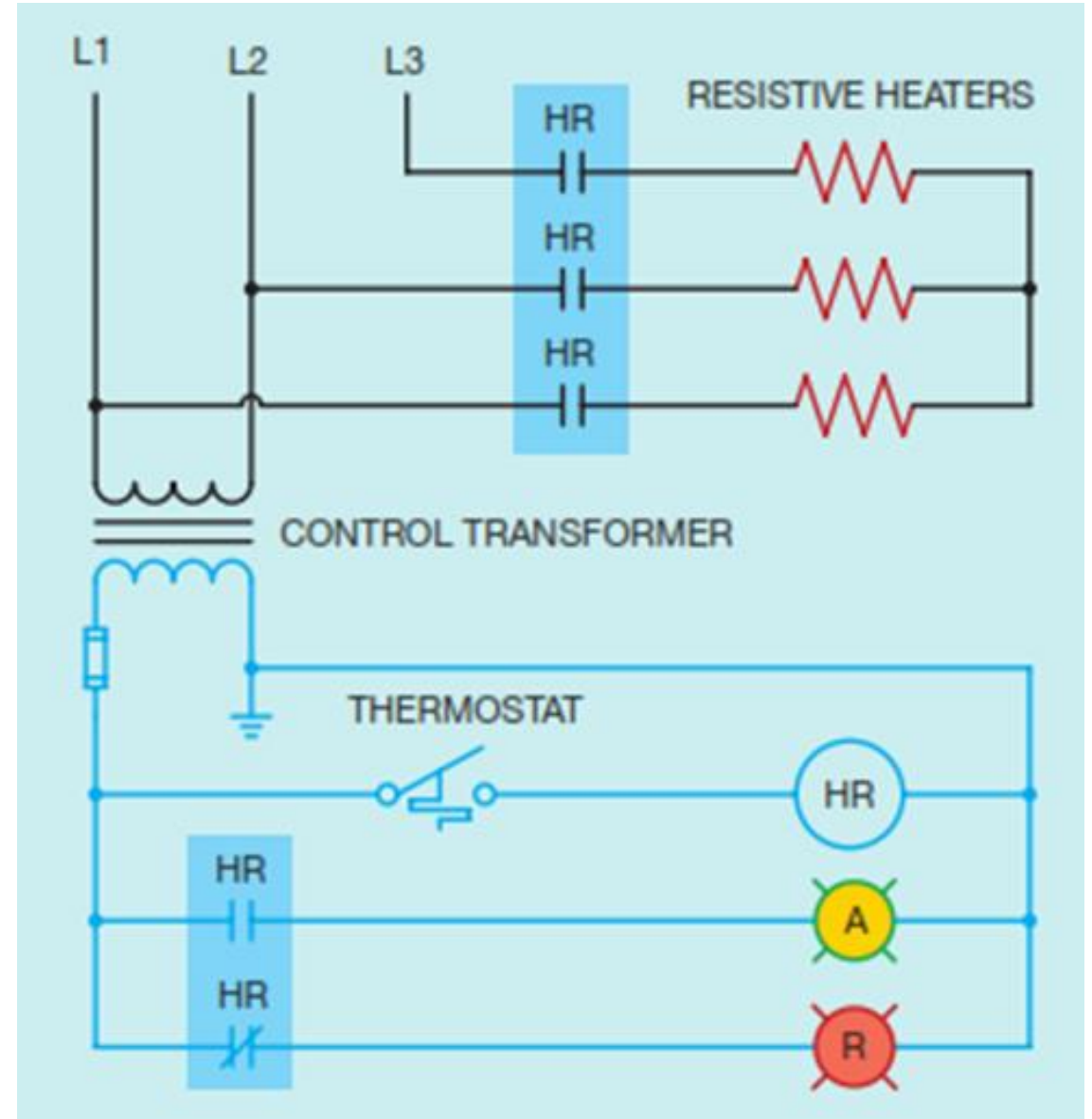# *Hard-wired control systems*

Conventional Relays

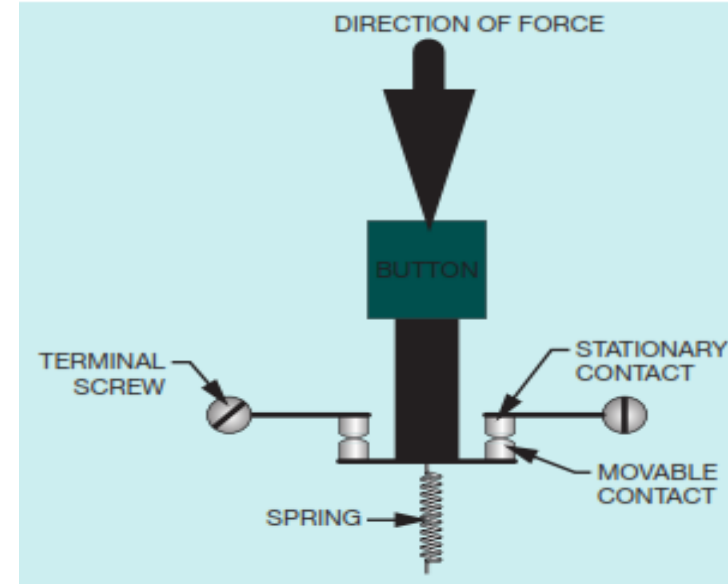# *Hard-wired control systems*

Simple relay circuit.

Hard-wired control systems

Contactors

Push Buttons

DIRECTION OF FORCE

BUTTON

MOVABLE CONTACT

TERMINAL SCREW

STATIONARY CONTACT

SPRING

DIRECTION OF FORCE

BUTTON

TERMINAL SCREW

STATIONARY CONTACT

MOVABLE CONTACT

SPRING

NORMALLY OPEN PUSH BUTTON
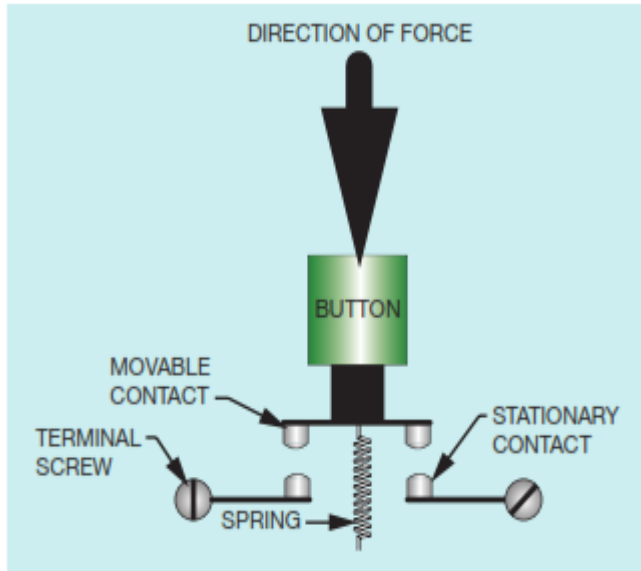
MOVABLE CONTACT

STATIONARY CONTACTS
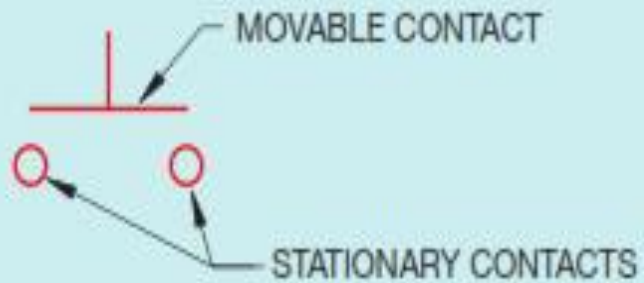
NORMALLY OPEN PUSH BUTTONS ARE DRAWN WITH THE MOVABLE CONTACT ABOVE AND NOT TOUCHING THE STATIONARY CONTACTS.

NORMALLY CLOSED PUSH BUTTON

MOVABLE CONTACT

STATIONARY CONTACTS
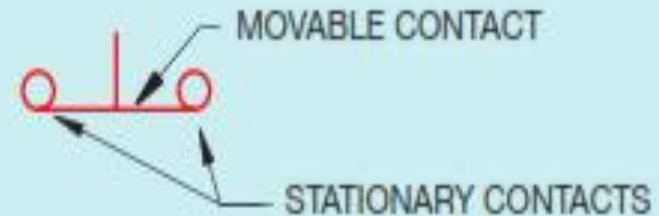
NORMALLY CLOSED PUSH BUTTONS ARE DRAWN WITH THE MOVABLE CONTACT BELOW AND TOUCHING THE STATIONARY CONTACTS.

Double-Acting Push Buttons
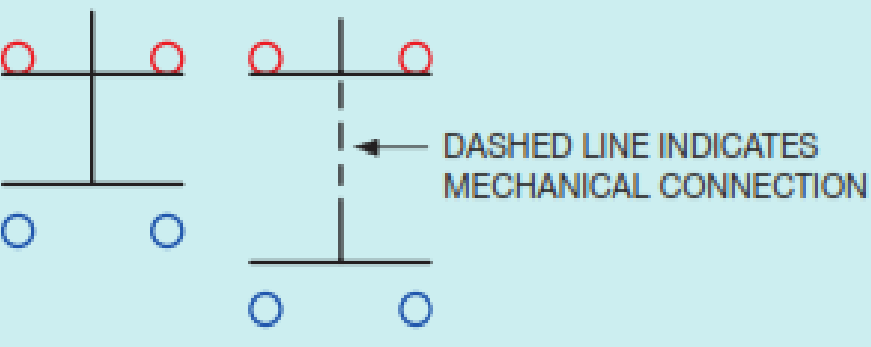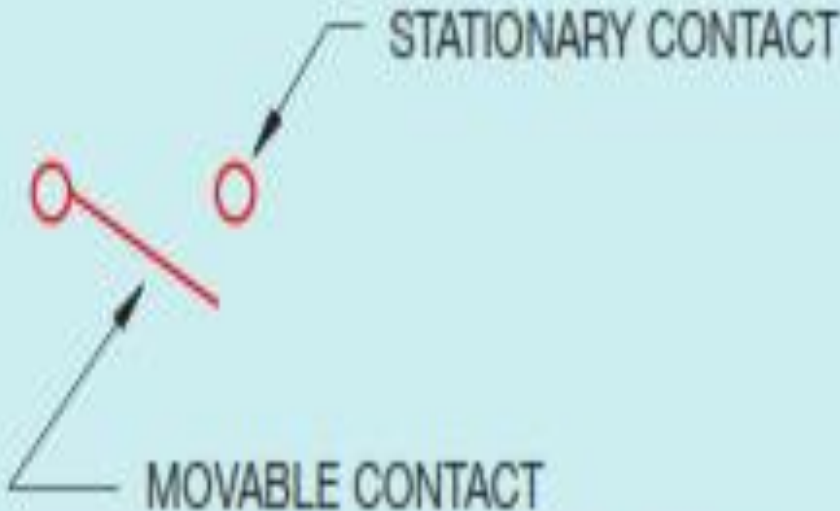

DIRECTION OF FORCE

BUTTON

NC   NC

MOVABLE
CONTACT

NO   SPRING   NO

NORMALLY CLOSED CONTACTS

NORMALLY OPEN CONTACTS

DASHED LINE INDICATES
MECHANICAL CONNECTION
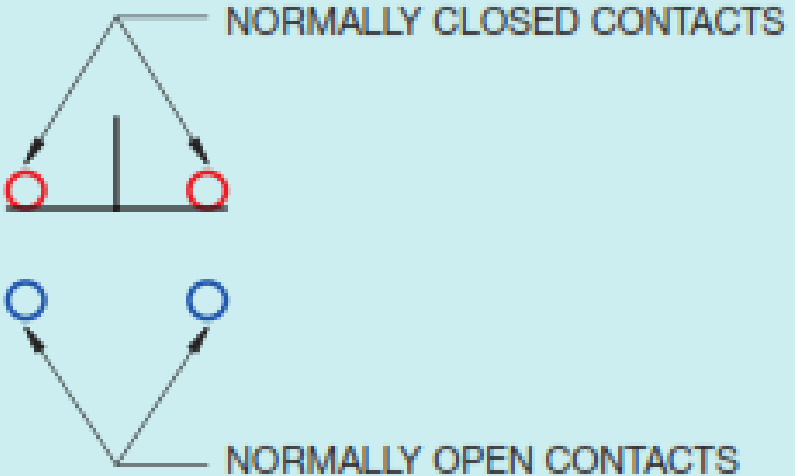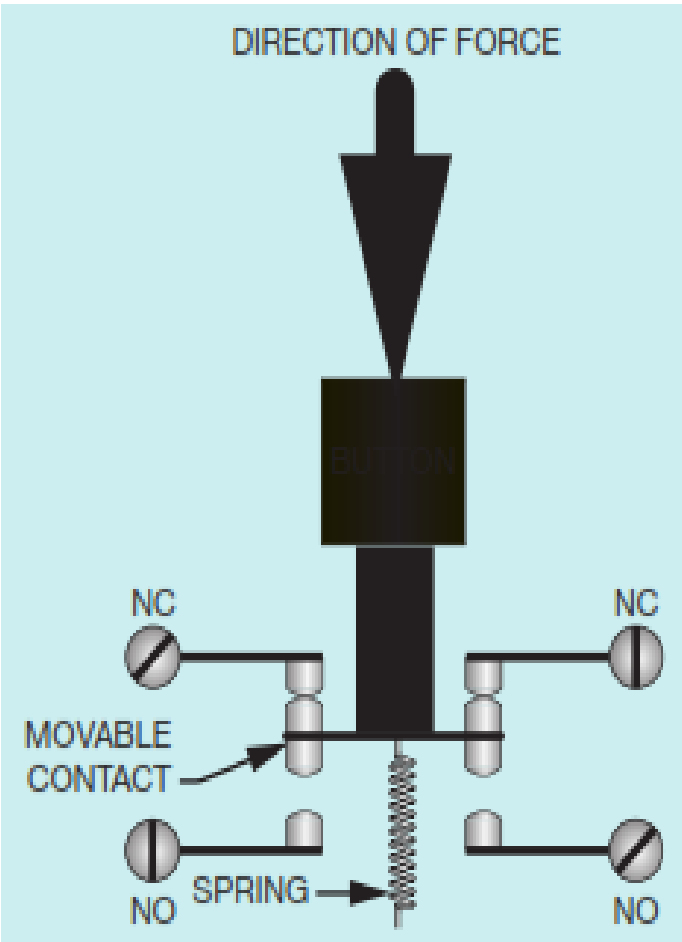
Switch Symbols

NORMALLY OPEN SWITCH

STATIONARY CONTACT
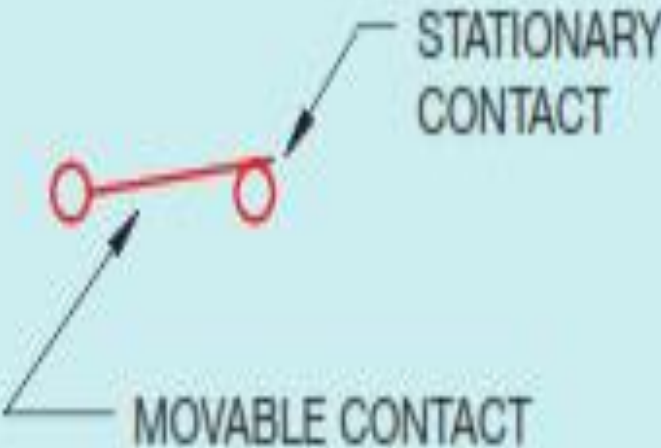
MOVABLE CONTACT

THE MOVABLE CONTACT IS DRAWN BELOW
AND NOT TOUCHING THE STATIONARY CONTACT

NORMALLY CLOSED SWITCH

STATIONARY CONTACT

MOVABLE CONTACT

THE MOVABLE CONTACT IS DRAWN ABOVE
AND TOUCHING THE STATIONARY CONTACT

Hard wired control systems consist of three division

1. **Input section** – Consists of pushbuttons, switches and sensors. They transfer signals to the processing section

2. **Processing section –**Consists of relay coils and contacts. They determined the relationship between the inputs received and outputs required

3. **Output section –**Consists of solenoids, lamps, and contactor coils etc. The processed signals are transferred to this section.
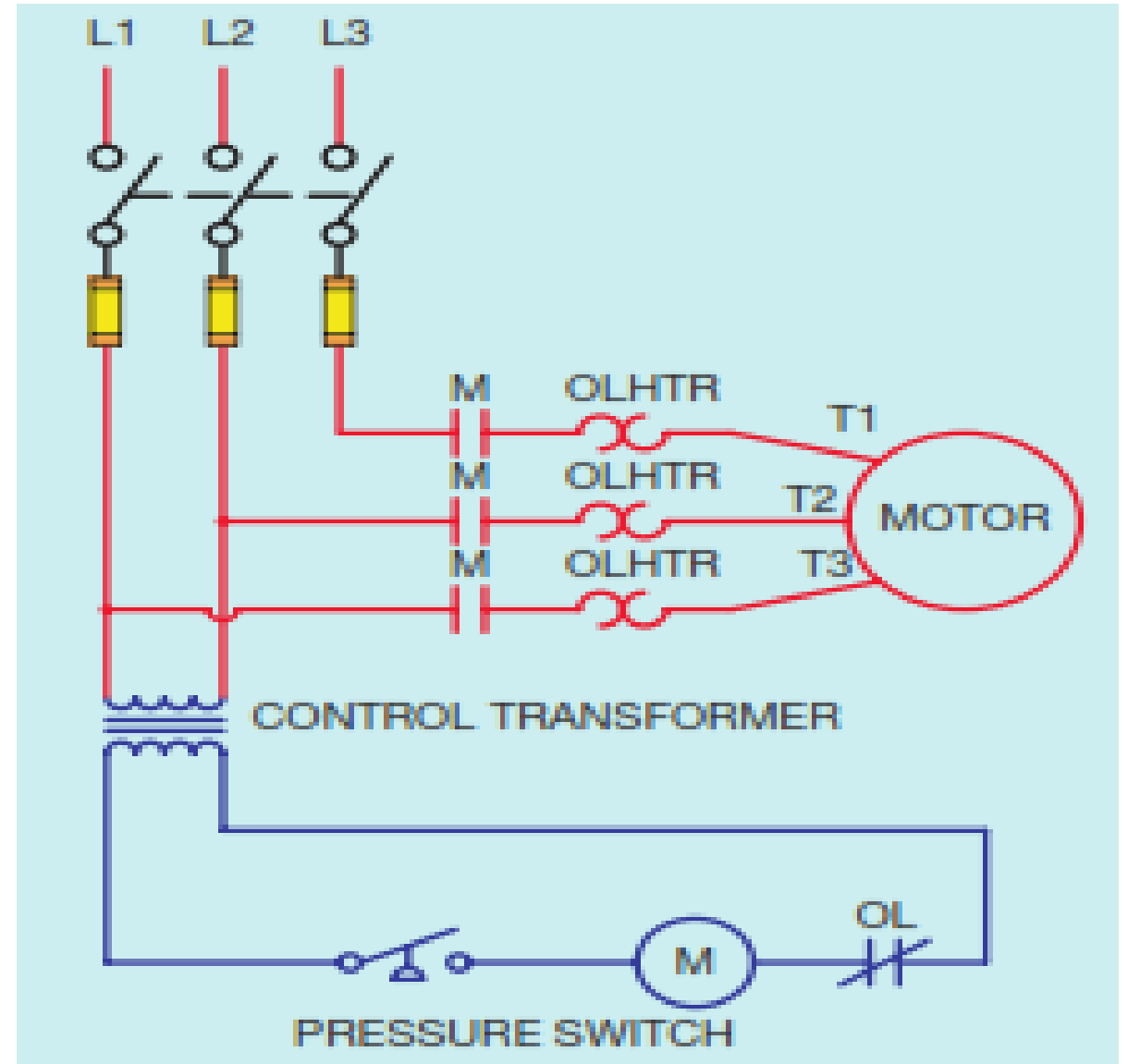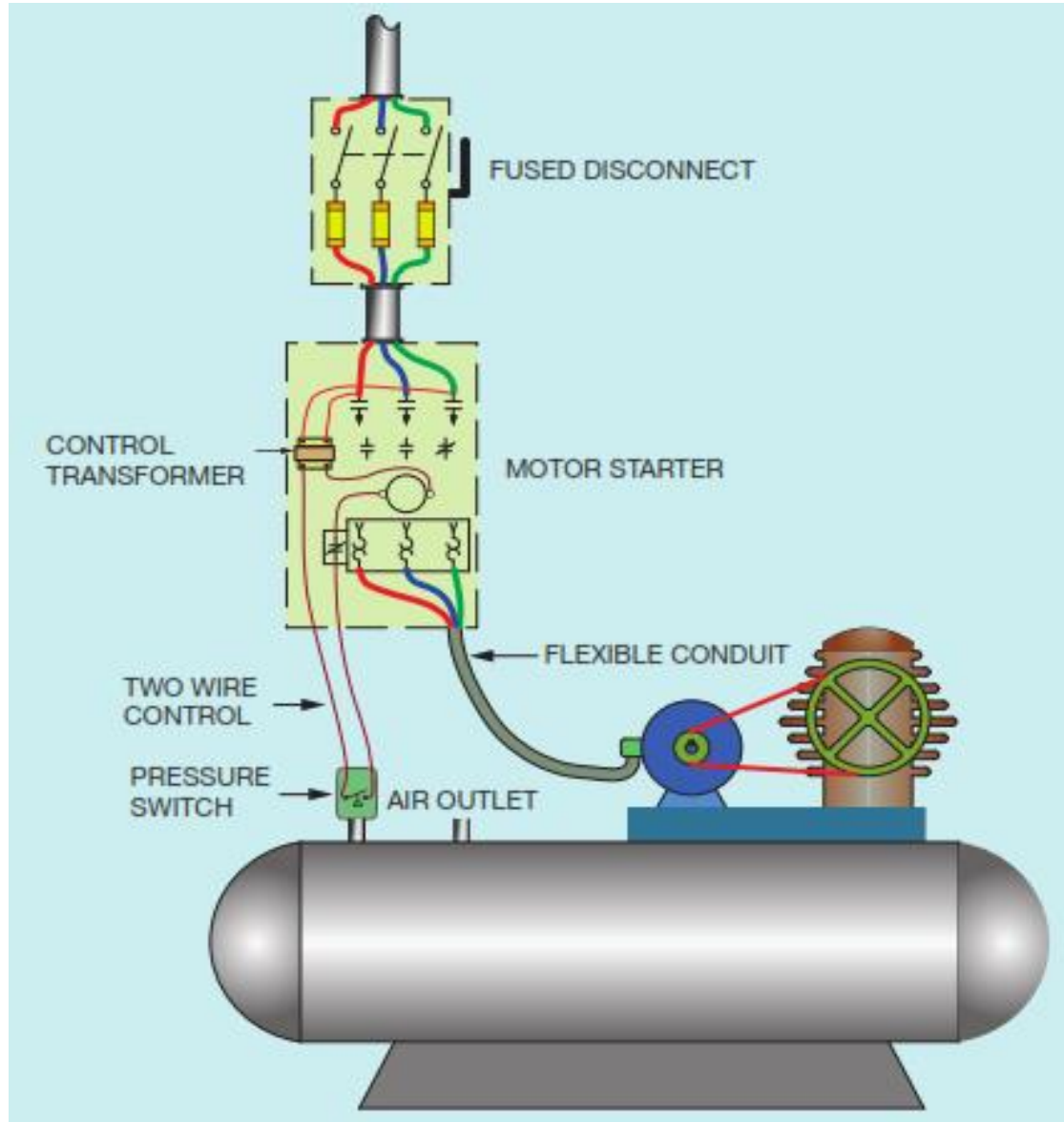
Hard-wired control systems
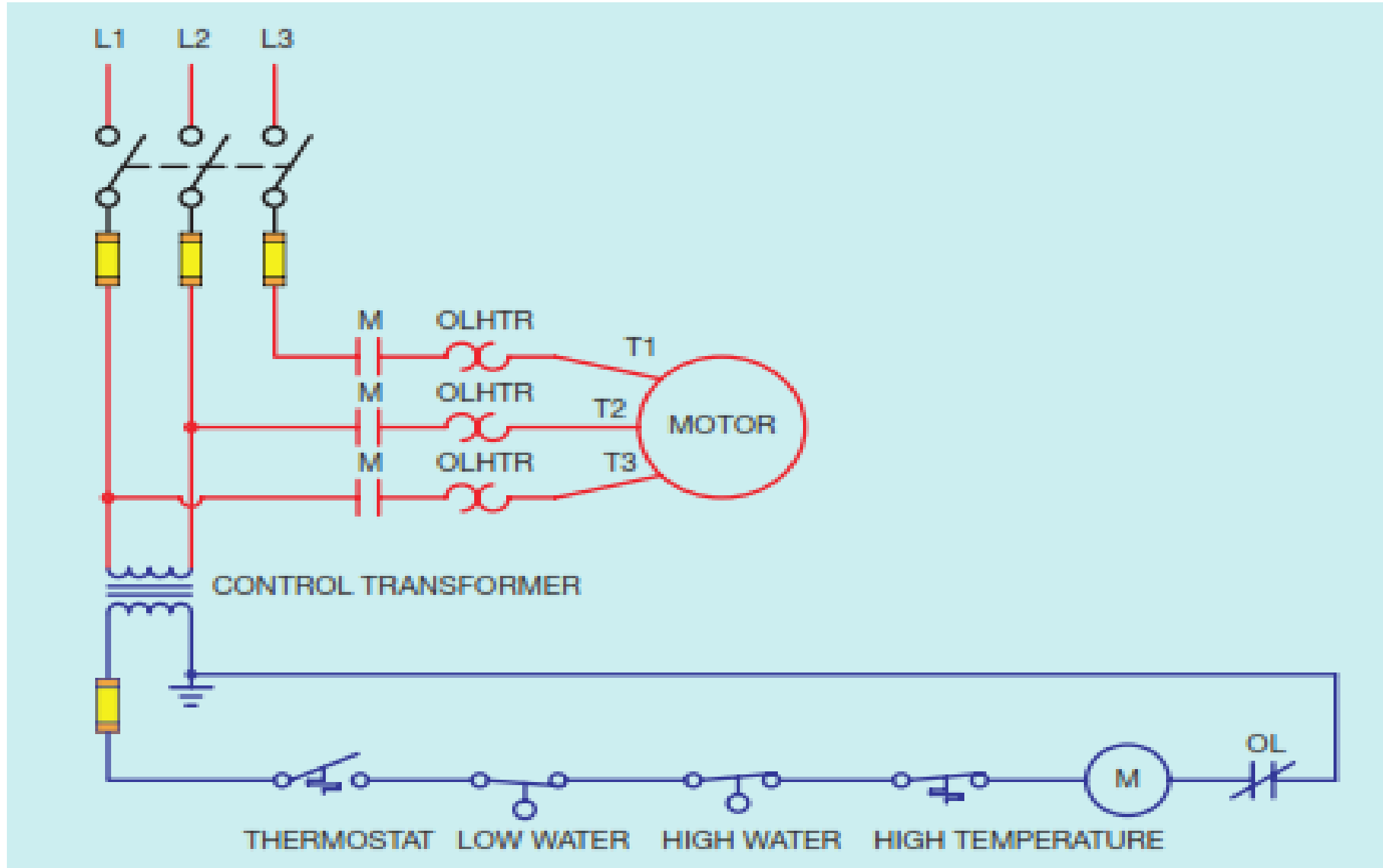# Simple control circuits

(a) (b) (c)
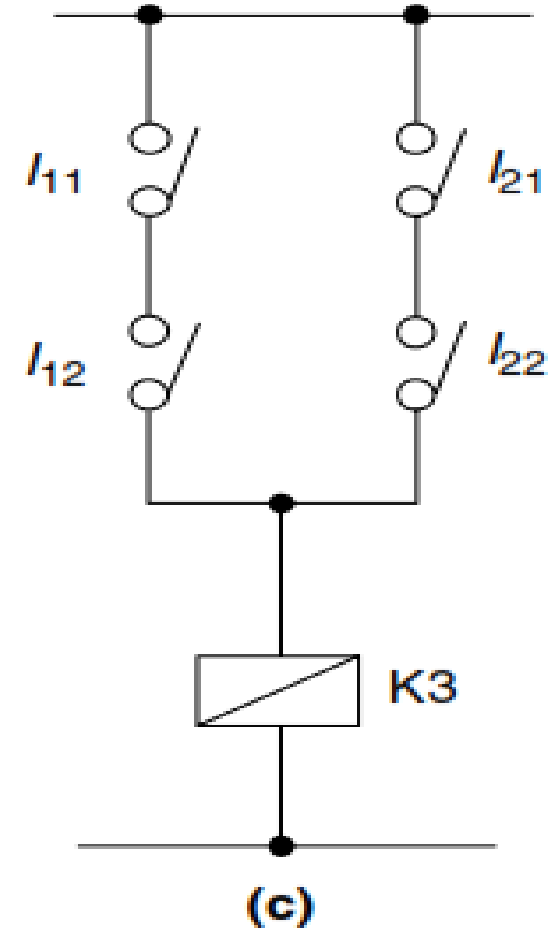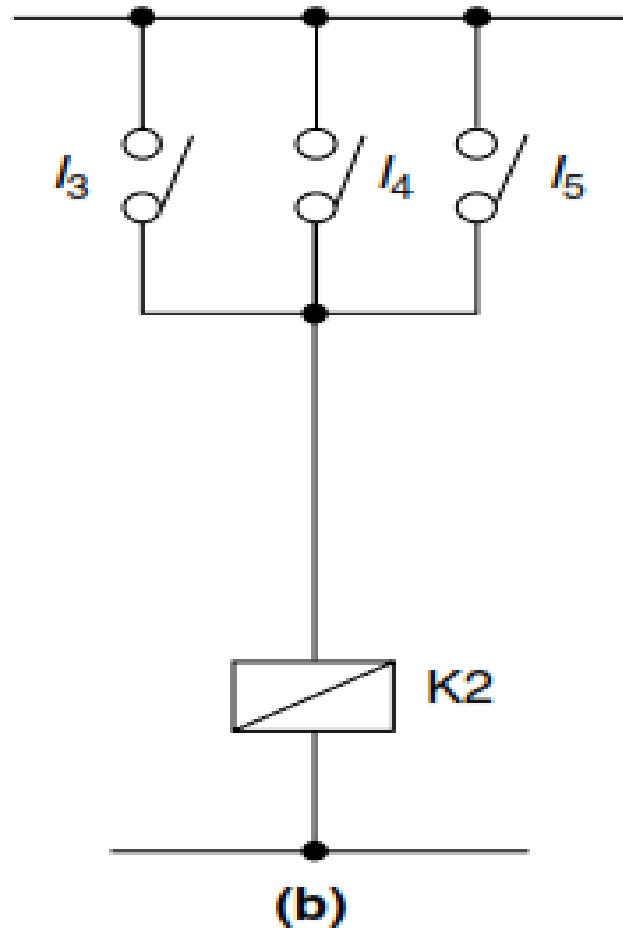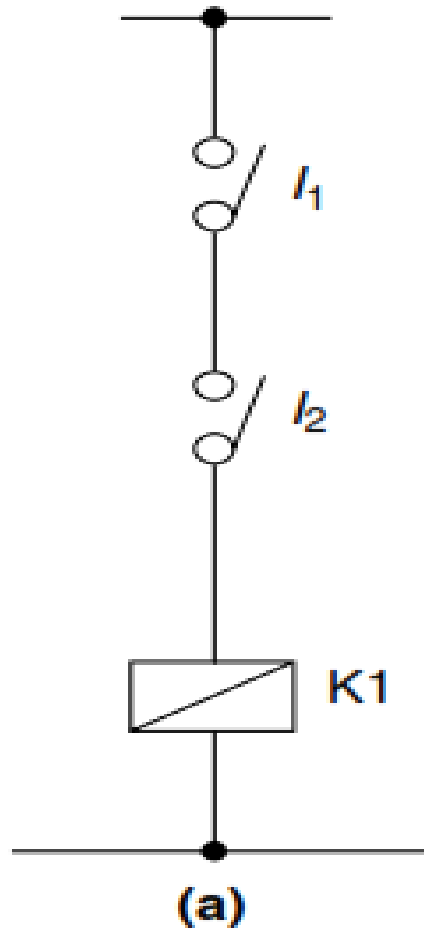
Basic Control Circuits

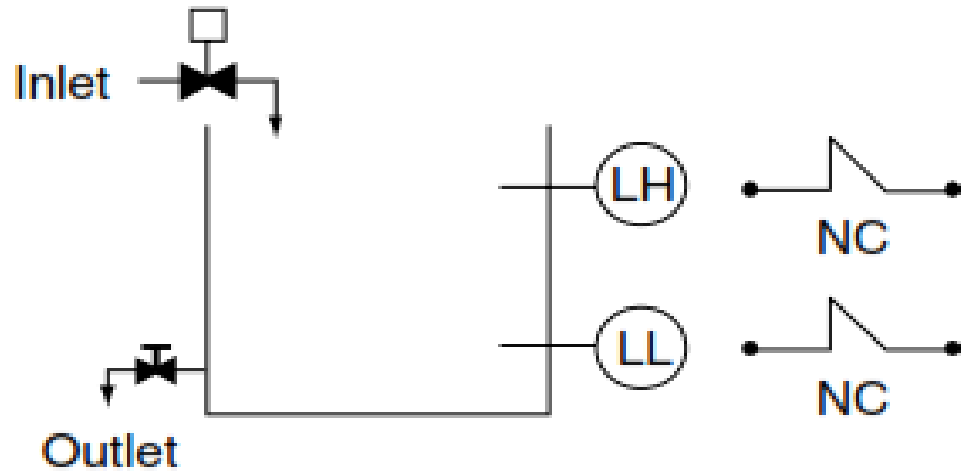The motor starter is controlled by running two wires to a pressure switch.
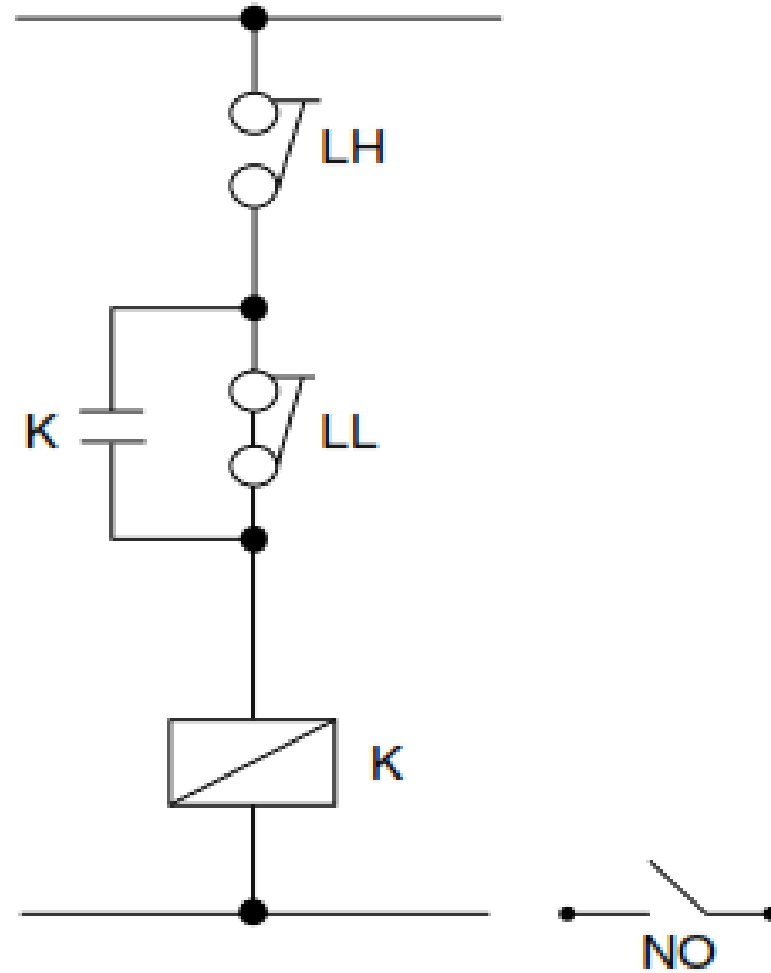
Basic Control Circuits

Two-wire control circuits may contain any number of external sensing devices.

# Example of simple control circuit for water tank inlet valve operation

Inlet

LH

LL

Outlet

NC

NC

Assume: both LH & LL as NC
(when level is below switch)

LH

K

LL

K

NO

Same NO contact is used
to drive the inlet relay coil

Basic Control Circuits

Three wires are required to control a starter with momentary contact devices, such as push buttons.

THREE WIRES ARE
REQUIRED TO CONTROL
THE STARTER.

L1 L2 L3

M   OL

M   OL

M   OL

MOTOR

CONTROL
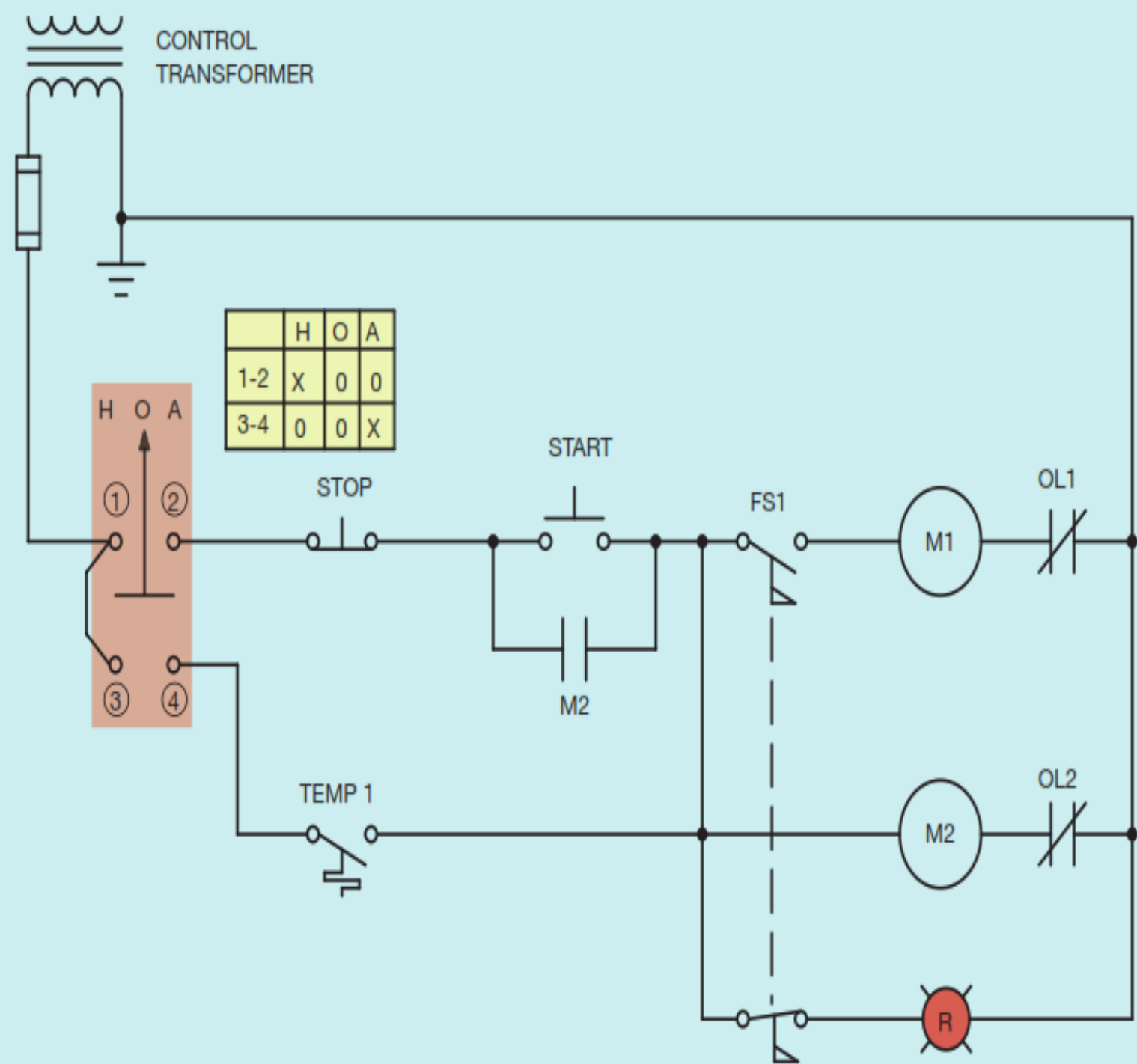TRANSFORMER

STOP   START   OL

M
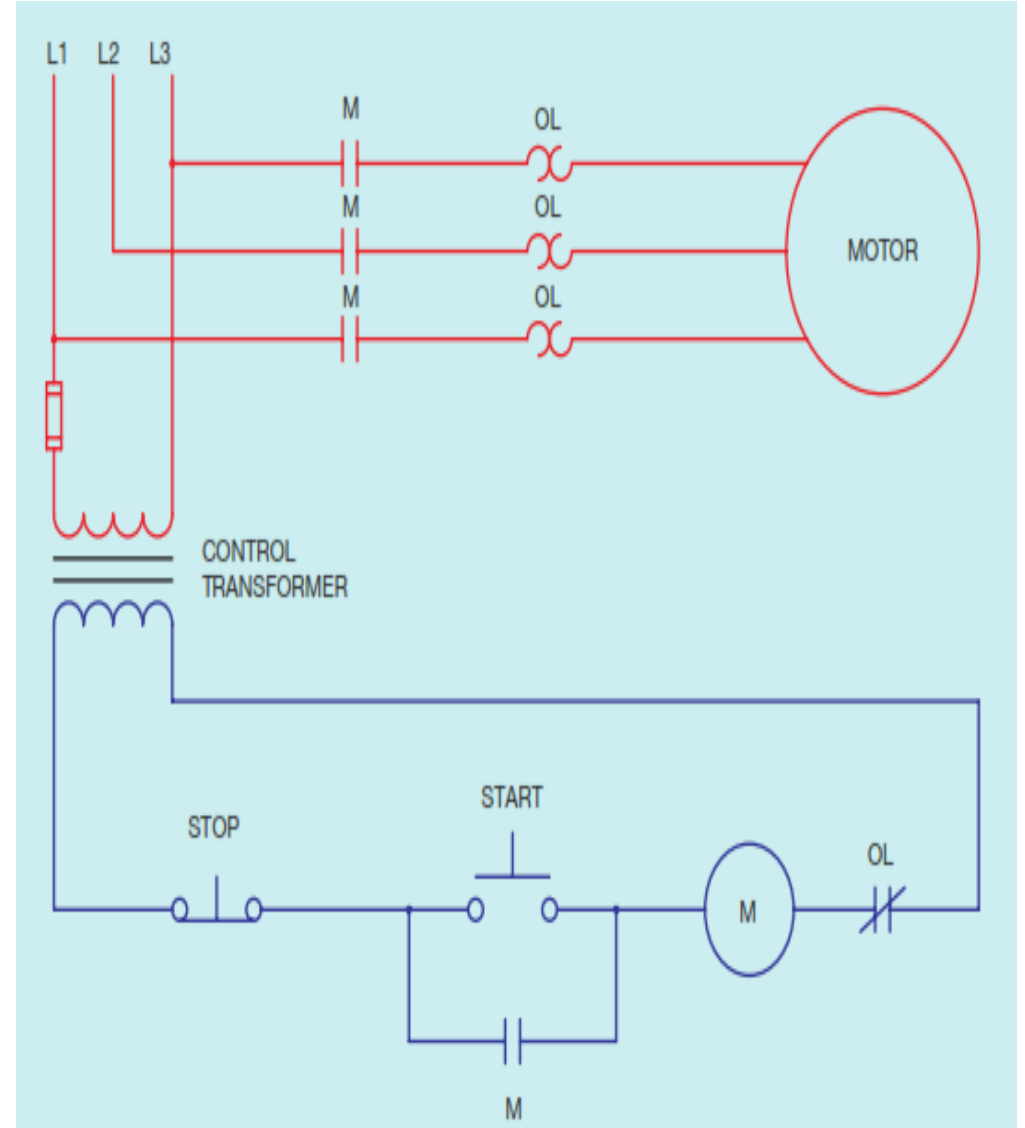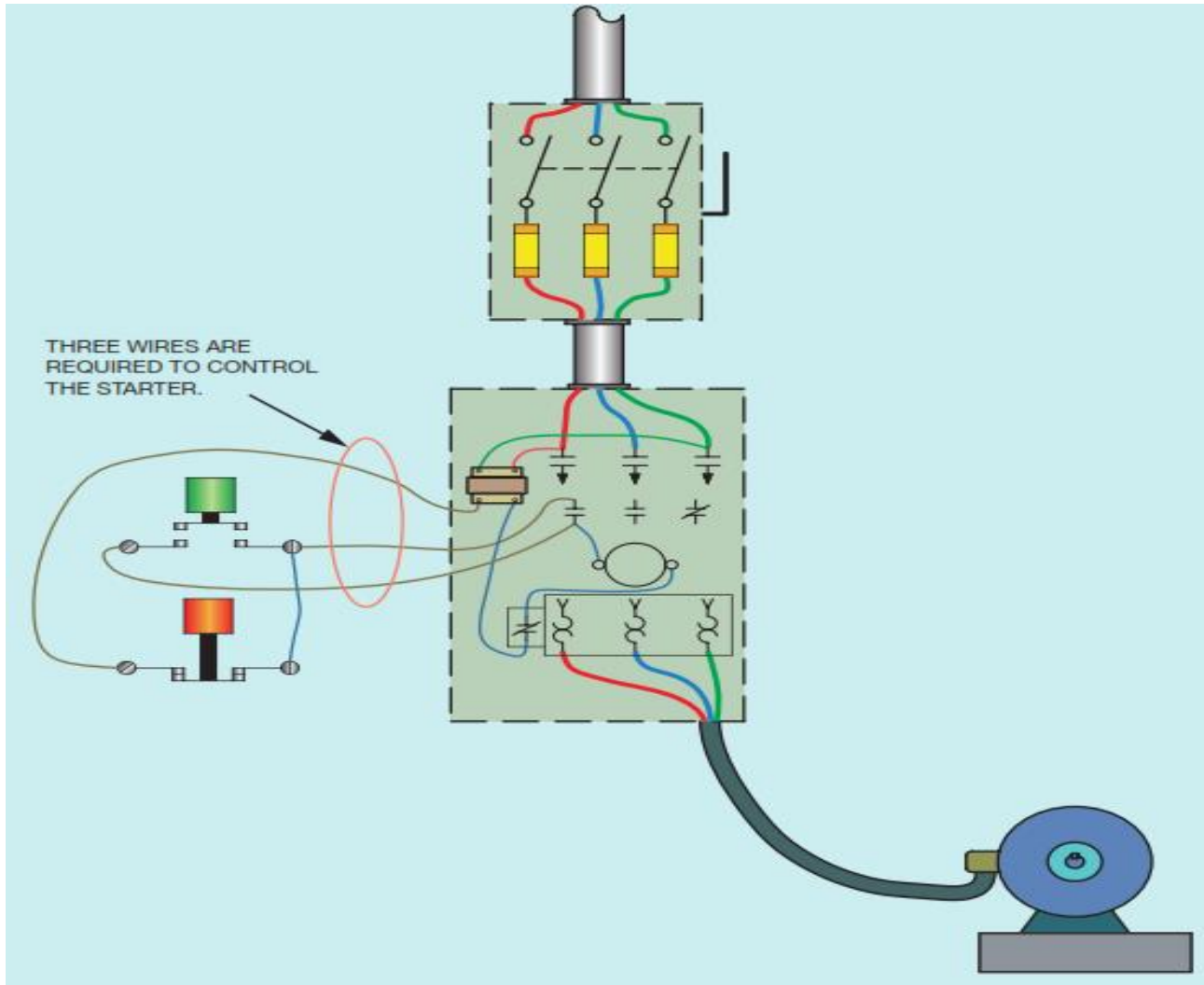
Hand-Off-Automatic Controls

Hand-off-automatic switch provides manual control of a motor, or control can be provided by a float switch.
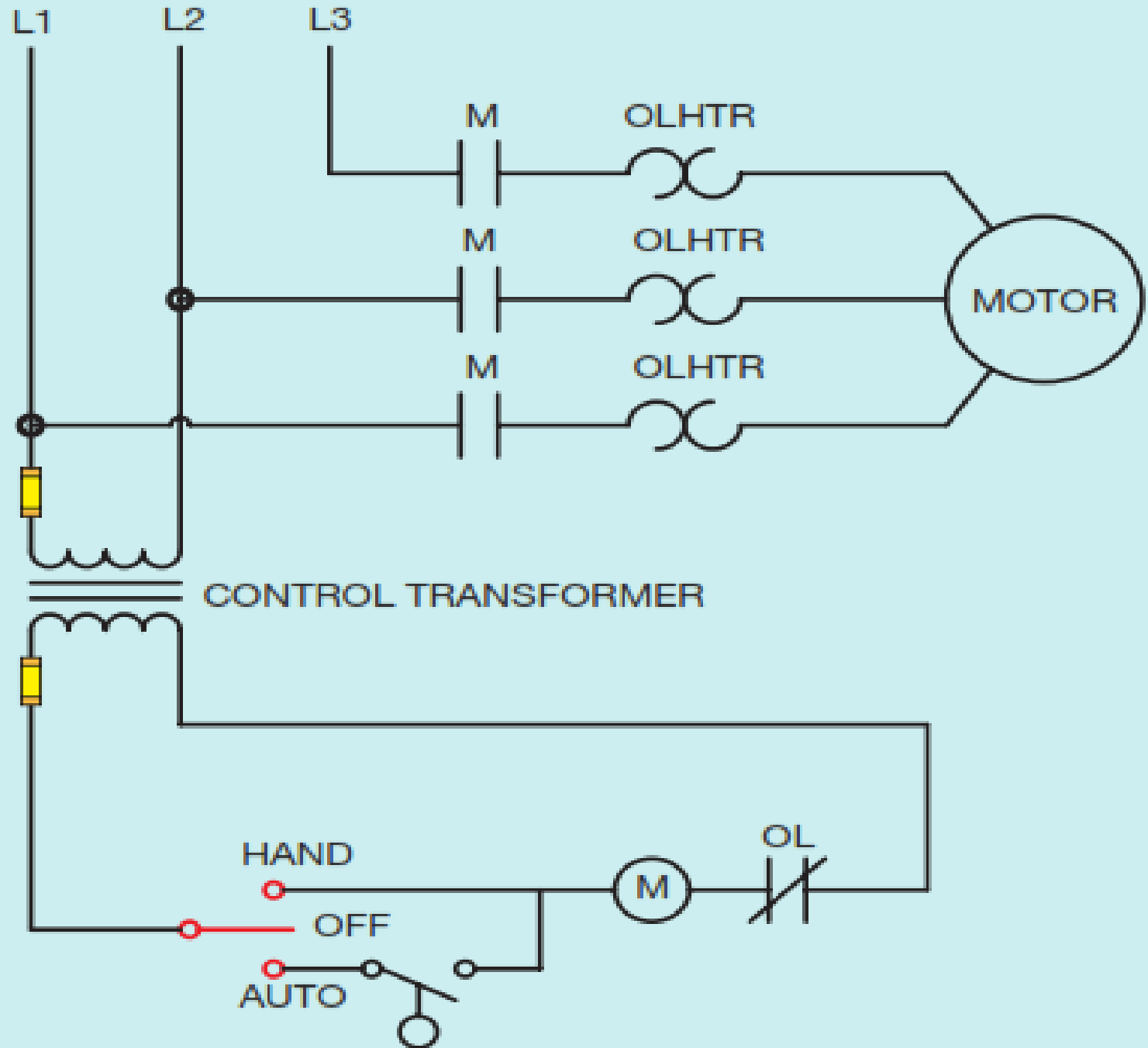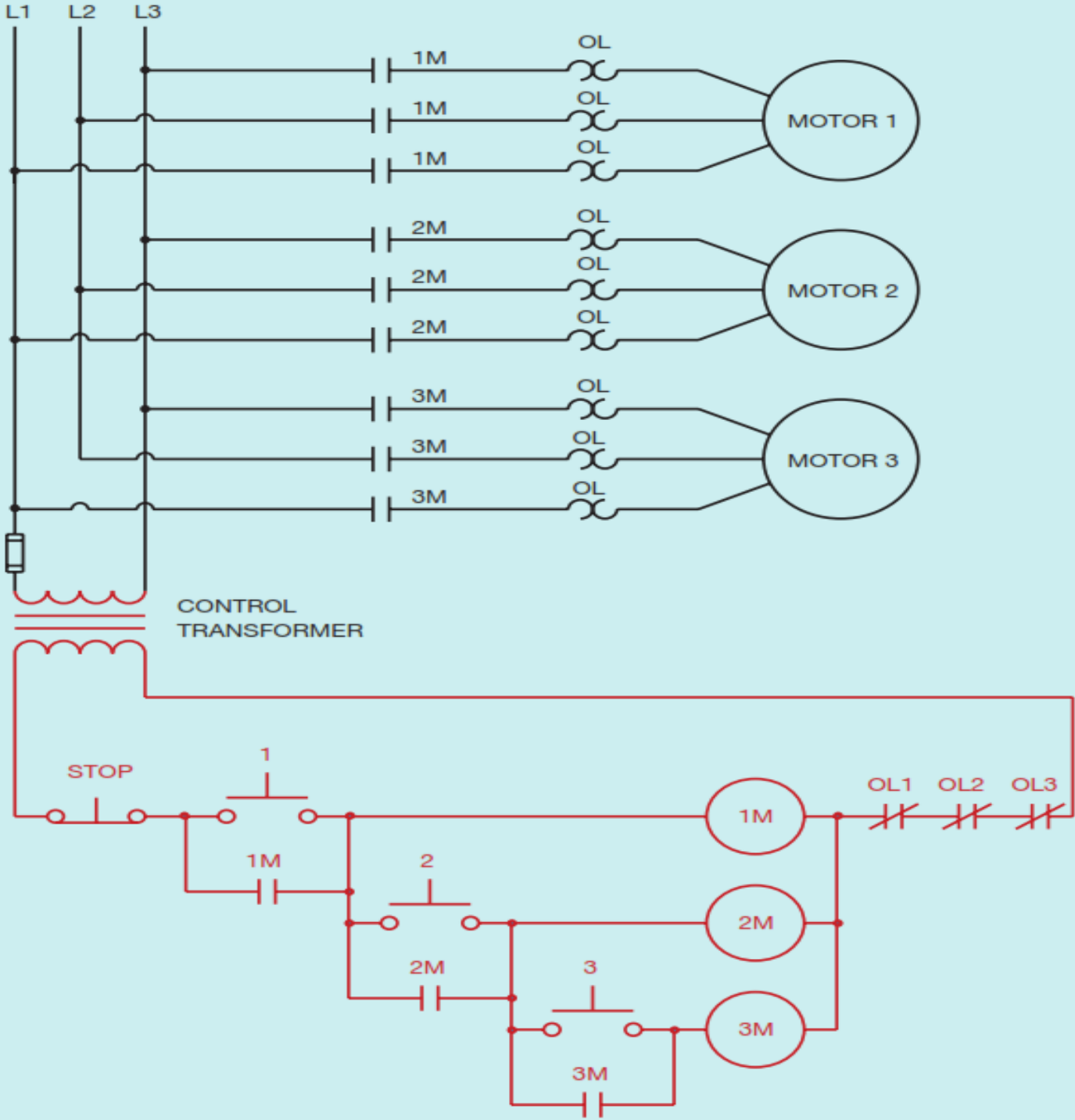
Hand-Off-Automatic Controls

A water-cooled motor must have a flow of water before it is permitted to run.
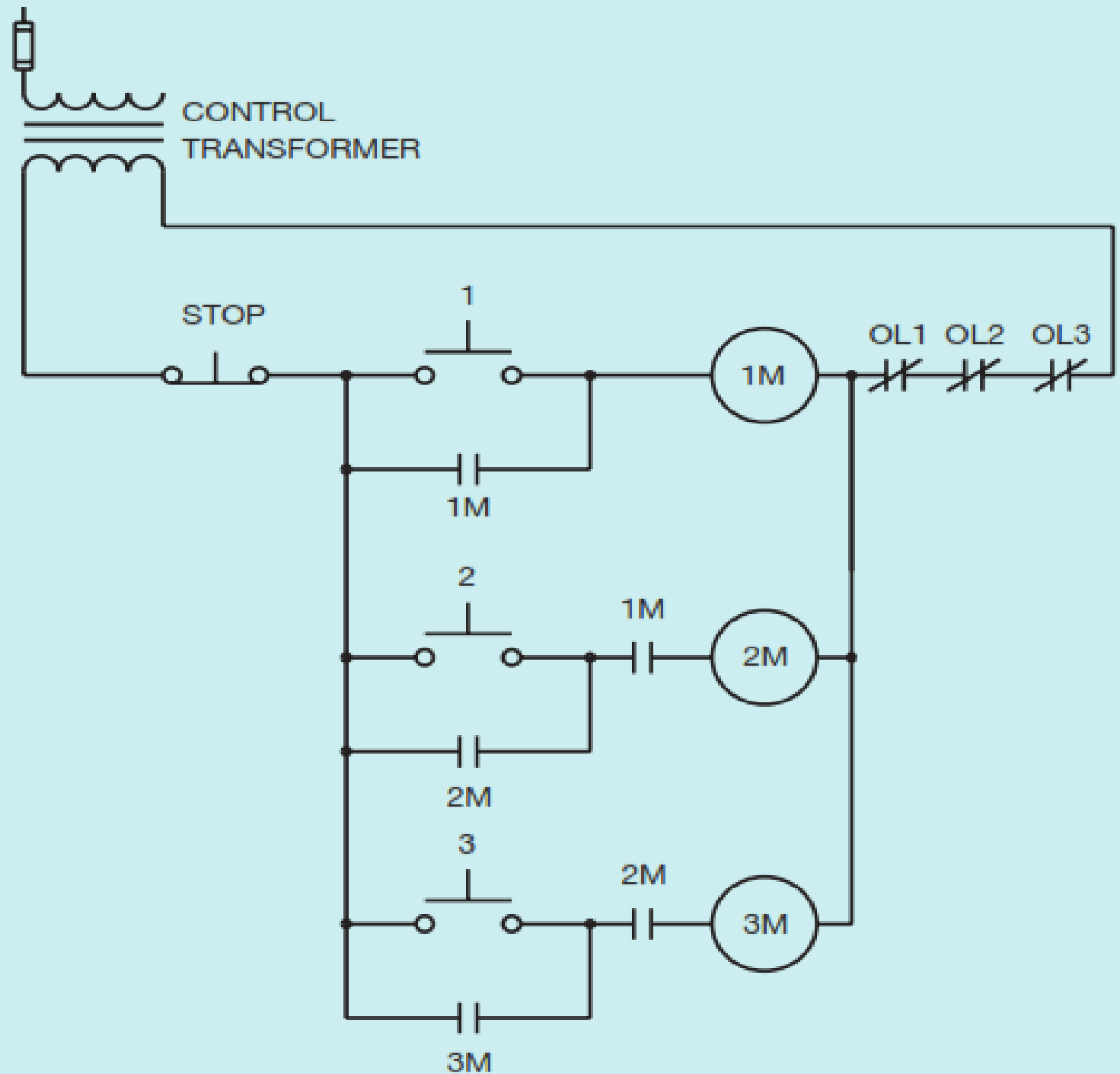
Sequence control

One example of a circuit that provides sequence control.

Sequence control

A second circuit for sequence control.

Sequence control

A third circuit for sequence control.