

U.S.C.G. Merchant Marine Exam

Assistant Engineer – Limited

Q615 Electrical Electronics and Control Engineering

(Sample Examination)

Choose the best answer to the following Multiple-Choice Questions:

1. For the purpose of calculating line current, which of the following procedures should be used to determine the total line current of a three-phase, delta wound, AC generator?
- A. Divide the total amperage in all phases by the square root of three.
 - B. Divide the total amperage in all phases by three.
 - C. Multiply the amperage in one phase by the square root of three.
 - D. Multiply the amperage in one phase by three.

Correct answer: C

2. Referring to figure "B" of the illustration, what statement is true? Illustration EL-0020
- A. The current drawn by the circuit will be inversely proportional to the total resistance of the entire circuit.
 - B. The current drawn by an individual resistor will be proportional to the resistance of that resistor.
 - C. The current drawn by the circuit will be directly proportional to the total resistance of the entire circuit.
 - D. If the resistance values of the individual resistors are uniquely different, each resistor will have a uniquely different current draw.

Correct answer: A

3. What statement is true concerning the total resistance of a parallel circuit?
- A. The total resistance is equal to the sum of the individual branch resistances divided by the number of branches.
 - B. The total resistance is equal to the sum of the individual branch resistances.
 - C. The total resistance is larger than that of the branch with the greatest resistance.
 - D. The total resistance is less than that of the branch with the lowest resistance.

Correct answer: D

4. In the schematic of the electrical circuit shown in figure "A" of the illustration, assuming that C1 and C2 are equal in capacitance, what is the value of the total capacitance, when compared to the value of equal individual capacitors? Illustration EL-0038
- A. Half
 - B. Equal
 - C. Double
 - D. Squared

Correct answer: C

5. In figure "2" of the diagram shown in the illustration, the three-phase step-down power transformer has a turns ratio of four to one. If a three-phase 480-volt supply is connected to terminals "A1-B1-C1", what voltage should develop across terminals "A2-B2-C2"? Illustration EL-0084
- A. 69 volts
 - B. 120 volts
 - C. 208 volts
 - D. 277 volts

Correct answer: B

6. What is the shape of the schematic symbol for an operational amplifier used in an analog circuit?
- A. circle
 - B. triangle
 - C. trapezoid
 - D. square

Correct answer: B

7. In figure "1" of the illustration, what type of circuit breaker trip element is featured? Illustration EL-0033
- A. thermal trip
 - B. magnetic trip
 - C. shunt trip
 - D. ambient compensated trip

Correct answer: A

8. What statement is true concerning the electrical diagrams for the motor controller shown in the illustration? Illustration EL-0007
- A. Figure "A" is a wiring diagram and figure "B" is a ladder or line diagram (schematic).
 - B. Figure "A" is a pictorial drawing and figure "B" is a wiring diagram.
 - C. Figure "A" is a ladder or line diagram (schematic) and figure "B" is a wiring diagram.
 - D. Figure "A" is a one-line diagram and figure "B" is a ladder or line diagram (schematic).

Correct answer: A

9. What practice could potentially damage a multimeter?
- A. placing the test leads across a voltage source to measure voltage while in the resistance mode
 - B. placing the test leads in series with the load of a circuit to measure current while in the voltmeter mode
 - C. placing the test leads across a de-energized and isolated resistance to measure resistance while in the voltmeter mode
 - D. placing the test leads across a de-energized and isolated resistance to measure resistance while in the ammeter mode

Correct answer: A

10. What is an ammeter used to measure?
- A. continuity
 - B. resistance
 - C. voltage
 - D. current

Correct answer: D

11. If a digital multimeter set up to measure AC volts reads low value, but constantly changing "ghost voltages" when its leads are disconnected, what does this indicate?
- A. Stray electromagnetic fields from electrical equipment exist in the air.
 - B. The digital multimeter test leads are acting as an antenna.
 - C. The digital multimeter AC voltage range is at its lowest value.
 - D. All the above conditions must exist.

Correct answer: D

12. When a battery-operated megohmmeter (insulation tester) is used to perform a dielectric absorption test, the resistance is measured and recorded from each conductor to ground each minute for 10 consecutive minutes. What condition accounts for a gradual rise in resistance each successive minute?
- A. The insulation has direct continuity with ground.
 - B. The insulation is in good condition.
 - C. The insulation is cracked and otherwise deteriorated.
 - D. The insulation is contaminated with moisture.

Correct answer: B

13. What condition associated with a lead-acid battery cell can cause the plates to partially short-out and cause the cell to fail to hold a charge?
- A. dirty or acid-wet tops and sides of batteries
 - B. accumulation of sediment within the cells due to excessive overcharging and discharging
 - C. lime accumulation on both the positive and negative terminal posts
 - D. sulfation of the plates due to consistent undercharging or leaving the battery in a discharged state

Correct answer: B

14. The leads from an ohmmeter are attached to the leads of the opposite ends of an AC induction motor stator coil. If a reading of infinity (OL) is obtained, what does this indicate?
- A. grounded stator coil
 - B. shorted stator coil
 - C. open stator coil
 - D. shunted stator coil

Correct answer: C

15. If the motor shown in the illustration will not start when the "off-run" switch is placed in the run position, which of the listed components should be checked FIRST? Illustration EL-0017
- A. check the overload relay for tripped condition, reset as necessary
 - B. check the main contactor coil for continuity, replace as necessary
 - C. check the overload relay (OL) heaters for continuity, replace as necessary
 - D. check the disconnect switch open, open as necessary

Correct answer: A

16. If the cooling water system is isolated for repairs, but in an operational emergency, it is still desirable to run the alternator pictured in figure "A" of the illustration, what must be done? Illustration EL-0037
- A. The emergency air inlet panel and air outlet doors must be opened, but in doing so allows the alternator to be run at rated load.
 - B. The alternator may not be run without cooling water under any circumstances.
 - C. The emergency air inlet panel and air outlet doors must be opened and only then can the alternator be run, but at reduced load.
 - D. The emergency air inlet panel and air outlet doors must remain closed, which requires the alternator to be run only at reduced loads.

Correct answer: C

17. According to 46 CFR Subchapter J, what is true concerning the installation of batteries used for diesel engine starting?
- A. be located as close as possible to the engine
 - B. be located in a locker on the weather deck
 - C. have sufficient capacity to provide at least 50 starts consecutively without recharging
 - D. only be of the nickel alkaline type

Correct answer: A

18. What is the nominal open-circuit cell voltage of one lead-acid storage battery cell?
- A. 1.2 volts
 - B. 2 volts
 - C. 6 volts
 - D. 12 volts

Correct answer: B

19. The nominal voltage of one cell of a wet cell nickel-cadmium battery is approximately how many volts?
- A. 1.2 volts
 - B. 1.5 volts
 - C. 2.0 volts
 - D. 3.0 volts

Correct answer: A

20. Which of the illustrated motors has an open, drip-proof (ODP) motor enclosure? Illustration EL-0001
- A. A
 - B. B
 - C. C
 - D. D

Correct answer: C

21. Which type of AC single phase motor will also operate on direct current?

- A. Split phase
- B. Shaded-pole
- C. Repulsion-start
- D. Series-wound

Correct answer: D

22. Which of the listed motors will operate at the highest RPM, assuming that each operates at the same frequency?

- A. A four-pole synchronous motor under normal load
- B. A four-pole induction motor under no load
- C. A six-pole synchronous motor under normal load
- D. A six-pole induction motor under full load

Correct answer: A

23. What type of AC motor would use a rheostat in the rotor circuit to vary the speed of the motor?

- A. squirrel-cage induction motor
- B. regenerative braking motor
- C. wound-rotor induction motor
- D. synchronous motor

Correct answer: C

24. Assuming that a three-phase synchronous motor is separately excited, what statement is true concerning power supplies?

- A. The rotor winding via slip rings and brushes is connected to a single-phase AC power source, and the stator winding is directly connected to a three-phase AC power source.
- B. The rotor winding via slip rings and brushes is connected to a three-phase AC power source, and the stator winding is directly connected to a single-phase AC power source.
- C. The rotor winding via slip rings and brushes is connected to a DC power source, and the stator windings are directly connected to a three-phase AC power source.
- D. The rotor windings via slip rings and brushes are connected to a three-phase AC power source, and the stator winding is directly connected to a DC power source.

Correct answer: C

25. What is the function of the movable cams in a master-switch winch motor drum controller?

- A. regulate the speed of the motor
- B. insulate the operating handle
- C. limit the amount of load put on the motor
- D. maintain resistance contacts in clean condition

Correct answer: A

26. As shown in the illustrated feeder disconnect controller, what statement is true? Illustration EL-0138

- A. the feeder disconnect contactor is electrically tripped
- B. the feeder disconnect contactor is mechanically closed
- C. the feeder disconnect contactor is electrically latched
- D. the feeder disconnect contactor remains closed on a loss of power

Correct answer: D

27. What is the name of the device that works in conjunction with an automatic voltage regulator and is used as the source of magnetizing direct current delivered to the rotating field of an AC generator?

- A. magnetizer
- B. alternator
- C. exciter
- D. governor

Correct answer: C

28. In which of the following branch circuits types would time lag fuses (or dual-element fuses) be MOST likely used?

- A. emergency lighting circuits
- B. general alarm circuits
- C. motor starting circuits
- D. main lighting circuits

Correct answer: C

29. What is the basic similarity between a circuit breaker and a fuse?

- A. after a short or overload condition, both should open to de-energize the circuit
- B. a circuit breaker and a fuse have no similarities
- C. after a short or overload condition, both must be reset to re-energize the circuit
- D. after a short or overload condition, both have to be replaced before the circuit can be re-energized

Correct answer: A

30. If the illustrated device in figure "B" has a step-up ratio of 10 to 1 what voltage would be measured at the secondary shortly after the primary of the device is connected to 110 volts DC and the primary current stabilized with a current of 12 amps? Illustration EL-0055

- A. 0 volts
- B. 110 volts
- C. 1000 volts
- D. 1100 volts

Correct answer: A

31. Which of the following is the only known perfect dielectric for the purpose of serving as electrical insulation?

- A. glass
- B. vacuum
- C. ceramic
- D. mica

Correct answer: B

32. The timer element of a reverse power relay cannot be energized unless what condition is met?

- A. the movement of the disk is damped by a permanent magnet
- B. the power flow is the same as the tripping direction
- C. the power flow is the opposite to the tripping direction
- D. one generator is fully motorized

Correct answer: B

33. Upon failure of the normal power supply, how is the emergency generator placed on the line to feed power to the emergency bus?

- A. line connection feeder
- B. main bus tie feeder
- C. automatic bus transfer device
- D. power failure alarm bus

Correct answer: C

34. The multiplier prefix "giga" (G) such as used in "gigabytes" represents what multiplication factor?

- A. thousand (10 to the 3rd power)
- B. million (10 to the 6th power)
- C. billion (10 to the 9th power)
- D. trillion (10 to the 12th power)

Correct answer: C

35. Which of the wave shapes shown in the illustration is termed a sinusoidal wave? Illustration EL-0088

- A. A
- B. B
- C. C
- D. D

Correct answer: A

36. A silicon-controlled rectifier (SCR) is a solid-state device used for what functional purpose?

- A. triggering the operation of a switching function
- B. automatic impedance matching function
- C. amplifying voltage, current, and/or power
- D. attenuating of voltage, current, and/or power

Correct answer: A

37. What is the functional purpose of the Zener diode "CR1" as shown in section "D" of the regulated DC power supply? Illustration EL-0085

- A. aids in output voltage regulation
- B. prevents excessive currents
- C. is a temperature compensator
- D. corrects power factor

Correct answer: A

38. A voltage amplifier has a calculated voltage gain of 5. Which statement is true concerning input and output voltages?

- A. If the input changes 5 volts, the output changes 10 volts.
- B. If the input changes 10 volts, the output changes 5 volts.
- C. If the input changes 2 volts, the output changes 10 volts.
- D. If the input changes 10 volts, the output changes 2 volts.

Correct answer: C

39. In referring to the frequency response filters shown in the illustration, what determines the band pass or band stop frequencies as appropriate? Illustration EL-0078

- A. The magnitude of the incoming voltage
- B. The value of the resonant frequencies associated with L and C
- C. The value of the RC time constant
- D. The value of the total load resistance

Correct answer: B

40. As shown in all four diagrams included in the illustration, what type of logic circuit is represented? Illustration EL-0226

- A. NOR gate
- B. OR gate
- C. AND gate
- D. NAND gate

Correct answer: C

41. Referring to figure "2" of the illustration, what type of logic gate is symbolized? Illustration EL-0035

- A. XOR gate
- B. AND gate
- C. OR gate
- D. NOR gate

Correct answer: D

42. An electric propulsion drive system in which the propulsion generator supplies power to both the propulsion motor and ship service loads is referred to as what type of system?

- A. an integrated system
- B. a composite system
- C. a dedicated system
- D. a multi-purpose system

Correct answer: A

43. Ships requiring extremely rapid maneuvering response using propeller shaft speed and direction as the sole means of controlling propeller thrust are most likely to use what type of drive system?
- A. Direct or geared diesel drive
 - B. Gas turbine geared drive
 - C. Diesel-electric drive
 - D. Steam turbine geared drive

Correct answer: C

44. While standing an "at sea watch" onboard an AC diesel-electric drive ship with a synchronous propulsion motor with the ability to vary the field excitation strength and still remain in synchronism. Ideally what would be the character of the power factor associated with the main power distribution system including all motors?
- A. unity
 - B. leading
 - C. lagging
 - D. zero

Correct answer: A

45. The propulsion motor most often utilized in an AC drive system operating in the moderate to high power range is of what type?
- A. split-phase induction type
 - B. wound rotor induction type
 - C. squirrel-cage induction type
 - D. synchronous type with wound field

Correct answer: D

46. In a podded azimuthing propulsion system, how is three-phase, frequency and voltage-controlled power delivered to the synchronous propulsion motor stator windings?
- A. By the use of commutator bars and brushes
 - B. By the use of slip rings and brushes
 - C. By rotary transformer action
 - D. By direct connection to the stator windings

Correct answer: B

47. In order for a live-line tester to be used to test and prove dead a high voltage circuit, what must be done to verify the ability of the tester to detect a voltage?
- A. The live-line tester should be checked by connecting to a known high voltage source before and after the circuit to be worked upon is tested.
 - B. The live-line tester should be checked by connecting to a known high voltage source only before testing the circuit to be worked upon.
 - C. The live-line tester should be checked by connecting to a known high voltage source only after testing the circuit to be worked upon.
 - D. The live-line tester need not be checked prior to testing the circuit to be worked upon as long as it has not been declared inoperative.

Correct answer: A

48. In addition to high voltage circuit grounding with ground-connecting switching devices, for additional operator safety and confidence, portable grounding straps may be used. What is the proper procedure for connecting these portable grounding straps?
- A. The common to hull ground connection and the phase connections to common should all be made simultaneously.
 - B. Connect the phase connections to common first, then connect the common connection to hull ground.
 - C. Connect the common connection to hull ground first, then connect the phase connections to common.
 - D. The common to hull ground connection and the phase connections to common can be made in any sequence.

Correct answer: C

49. A salinity indicator system such as that used to measure the salt content of potable water systems and boiler feed and condensate systems uses what technology?
- A. a salinity cell that senses the electrical conductivity of water
 - B. a salinity cell that senses the brine density of water
 - C. a salinity cell that senses the pH of water
 - D. a salinity cell that senses the optical refraction of water

Correct answer: A

50. A bearing temperature monitoring system such as that used for measuring selected propulsion plant bearings uses what technology?
- A. self-powered thermocouples (TC)
 - B. self-powered resistance temperature detectors (RTD)
 - C. externally powered thermocouples (TC)
 - D. externally powered resistance temperature detectors (RTD)

Correct answer: D

51. As shown in the illustrated block diagram for a distributed automation system, what statement is true concerning the workstations labeled "LOS" associated with the port power management system?
Illustration EL-0096
- A. These are local operating system workstations that allow local control of processes related to the operation and control of all functions within the engineering plant.
 - B. These are local operating system workstations that allow local control of processes related to the operation and control of the port generator.
 - C. These are lube oil system workstations that allow local control of processes related to the lubrication of the port generators.
 - D. These are lube oil system workstations that allow local control of processes related to the lubrication of all machinery within the engineering plant.

Correct answer: B

52. Which of the following data communication cable types offers the greatest immunity to electromagnetic "noise"?

- A. Coaxial (coax)
- B. Unshielded twisted pair
- C. Fiber-optic
- D. Shielded twisted pair

Correct answer: C

53. Referring to the illustration pertaining to an alternator protection and alarm system, what statement is true concerning the component labeled "LO"? Illustration EL-0067

- A. LO is an alternator bearing low lube oil pressure safety shutdown and alarming device.
- B. LO is an alternator prime mover low lube oil pressure safety shutdown and alarming device.
- C. LO is an alternator phase loss safety shutdown and alarming device.
- D. LO is an alternator electrical fault trip master lock-out and alarm device.

Correct answer: D

54. In an impressed current cathodic hull protection system, what statement is true concerning the composition and arrangement of the anodes?

- A. The protective anodes are made of zinc and are electrically insulated from the hull.
- B. The protective anodes are made of lead or platinized titanium and are electrically insulated from the hull.
- C. The protective anodes are made of zinc and are electrically bonded to the hull.
- D. The protective anodes are made of lead or platinized titanium and are electrically bonded to the hull.

Correct answer: B

55. What type of motor is used in the AC hoist controller as shown in the illustration? Illustration EL-0102

- A. stepper motor
- B. wound rotor induction motor
- C. squirrel-cage induction motor
- D. synchronous motor

Correct answer: B

56. As shown in the illustration, what is responsible for maintaining the "UV" relay energized when the master switch handle is moved away from the "off" position? Illustration EL-0102

- A. normally open "UV" sealing contact
- B. normally closed "OL" contact
- C. "MS 2" contact
- D. "MS 1" contact

Correct answer: A

57. Referring to the sound-powered telephone circuit shown in the illustration, what statement is true?
Illustration EL-0093

- A. The sound-powered telephone circuitry consists of a common-talk circuit and a selective-ringing circuit.
- B. The sound-powered telephone circuitry consists of selective-talk and selective-ringing circuits.
- C. The sound-powered telephone circuitry consists of common-talk and common-ringing circuits.
- D. The sound-powered telephone circuitry consists of a selective-talk circuit and a common-ringing circuit.

Correct answer: A

58. What would be the indication of a grounded switch or cable as measured by a megohmmeter?

- A. being unsteady in the low range
- B. infinity
- C. "zero"
- D. being unsteady in the high range

Correct answer: C

59. Before any work on electrical or electronic equipment is performed, which of the following precautions should be carried out?

- A. Station a man at the circuit supply switch.
- B. De-energize the applicable switchboard bus.
- C. Secure and tag the supply circuit breaker in the open position.
- D. Bypass the interlocks.

Correct answer: C

60. What is the best method of determining the state of charge of a flooded lead-acid storage battery?

- A. ampere-hour capacity of the battery
- B. testing of the individual cell voltages
- C. specific gravity of the electrolyte
- D. total cell voltages

Correct answer: C

61. What should you be aware of when checking the specific gravity of the battery electrolyte with a hydrometer?

- A. a hydrometer reading is accurate if taken immediately after water is added to the cell
- B. the battery is fully charged when the float sinks deepest into the electrolyte
- C. depending on the temperature it may be necessary to correct for temperature
- D. the battery is discharged when the float is highest in the electrolyte

Correct answer: C

62. Large machines undergoing a resistance insulation testing using a megohmmeter should be discharged to remove any accumulated electrostatic/capacitive/dielectric-absorption charge stored. When should this discharge be performed?

- A. while performing the insulation resistance check only
- B. prior to conducting the insulation resistance check only
- C. prior to and after conducting the insulation resistance check
- D. after conducting the insulation resistance check only

Correct answer: C

63. When you are making a high potential test (insulation resistance) on the motor coils of repaired electrical machinery to ground, what would a low resistance reading indicate?

- A. a high slot discharge factor
- B. high insulation power factor
- C. bad insulation
- D. good insulation

Correct answer: C

64. When an alternator is to remain idle for even a few days, what should be ensured or manually accomplished?

- A. ensure energization the space heater circuit (usually automatic)
- B. insulate the collector rings with strips of cardboard if applicable
- C. manually open the equalizing bus disconnect switch as required
- D. manually lift the brushes and disconnect the pigtails if applicable

Correct answer: A

65. Rotor-to-stator air gap readings should be periodically taken for electrical generation equipment. What is the best tool to use to take these measurements?

- A. cloth (non-metallic) tape measure
- B. inside micrometer
- C. tapered, long blade, feeler gage
- D. dial indicator

Correct answer: C

66. Before working on an electric cargo winch master switch or controller, what should be done?

- A. heat the switch box to remove any moisture
- B. spray the gasket surface with a solvent
- C. open the circuit breaker in the power supply and tag-out
- D. drain condensate from the box

Correct answer: C

67. As shown in figure "A" of the illustration, what phenomenon is illustrated with respect to electrical cable conductors and hull ground? Illustration EL-0126

- A. distributed capacitance
- B. distributed inductance
- C. distributed impedance
- D. distributed reactance

Correct answer: A

68. If it becomes absolutely necessary to run an alternator at lower than 5% below its rated frequency, in terms of output voltage, what must be done?

- A. The alternator output voltage must be maintained at the rated value for the alternator output voltage.
- B. The alternator output voltage must be increased proportionately upward to compensate for the frequency decrease.
- C. The alternator output voltage must be decreased proportionately downward with the frequency decrease.
- D. Under no circumstances is it permissible to run an alternator at a frequency lower than 5% below its rated frequency.

Correct answer: C

69. Which of the following voltage testers would be associated with high quality, be safe to use, and minimize the electric shock hazard?

- A. a voltage tester with a low input impedance and a lower voltage rating than any expected measured voltages
- B. a voltage tester with a high input impedance and a voltage rating higher than any expected measured voltages
- C. a voltage tester with a high input impedance and a lower voltage rating than any expected measured voltages
- D. a voltage tester with a low input impedance and a higher voltage rating than any expected measured voltages

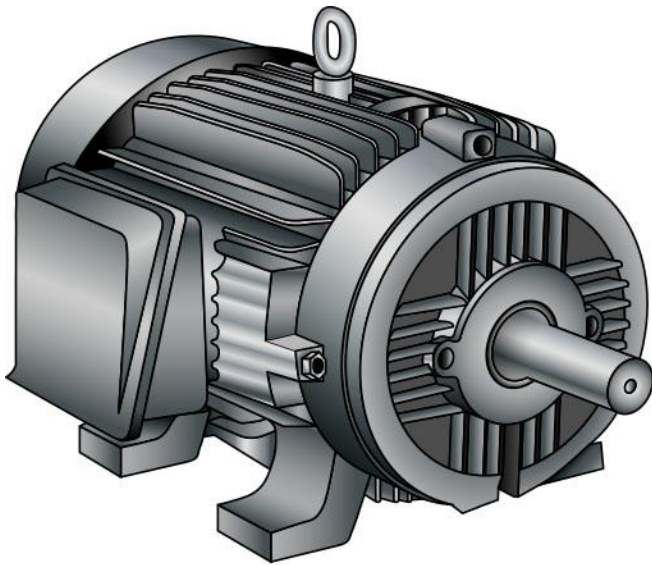
Correct answer: B

70. Which of the following devices would be forbidden to use as a primary means of electrical isolation?

- A. non-fused disconnect switch
- B. circuit breaker
- C. start/stop push button station
- D. fused disconnect switch

Correct answer: C

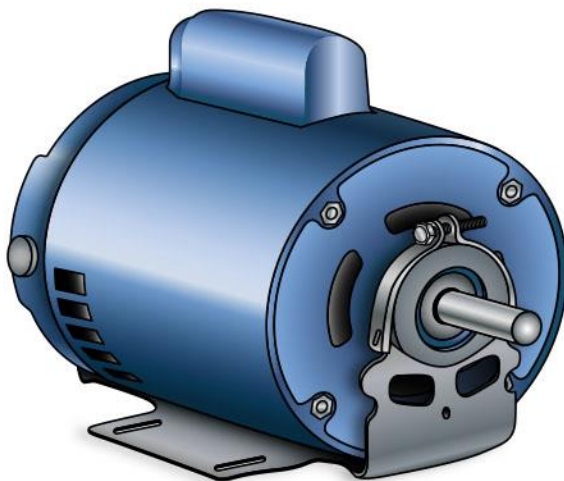
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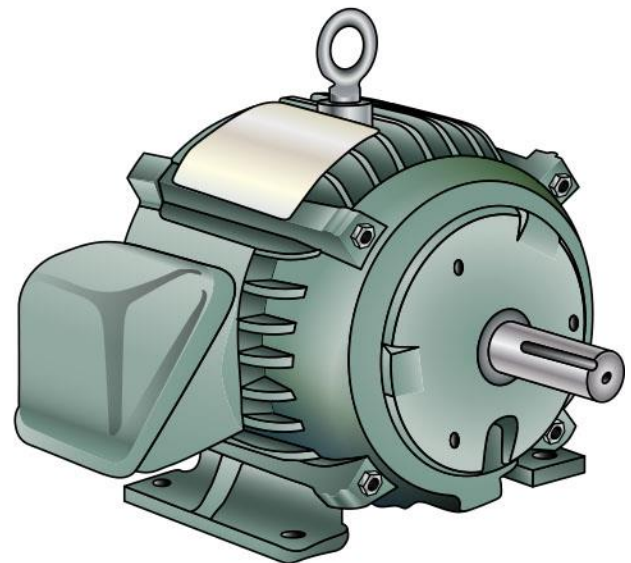
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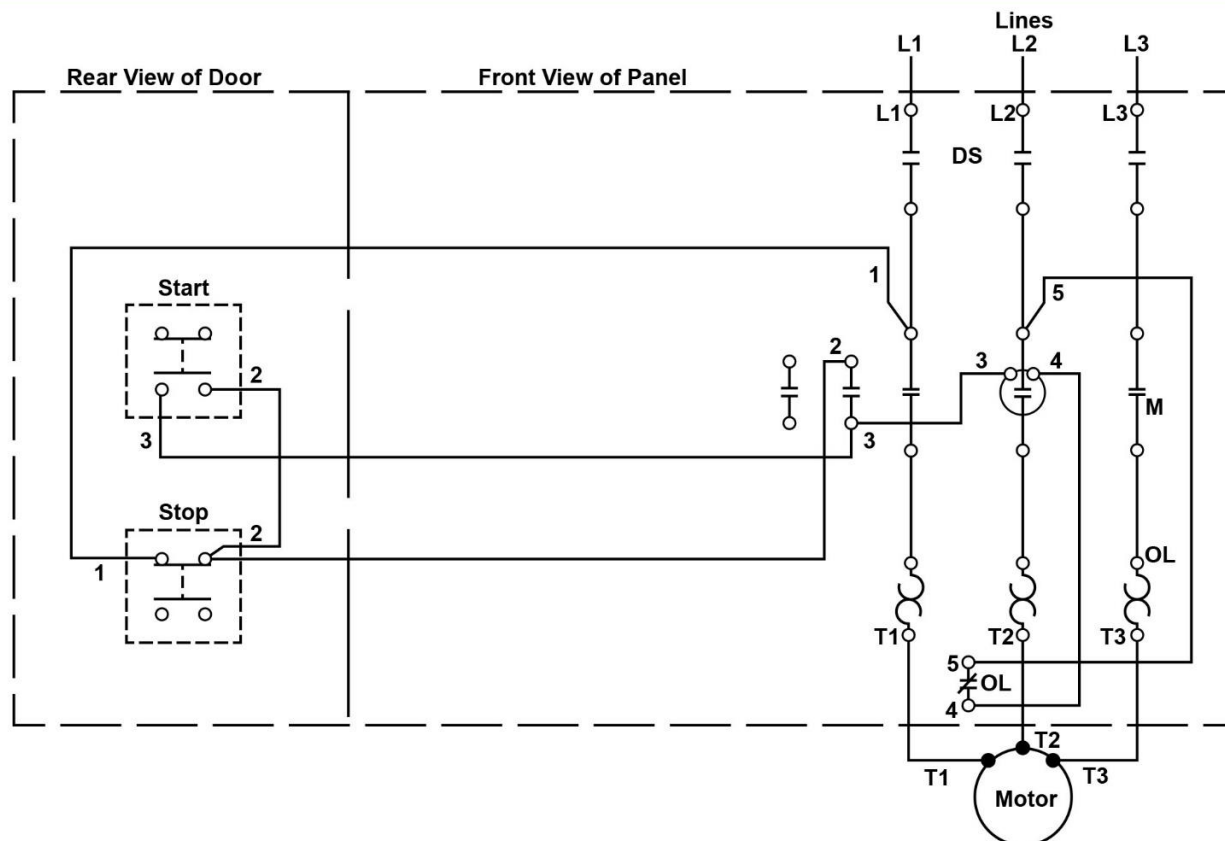
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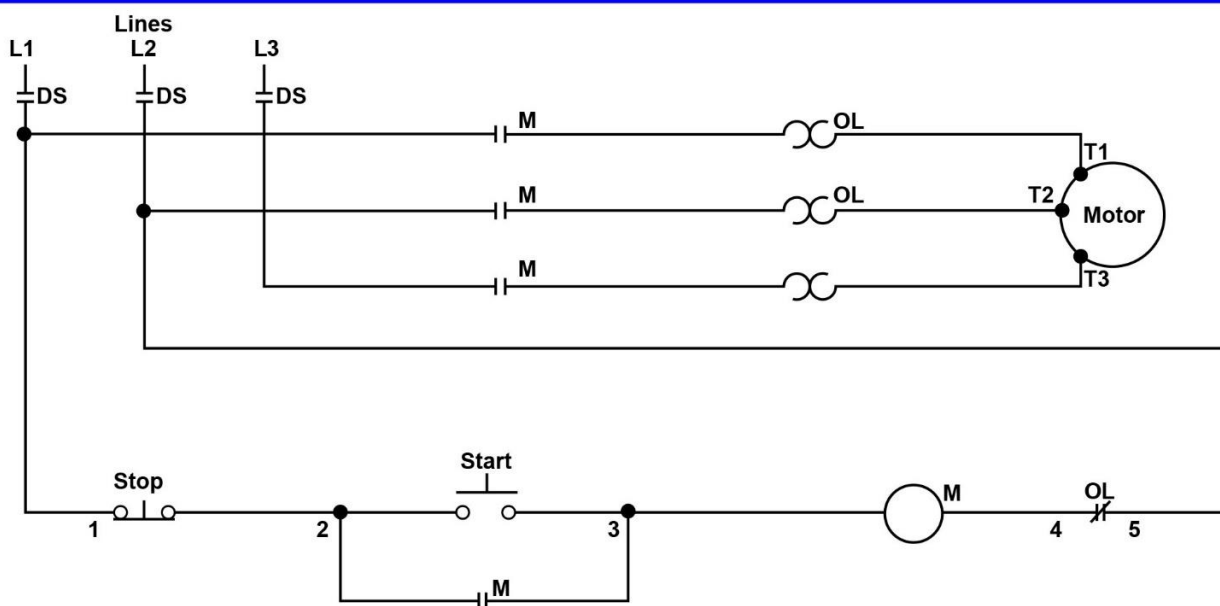
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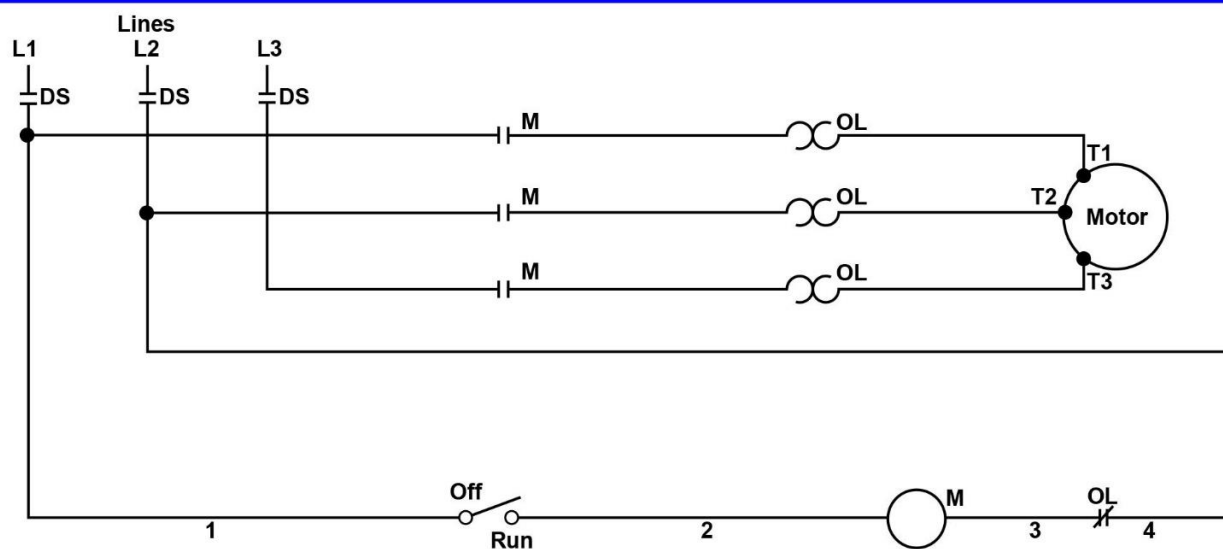
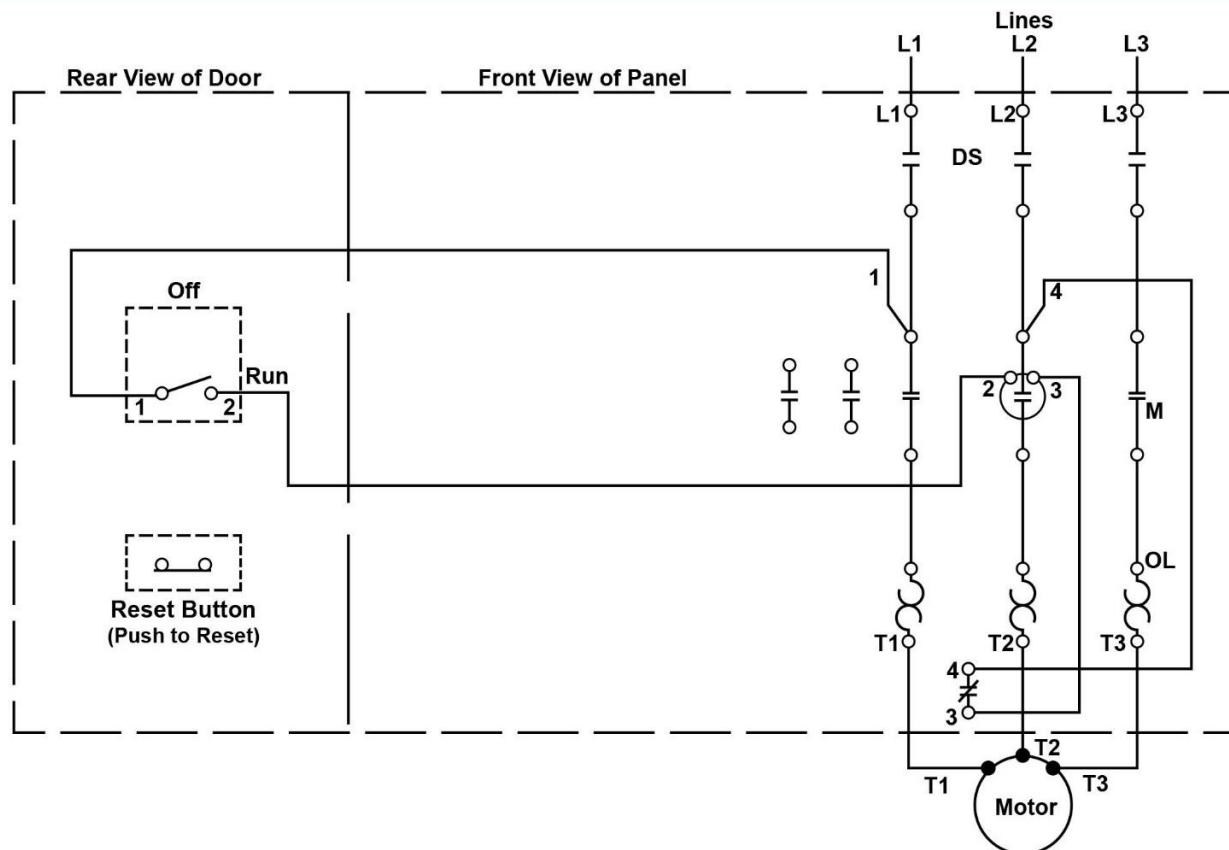
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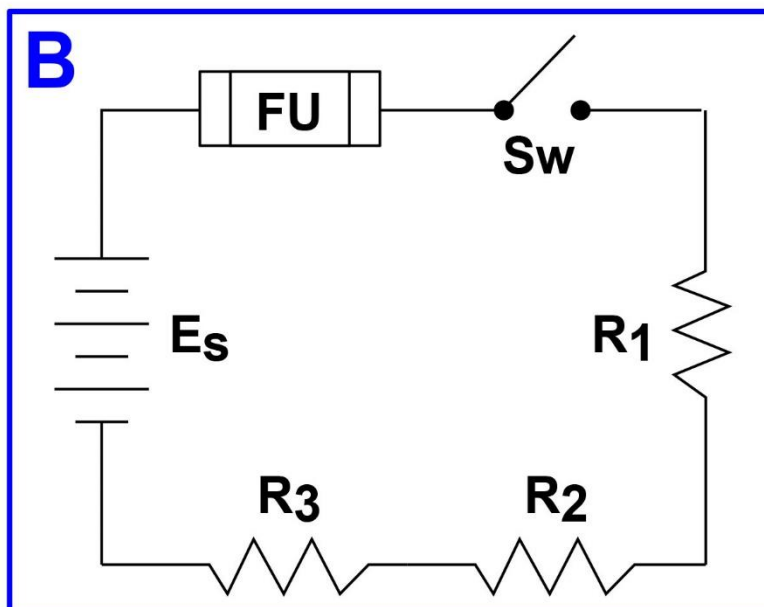
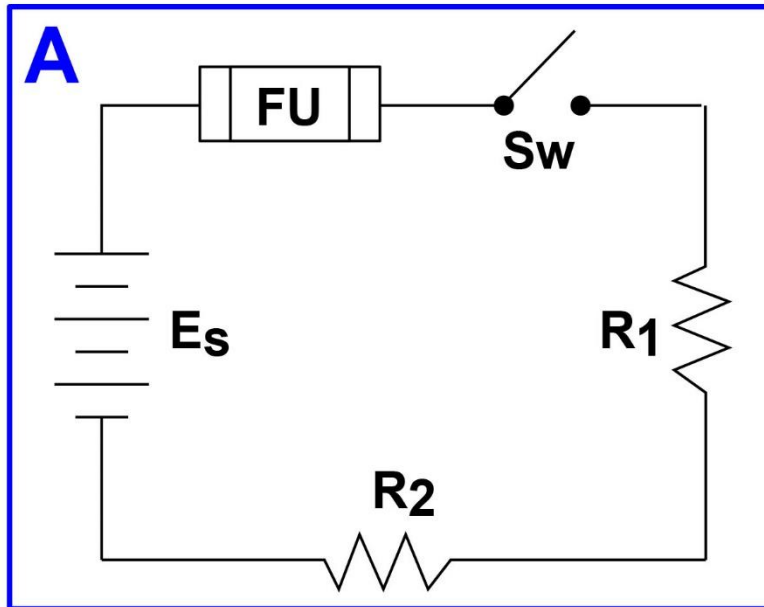
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EL-0033

A



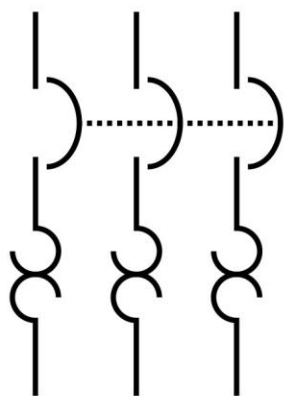
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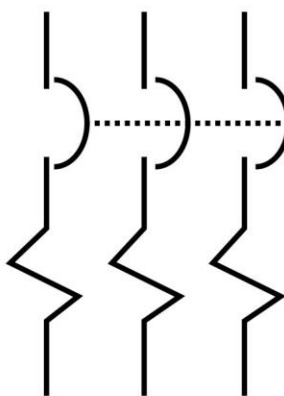
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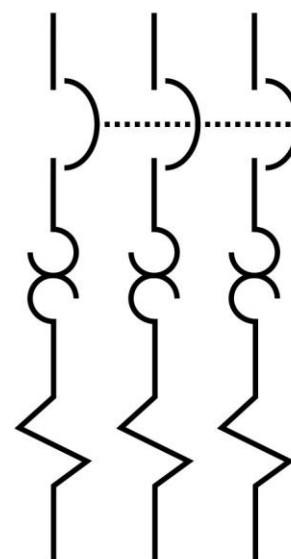
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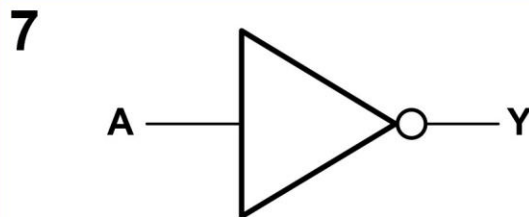
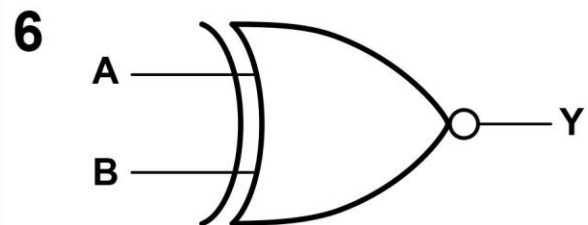
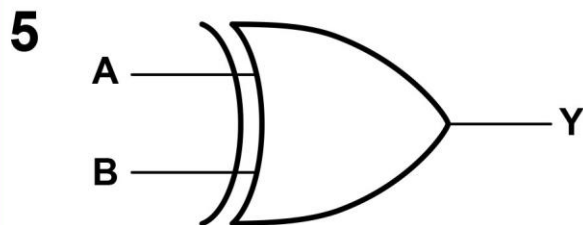
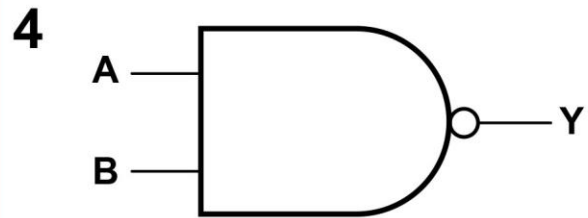
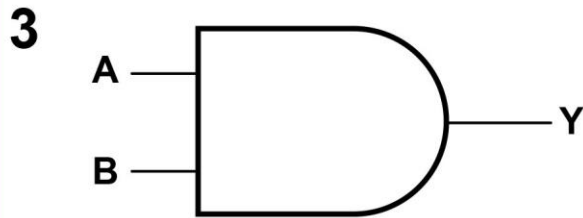
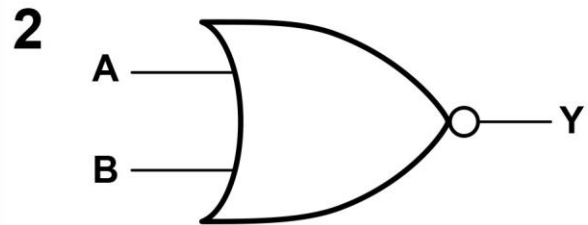
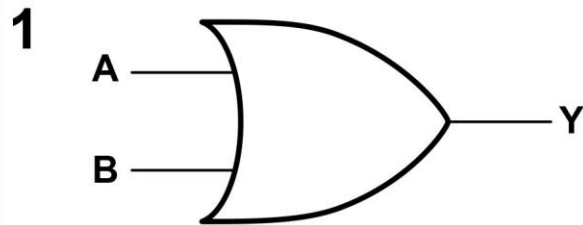
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3

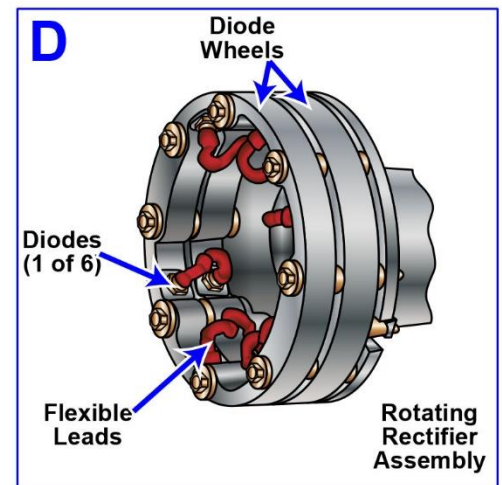
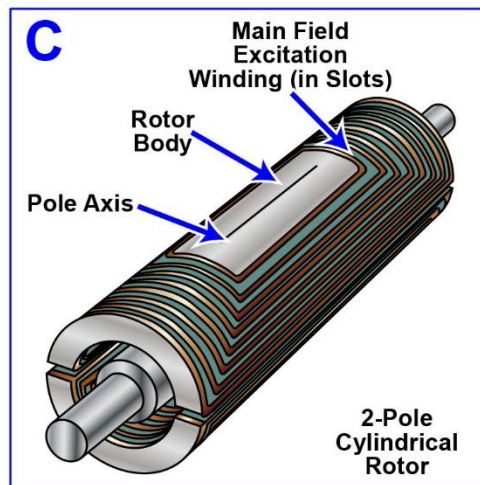
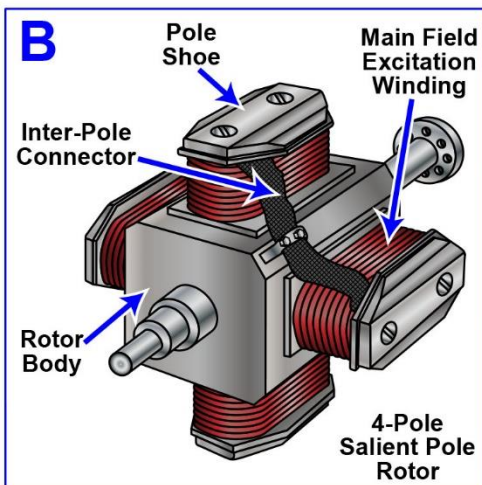
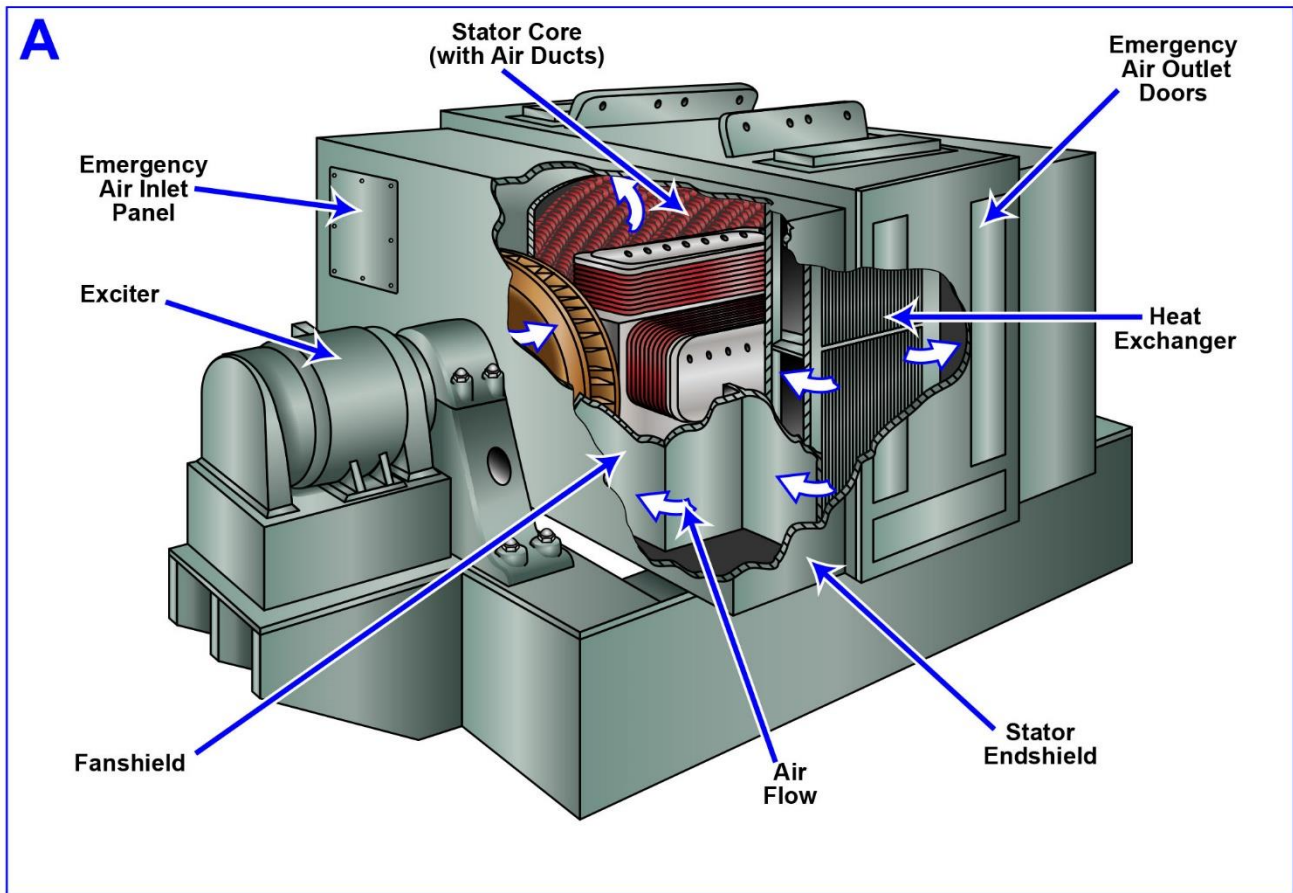


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EL-0037

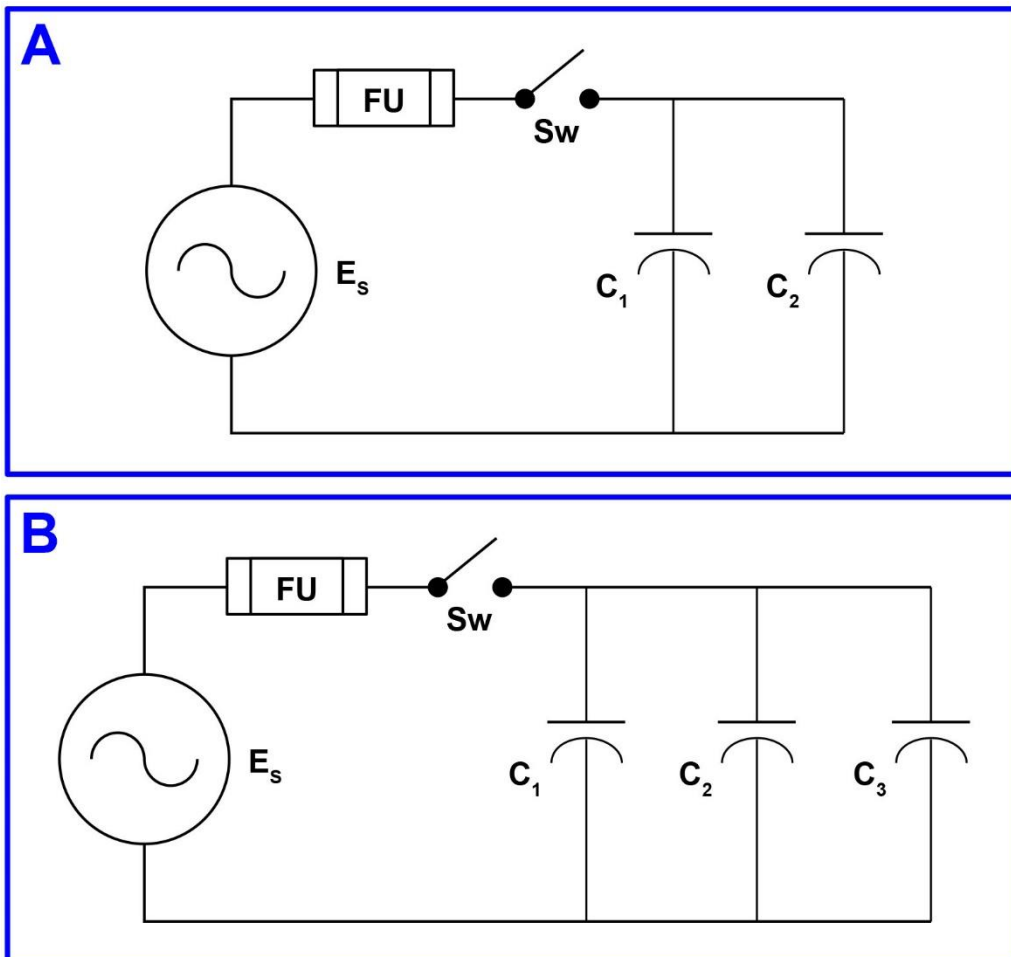


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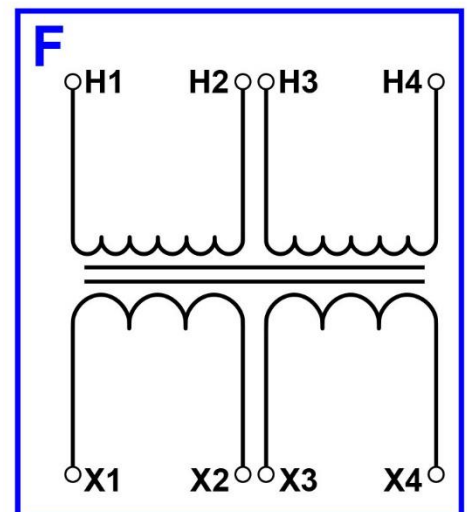
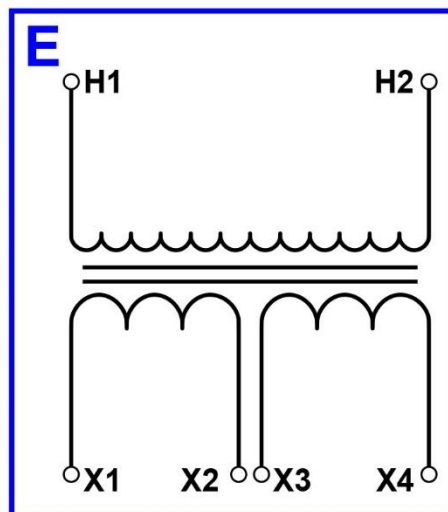
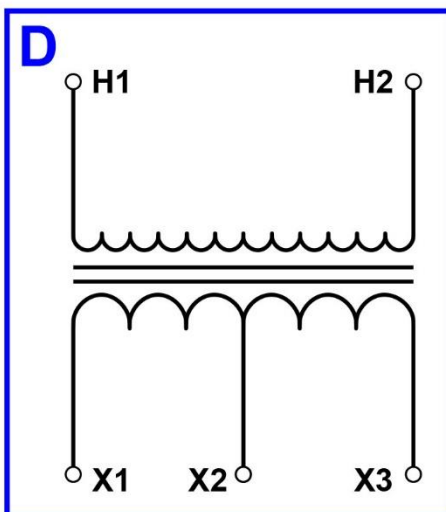
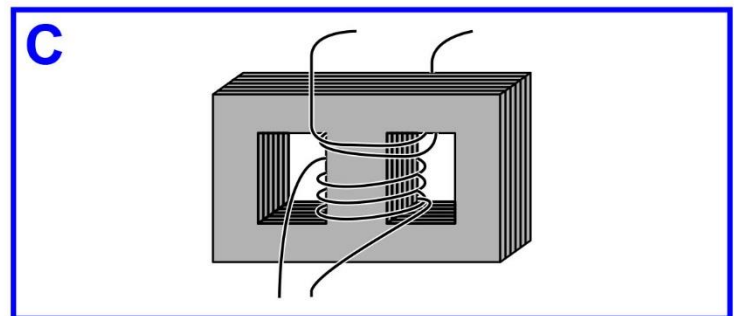
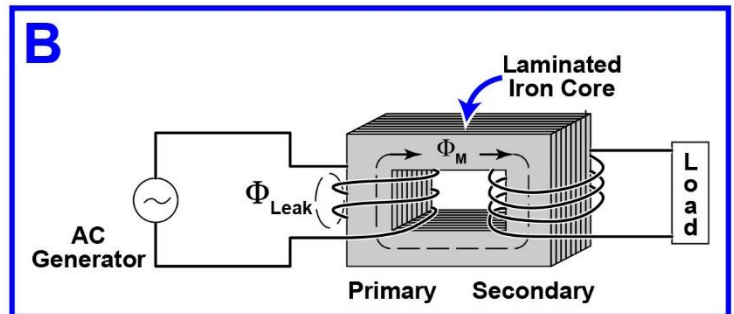
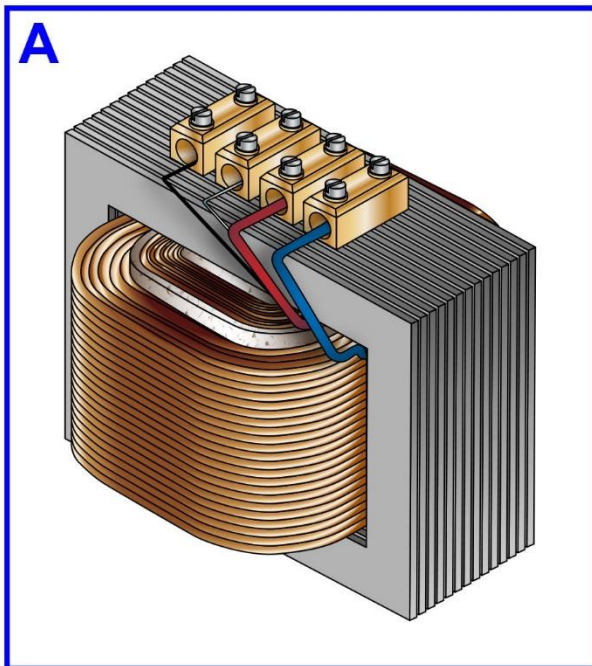
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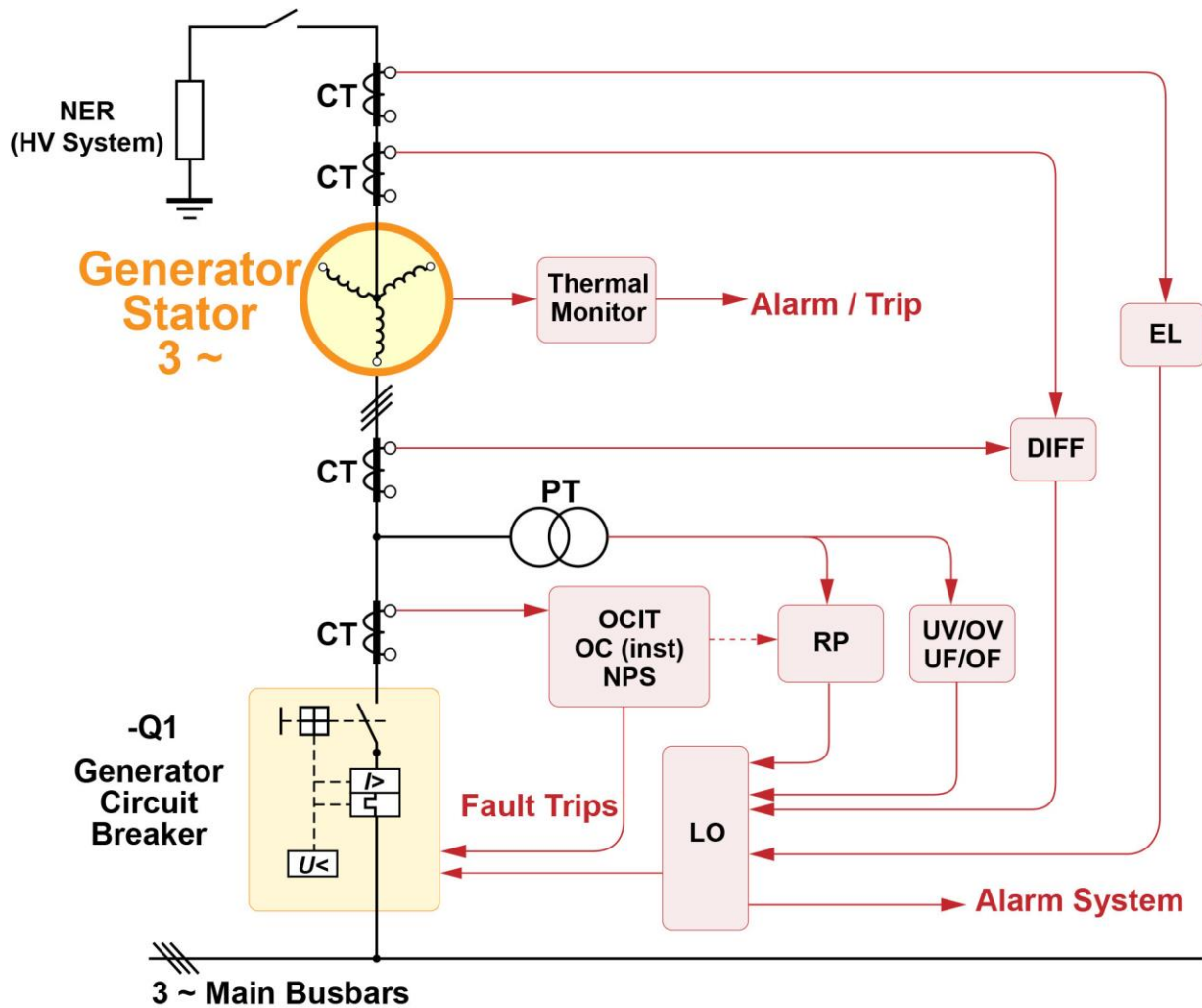


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EL-0055



EL-0067

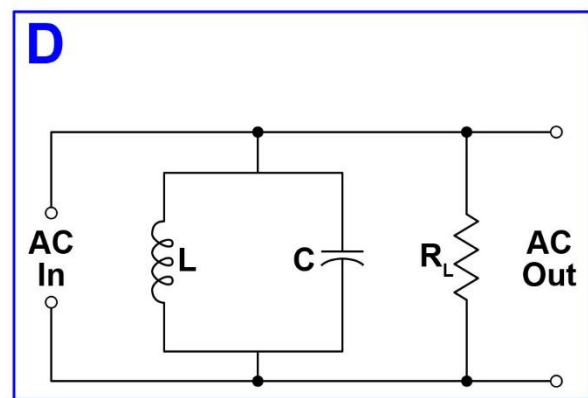
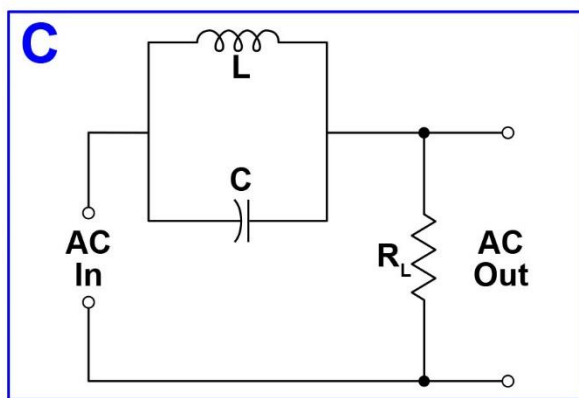
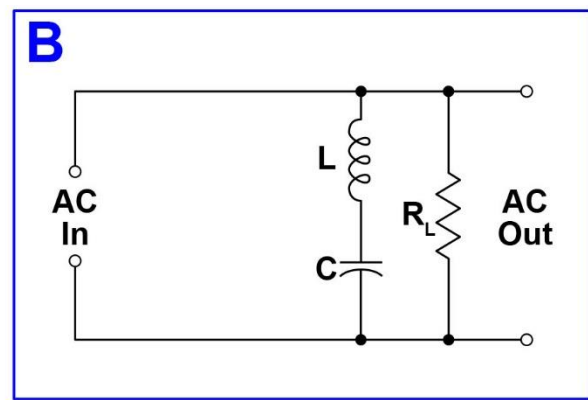
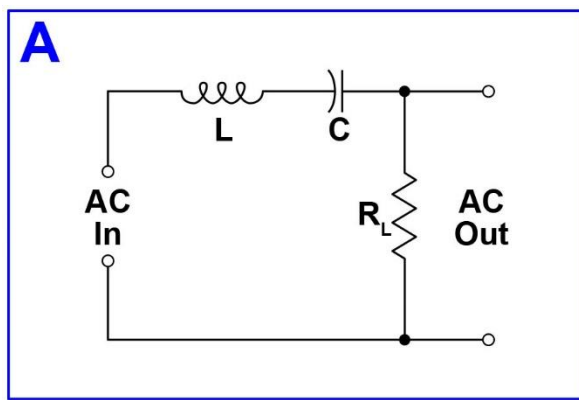


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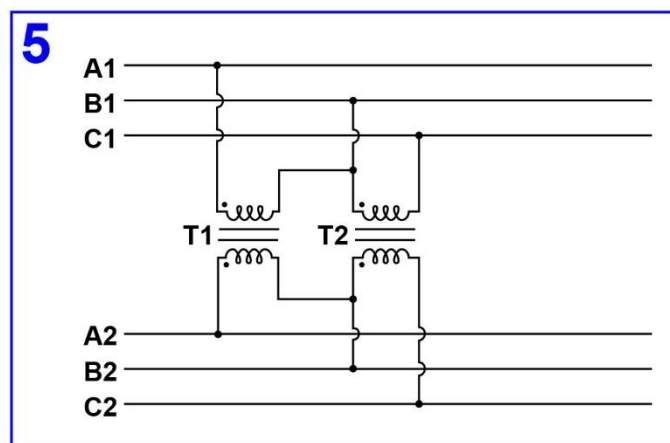
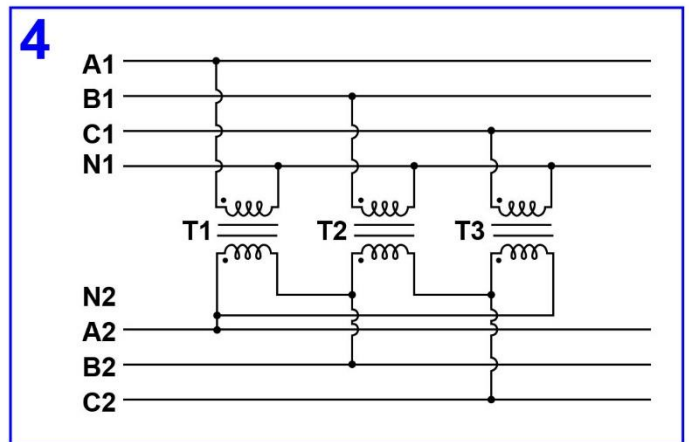
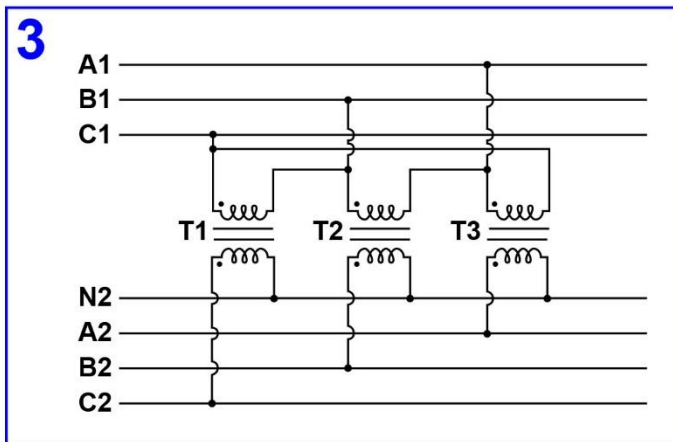
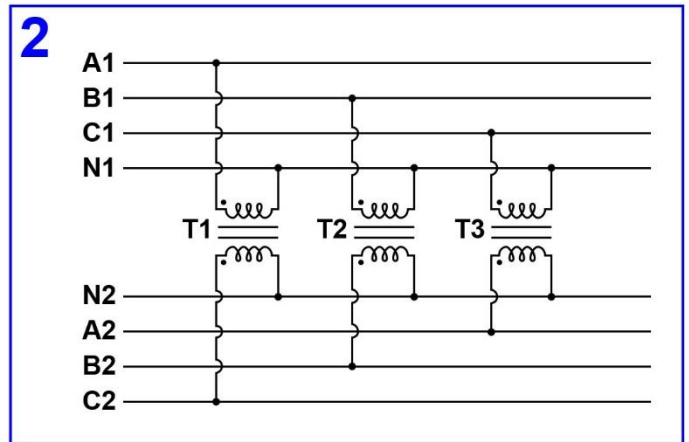
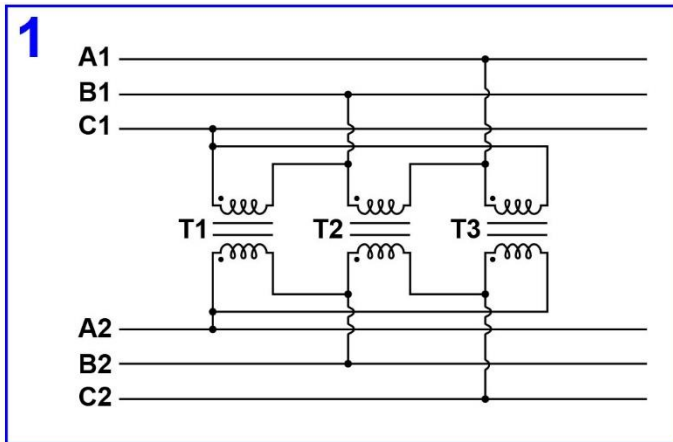
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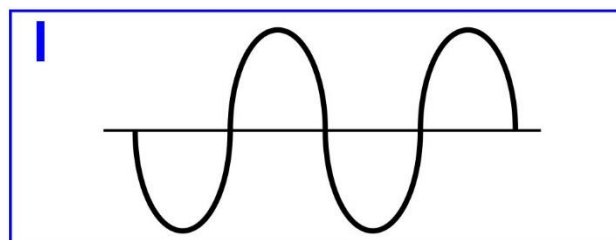
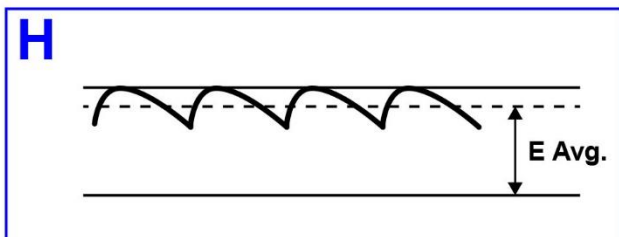
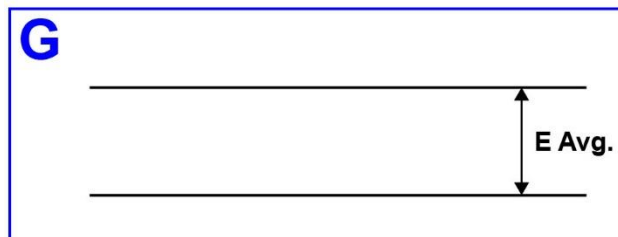
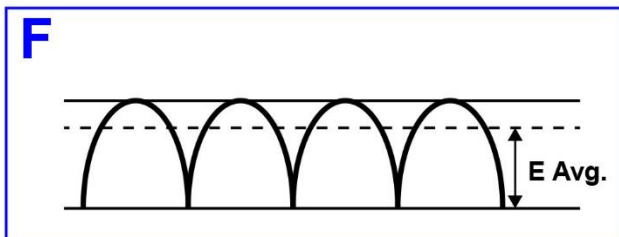
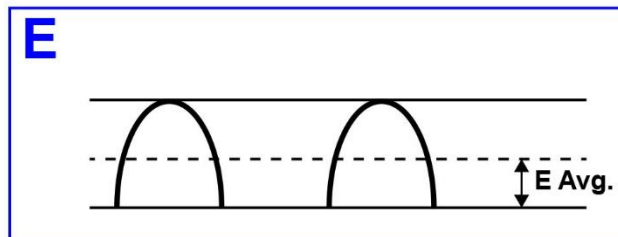
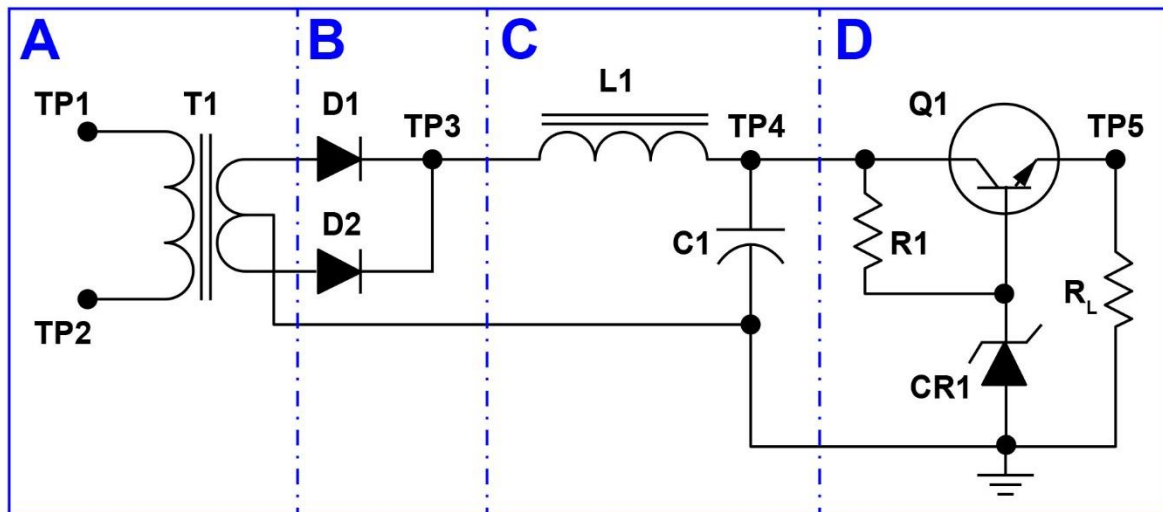
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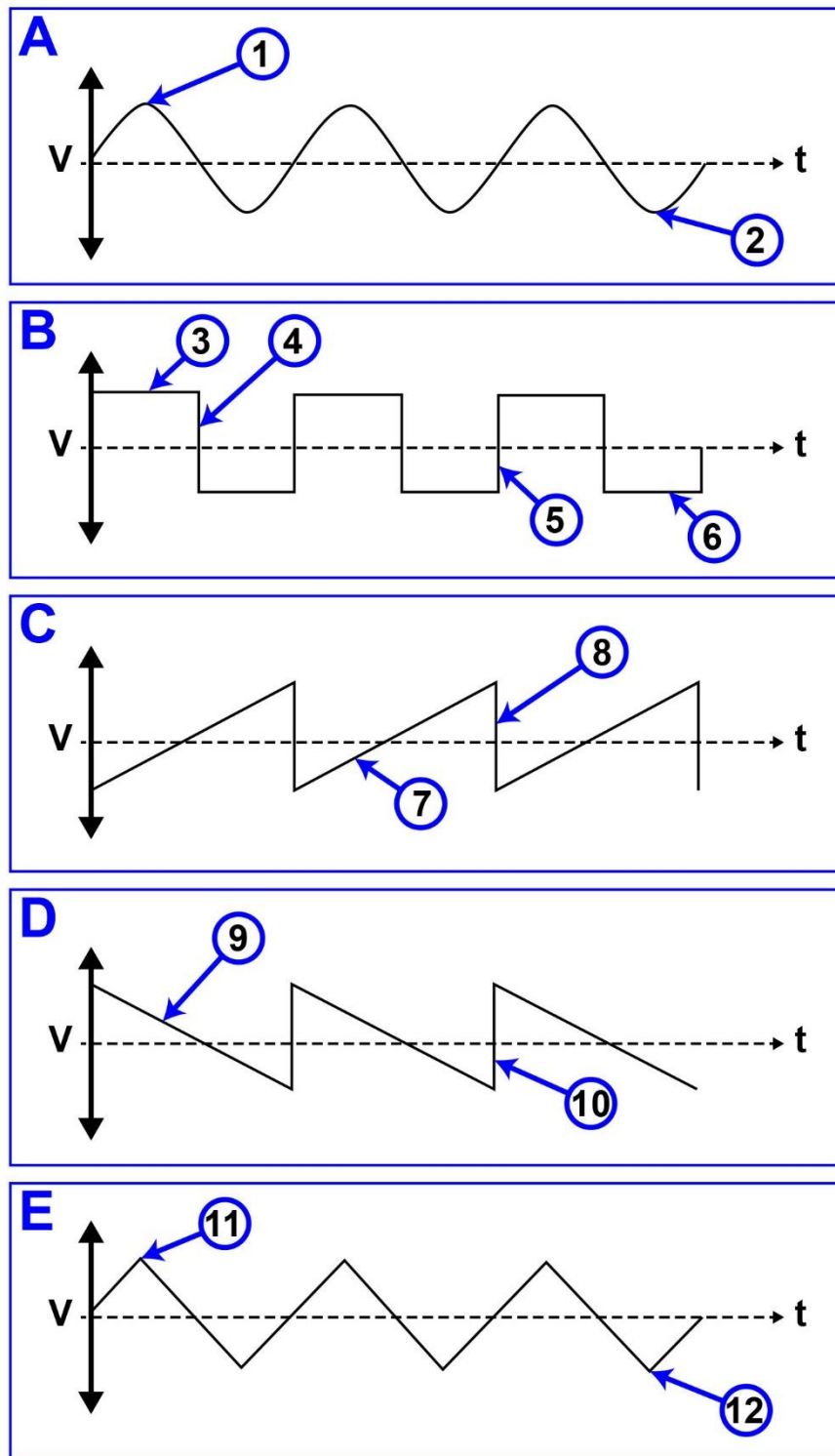
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EL-0085

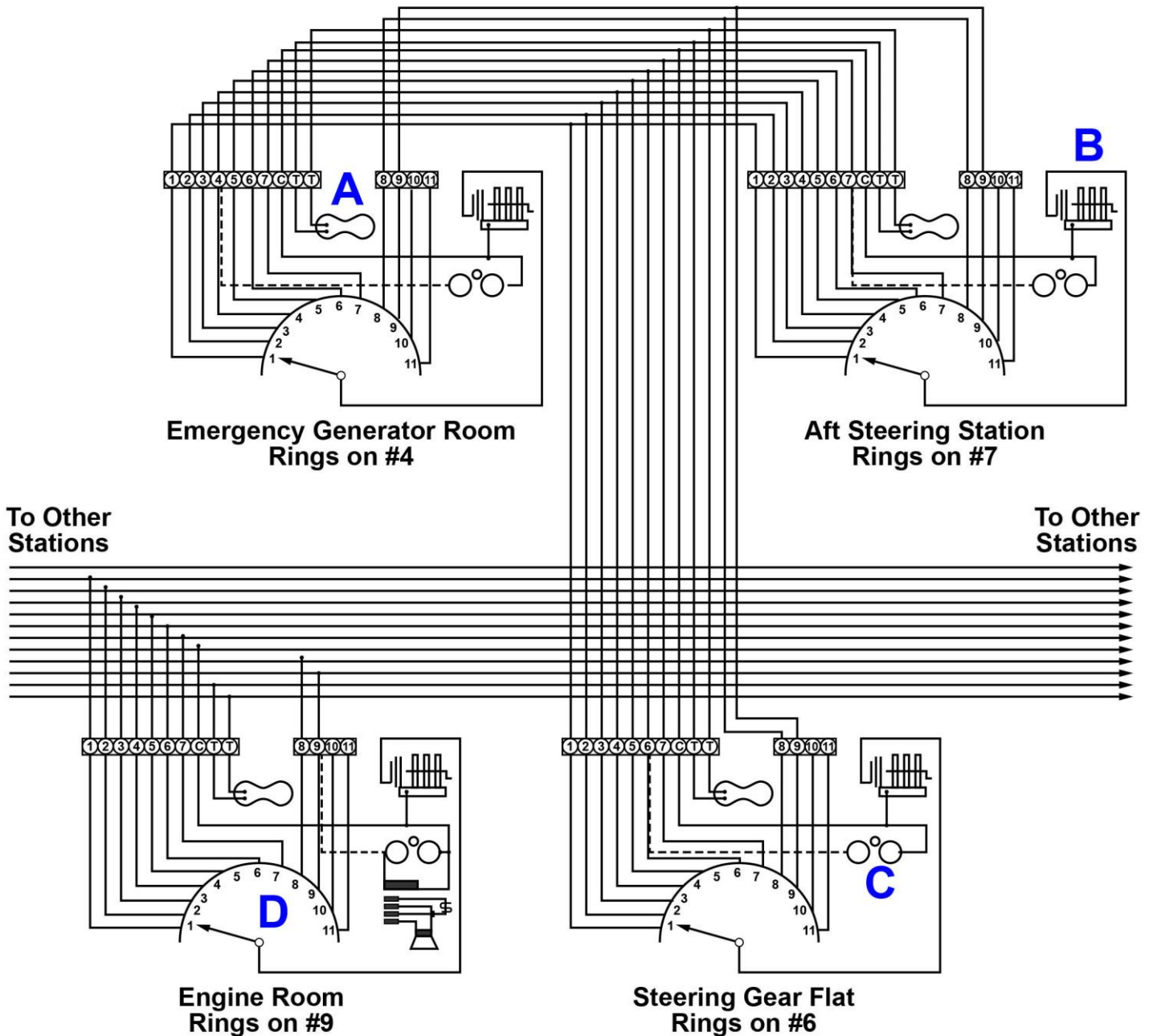


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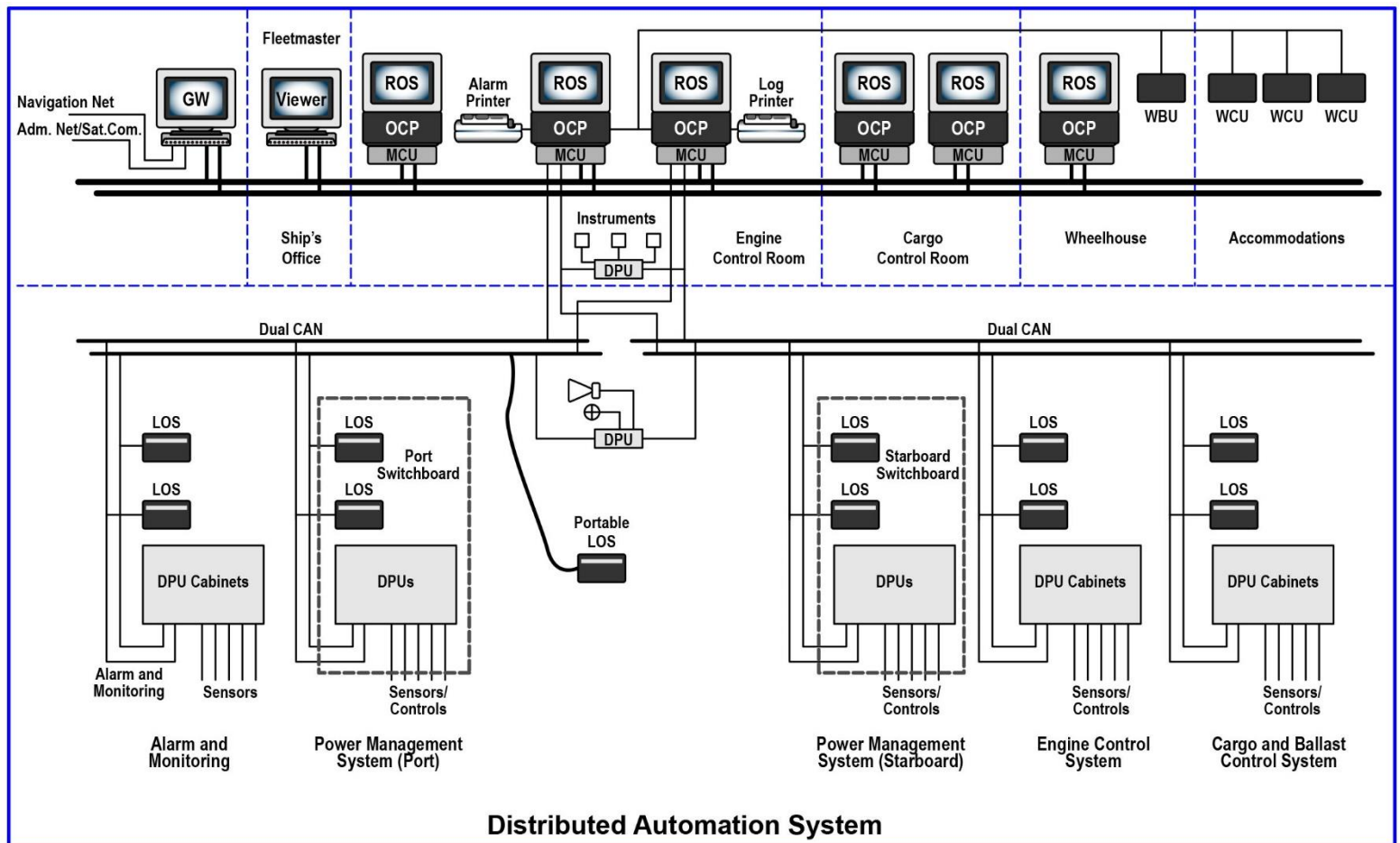
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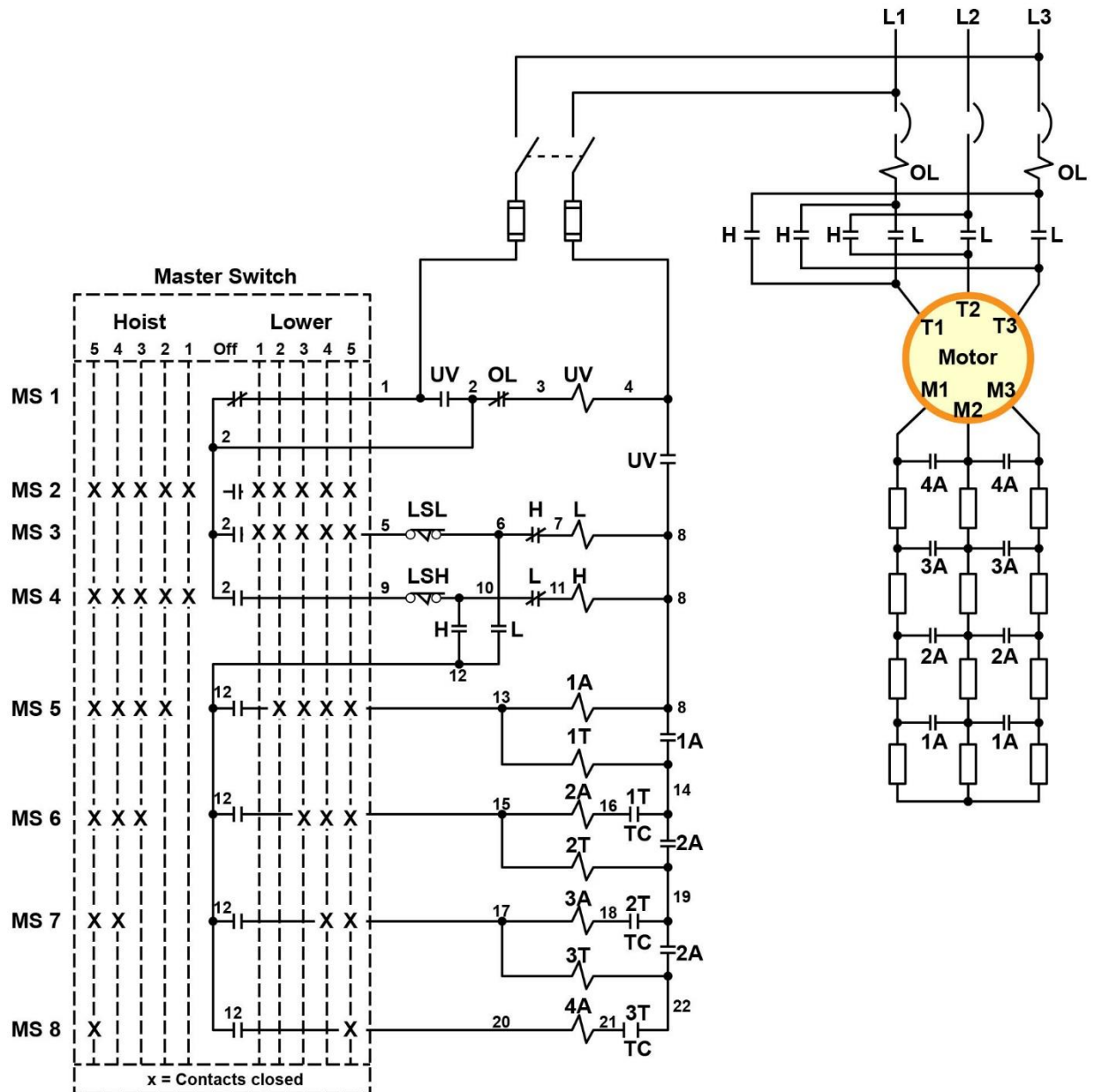
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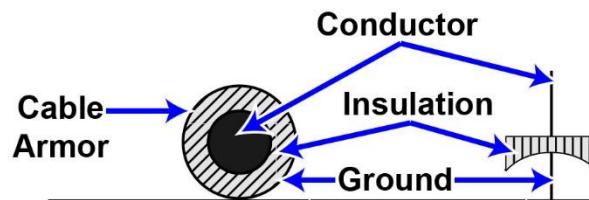
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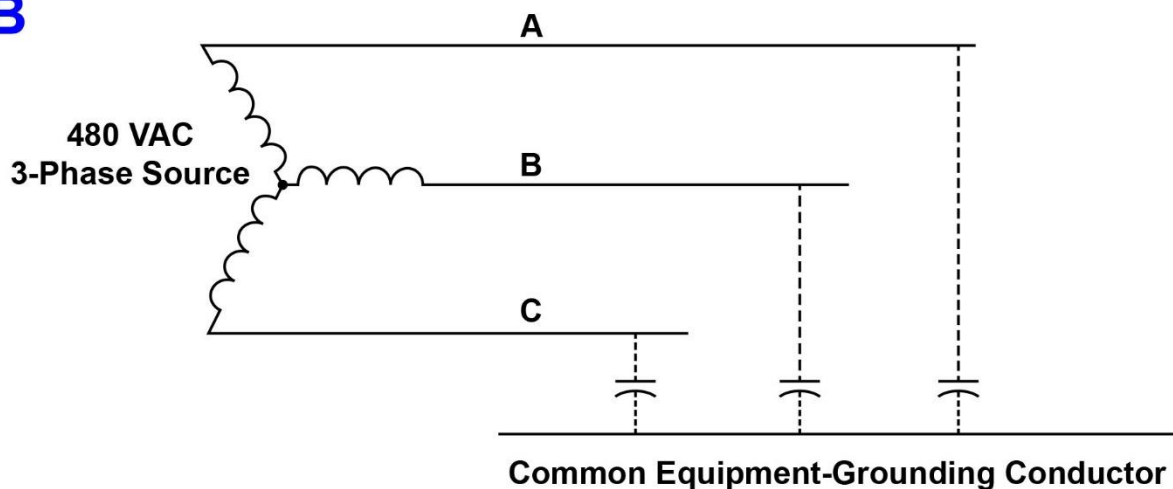


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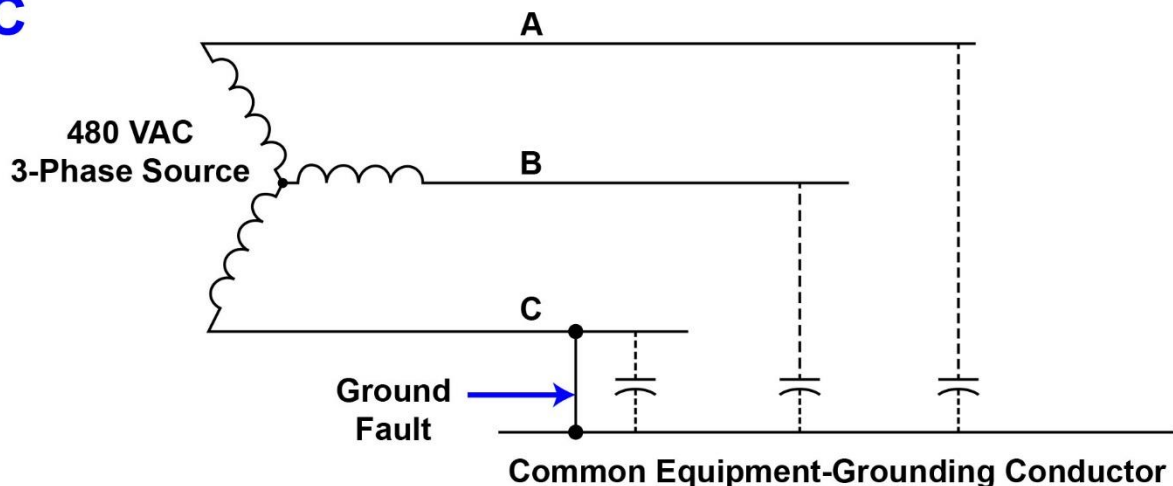
A



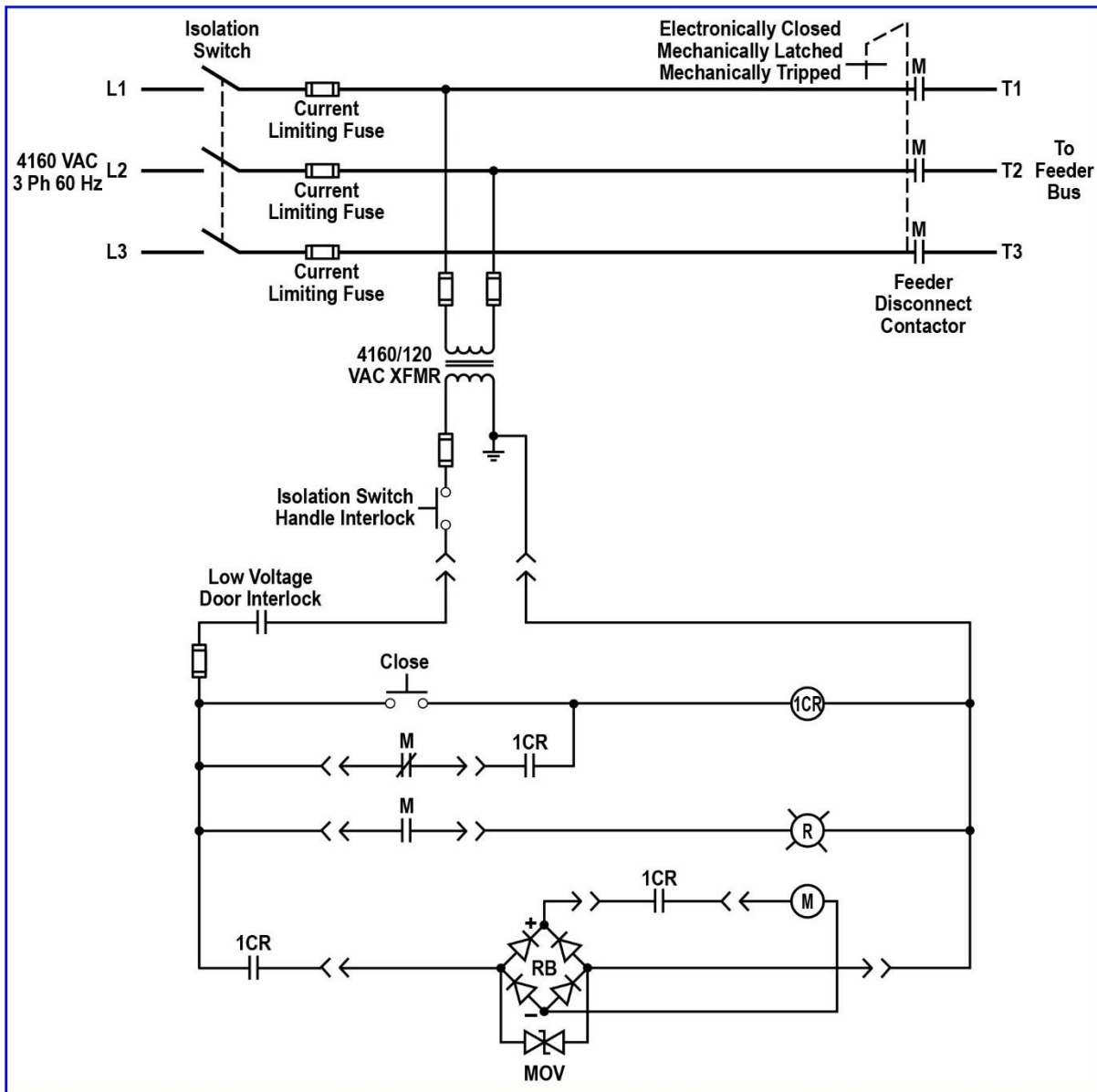
B



C



EL-0138



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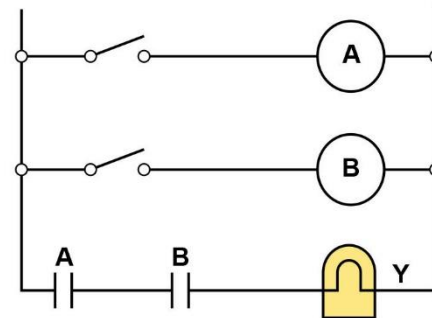
EL-0226 Relay and PLC Logic Compared

A

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

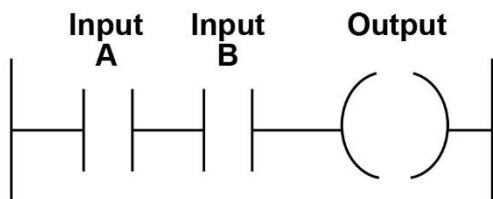
Truth Table

B



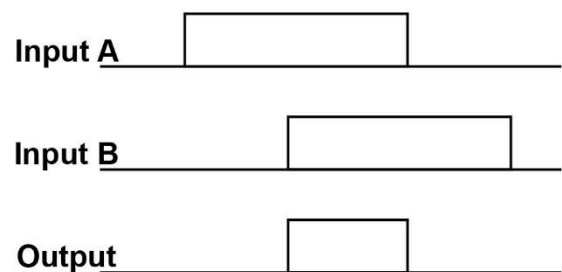
Equivalent Relay
Circuit Diagram

C



PLC Ladder Diagram

D



PLC Input/Output Diagram

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BOLTON, Programmable Logic Controllers, 5th Ed.
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