U.S.C.G. Merchant Marine Exam

DDE – Unlimited HP

Q625 Electrical – Electronic – Control Engineering

(Sample Examination)

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

1. In a series circuit, what is the applied voltage (or sum of the applied voltages) equal to?

   A. the sum of the individual voltage drops
   B. the total current divided by the total resistance
   C. the total resistance divided by the total current
   D. the sum of the individual currents multiplied by the number of resistors

   Correct answer: A

2. In the illustration, 1, 2, 3 and 4 are 12 volt batteries. What will be the nominal voltage as read by a voltmeter across the output of the battery bank? Illustration EL-0107

   A. 6 volts
   B. 12 volts
   C. 24 volts
   D. 48 volts

   Correct answer: C

3. From the instant of start-up, through the acceleration period, and until the motor reaches rated speed, when is the counter EMF produced in the windings of a DC motor "zero"?

   A. motor is almost up to rated speed
   B. armature is not yet turning
   C. armature has just begun to turn
   D. motor is at rated speed

   Correct answer: B

4. What statement is true concerning the total resistance of a parallel circuit?

   A. The total resistance is less than that of the branch with the lowest resistance.
   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 equal to the sum of the individual branch resistances divided by the number of branches.

   Correct answer: A

5. What is an ammeter used to measure?

   A. current
   B. continuity
   C. voltage
   D. resistance

   Correct answer: A

6. When configuring a digital multimeter as an ohmmeter, what will MOST likely be displayed on the screen when the test leads are shorted together?

   A. A reading of "OL" ohms will be displayed.
   B. A reading of residual test lead and internal resistance will be displayed (typically .2 to .5 ohms).
   C. A reading of 0 ohms will be displayed.
   D. B or C could be correct depending upon the digital multimeter.

   Correct answer: D

7. 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

8. Which statement is true concerning a split-phase induction motor?

   A. Motor rotation can be reversed without changing the windings or leads.
   B. Motor speed can be readily adjusted from zero to full speed.
   C. The motor will run as a generator with the proper wiring.
   D. Motor rotation can be reversed by reversing the leads on the starting winding.

   Correct answer: D

9. As shown in the illustrated wound-rotor induction motor, what statement is true concerning motor lead connections? Illustration EL-0148

   A. The "T1, T2, and T3" motor leads are connected to the rotor windings via slip rings and brushes and the "M1, M2, and M3" motor leads are directly connected to the stator windings.
   B. The "T1, T2, and T3" motor leads are directly connected to the rotor windings and the "M1, M2, and M3" motor leads are connected to the stator windings via slip rings and brushes.
   C. The "M1, M2, and M3" motor leads are connected to the rotor windings via slip rings and brushes and the "T1, T2, and T3" motor leads are directly connected to the stator windings.
   D. The "M1, M2, and M3" motor leads are directly connected to the rotor windings and the "T1, T2, and T3" motor leads are connected to the stator windings via slip rings and brushes.

   Correct answer: C

10. What type of electrical diagram for the electrical distribution system is shown in the illustration? Illustration EL-0014

    A. The diagram is an isometric diagram.
    B. The diagram is a ladder or line diagram (schematic).
    C. The diagram is a one-line diagram.
    D. The diagram is a wiring diagram.

    Correct answer: C

11. As shown in the illustrated devices and symbols, which of the symbols shown in the illustration represents a standard normally closed relay contact? Illustration EL-0005

    A. E
    B. F
    C. I
    D. K

    Correct answer: B

12. Which electrical schematic symbol shown in the illustration represents a thermostat which opens on rising temperature? Illustration EL-0059

    A. 1
    B. 6
    C. 8
    D. 9

    Correct answer: C

13. How are the line losses in a distribution circuit kept to a minimum?

    A. using higher current and lower voltage
    B. adding rubber insulation conductors to the circuit
    C. using higher voltage and lower current
    D. increasing the number of thermal relays in the circuit

    Correct answer: C

14. 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 is contaminated with moisture.
    B. The insulation has direct continuity with ground.
    C. The insulation is in good condition.
    D. The insulation is cracked and otherwise deteriorated.

    Correct answer: C

15. A split-phase induction squirrel-cage motor will not start and come up to speed, even though the rated voltage and frequency are applied. Assuming that the motor hums without rotating, which of the following troubles would MOST likely be suspected?

    A. an open run or start winding
    B. a shorted centrifugal switch
    C. a shorted rotor bar
    D. a shorted thermal protector

    Correct answer: A

16. Grounds occurring in electrical machinery as a result of insulation failure may result from deterioration over time and excessive heat. What could be another contributing cause?

    A. extended periods of operation at low ambient temperature
    B. extended operation at normal loads
    C. extended periods of vibration
    D. extended periods of operation at low load

    Correct answer: C

17. What could prevent a lead-acid battery from accepting a full charge?

    A. Attempting to force charging current into the battery in the opposite direction to that which occurs during discharge.
    B. Topping off low electrolyte levels (due to evaporation) with distilled water.
    C. Coating terminal posts with an antioxidant grease approved for battery use.
    D. Leaving the battery in a discharged condition for a great length of time.

    Correct answer: D

18. When troubleshooting a lead-acid storage battery, what is the best method for detecting a weak or dead cell?

    A. visually inspecting the electrolyte levels of each cell
    B. taking an open circuit voltage test of individual cells
    C. comparing the specific gravity of the electrolyte in each cell
    D. taking each cell's temperature with a calibrated mercury thermometer

    Correct answer: C

19. As shown in figure "A" of the ungrounded distribution system, under what conditions would an outage likely occur due to a ground fault (or faults) causing a circuit breaker to trip? Illustration EL-0129

    A. two ground faults associated with different phases
    B. two ground faults associated with the same phase
    C. ground faults do not result in outages regardless of the number and location of faults
    D. a single ground fault associated with any phase

    Correct answer: A

20. If a digital multimeter is set up as shown in figures "A" and "B" of the illustration, what is the status of the silicon diode if the display reads 5 megohms when configured as in figure "A" and the display reads infinite (OL) megohms when configured as in figure "B"? Illustration EL-0211

    A. the diode is functioning properly
    B. the diode is open
    C. the diode is shorted
    D. the diode is intermittently open

    Correct answer: A

21. The motor of the illustrated motor controller fails to start on an attempted startup. You ensure the motor has not tripped out on overload, and you check the disconnect switch closed. With the start button depressed, a voltmeter reading between 3 and 4, as in figure "A" shown in the illustration, indicates line voltage. After re-opening the disconnect switch and verifying the circuit de-energized, what should be your next step in the troubleshooting process? Illustration EL-0007

    A. check the resistance across the contactor coil "M" (across 3 and 5)
    B. after depressing, check the resistance across the normally open start button contacts (across 2 and 3)
    C. without depressing, check the resistance across the normally closed stop button contacts (across 1 and 2)
    D. check the resistance across the normally closed overload relay contacts (across 4 and 5)

    Correct answer: D

22. What can be the cause of excessive heat or burning contacts in an operating motor controller?

    A. burned out operating coil
    B. high ambient temperature
    C. low motor starting torque
    D. dirty or pitted contacts

    Correct answer: D

23. How can the loss of residual magnetism in an alternator with a brushless excitation system be corrected?

    A. using a storage battery or battery charger to "flash" the field
    B. running the rotor in the opposite direction for 5 minutes
    C. allowing the generator to run at 10% of normal speed for 5 minutes
    D. running the generator at normal speed with the field rheostat fully counter-clockwise

    Correct answer: A

24. What is the most reliable and preferred method for determining the state of charge of a wet cell NiCad battery while it is being charged?

    A. Measuring the specific gravity of each cell with a hydrometer
    B. Measuring the temperature corrected specific gravity of each cell with a hydrometer and thermometer
    C. Measuring the battery voltage with a digital voltmeter
    D. Measuring the battery voltage with a solenoid type voltage tester

    Correct answer: C

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

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

    Correct answer: C

26. 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 DC power source, and the stator windings are directly connected to a three-phase AC power source.
    C. 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.
    D. 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.

    Correct answer: B

27. How is the difference between the synchronous speed of a three-phase induction motor and its operating speed correctly expressed?

    A. a decimal fraction of full load speed
    B. deviation
    C. slip
    D. a percent of full load speed

    Correct answer: C

28. 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. maintain resistance contacts in clean condition
    D. limit the amount of load put on the motor

    Correct answer: A

29. Which of the following statements represents the main difference between an electromagnetic relay and an electromagnetic contactor as used in motor control and power circuits?

    A. Contactor contacts are made from silver and relay contacts are made from copper.
    B. Contactor contacts can handle heavier loads than relay contacts.
    C. Contactors control current and relays control voltage.
    D. A relay is series connected and a contactor is parallel connected.

    Correct answer: B

30. Which of the following pictures represents a magnetic reversing or two-speed motor starter? Illustration EL-0179

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

    Correct answer: D

31. Which of the following statements about a three-phase wye connected alternator is correct?

    A. The phase voltage is 1.73 times the line voltage.
    B. The phase current is 1.73 times the line current.
    C. The line voltage is 1.73 times the phase voltage.
    D. The line current is 1.73 times the phase current.

    Correct answer: C

32. 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. main lighting circuits
    C. general alarm circuits
    D. motor starting circuits

    Correct answer: D

33. Referring to the illustration, what is the position of the three circuit breakers labeled in figure A, B, and C respectively? Illustration EL-0033

    A. Circuit breaker in figure A is in the OFF position. Circuit breaker in figure B is in the ON position. Circuit breaker in figure C is in the TRIPPED position.
    B. Circuit breaker in figure A is in the ON position. Circuit breaker in figure B is in the OFF position. Circuit breaker in figure C is in the TRIPPED position.
    C. Circuit breaker in figure A is in the ON position. Circuit breaker in figure B is in the TRIPPED position. Circuit breaker in figure C is in the OFF position.
    D. Circuit breaker in figure A is in the OFF position. Circuit breaker in figure B is in the TRIPPED position. Circuit breaker in figure C is in the ON position.

    Correct answer: A

34. As shown in the illustration, which of the following pieces of equipment is supplied with a circuit breaker providing both overload and short-circuit protection? Illustration EL-0165

    A. Sewage Treatment Plant
    B. Lube Oil Service Pump No.1
    C. Cargo Oil Transfer Pump No.1
    D. S.W. Cooling Circ. Pump No.1

    Correct answer: A

35. Which of the following pictures shown in the illustration is a control transformer, usually used to step down line voltage for supplying reduced voltage control circuits? Illustration EL-0177

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

    Correct answer: B

36. What is the purpose of a three-phase lighting power transformer bank of a shipboard distribution system?

    A. increase source voltage temporarily for striking an arc in fluorescent lighting fixtures
    B. decrease generating system voltage to a lower voltage suitable for lighting fixtures
    C. stabilize the arc in fluorescent lighting fixtures
    D. transform electrical energy directly into light energy

    Correct answer: B

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

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

    Correct answer: C

38. As shown in the illustrated harmonic analysis diagram, which figure represents the fundamental (or first harmonic)? Illustration EL-0163

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

    Correct answer: B

39. 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

40. What does the symbol in figure "1" shown in the illustration represent? Illustration EL-0065

    A. PNP bipolar junction transistor
    B. junction field effect transistor
    C. silicon controller rectifier
    D. NPN bipolar junction transistor

    Correct answer: A

41. In what applications are semiconductor diodes commonly used?

    A. rectifiers
    B. photocells
    C. power sources
    D. potentiometers

    Correct answer: A

42. The component labeled "CR1" in the circuit shown in the illustration serves what functional purpose? Illustration EL-0085

    A. it varies its anode/cathode polarity depending on "RL" current
    B. it acts as a low capacitive reactance to smooth ripple
    C. it establishes a constant reference voltage for the base of "Q1"
    D. it rectifies the varying voltage from the collector of "Q1"

    Correct answer: C

43. In referring to figure "A" of the illustration, what type of active filter circuit is shown? Illustration EL-0077

    A. High-pass filter circuit
    B. Notch filter circuit
    C. Bandpass filter circuit
    D. Low-pass filter circuit

    Correct answer: D

44. As shown in all three diagrams included in the illustration, what type of logic circuit is represented? Illustration EL-0231

    A. NOT gate
    B. OR gate
    C. XOR gate
    D. NOR gate

    Correct answer: C

45. Which statement is TRUE concerning electric propulsion drives?

    A. Lack of flexibility of arrangement between the prime mover and motor
    B. Inability to be utilized as a source of ships service power
    C. The propeller speed and direction of rotation are easily controllable
    D. Lower transmission losses compared to other types of propulsion drives

    Correct answer: C

46. 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. Steam turbine geared drive
    B. Gas turbine geared drive
    C. Diesel-electric drive
    D. Direct or geared diesel drive

    Correct answer: C

47. As shown in figure "A" of the illustration, the load-commutated inverter drive illustrated has how many pulses? Illustration EL-0159

    A. 3
    B. 6
    C. 9
    D. 12

    Correct answer: B

48. In addition to SF6 gas circuit breakers, of the types listed below, what type of circuit breaker is used for high voltage practice aboard ship?

    A. vacuum-break
    B. gas-break
    C. air-break
    D. oil-break

    Correct answer: A

49. 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 after testing the circuit to be worked upon.
    C. The live-line tester should be checked by connecting to a known high voltage source only before 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

50. Of the following, what shipboard system is MOST likely to use the synchronous transmission system featuring a transmitter and receiver?

    A. Shaft revolution indicator system
    B. Turbocharger RPM indicator system
    C. Rudder angle indicator system
    D. Centrifuge RPM indicator system

    Correct answer: C

51. 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

52. What statement is true concerning read only memory (ROM)?

    A. ROM is volatile memory and the contents of ROM are lost when the power is removed.
    B. ROM is non-volatile memory and the contents of ROM are lost when the power is removed.
    C. ROM is non-volatile memory and the contents of ROM are not lost when the power is removed.
    D. ROM is volatile memory and the contents of ROM are not lost when the power is removed.

    Correct answer: C

53. Modern ships use multiple computers arranged in a client/server network to perform various shipboard functions. What type of computer network would most likely be used aboard ship?

    A. Wired local area network
    B. Wired wide area network
    C. Wireless local area network
    D. Wireless wide area network

    Correct answer: A

54. What type of motor is generally used in DC propulsion drive systems?

    A. shunt-wound or separately excited
    B. differentially compounded
    C. series-wound
    D. permanent magnet

    Correct answer: A

55. Referring to the illustration pertaining to the semi-automatic navigation light panel circuit, if the buzzer sounds and the masthead indicator light comes on, what statement is true concerning acknowledging and responding to the alarm while minimizing the danger to navigation? Illustration EL-0108

    A. The buzzer is immediately silenced by turning the masthead transfer switch in the line section off. The masthead light can only be illuminated by replacing the burned out bulb.
    B. The buzzer is immediately silenced by turning the masthead transfer switch in the line section to the secondary lamp position. The masthead light will then immediately illuminate.
    C. The buzzer is immediately silenced by turning the master switch in the master section off. The masthead light can only be illuminated by replacing the burned out bulb.
    D. The buzzer cannot be silenced and the masthead light cannot be illuminated until the burned out masthead lamp is replaced.

    Correct answer: B

56. In monitoring an impressed current cathodic hull protection system, it is important to ensure that the propeller screw receives the same cathodic protection as the hull. What should be checked?

    A. Ensure adequate individual anode current to the anode closest to the propulsion shafting as it passes through the hull.
    B. Ensure adequate grounding carbon brush pressure on the rotating shaft by checking associated current.
    C. No checks are necessary since the propeller screw is bronze and needs no protection.
    D. Nothing can be done short of checking the propeller screw at drydock availabilities.

    Correct answer: B

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

    Correct answer: D

58. When power is restored after a complete power failure, how will the steering gear pump motor which was on-line respond?

    A. It will have to be restarted manually
    B. It will restart automatically
    C. It will trip its overload relays
    D. It will have to be reset manually

    Correct answer: B

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

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

    Correct answer: C

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

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

    Correct answer: A

61. When testing insulation resistance of electric equipment and machinery, ideally when should the insulation resistance be tested for the lowest normal insulation values?

    A. immediately after shutting down the machine
    B. every time the brush rigging is adjusted
    C. every 30 days whether the machine is in use or not
    D. immediately after starting up the machine

    Correct answer: A

62. Which of the following methods should be used to dress the face of silver-plated contacts?

    A. Knurling with a knurling tool
    B. Burnishing with a burnishing tool
    C. Sanding with 400 grit sandpaper
    D. Filing with a mill file

    Correct answer: C

63. As shown in figure "6" of the illustration, what does the symbol represent as used in electrical drawings? Illustration EL-0026

    A. maintaining type push button with a mechanical interlock
    B. maintaining type push button with an electrical interlock
    C. limit switch with one set of normally open contacts
    D. normally closed contact held open mechanically by an interlock

    Correct answer: A

64. Which of the following statements concerning figure "6" of the illustration is true? Illustration EL-0026

    A. The symbol represents a computer cable pin plug.
    B. The symbol represents an overload relay.
    C. The symbol represents a switch which functions with analog parameters.
    D. The symbol represents a switch using maintained contact with "either/or" logic.

    Correct answer: D

65. What statement is true concerning the charging of a 100 amp-hour lead-acid battery?

    A. The temperature of the electrolyte should not be allowed to exceed 90°F.
    B. The charging rate should be 100 amps for one hour.
    C. The initial charging rate should be no greater than 100% of the battery amp-hour rating.
    D. The source of power for charging should be 2.0 volts per cell.

    Correct answer: C

66. 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 and after conducting the insulation resistance check
    C. after conducting the insulation resistance check only
    D. prior to conducting the insulation resistance check only

    Correct answer: B

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

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

    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 increased proportionately upward to compensate for the frequency decrease.
    B. The alternator output voltage must be maintained at the rated value for the alternator output voltage.
    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. Contact with any energized electrical system conductor is potentially hazardous and precautions should be taken to prevent exposure. With all other factors considered equal (such as voltage, conducting path through the body and the duration of contact), contact with an energized electrical system conductor of which system type would produce the most damaging effect?

    A. DC systems
    B. 60 Hz AC systems
    C. 10 kHz AC systems
    D. All the above systems would be equally as damaging

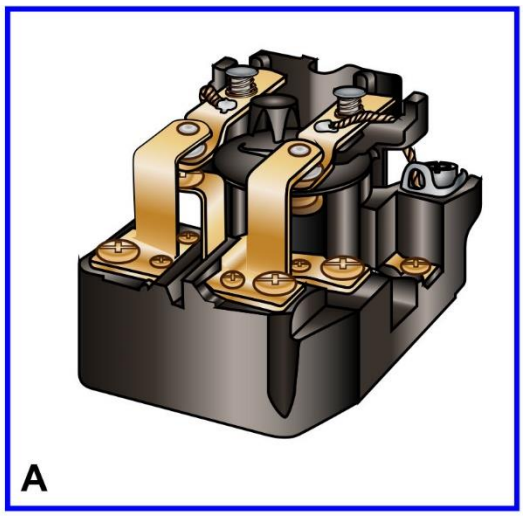
    Correct answer: B

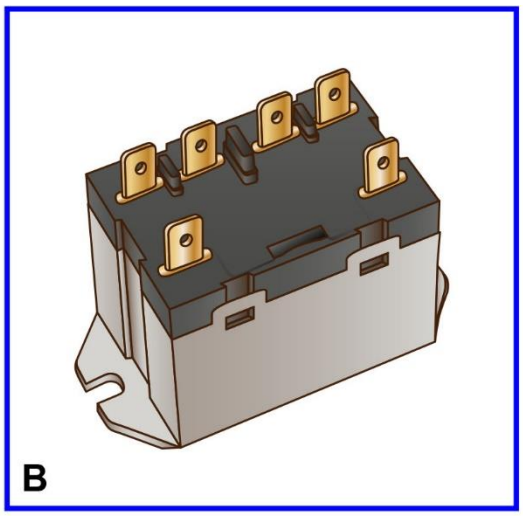
70. After prior isolation and lock-out/tag-out procedures are performed, it is still possible that stored electrical energy within the circuit can pose an electrical shock hazard. Which electrical device requires discharging any stored electrical energy before any work may safely begin?

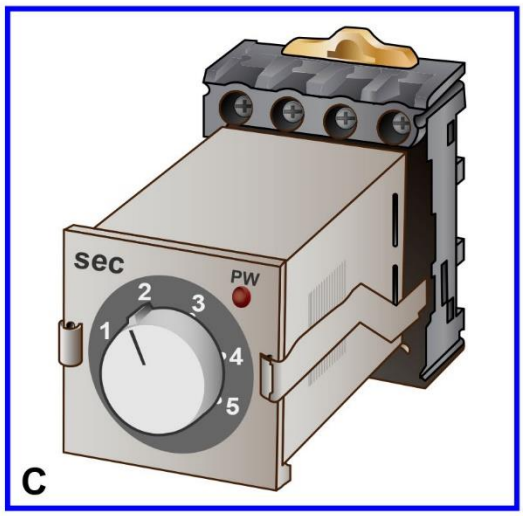
    A. choke coil
    B. capacitor
    C. resistor bank
    D. potential transformer

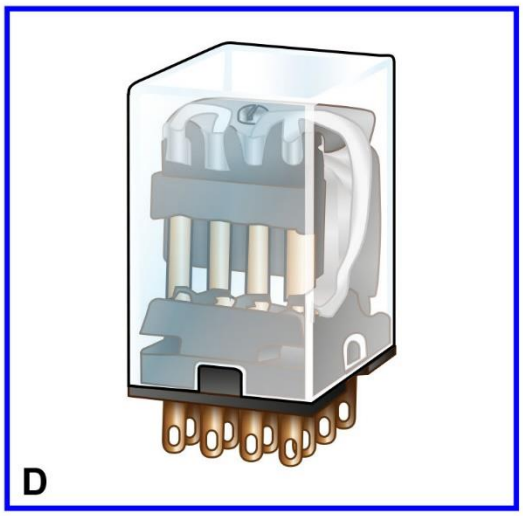
    Correct answer: B

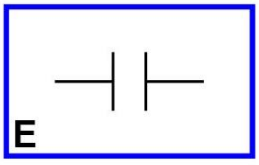
EL-0005

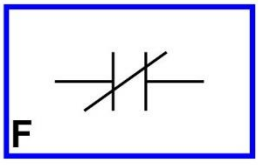


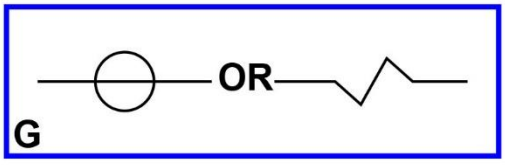


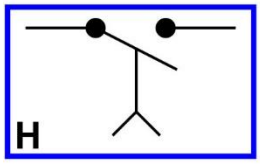


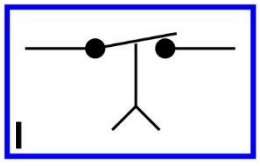


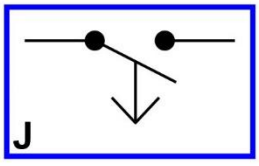


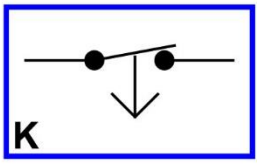












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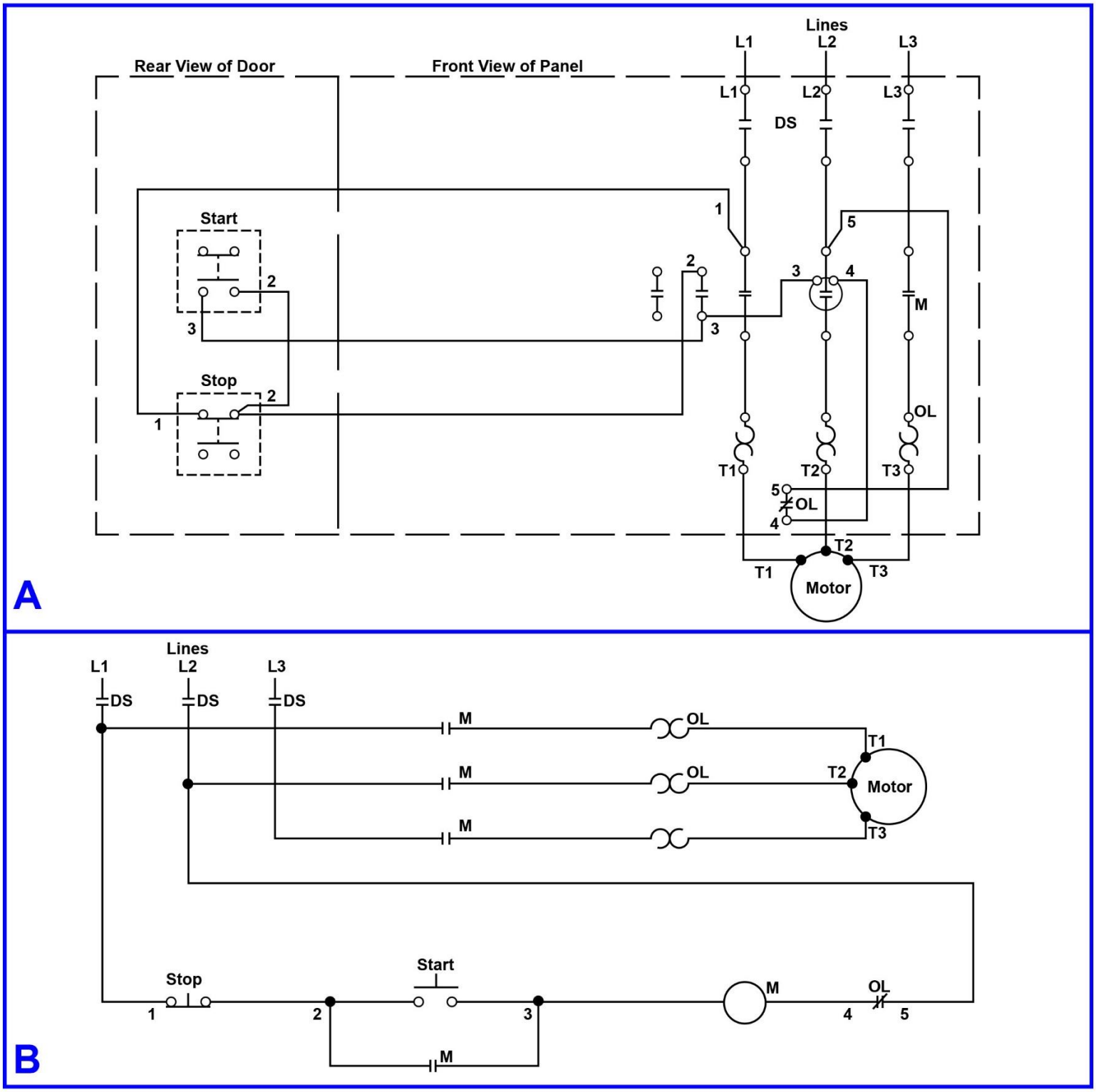

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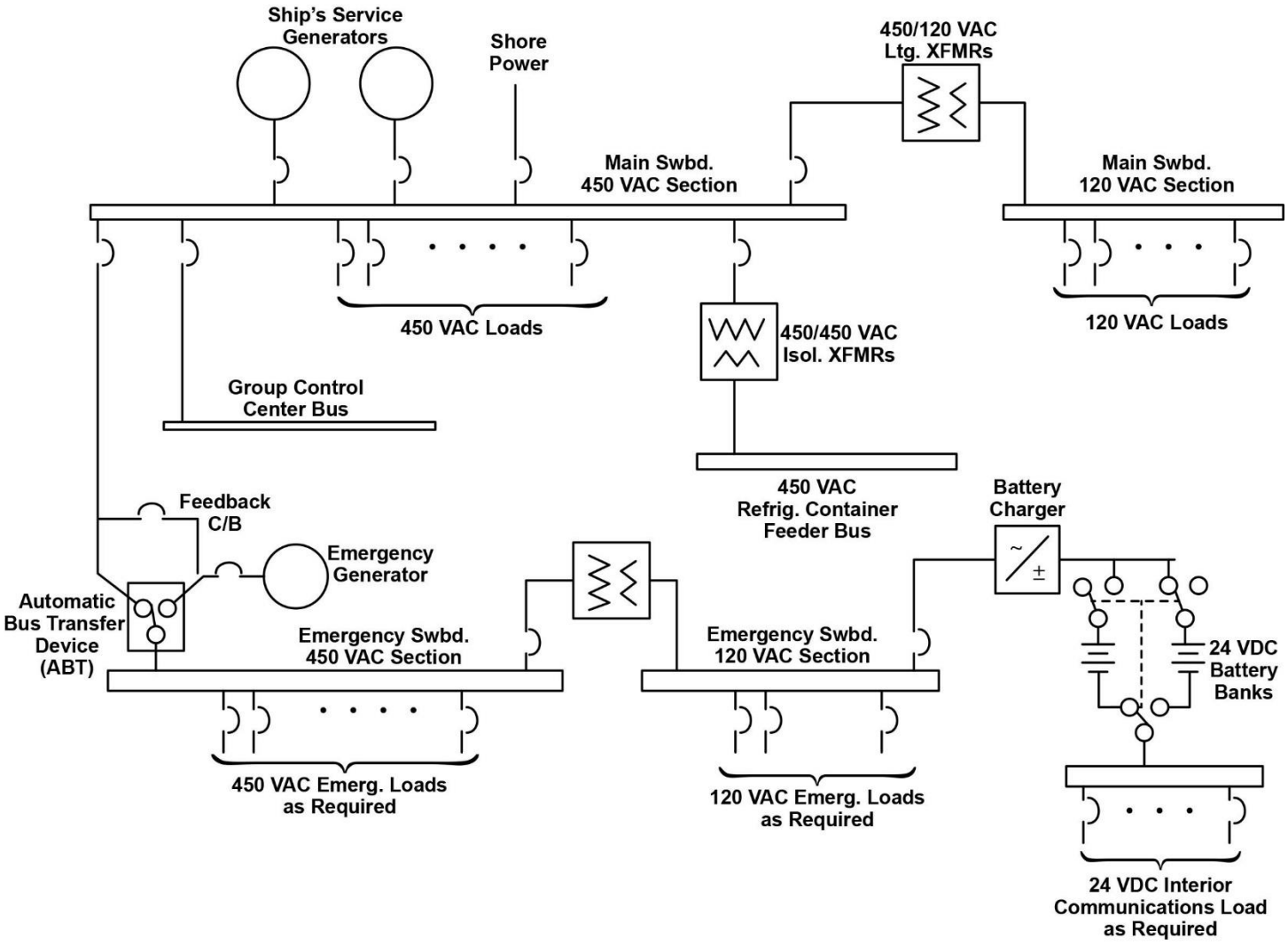

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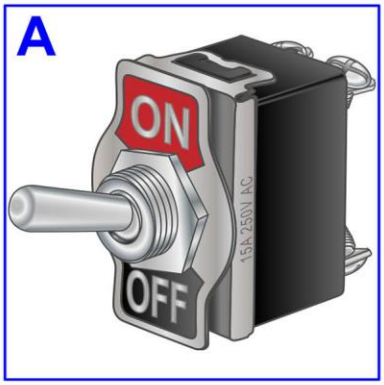

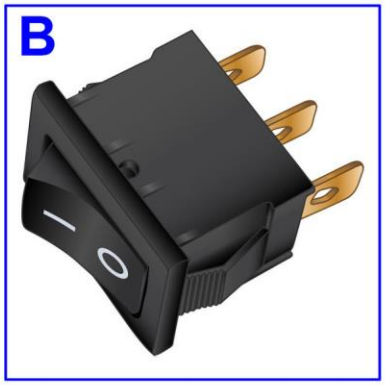

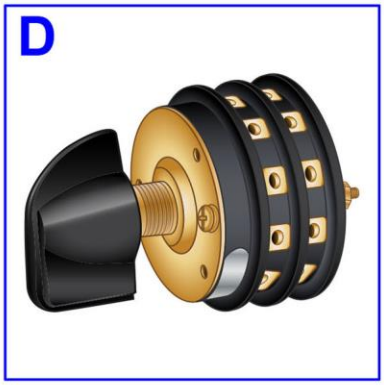

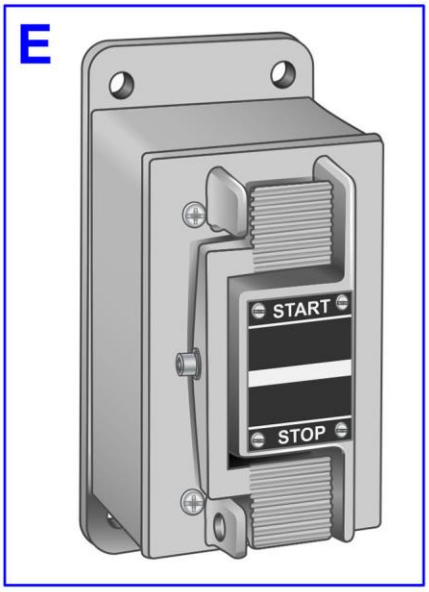

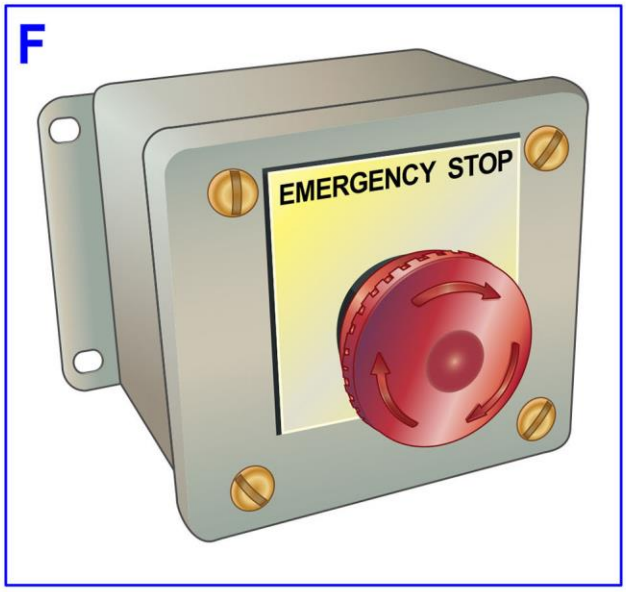

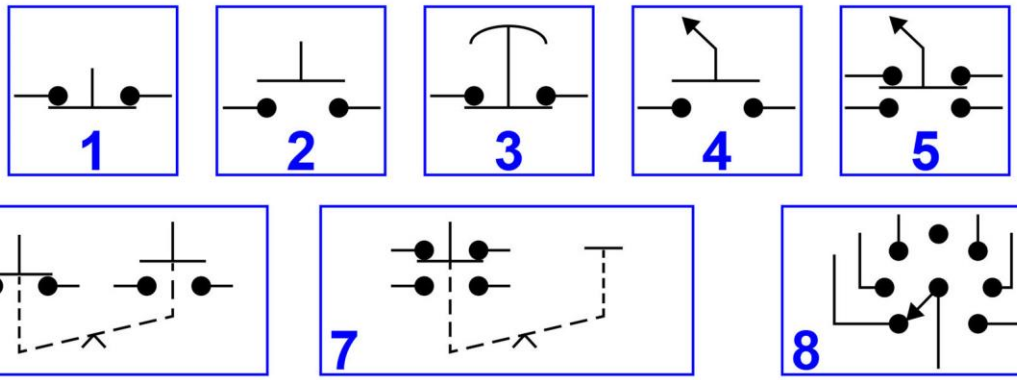

EL-0033

A

B

C

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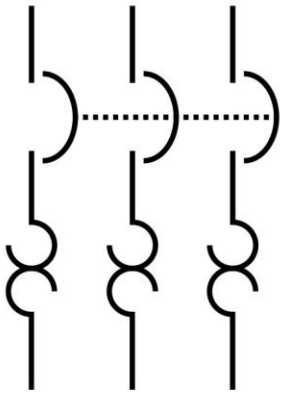

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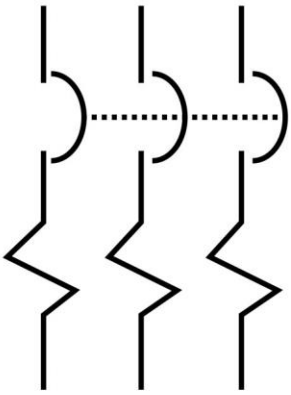

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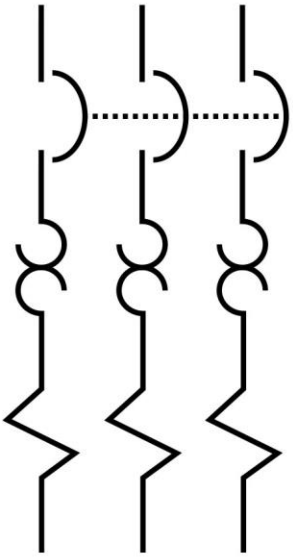

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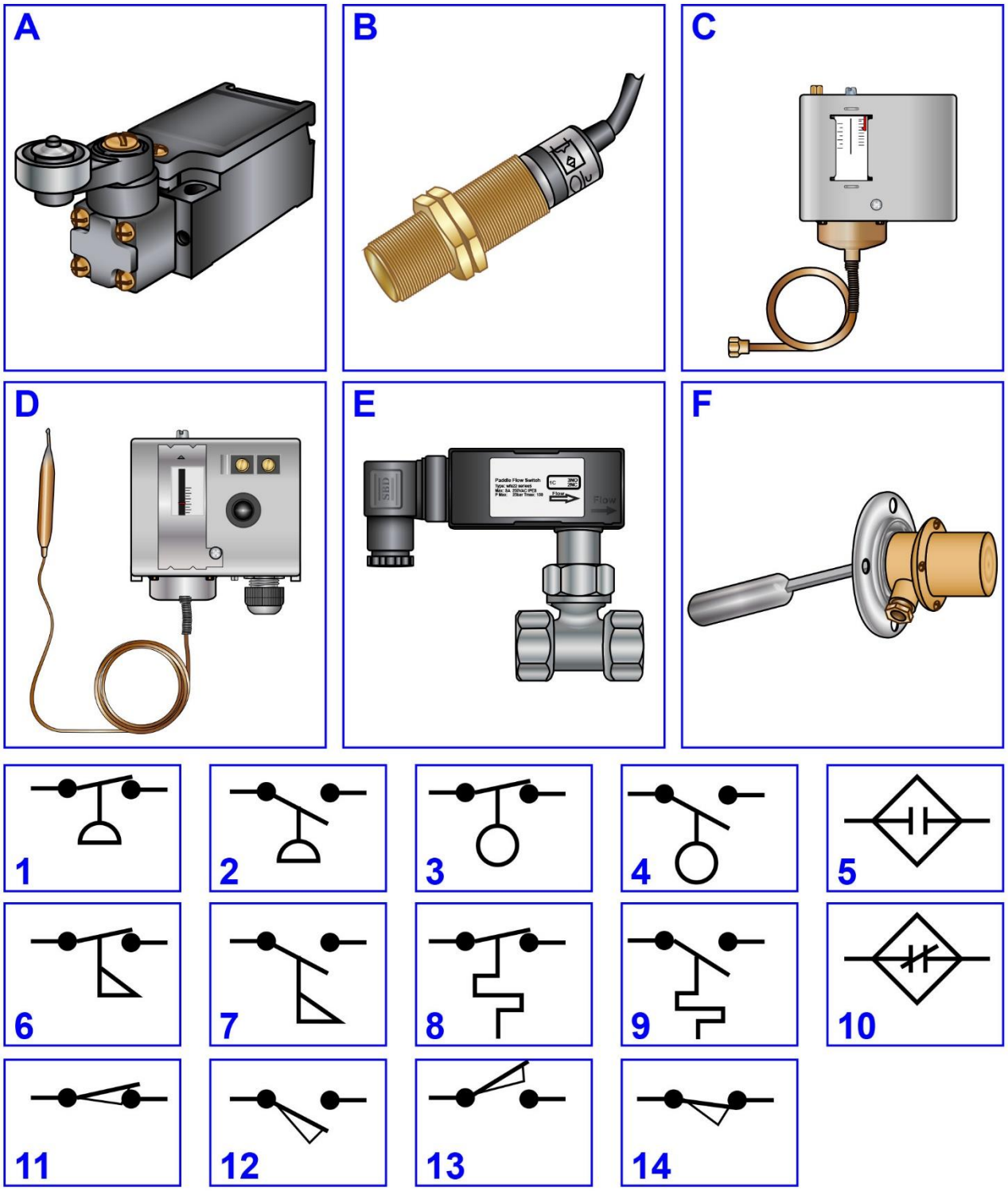

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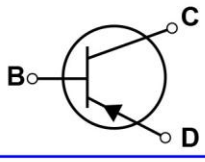

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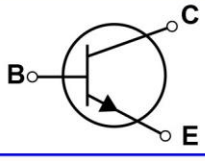

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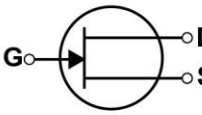

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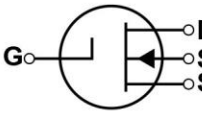

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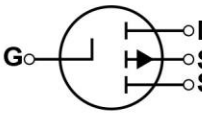

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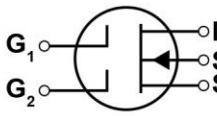

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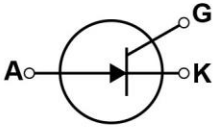

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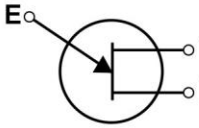

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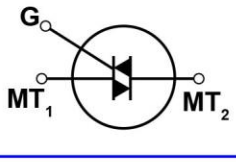

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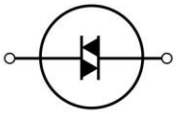

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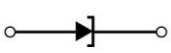

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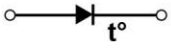

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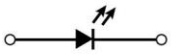
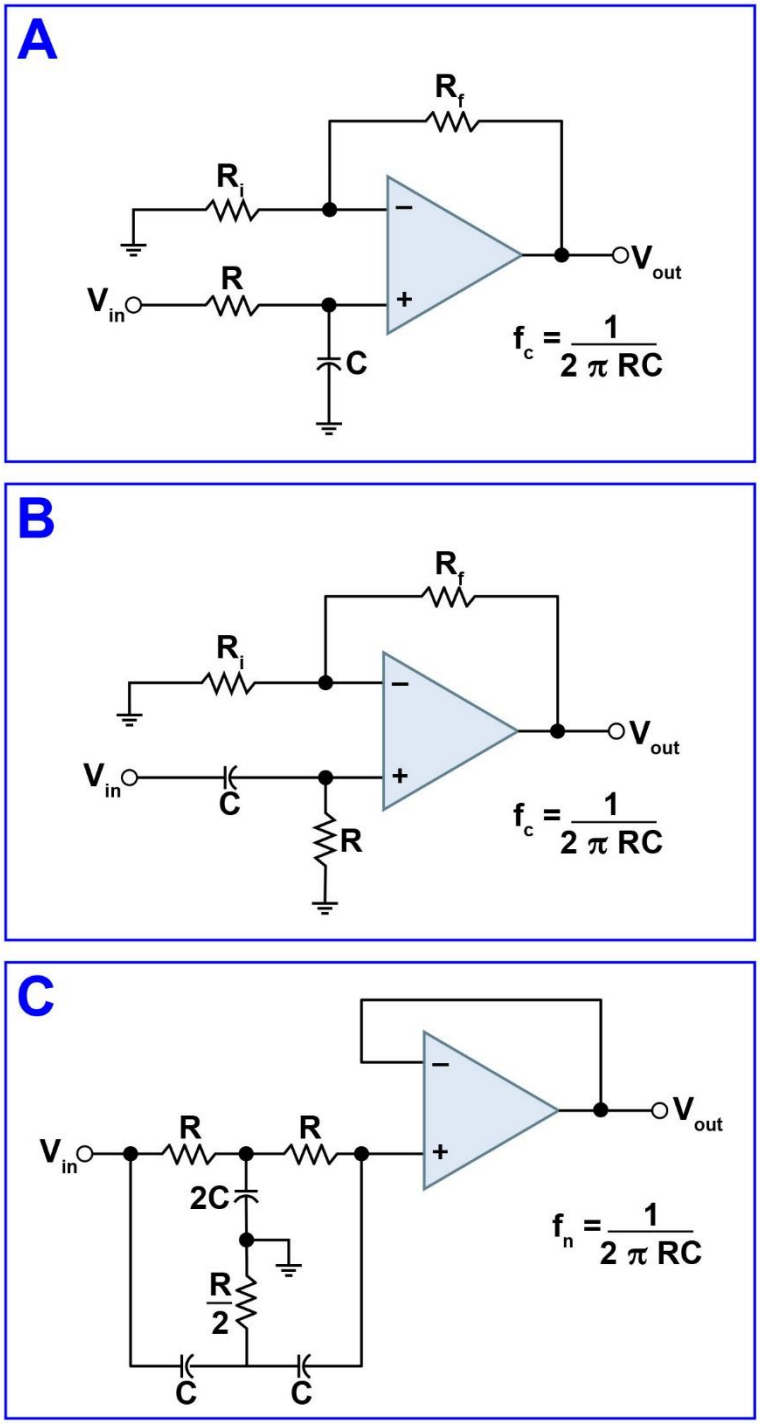


EL-0077



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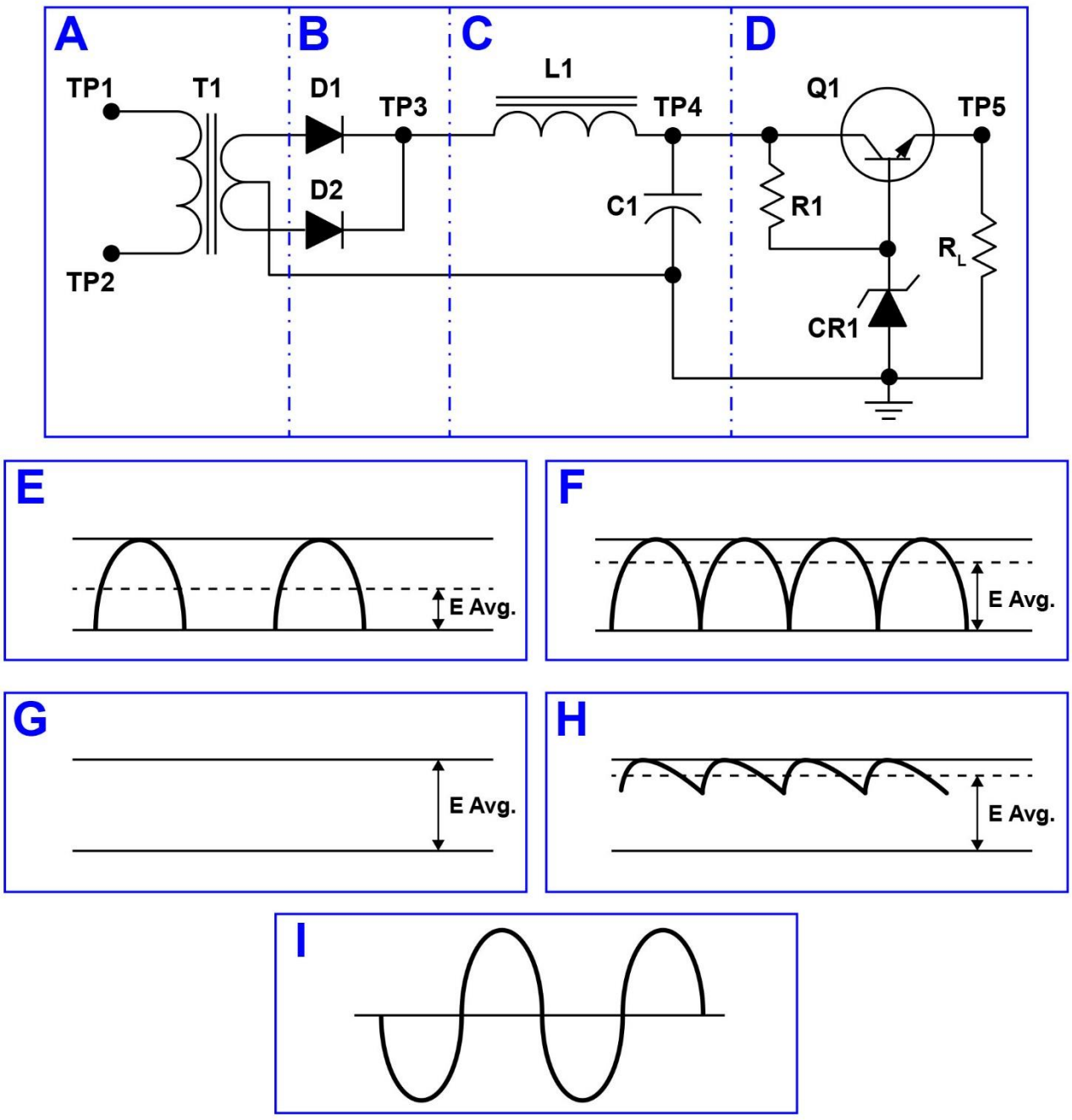

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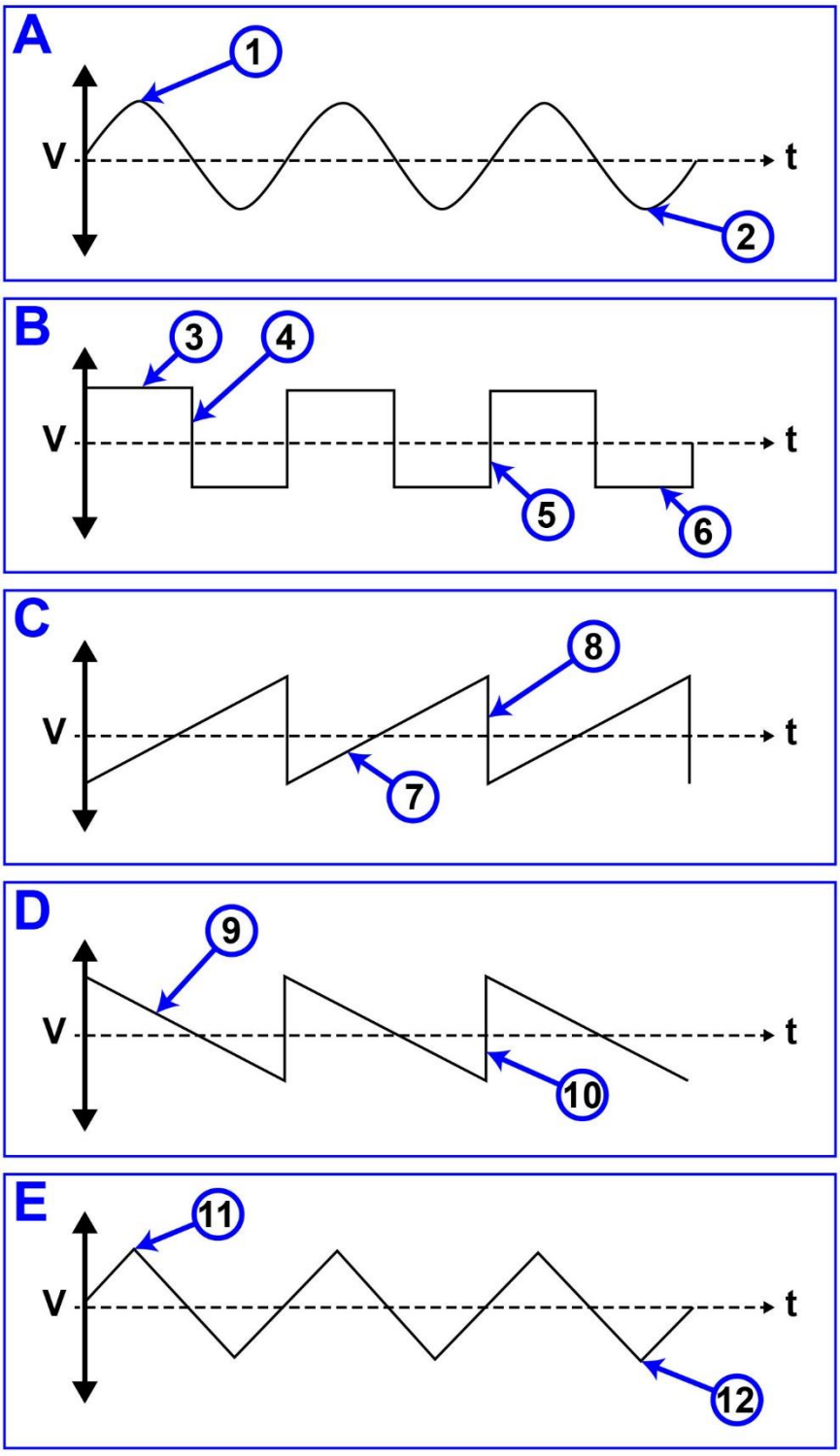

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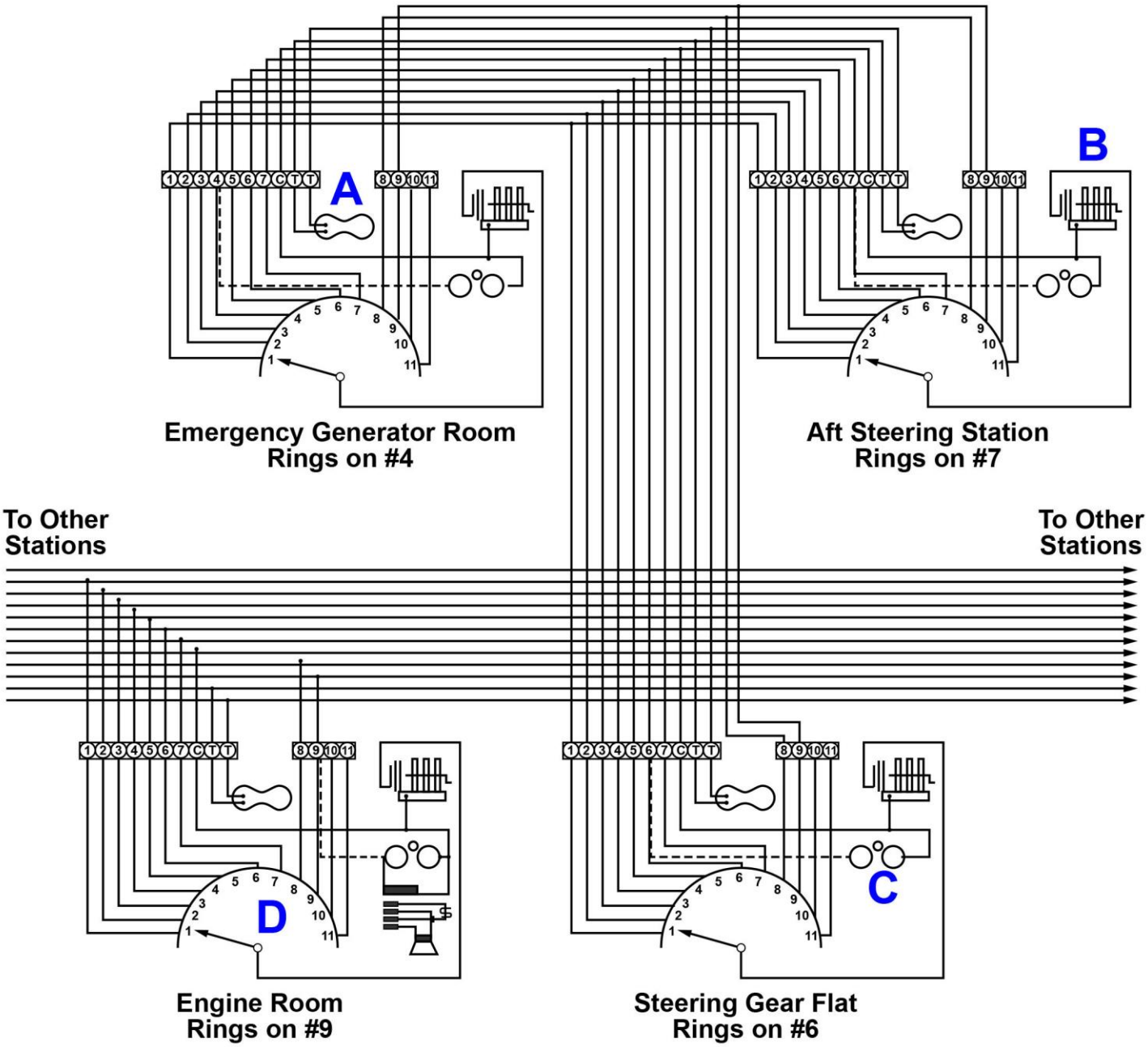

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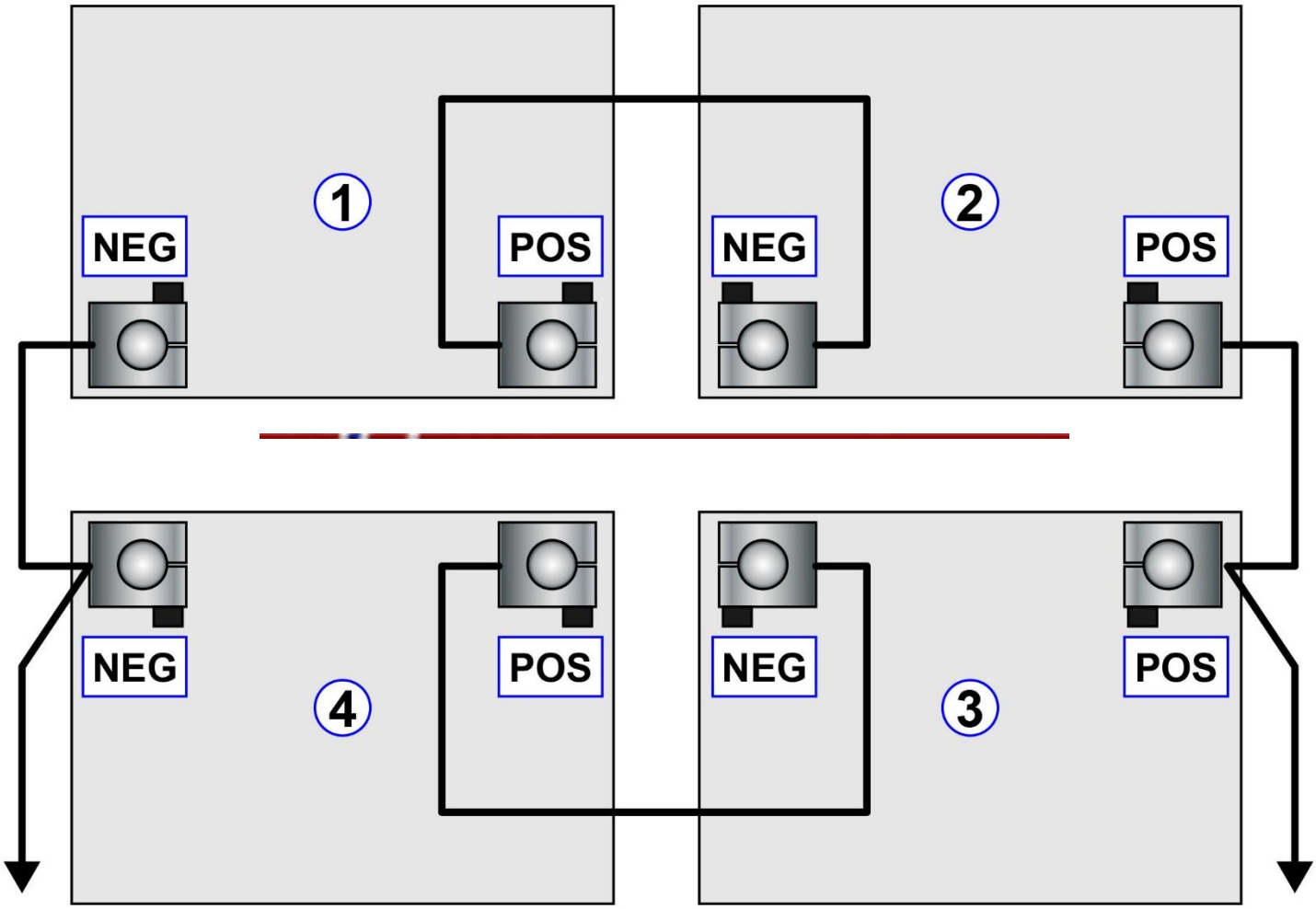

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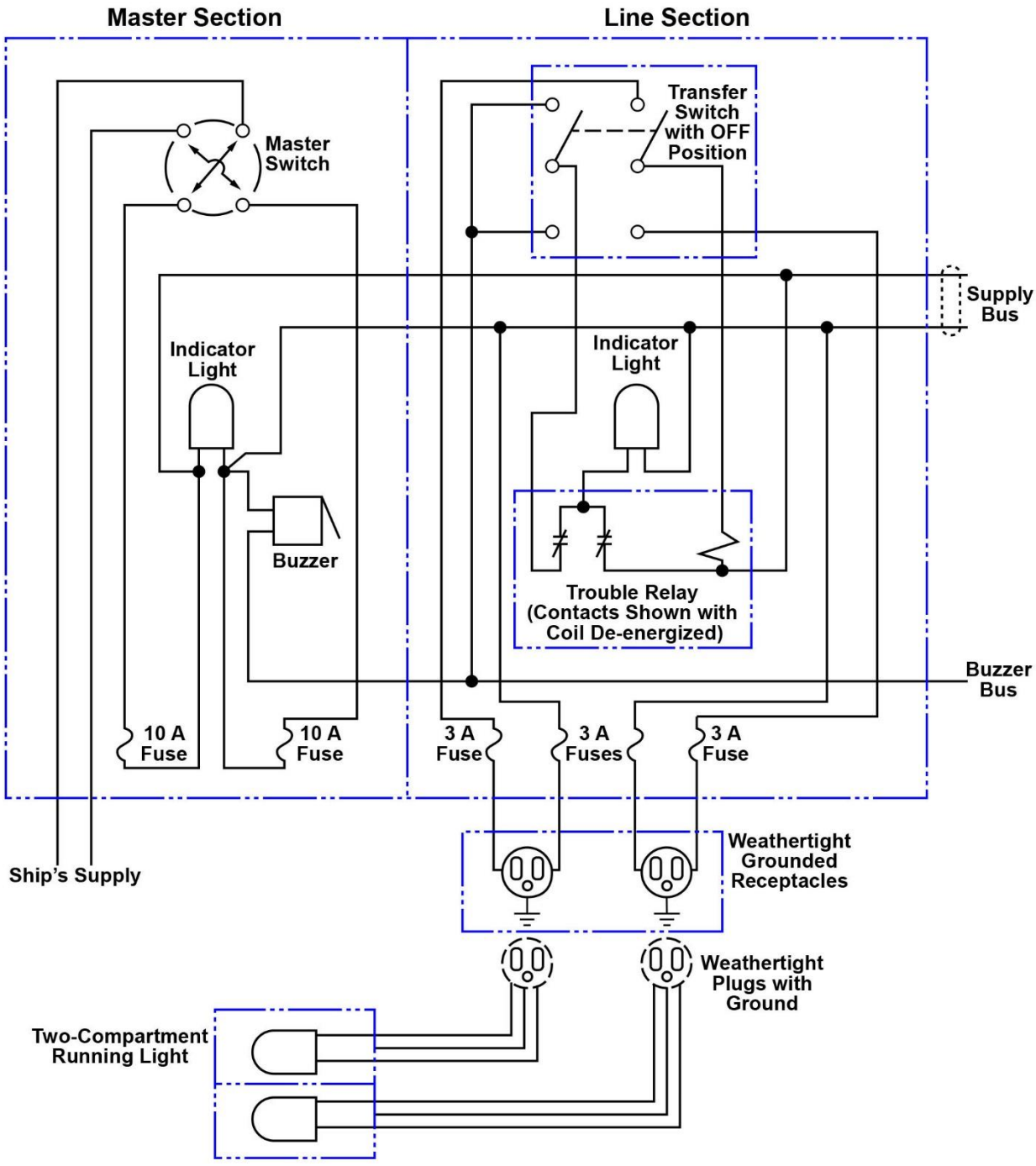

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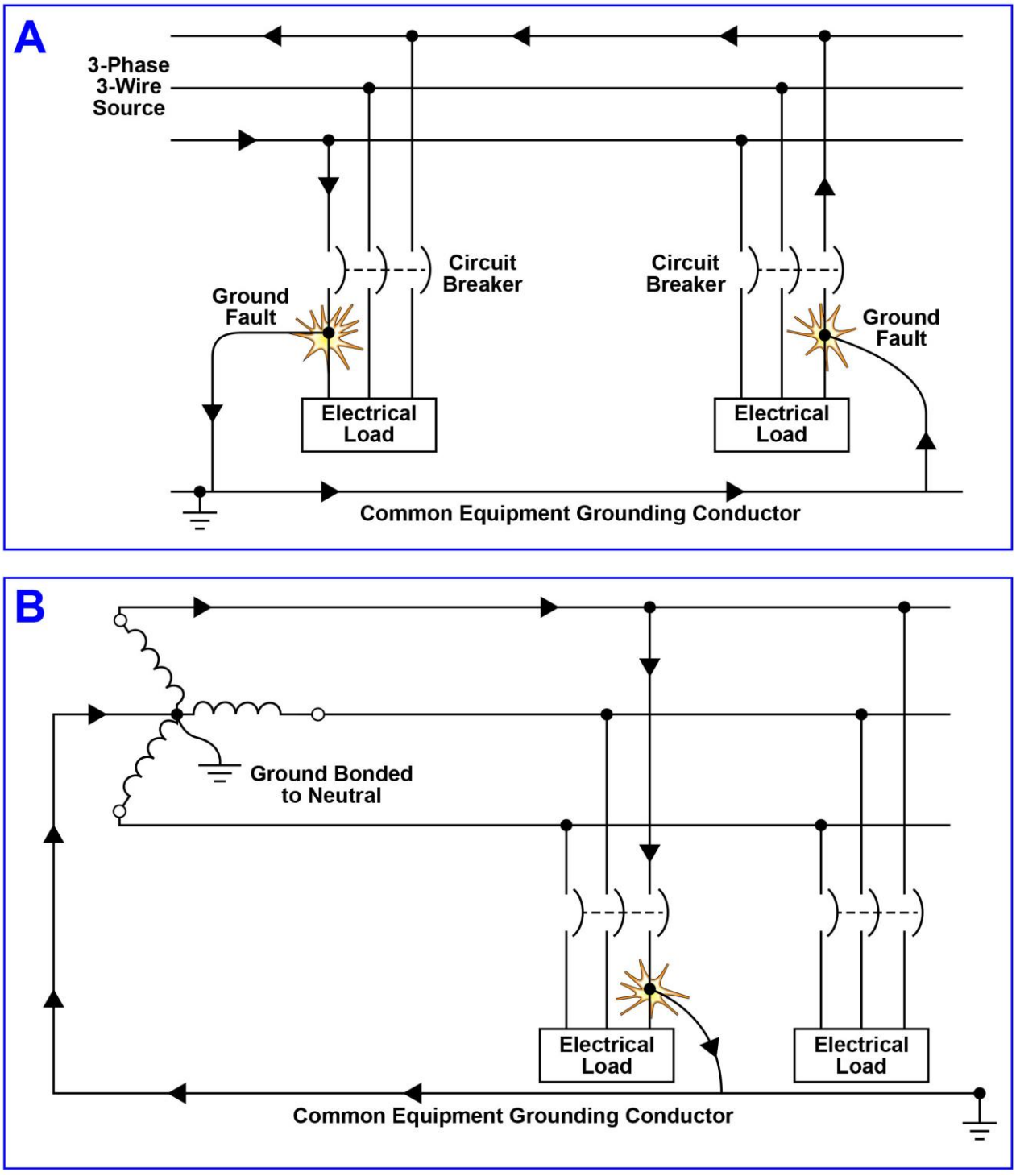

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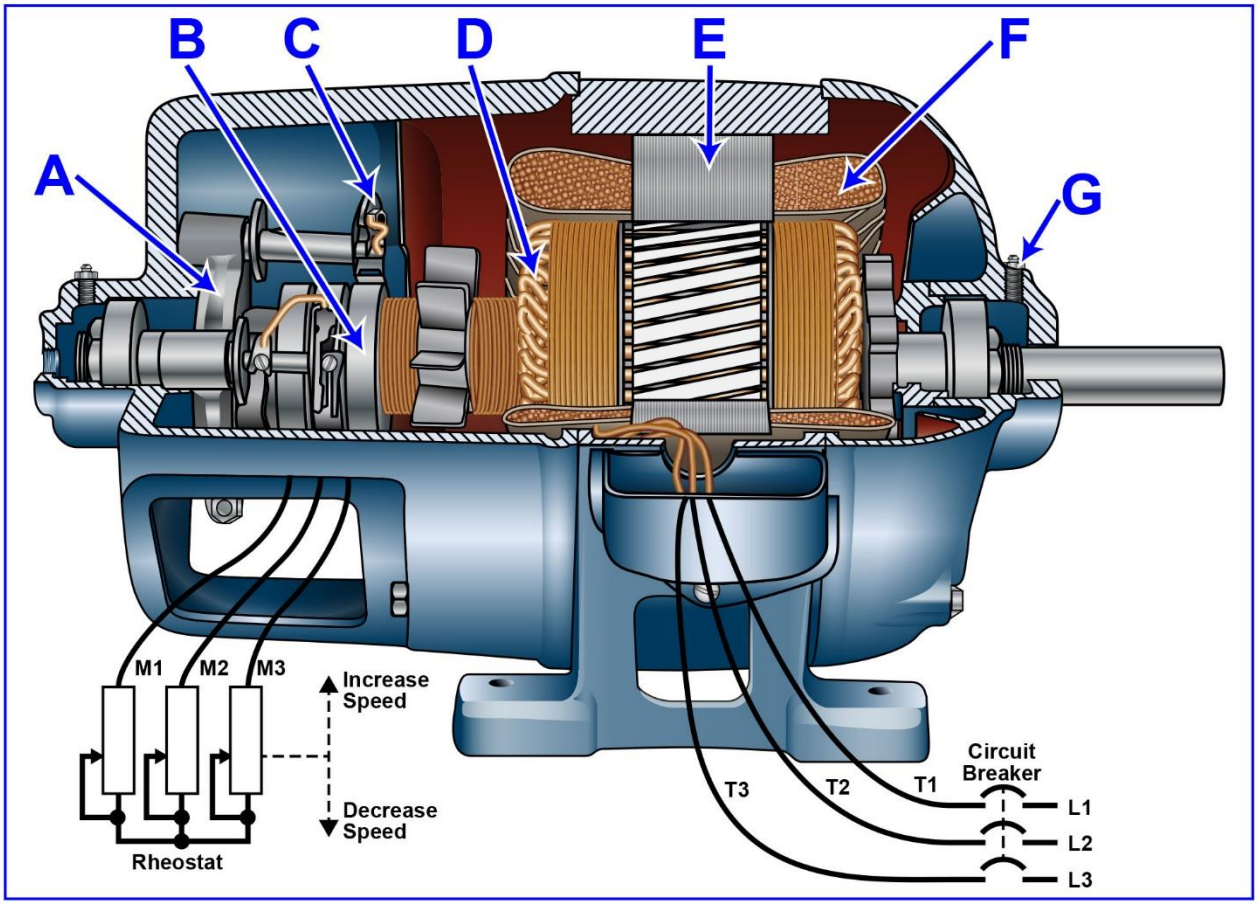

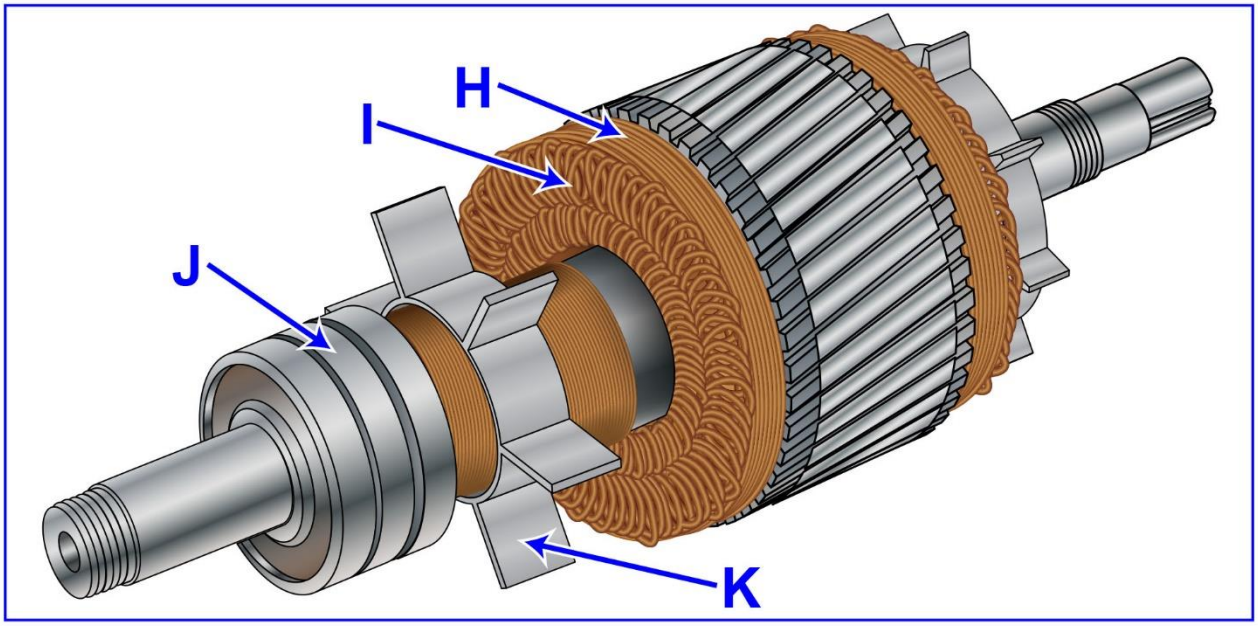

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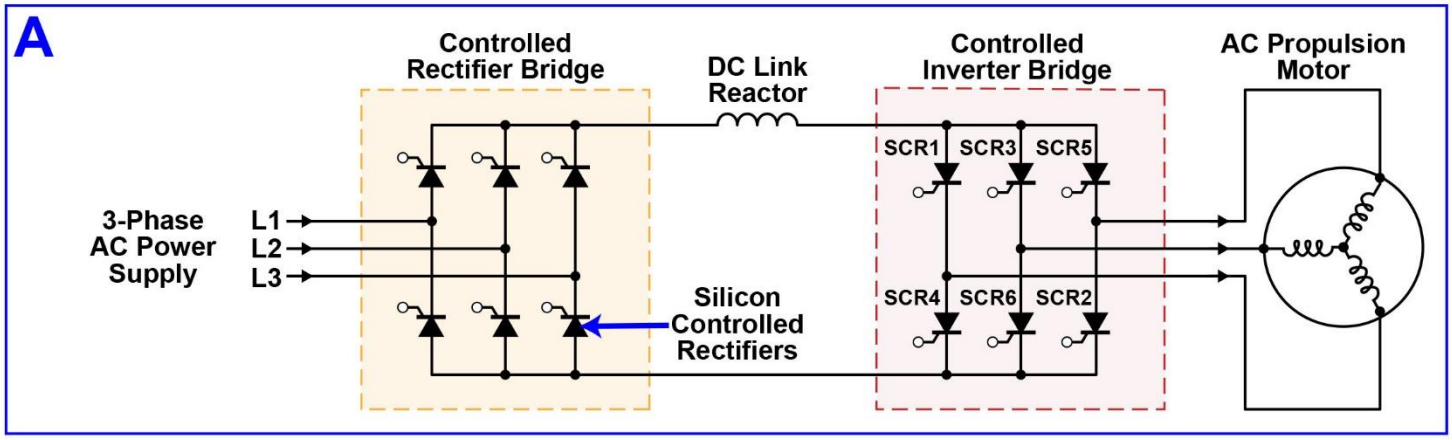

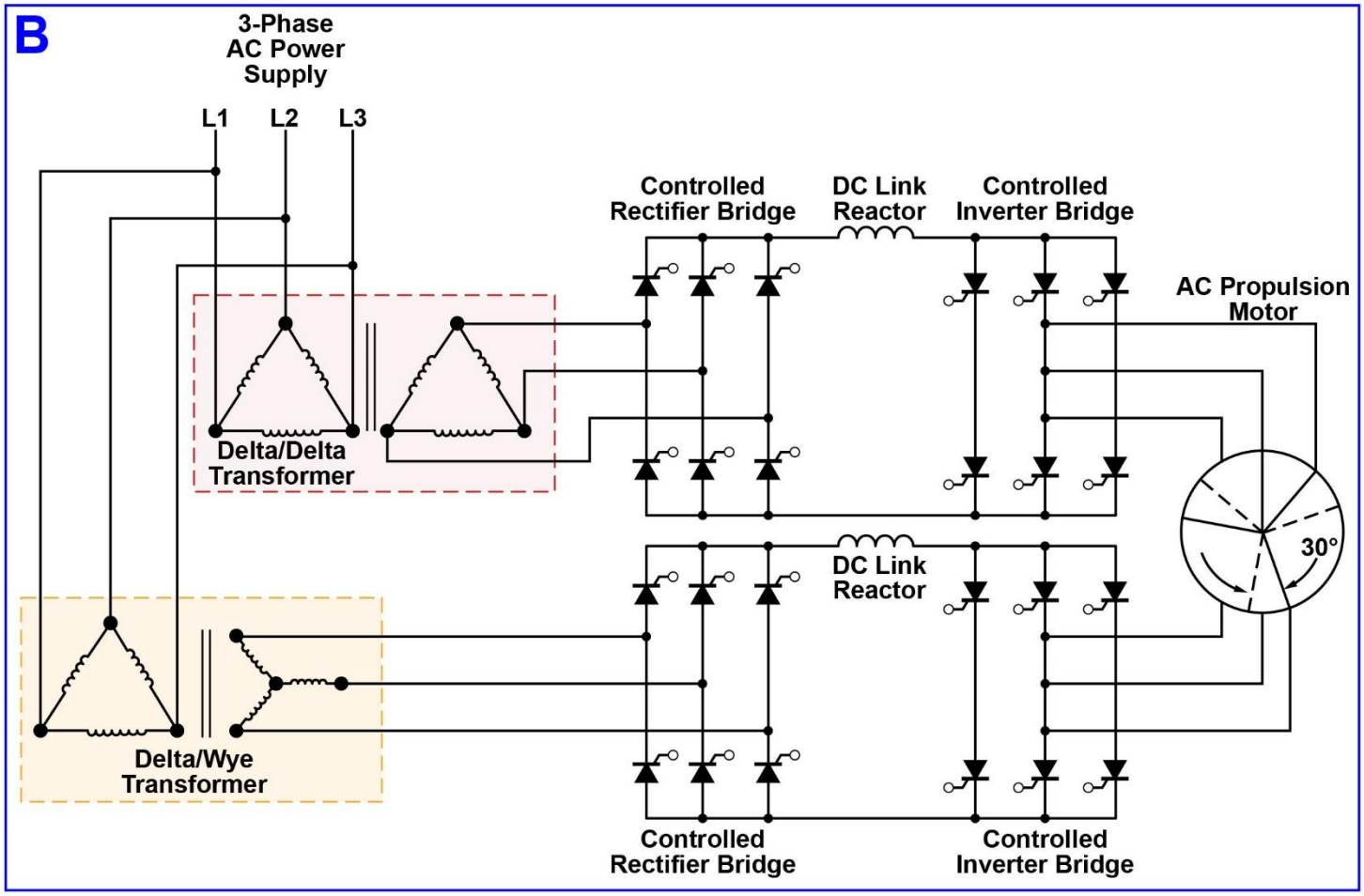

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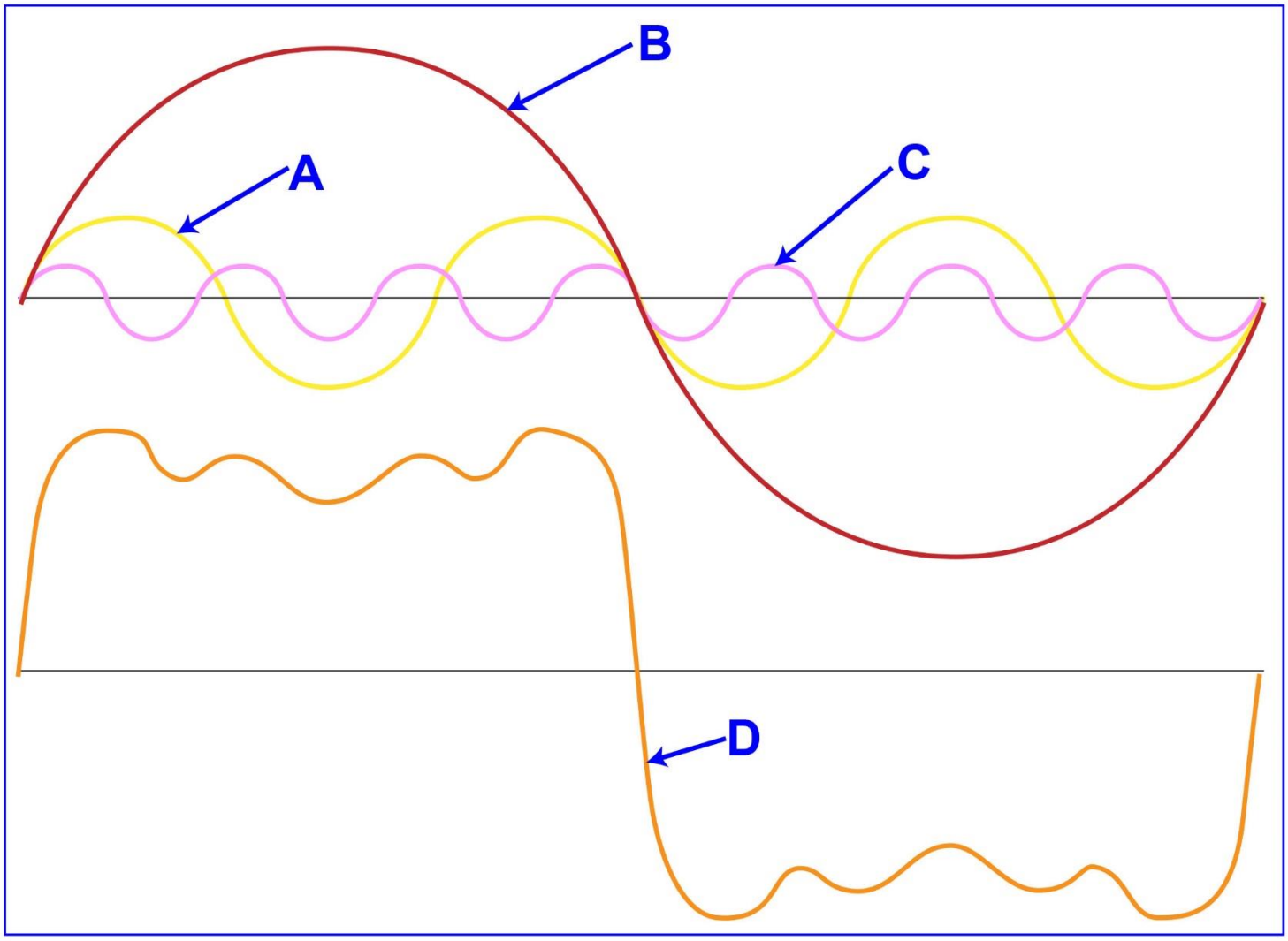

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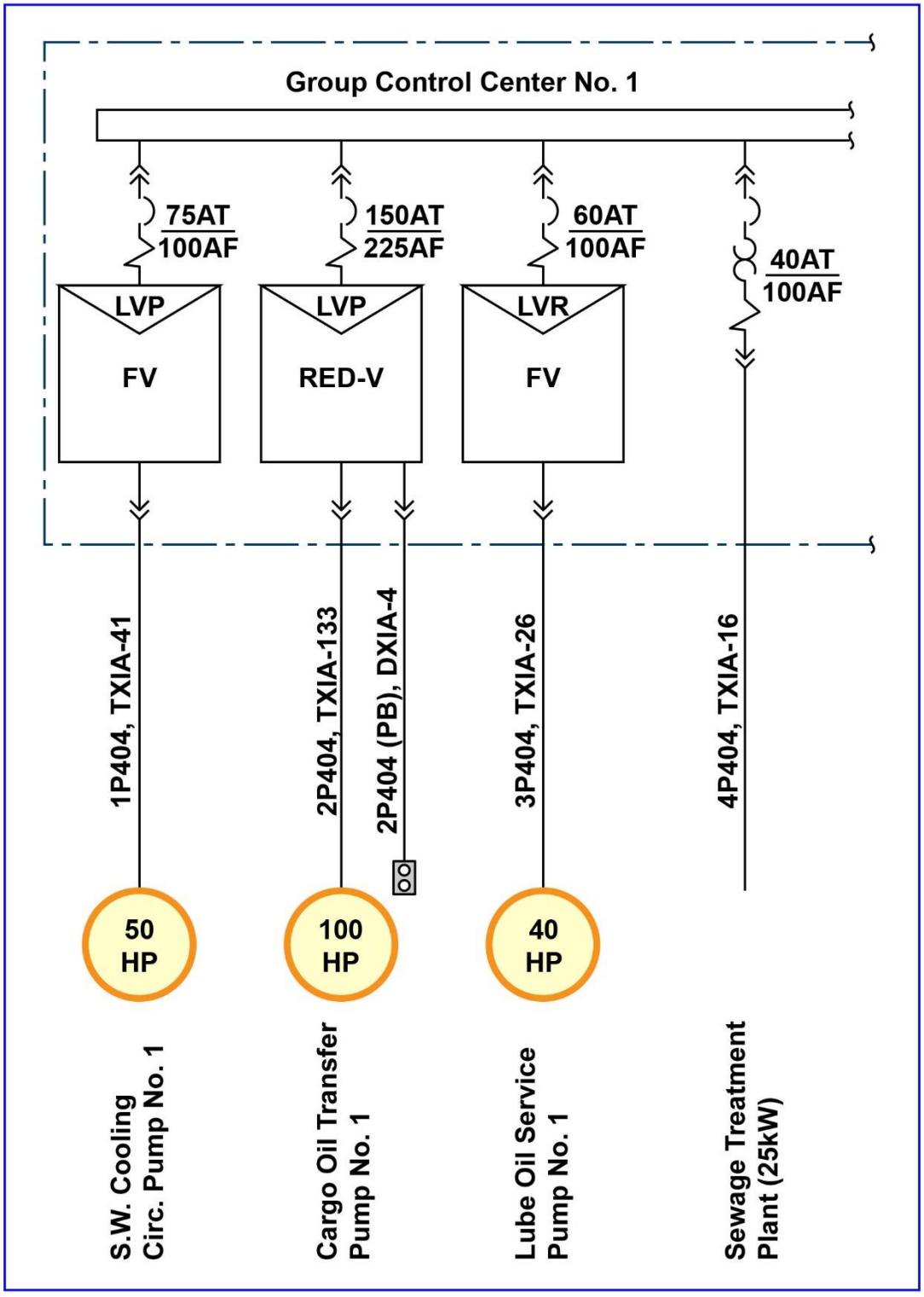
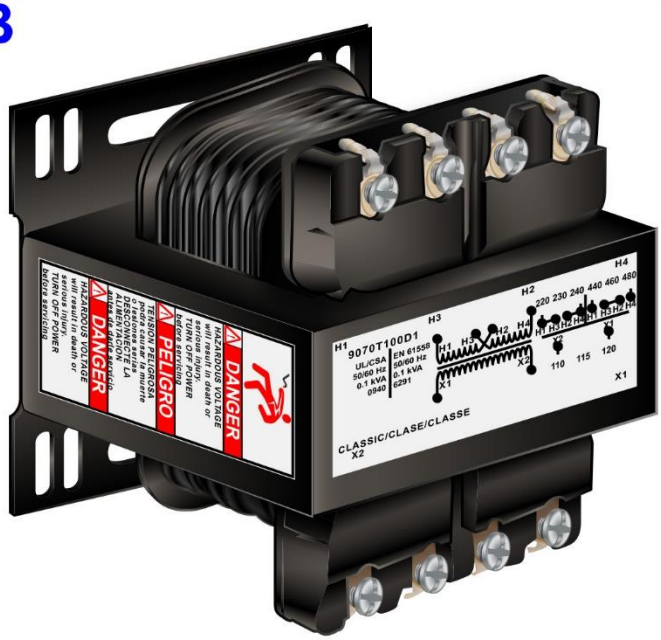


EL-0177

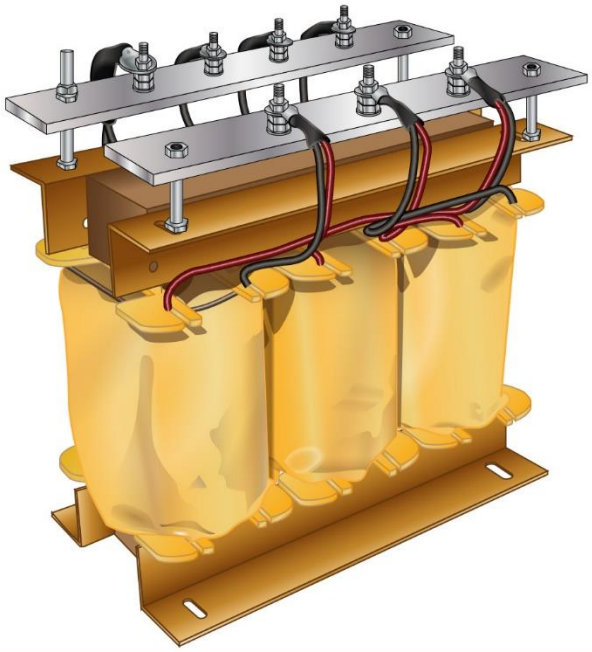
A

B



C

D



EL-0179

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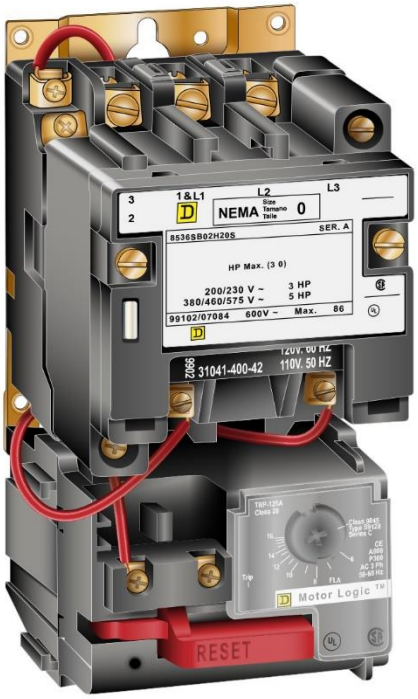

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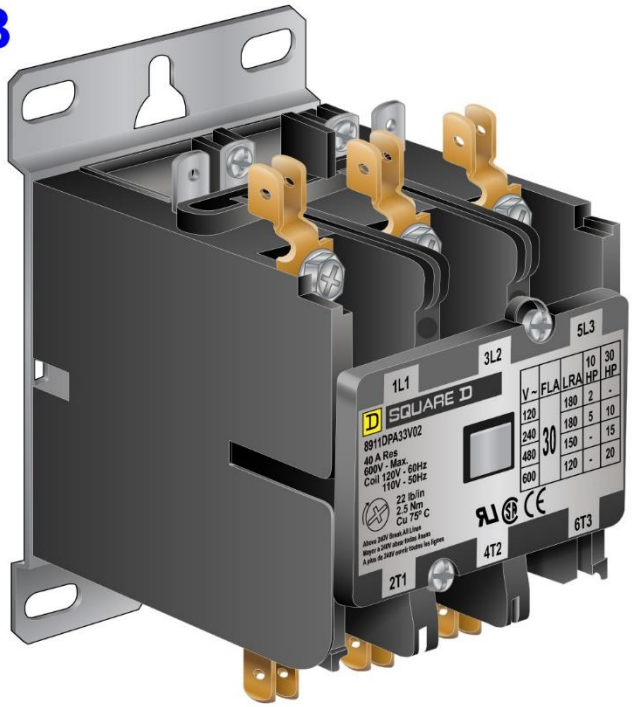

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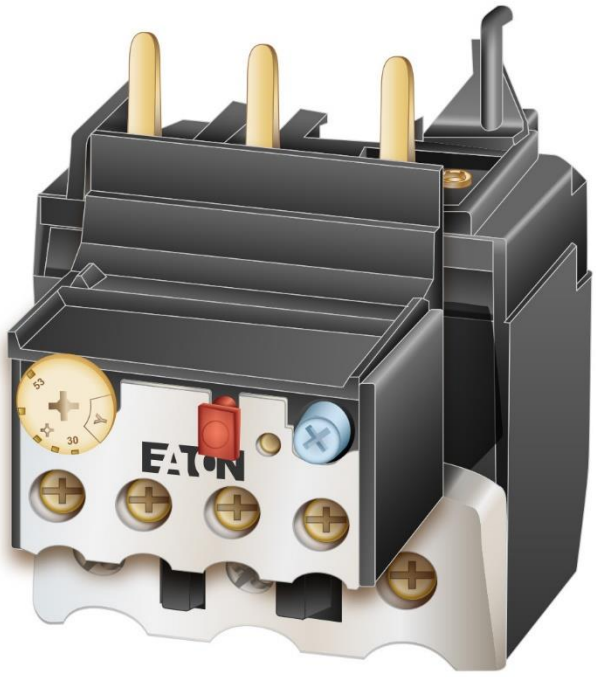

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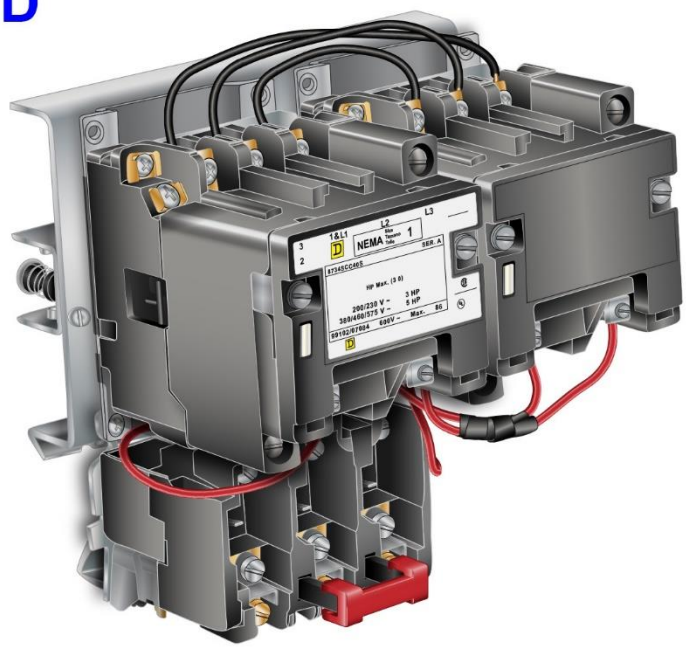
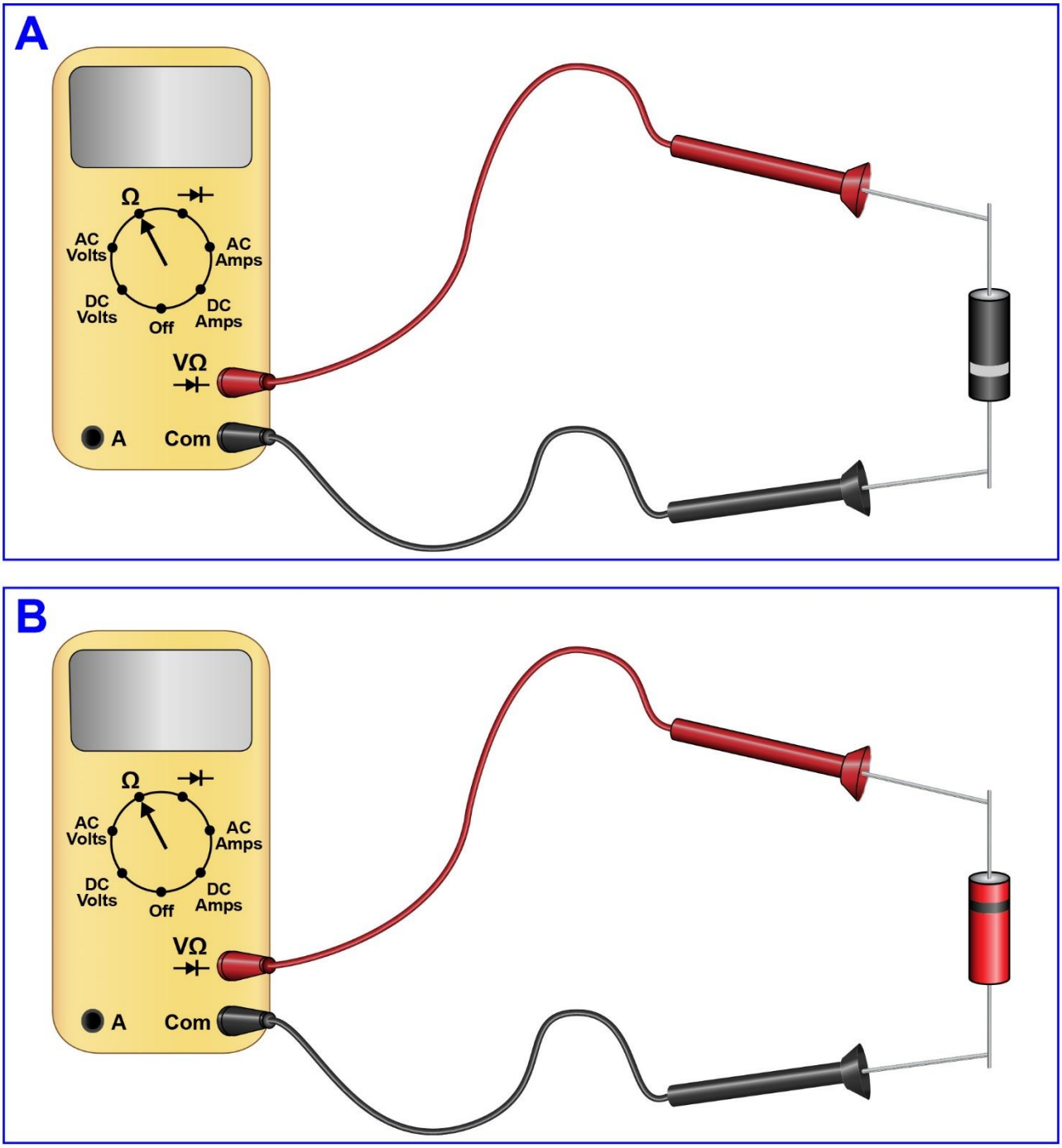


EL-0211



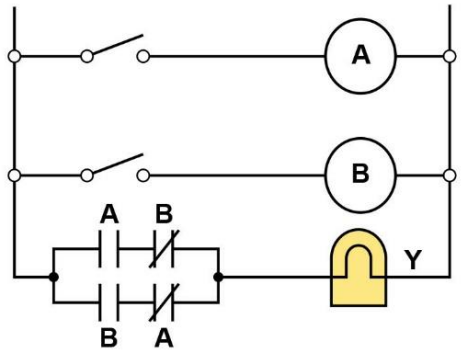
EL-0231
Relay and PLC Logic Compared

A

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

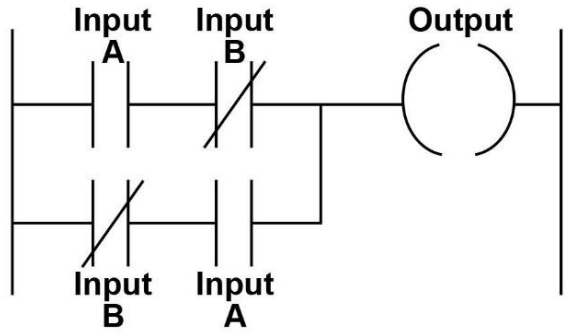
Truth Table

B



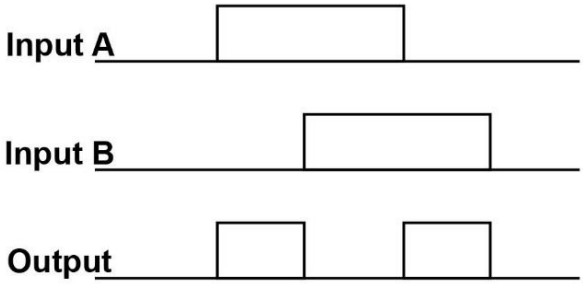
Equivalent Relay Circuit Diagram

C



PLC Ladder Diagram

D



PLC Input/Output Diagram