U.S.C.G. Merchant Marine Exam

OSV – Assistant Engineer

Q654 Electrical – Electronics – Control Engineering

(Sample Examination)

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

1. An unintended path of low resistance bypassing the intended path and allowing passage of an abnormally high amount of current is known as what?

   A. polarized ground
   B. open circuit
   C. short circuit
   D. ground reference point

   Correct answer: C

2. In terms of the type of load in an alternating circuit, in what type of alternating current circuit will the voltage always lead the current?

   A. capacitive circuit
   B. inductive circuit
   C. resistive circuit
   D. resistive-capacitive circuit

   Correct answer: B

3. Which of the following statements is correct for the illustrated circuit in figure "B"? Illustration EL-0020

   A. "R1", "R2", and "R3" are connected in series
   B. The voltages measured across "R1", "R2", and "R3" are equal
   C. "R1", "R2", and "R3" are connected in parallel
   D. The total resistance equals 1/R1 + 1/R2 + 1/R3

   Correct answer: A

4. As shown in figure "A" of the illustration, with the switch closed what statement is true if "R1" and "R2" have unequal resistance values? Illustration EL-0019

   A. The current flow through "R1" will equal the current flow through "R2".
   B. The current flow through "R1" will differ from the current flow through "R2".
   C. The voltage drop across "R1" will not be equal to the voltage drop across "R2".
   D. The energy dissipated in "R1" will be the same as the energy dissipated in "R2".

   Correct answer: B

5. 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

6. What practice could potentially damage a multimeter?

   A. placing the test leads across a de-energized and isolated resistance to measure resistance while in the ammeter mode
   B. placing the test leads across a voltage source to measure voltage while in the resistance 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 in series with the load of a circuit to measure current while in the voltmeter mode

   Correct answer: B

7. A resistance is added in series and internally with the analog meter movement of which of the following instruments?

   A. AC frequency meter
   B. DC voltmeter
   C. AC ammeter
   D. DC ammeter

   Correct answer: B

8. What is an ammeter used to measure?

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

   Correct answer: A

9. 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. The digital multimeter AC voltage range is at its lowest value.
   B. Stray electromagnetic fields from electrical equipment exist in the air.
   C. The digital multimeter test leads are acting as an antenna.
   D. All the above conditions must exist.

   Correct answer: D

10. To keep emergency lead-acid batteries in a full state of charge for emergency use, what is normally done?

    A. Batteries are kept charged by maintaining a continuous trickle charge.
    B. Batteries are kept charged by performing an equalizing charge daily.
    C. Batteries are kept charged by maintaining the maximum charging rate.
    D. Batteries are kept charged by cycling through discharge and charge cycles daily.

    Correct answer: A

11. A shaded-pole motor is a specific type of motor included in what class of motor?

    A. polyphase synchronous motor
    B. DC compound-wound motor
    C. single phase induction motor
    D. three-phase induction motor

    Correct answer: C

12. 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

13. Which of the illustrated motors has an open motor enclosure? Illustration EL-0001

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

    Correct answer: B

14. 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. synchronous motor
    D. wound-rotor induction motor

    Correct answer: D

15. What is the primary advantage of stranded cable over solid cable which establishes the basis for the requirement for stranded cable for shipboard applications?

    A. provides the flexibility required for easy handling and installation
    B. reduces the resistance to current flow for a given wire size
    C. limits the number of supports needed for a horizontal overhead run
    D. reduces the overall weight of the cable run

    Correct answer: A

16. 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 cracked and otherwise deteriorated.
    D. The insulation is in good condition.

    Correct answer: D

17. 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. open stator coil
    B. grounded stator coil
    C. shunted stator coil
    D. shorted stator coil

    Correct answer: A

18. As shown in the illustrated diagnostic setup for locating a shorted field coil of a ten-pole synchronous motor, if 240 VAC/60 Hz is applied across the brushes, what would be the individual voltage drops measured across each field coil assuming that none of the field coils are shorted? Illustration EL-0202

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

    Correct answer: C

19. As shown in figure "B" of the typical ground fault relay shown in the illustration, what statement concerning the leakage current setting adjustment is true? Illustration EL-0223

    A. Setting the leakage current for too high or too low a value may increase the likelihood of nuisance trips.
    B. Setting the leakage current for too high or too low a value may result in incidental damage due to a ground fault.
    C. Setting the leakage current for too high a value may increase the likelihood of nuisance trips and setting the leakage current for too low a value may result in incidental damage due to a ground fault.
    D. Setting the leakage current for too low a value may increase the likelihood of nuisance trips and setting the leakage current for too high a value may result in incidental damage due to a ground fault.

    Correct answer: D

20. 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 and only then can the alternator be run, but at reduced load.
    B. 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.
    C. The emergency air inlet panel and air outlet doors must remain closed, which requires the alternator to be run only at reduced loads.
    D. The alternator may not be run without cooling water under any circumstances.

    Correct answer: A

21. The individual 12 volt lead-acid batteries, when connected as shown in the illustration, as a battery bank would produce how many volts? Illustration EL-0070

    A. 12 volts
    B. 24 volts
    C. 36 volts
    D. 48 volts

    Correct answer: A

22. Why should battery rooms be well ventilated during the charging of lead-acid storage batteries?

    A. highly toxic lead gas must not be allowed to accumulate
    B. highly toxic sulfuric acid gas must not be allowed to accumulate
    C. highly flammable oxygen and hydrogen gases must not be allowed to accumulate
    D. highly poisonous chlorine gas must not be allowed to accumulate

    Correct answer: C

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

    Correct answer: B

24. 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

25. How can the direction of rotation of a DC motor be reversed?

    A. reversing both the field and the armature connections
    B. wiring the field and armature in series
    C. wiring the field and armature in parallel
    D. reversing the field or armature connections

    Correct answer: D

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

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

    Correct answer: A

27. Which metal is primarily used on shipboard equipment to face contacts in electrical equipment?

    A. chromium
    B. nickel
    C. titanium
    D. silver

    Correct answer: D

28. What is the functional name of an electrical device which prevents simultaneous energization of loads thereby preventing damage or injury?

    A. electrical interlock device
    B. modulating device
    C. mechanical limit device
    D. monitoring device

    Correct answer: A

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

    Correct answer: B

30. What is the primary means by which an electrical maintenance worker is protected from electrical hazards while performing work on an electrical circuit?

    A. performing a lock-out/tag-out procedure
    B. using the appropriate personal protective equipment
    C. shutting down the necessary equipment
    D. posting of safety warning signs

    Correct answer: A

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

    Correct answer: C

32. At a minimum threshold, how many milliamps of current through the body produces a painful sensation that most people would perceive as an electric shock?

    A. 3 to 7 mA
    B. 10 to 16 mA
    C. 30 mA
    D. 100 mA for 2.5 sec.

    Correct answer: A

33. 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

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

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

    Correct answer: D

35. When shore power is being connected to a ship in dry-dock, what must be ensured, assuming that the ship's generators are rated at 450 VAC, 60 Hz with a total plant generating capacity of 10000 kW?

    A. shore power must be capable of delivering a total of 10000 kW
    B. shore power phase sequence must agree with that of the ship
    C. exactly 450 volts must be supplied from shore, with no deviation permitted
    D. exactly 60 Hz must be supplied from shore, with no deviation permitted

    Correct answer: B

36. From the information given in the illustration, which of the following statements is correct? Illustration EL-0106

    A. It is possible for the main-emergency bus-tie circuit breaker and the emergency generator circuit breaker to be simultaneously closed.
    B. The emergency generator is capable of being connected directly to the main 480 VAC bus.
    C. During normal operation, the main-emergency bus-tie circuit breaker and any on-line ship's service generator circuit breakers are simultaneously closed.
    D. Shore power, in port, is only capable of feeding emergency loads.

    Correct answer: C

37. How is the main propeller shaft rotation of a rectified DC diesel-electric drive normally reversed?

    A. reversing the polarity of the interpoles
    B. reversing the diesel engine rotation
    C. reversing the field or armature polarity of the DC motor
    D. reversing the field polarity in the AC generator

    Correct answer: C

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

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

    Correct answer: D

39. Which pair of safety disconnect switches shown in the illustration represents the exterior and interior views of a double-throw switch? Illustration EL-0176

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

    Correct answer: B

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

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

    Correct answer: B

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

    Correct answer: C

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

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

    Correct answer: A

43. In the diagram of the switchboard shown in the illustration, if one of the turbines should fail due to a throttle trip, what will happen? Illustration EL-0003

    A. The emergency generator should automatically start and be placed on line to supply emergency load centers.
    B. The operator must open all the devices labeled 'Generator Circuit Breaker' to reduce the load on the remaining turbo-alternator.
    C. The device labeled 'Exciter' will drive the alternator.
    D. The device labeled 'Generator Circuit Breaker' for that alternator should automatically open because of the reverse power relay.

    Correct answer: D

44. When placed in a magnetic field, which of the materials listed has the highest permeability?

    A. Bakelite
    B. Iron
    C. Glass
    D. Aluminum

    Correct answer: B

45. Which line in figure "B" shown in the illustration represents the trailing edge of the wave? Illustration EL-0088

    A. 3
    B. 4
    C. 5
    D. 6

    Correct answer: B

46. In what applications are semiconductor diodes commonly used?

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

    Correct answer: B

47. What is the name of the component labeled CR1 as shown in section "D" of the regulated DC power supply illustrated? Illustration EL-0085

    A. rectifier diode
    B. zener diode
    C. diac
    D. tunnel diode

    Correct answer: B

48. Assuming a 120 VAC input across TP1 and TP2 and a regulated output of 24 VDC across TP5 and ground, in which section of the 24 VDC power supply circuit illustrated does the greatest absolute change in voltage level take place? Illustration EL-0085

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

    Correct answer: A

49. 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

50. Referring to figure "1" of the illustration, what type of logic gate is symbolized? Illustration EL-0035

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

    Correct answer: A

51. Which statement is TRUE concerning electric propulsion drives?

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

    Correct answer: C

52. Which of the listed temperature measuring devices installed on a large turbo-electric alternating current propulsion generator would be the most reliable for monitoring generator temperatures to avoid premature winding insulation failure?

    A. Temperature sensors measuring the temperature of the cooling air associated with the generator air cooler
    B. Current transformers are the most reliable means of monitoring generator temperatures.
    C. Temperature sensors measuring the temperature of the cooling water associated with the generator air cooler
    D. Temperature sensors inserted in the stator slots for measuring stator winding temperature

    Correct answer: D

53. 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

54. As shown in the illustration, if the port propulsion motor field excitation circuit experienced a failure of an individual component, of the following listed field excitation circuit components, the failure of which component would allow the use of the standby excitation transformer and field controller to resume normal operation? Illustration EL-0164

    A. port rotary transformer
    B. port motor field winding
    C. port field controller
    D. port rotating rectifier

    Correct answer: C

55. 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 three-phase AC power source, and the stator winding is directly connected to a single-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 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.
    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: B

56. 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

57. Which of the following fixed temperature heat-actuated fire detectors can be reused after it has detected a fire?

    A. liquid expansion
    B. thermostatic cable
    C. fusible metal
    D. bimetallic snap-disc

    Correct answer: D

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

    Correct answer: B

59. Referring to the impressed current cathodic hull protection system shown in the illustration, if required to control the impressed current to the anodes manually by using the hand adjustment potentiometer, what parameter should be maintained at a constant value? Illustration EL-0090

    A. Control amplifier output voltage
    B. Individual anode currents
    C. Total anode current
    D. Reference electrode voltage

    Correct answer: D

60. As shown in the illustration, how are the rotor windings (terminating as marked motor leads M1, M2, and M3) of the motor configured? Illustration EL-0102

    A. open delta
    B. wye
    C. series-parallel
    D. delta

    Correct answer: B

61. In the event of a power failure during cargo loading operations, the movement of an electric powered cargo winch will be stopped by what means?

    A. the weight of the load on the boom
    B. a spring set brake
    C. a hand-operated band brake
    D. a manual override switch

    Correct answer: B

62. Which of the listed battery charging circuits is used to maintain a wet cell, lead-acid, storage battery in a fully charged state during long periods of disuse?

    A. Normal charging circuit
    B. Trickle charging circuit
    C. Quick charging circuit
    D. High ampere charging circuit

    Correct answer: B

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

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

    Correct answer: B

64. As shown in the illustrated plots of uncorrected and temperature corrected insulation resistance readings for a particular piece of equipment, at what point in time should the equipment have been refurbished or replaced? Illustration EL-0120

    A. 2006
    B. 2008
    C. 2010
    D. no refurbishment or replacement was necessary through 2011

    Correct answer: D

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

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

    Correct answer: B

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. drain condensate from the box
    D. open the circuit breaker in the power supply and tag-out

    Correct answer: D

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

    Correct answer: C

68. Suppose it is desired to connect a dual voltage three-phase squirrel-cage induction motor for low volts, but it is undetermined whether the nine-lead motor is internally configured for wye or delta configuration. Using an ohmmeter, the motor itself with leads disconnected, and the illustration as a guide, what statement is true? Illustration EL-0134

    A. If leads "7", "8", and "9" have continuity across each other, the motor is "wye" configured. Without continuity, the motor is "delta" configured.
    B. If leads "7", "8", and "9" have continuity across each other, the motor is "delta" configured. Without continuity, the motor is "wye" configured.
    C. If leads "4", "5", and "6" have continuity across each other, the motor is "wye" configured. Without continuity, the motor is "delta" configured.
    D. If leads "4", "5", and "6" have continuity across each other, the motor is "delta" configured. Without continuity, the motor is "wye" configured.

    Correct answer: A

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

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

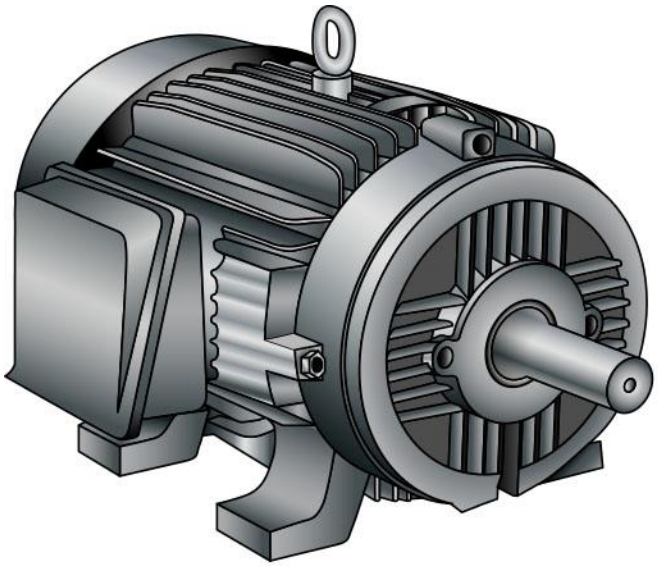
    Correct answer: B

70. Referring to the containership one-line distribution diagram shown in the illustration, what is the purpose of the transformers providing power to the refrigerated container feeder bus? Illustration EL-0014

    A. Step up the voltage from the 450 VAC main bus to the voltage required for the refrigerated container feeder bus.
    B. Step down the voltage from the 450 VAC main bus to the voltage required for the refrigerated container feeder bus.
    C. Reduce the kVA loading on the 450 VAC main distribution system main switchboard.
    D. Prevent any unintentional grounds in the refrigerated container distribution system from affecting the 450 VAC main distribution system.

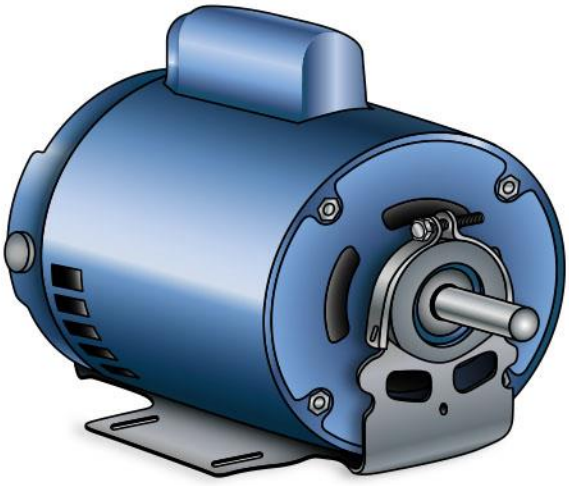
    Correct answer: D

EL-0001

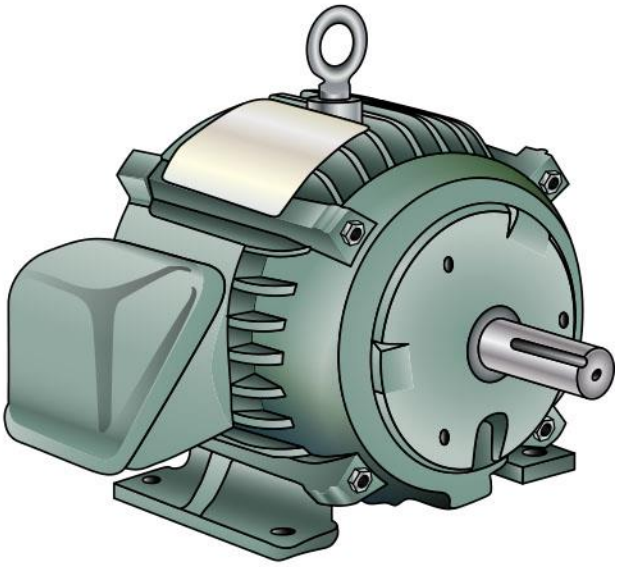


A

B



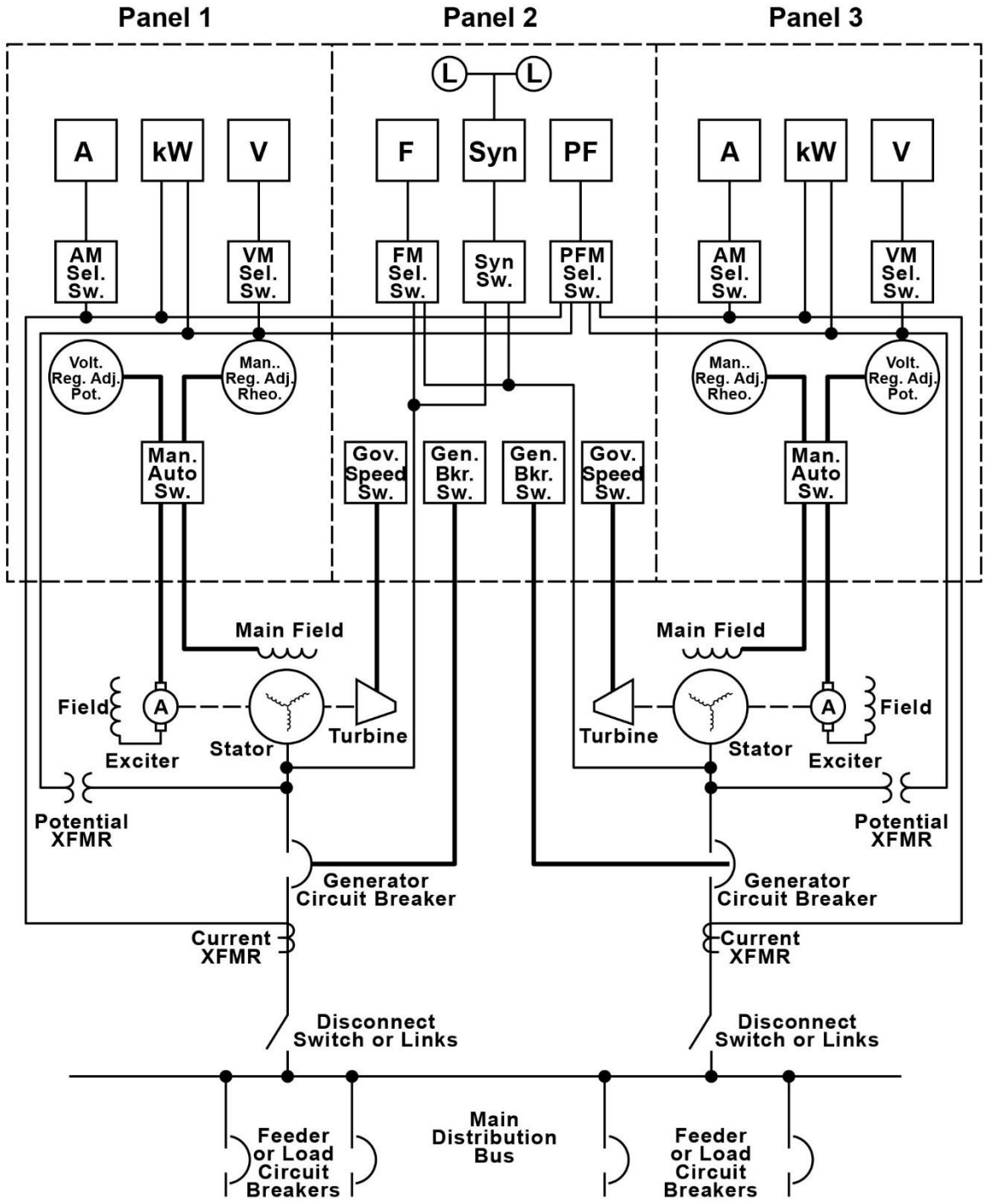
C



D

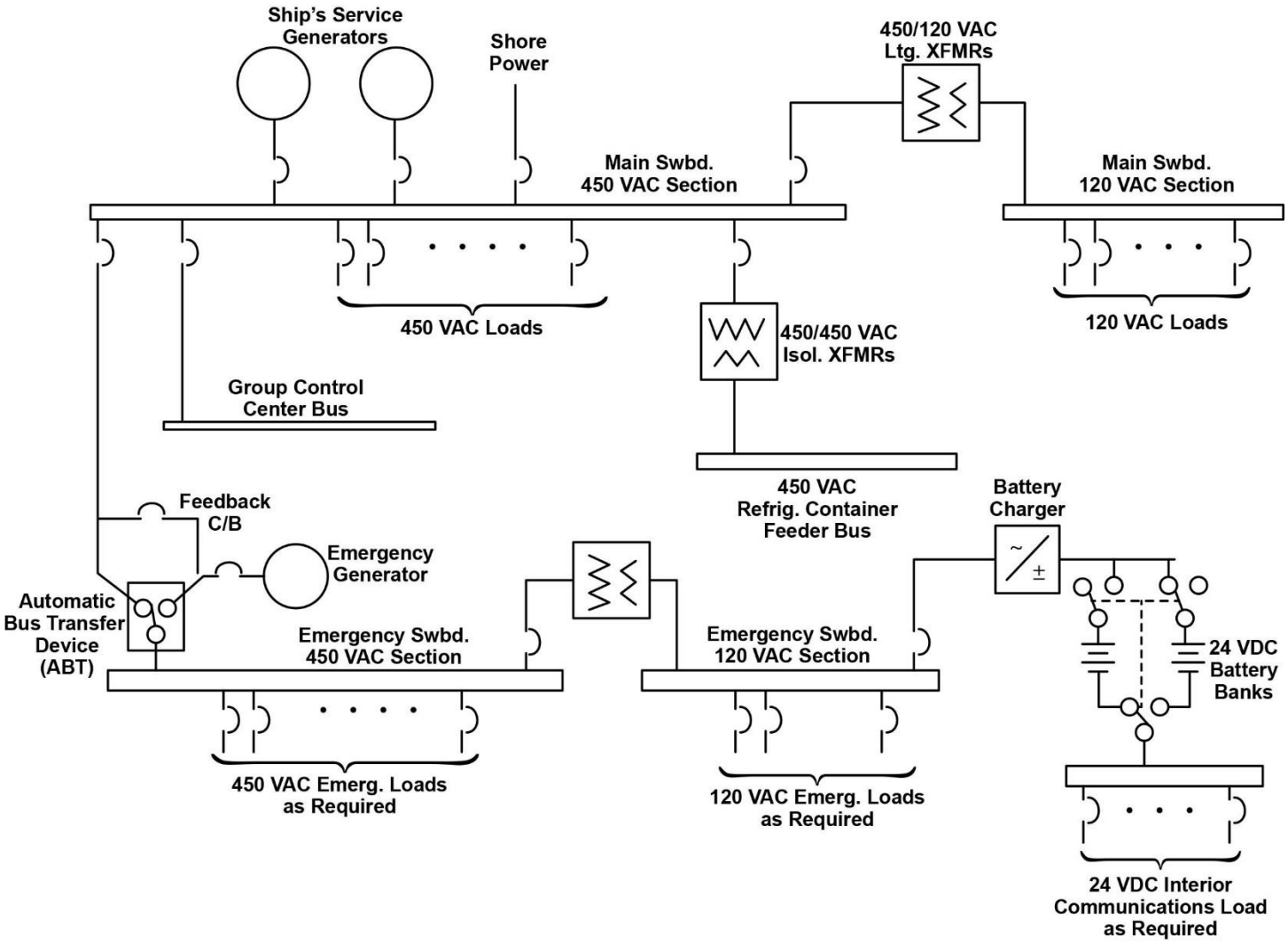
Adapted for testing purposes only from MAZUR, Troubleshooting Electric Motors, 4th Ed.
Copyright © 2010 by American Technical Publishers, Inc.
Further reproduction prohibited without permission

EL-0003



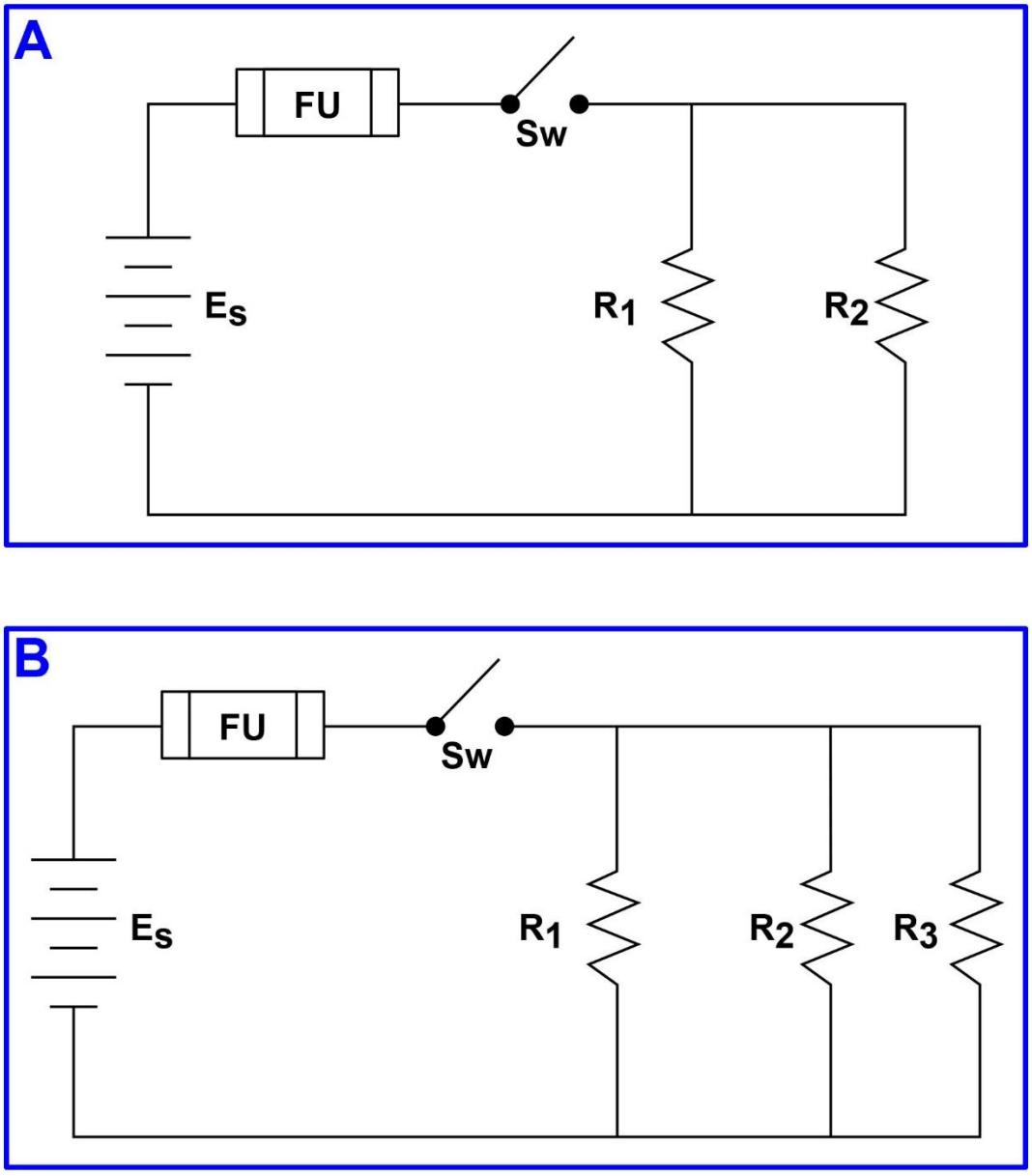
Adapted for testing purposes only from HUBERT, Operating, Testing and Preventive Maintenance of Electrical Power Apparatus
Copyright © 2003 Pearson Education
Further reproduction prohibited without permission

EL-0014



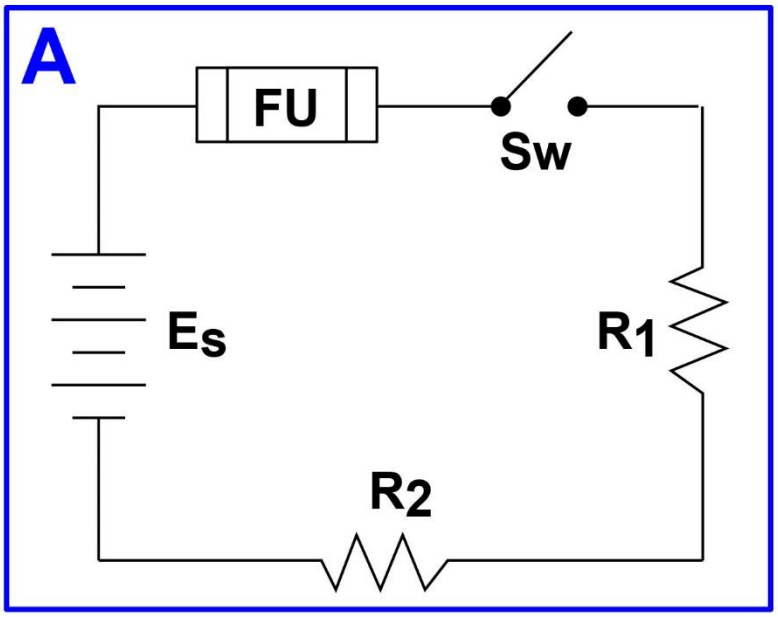
Adapted for testing purposes only from HUNT, Modern Marine Engineer's Manual, Vol. II, 3rd Ed.
Copyright © 2002 by Cornell Maritime Press, Inc.
Further reproduction prohibited without permission

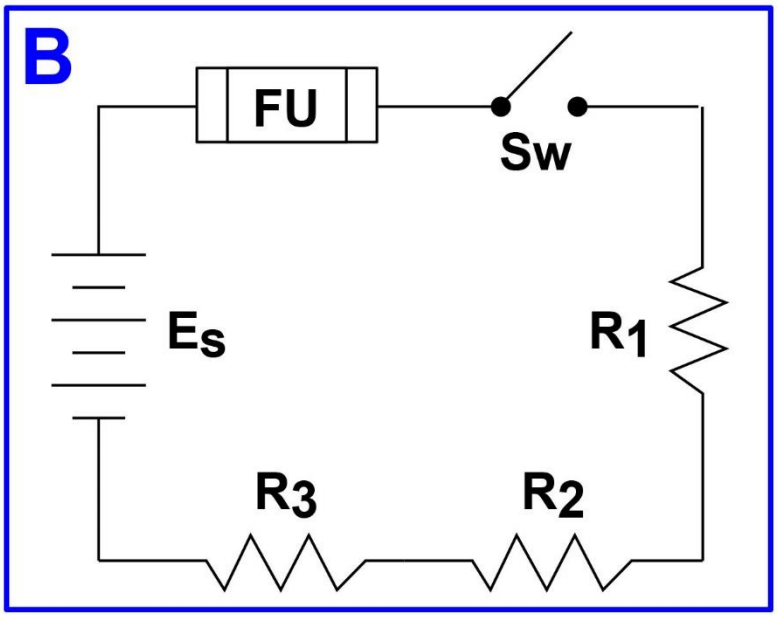
EL-0019



Adapted for testing purposes only from GROB, Basic Electronics, 4th Ed.
Copyright © 1977 by McGraw-Hill, Inc.
Further reproduction prohibited without permission

EL-0020





Adapted for testing purposes only from GROB, Basic Electronics, 4th Ed.
Copyright © 1977 by McGraw-Hill, Inc.
Further reproduction prohibited without permission

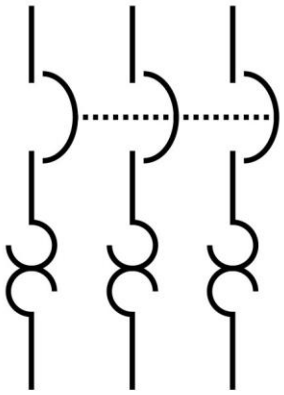
EL-0033

A

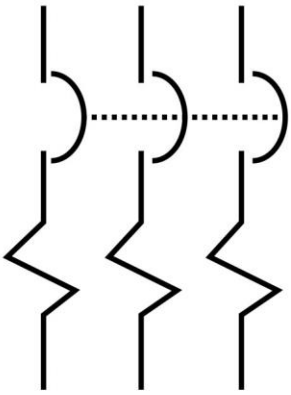
B

C

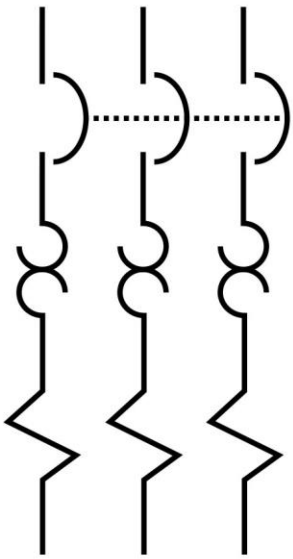
1



2



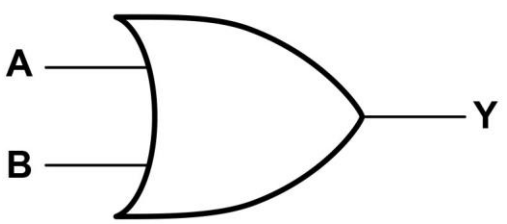
3



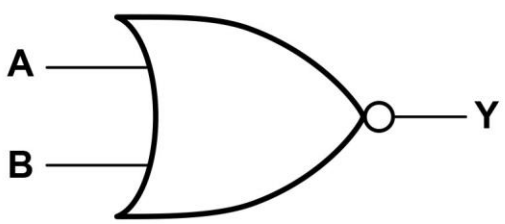
Adapted for testing purposes only from HUBERT, Operating, Testing and Preventive Maintenance of Electrical Power Apparatus
Copyright © 2003 Pearson Education
Further reproduction prohibited without permission

EL-0035

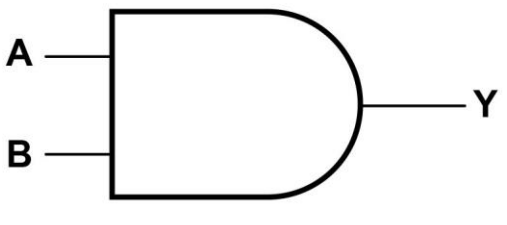
1



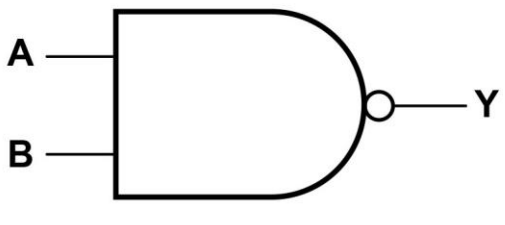
2



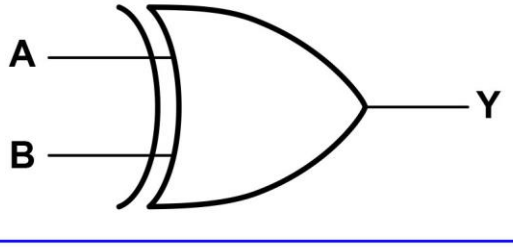
3



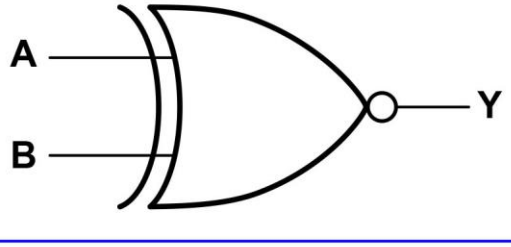
4



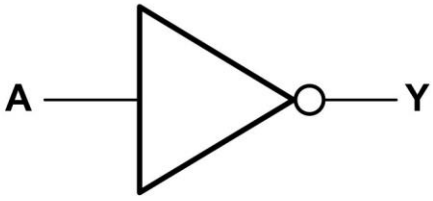
5



6

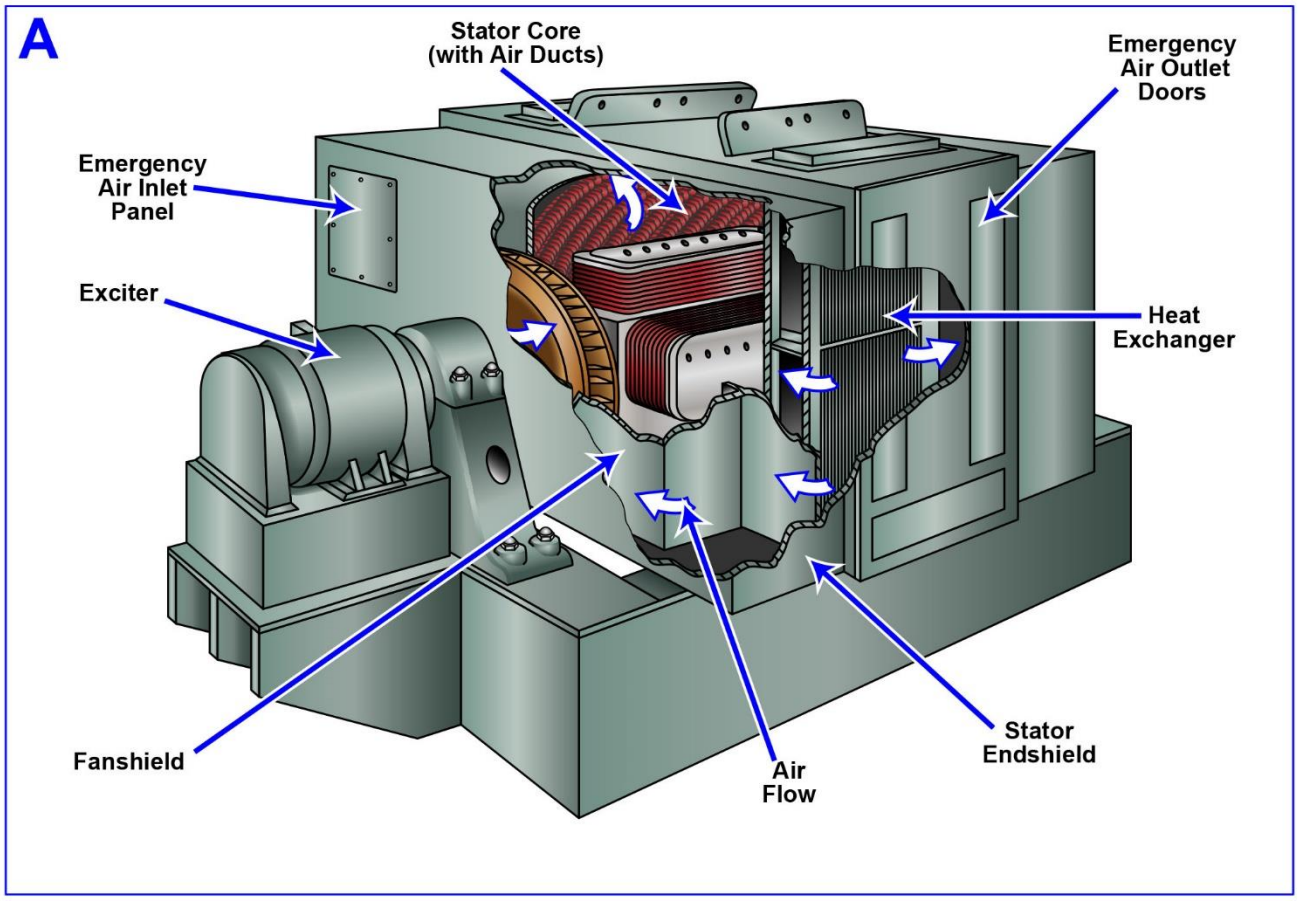


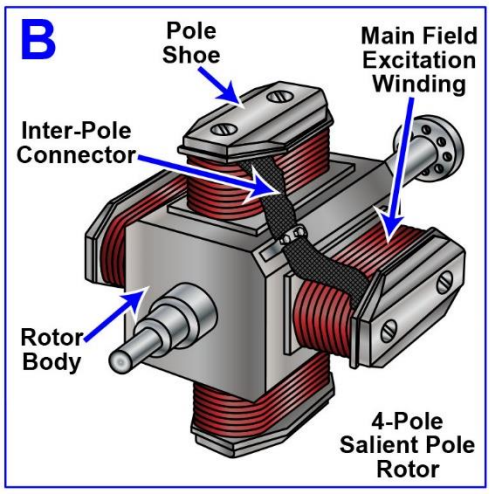
7

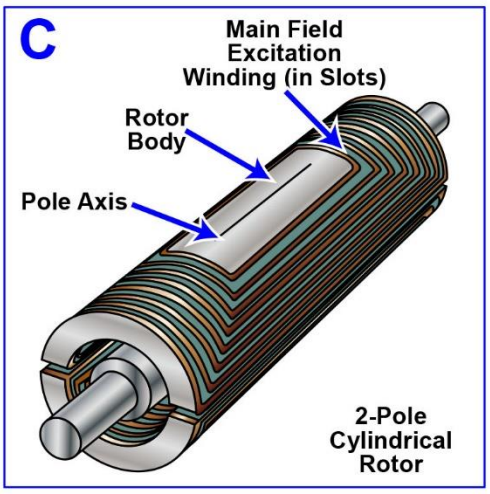


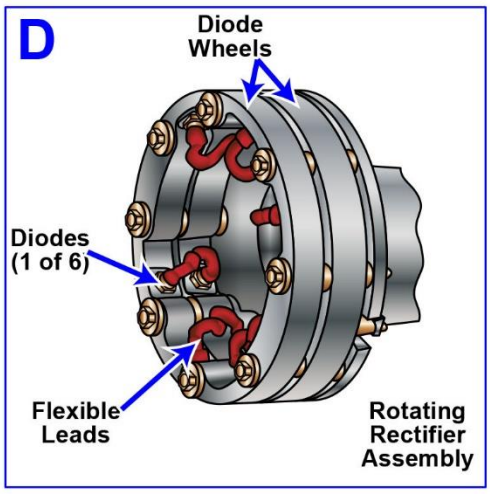
Adapted for testing purposes only from HERMAN, Industrial Motor Control,, 6th Ed.
Copyright © 2010 by Delmar, Cengage Learning
Further reproduction prohibited without permission

EL-0037



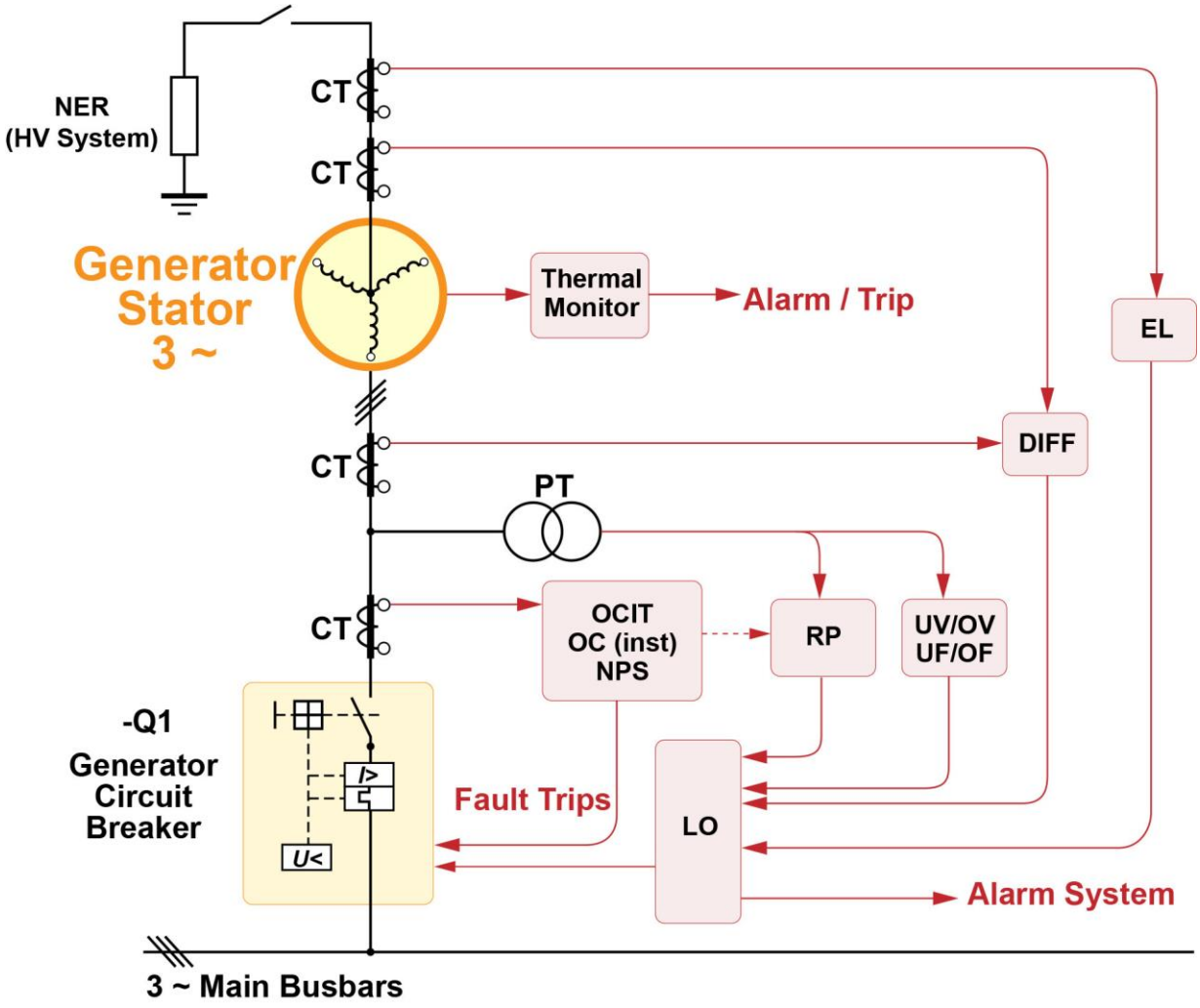






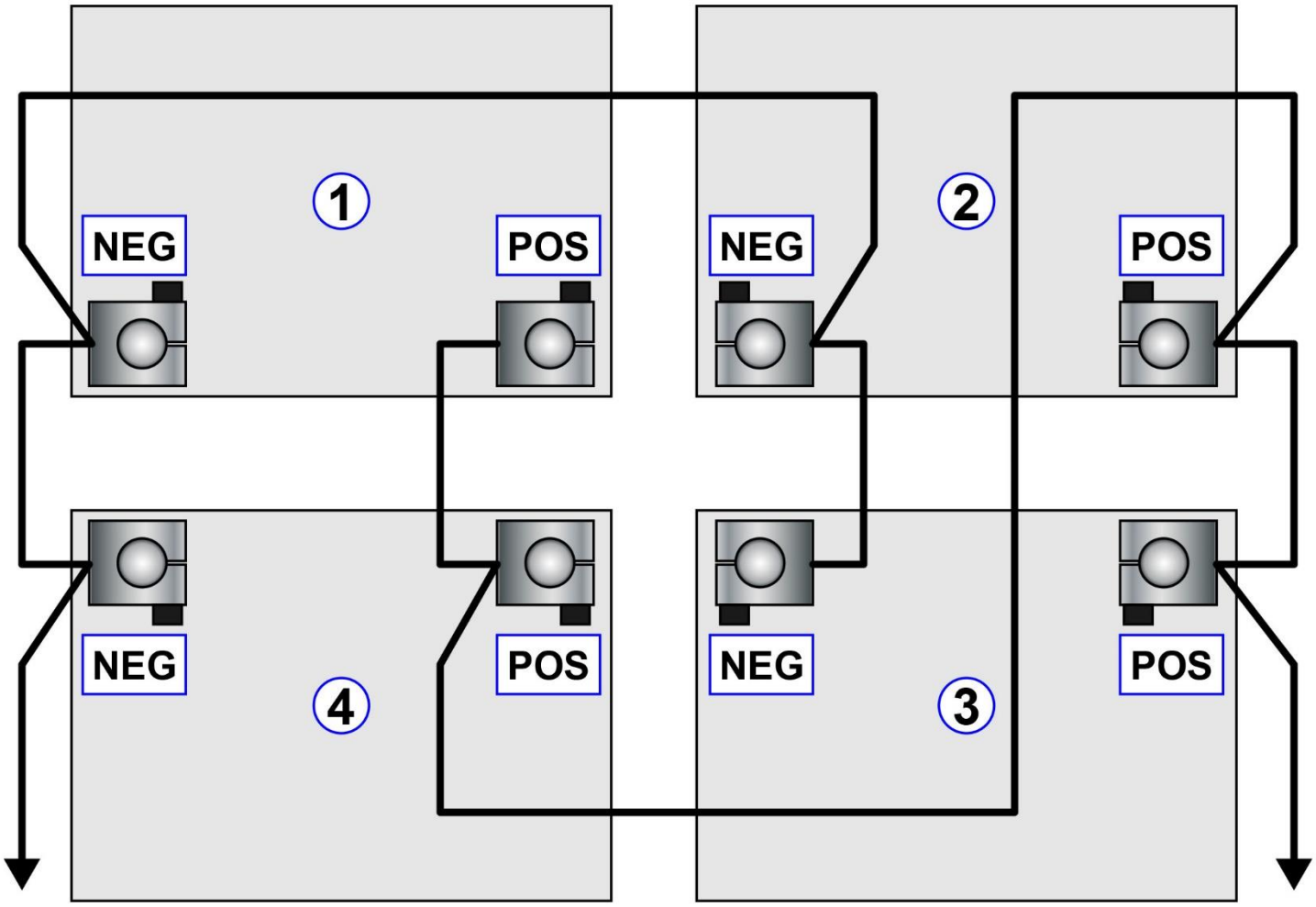
Adapted for testing purposes only from HALL, Practical Marine Electrical Knowledge, 2nd Ed.
Copyright © 1999 by Dennis T. Hall
Further reproduction prohibited without permission

EL-0067



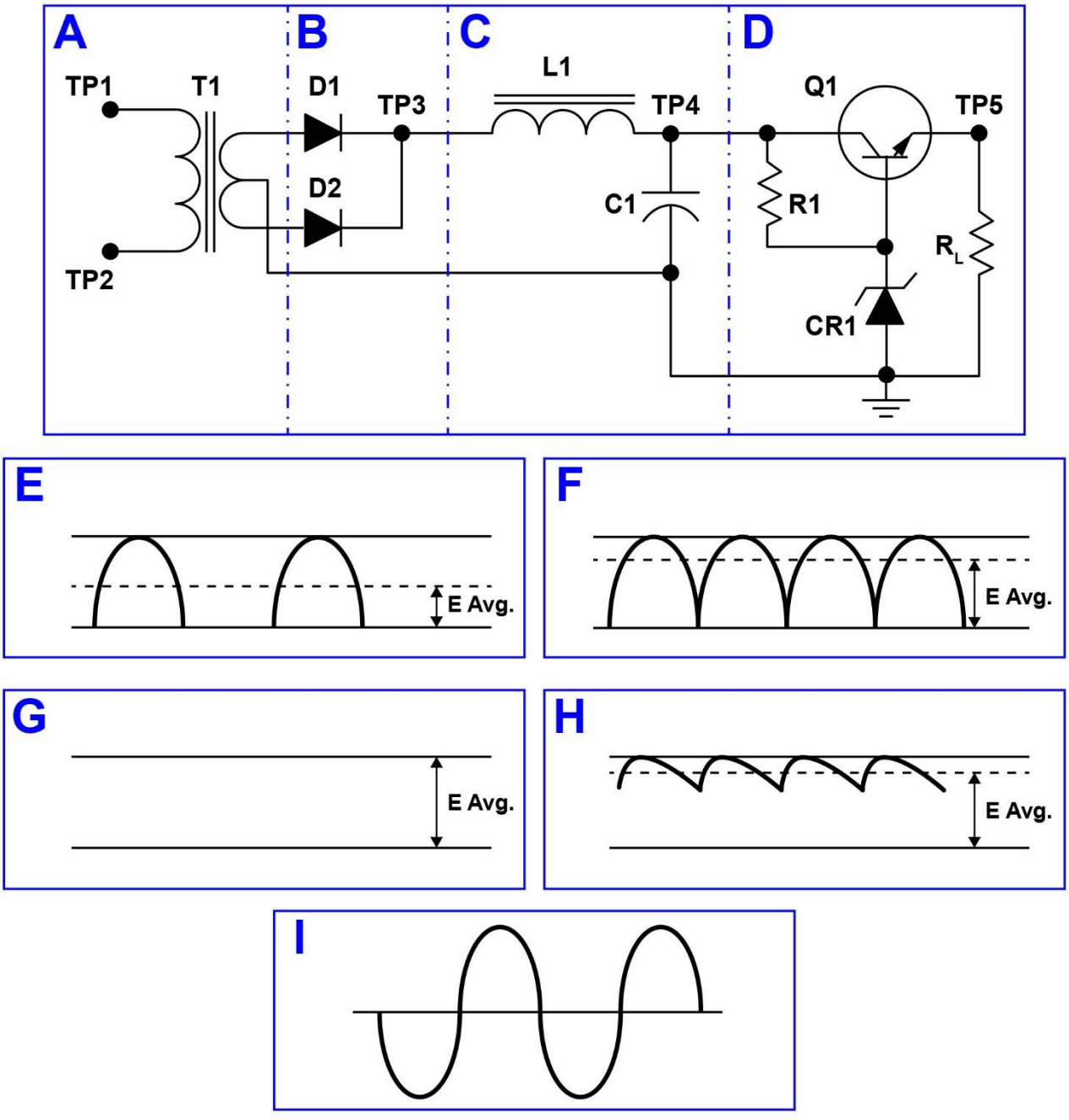
Adapted for testing purposes only from HALL, Practical Marine Electrical Knowledge, 3rd Ed.
Copyright © 2014 by Dennis T. Hall
Further reproduction prohibited without permission

EL-0070



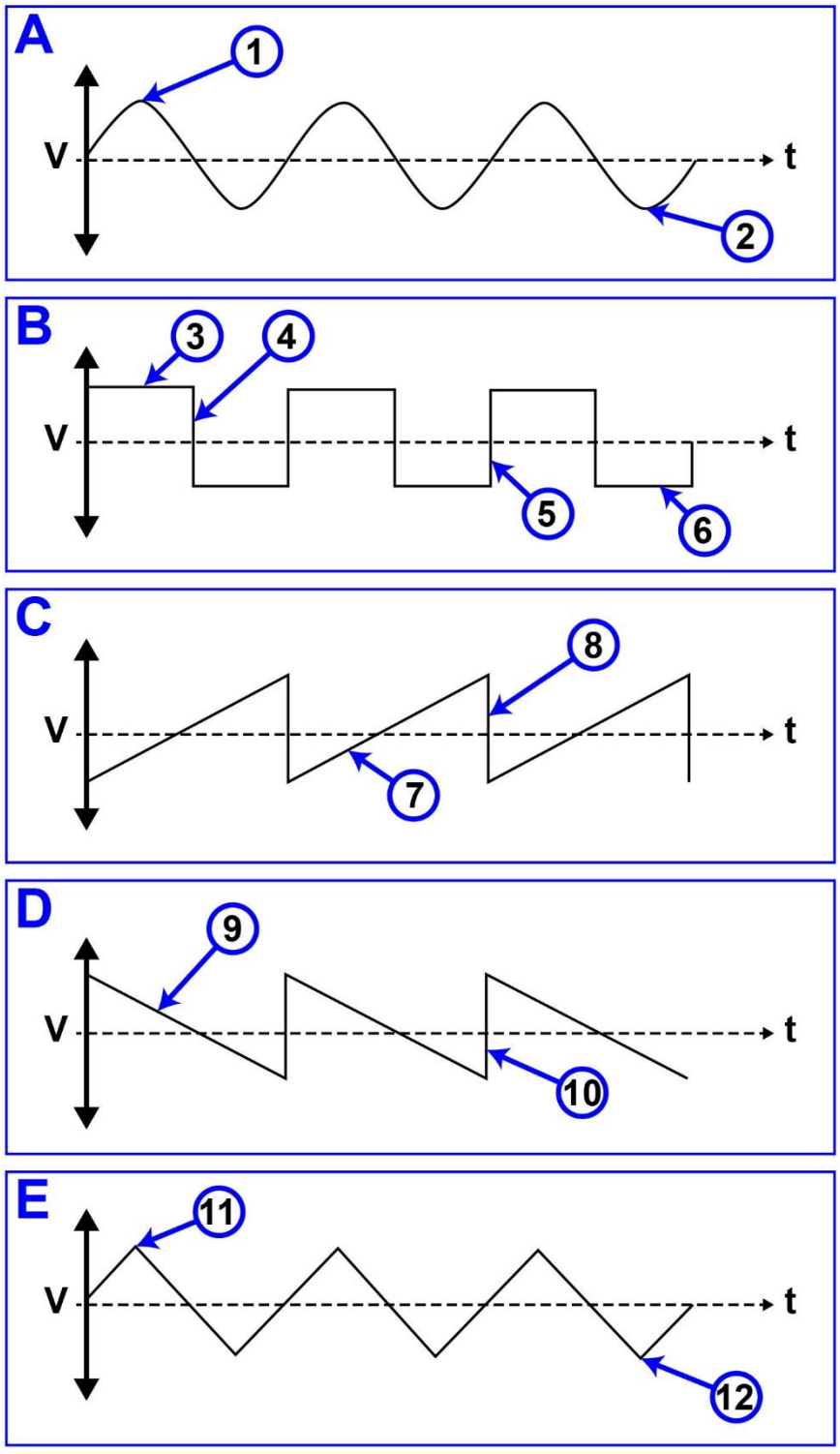
Adapted for testing purposes only
Further reproduction prohibited without permission

EL-0085



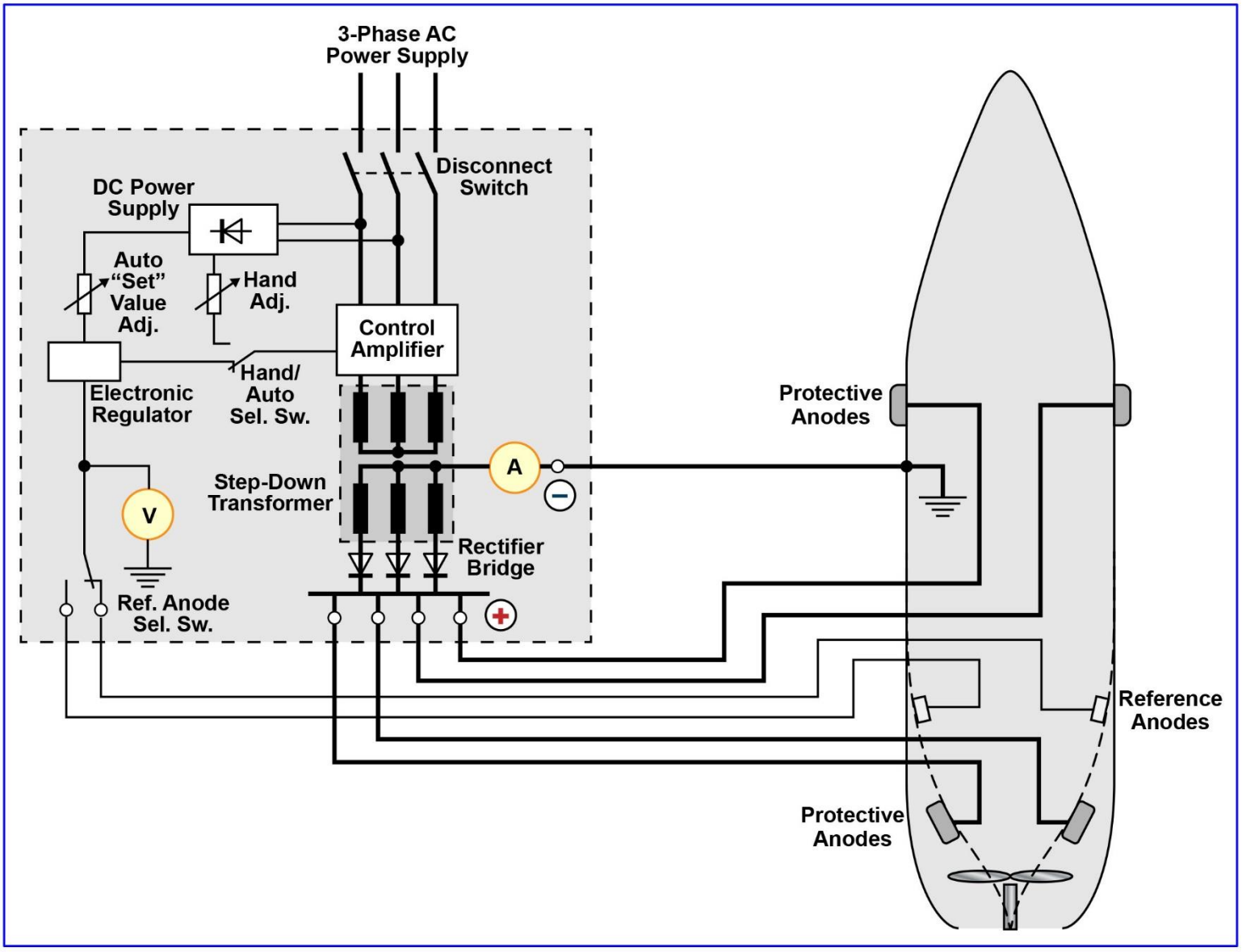
Adapted for testing purposes only from Introduction to Solid-State Devices and Power Supplies Training Series, Module 7
NAVEDTRA 14179
Further reproduction prohibited without permission

EL-0088



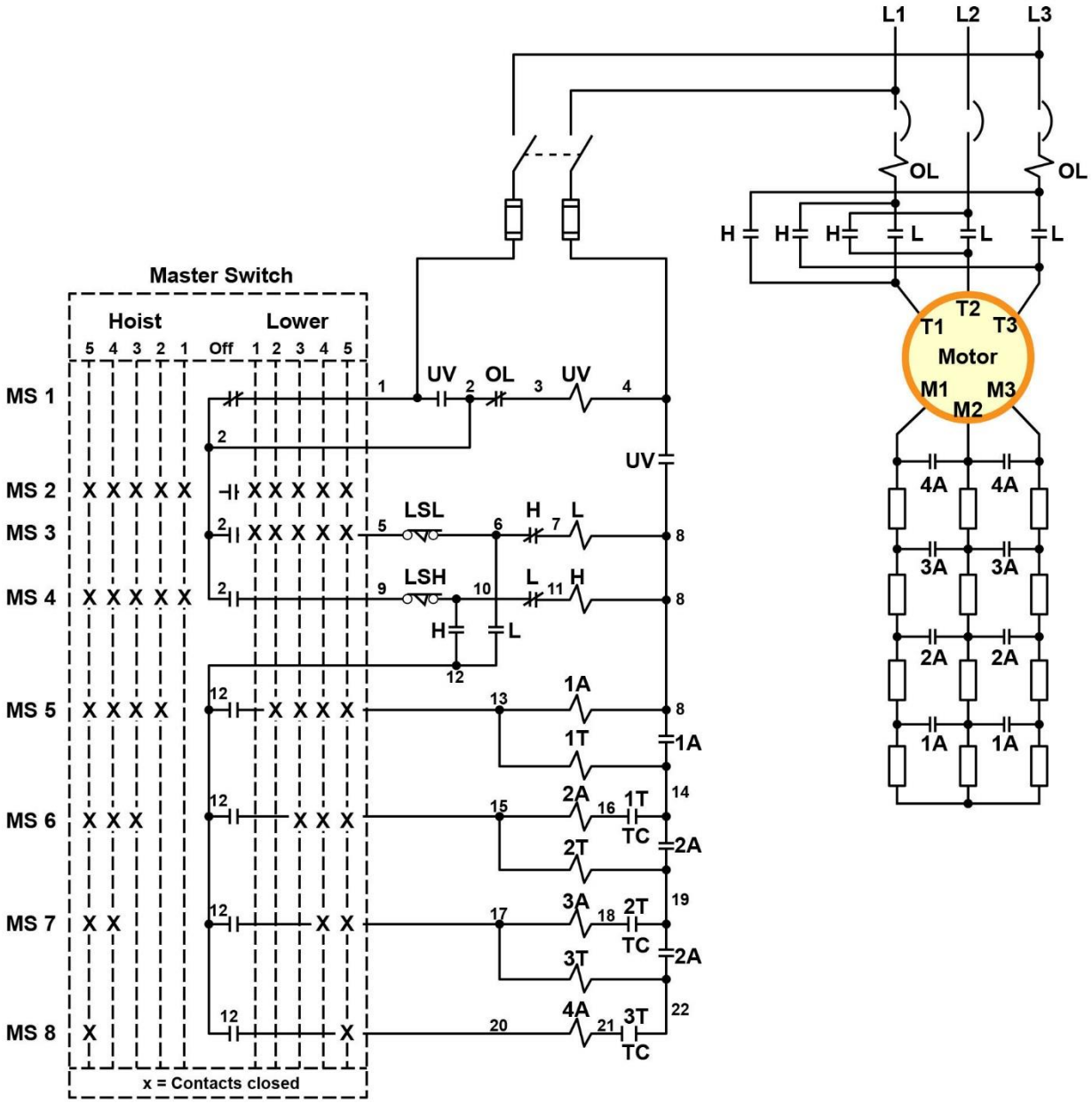
Adapted for testing purposes only from GROB, Basic Electronics, 4th Ed.
Copyright © 1977 by McGraw-Hill Inc.
Further reproduction prohibited without permission

EL-0090



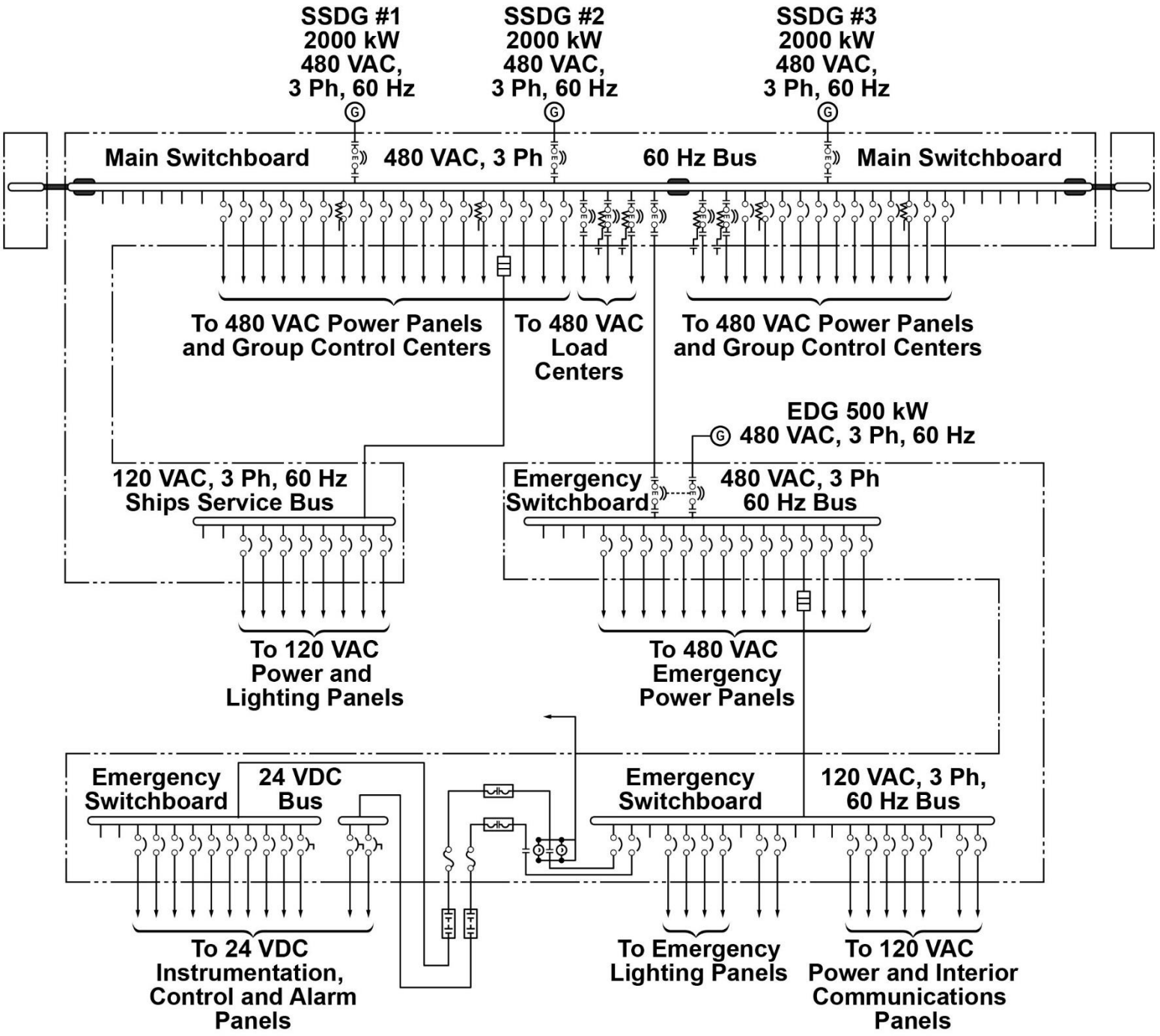
Adapted for testing purposes only from HALL, Practical Marine Electrical Knowledge, 2nd Ed.
Copyright © 2003 by Dennis T. Hall
Further reproduction prohibited without permission

EL-0102



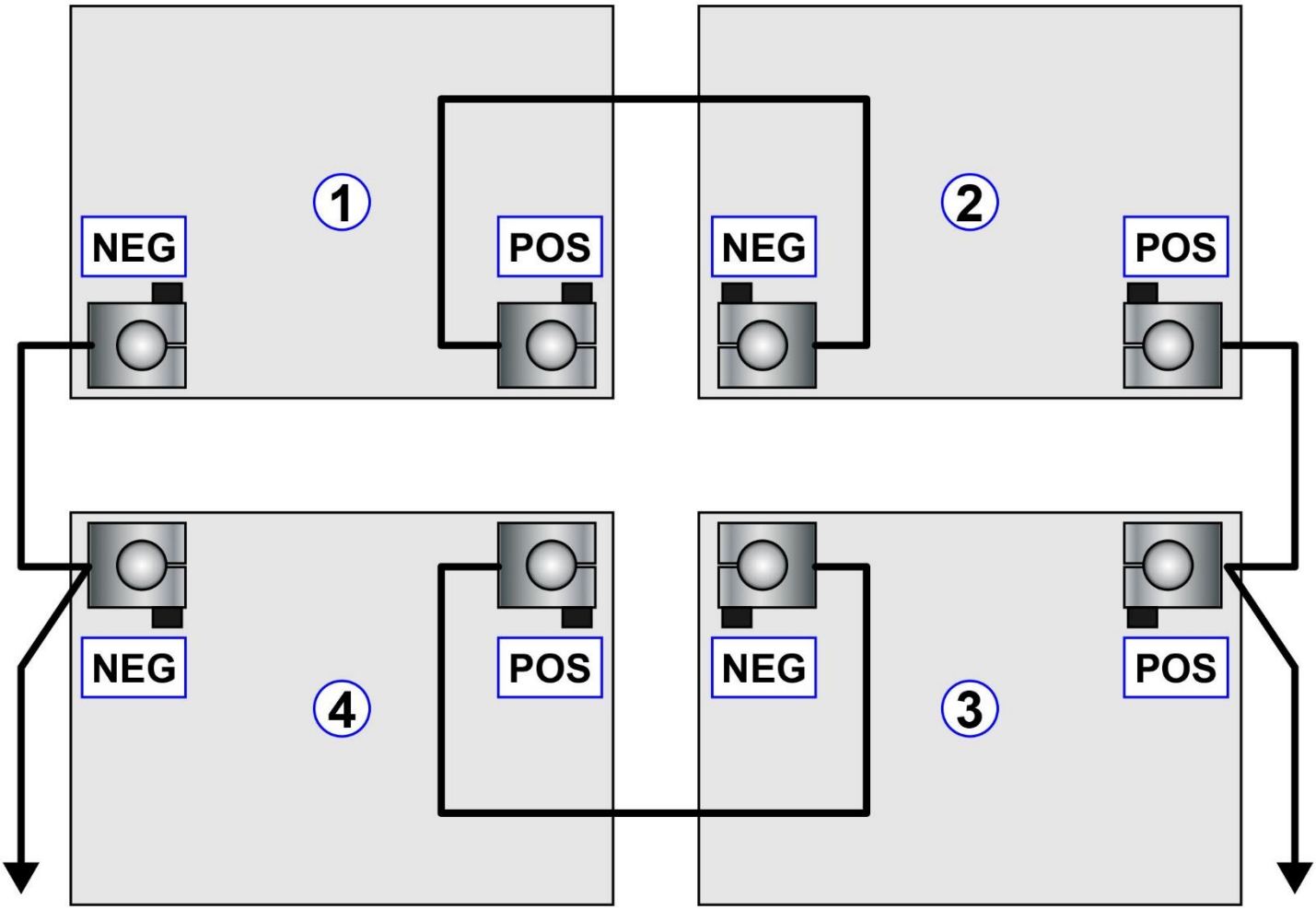
Adapted for testing purposes only from HUBERT, Operating, Testing, and Preventive Maintenance of Electrical Power Apparatus
Copyright © 2003 by Pearson Education, Inc.
Further reproduction prohibited without permission

EL-0106
One Line Distribution Diagram



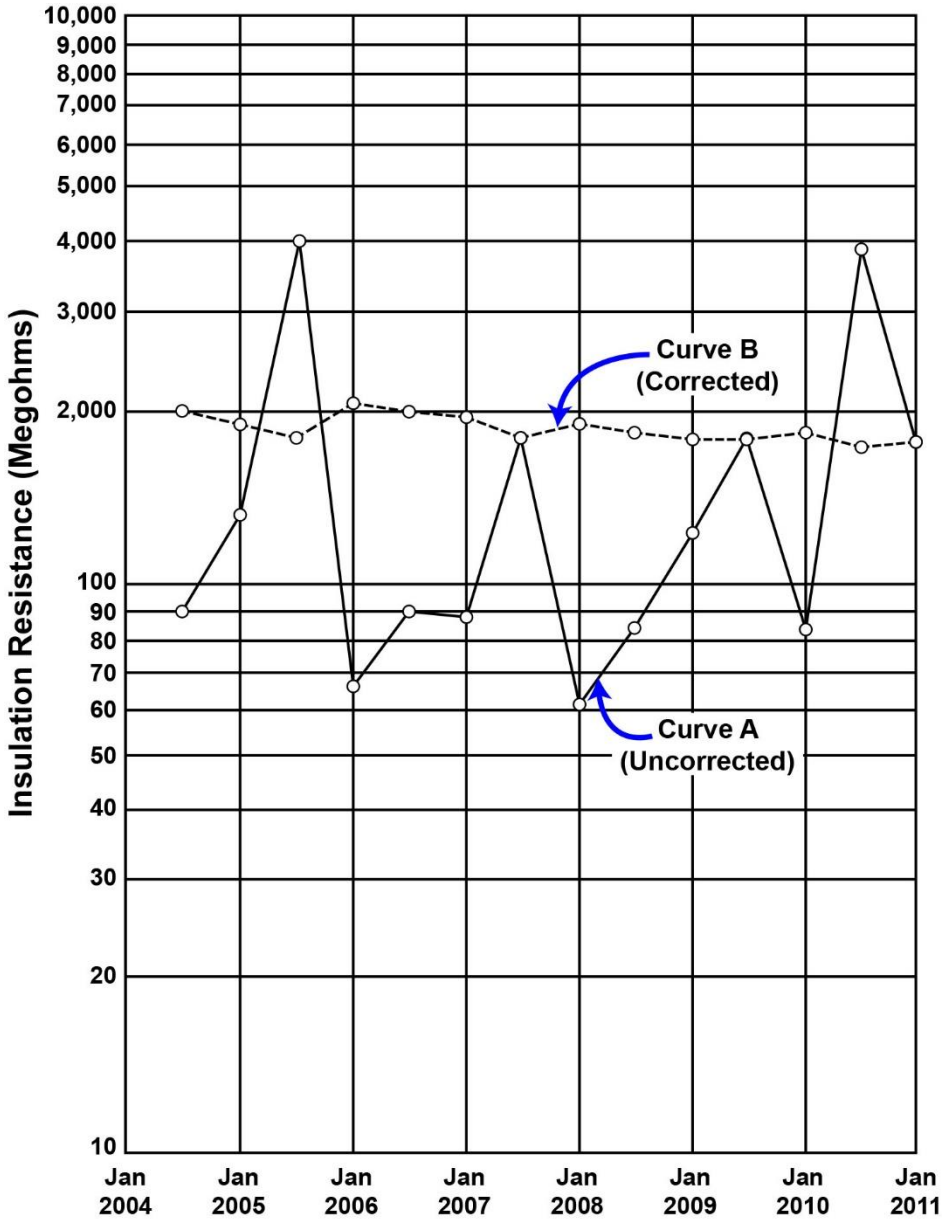
Adapted for testing purposes only from HARRINGTON, Marine Engineering
Copyright © 1992 by The Society of Naval Architects and Marine Engineers
Further reproduction prohibited without permission

EL-0107



Adapted for testing purposes only
Further reproduction prohibited without permission

EL-0120

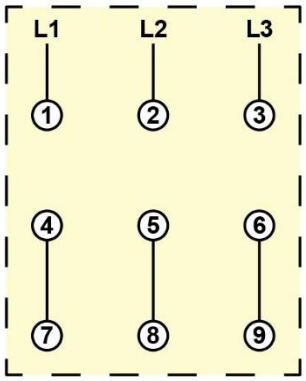


Adapted for testing purposes only from HUBERT, Operating, Testing and Preventive Maintenance of Electrical Power Apparatus
Copyright © 2003 Pearson Education
Further reproduction prohibited without permission

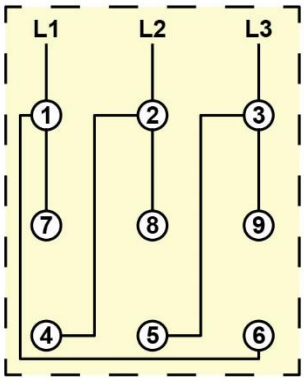
EL-0134

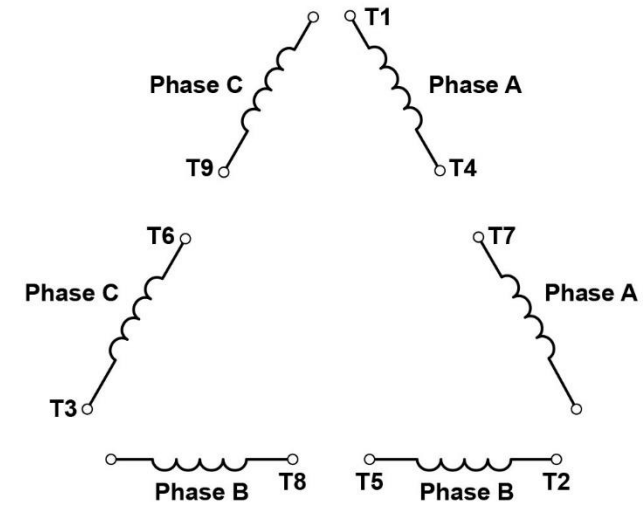
Dual Voltage Nine Lead Delta Connected Motor

High Voltage Connections



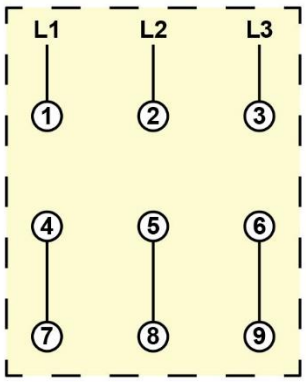
Low Voltage Connections



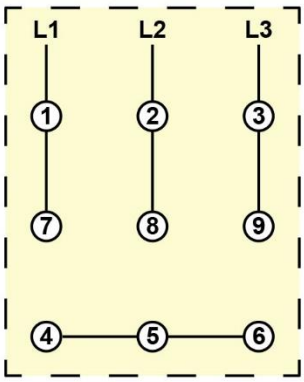


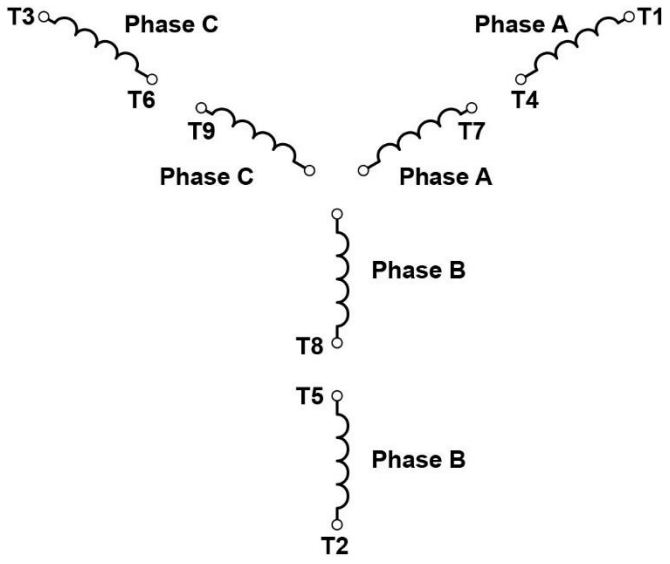
Dual Voltage Nine Lead Wye Connected Motor

High Voltage Connections



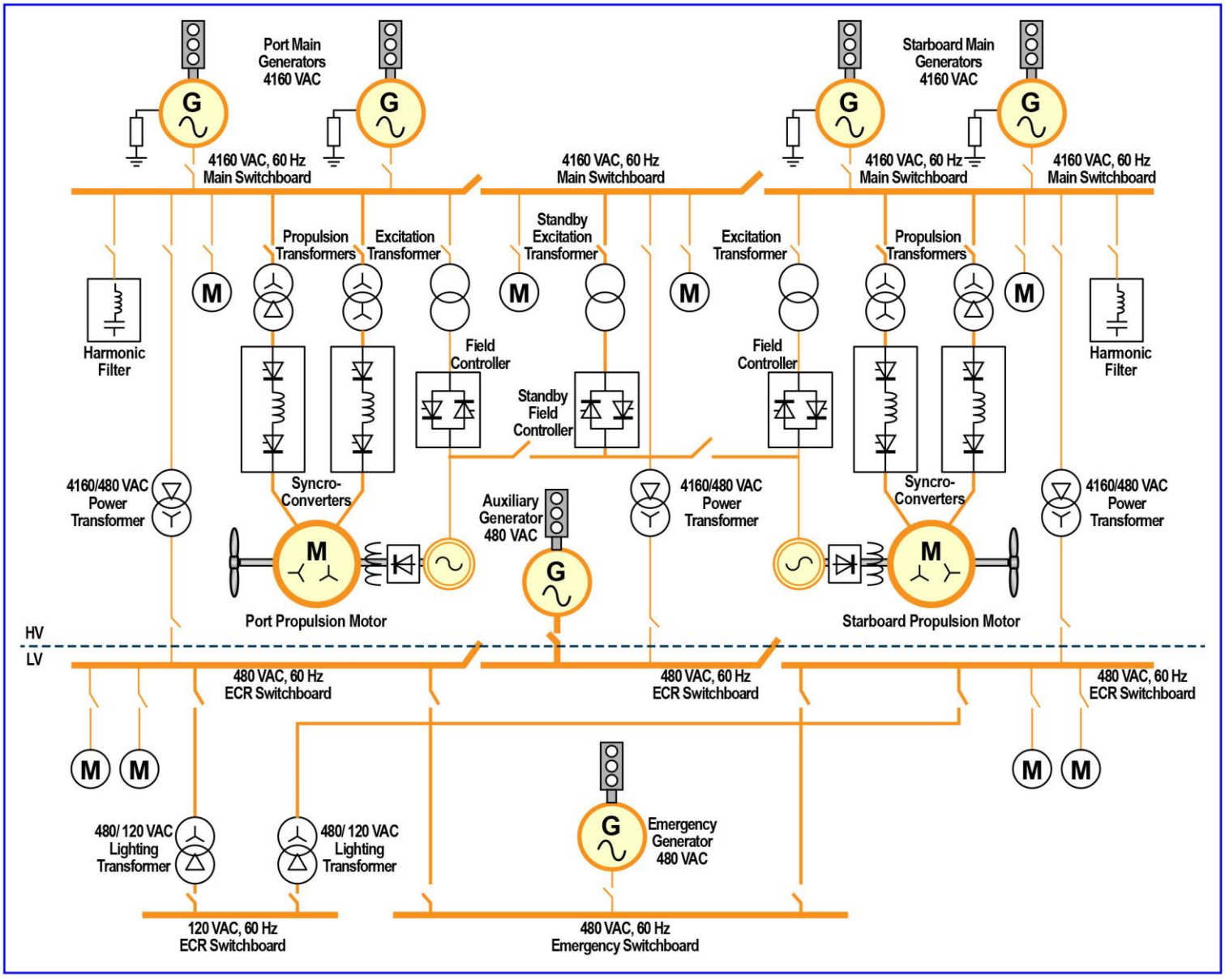
Low Voltage Connections





Adapted for testing purposes only from HERMAN, Industrial Motor Control, 6th Ed.
Copyright © 2010 by Delmar, Cengage Learning
Further reproduction prohibited without permission

EL-0164

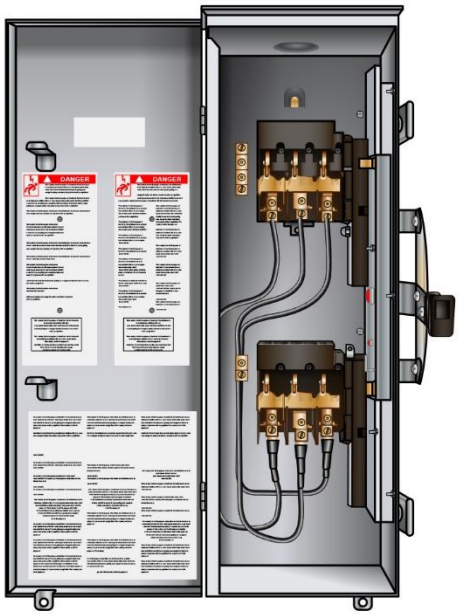


Adapted for testing purposes only from HALL, Practical Marine Electrical Knowledge, 3rd Ed.
Copyright © 2014 by Dennis T. Hall
Further reproduction prohibited without permission

EL-0176

A

B



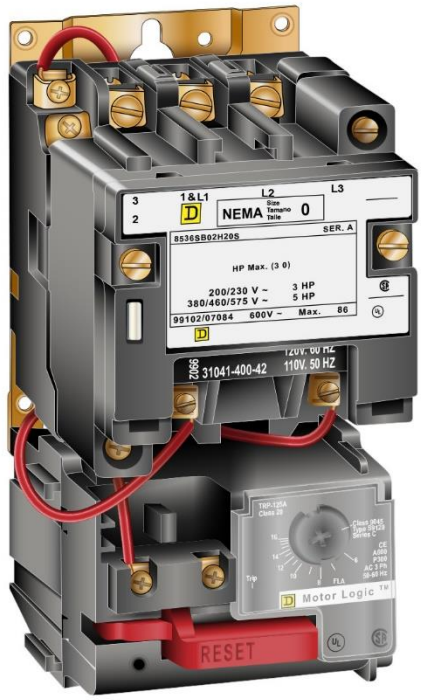
C

D

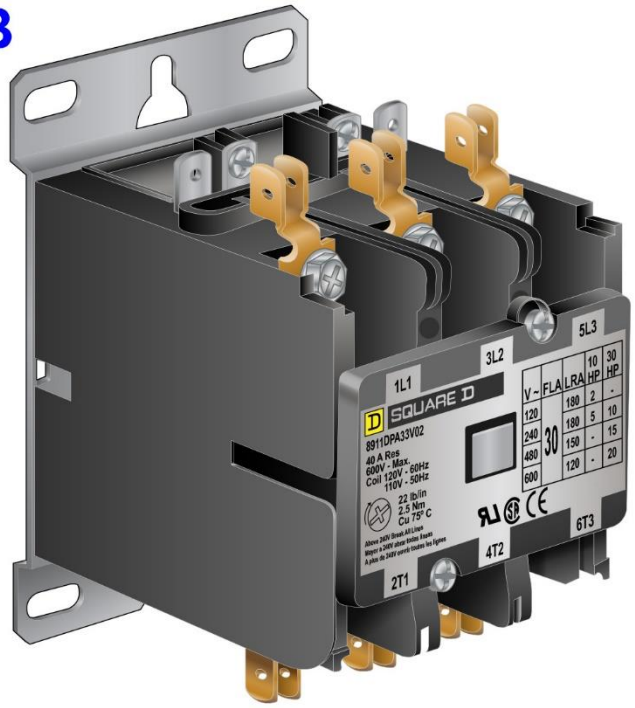
Adapted for testing purposes only
Further reproduction prohibited without permission

EL-0179

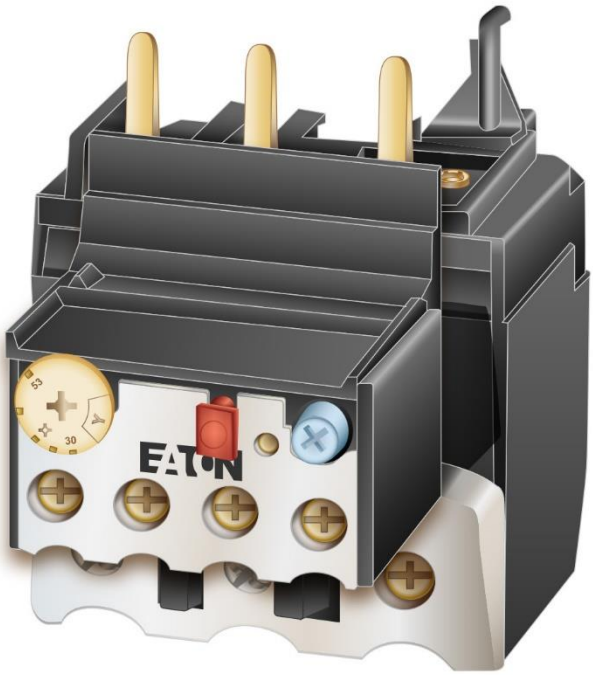
A



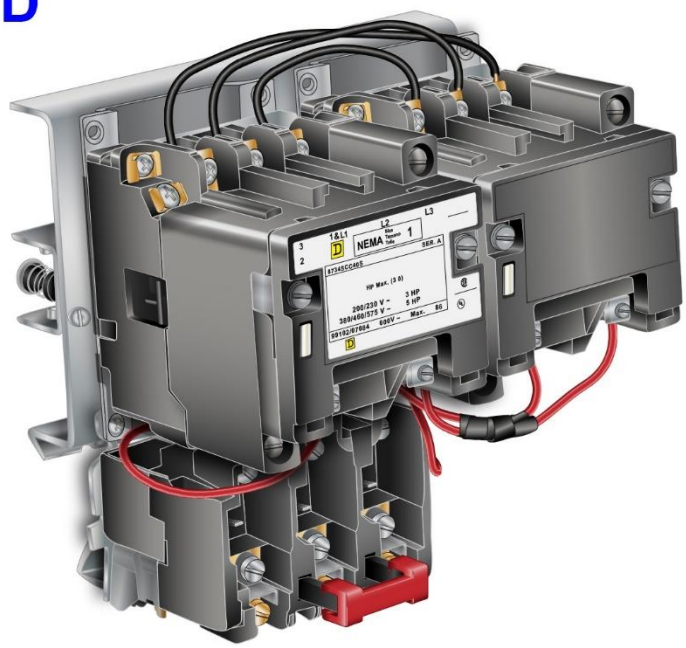
B



C

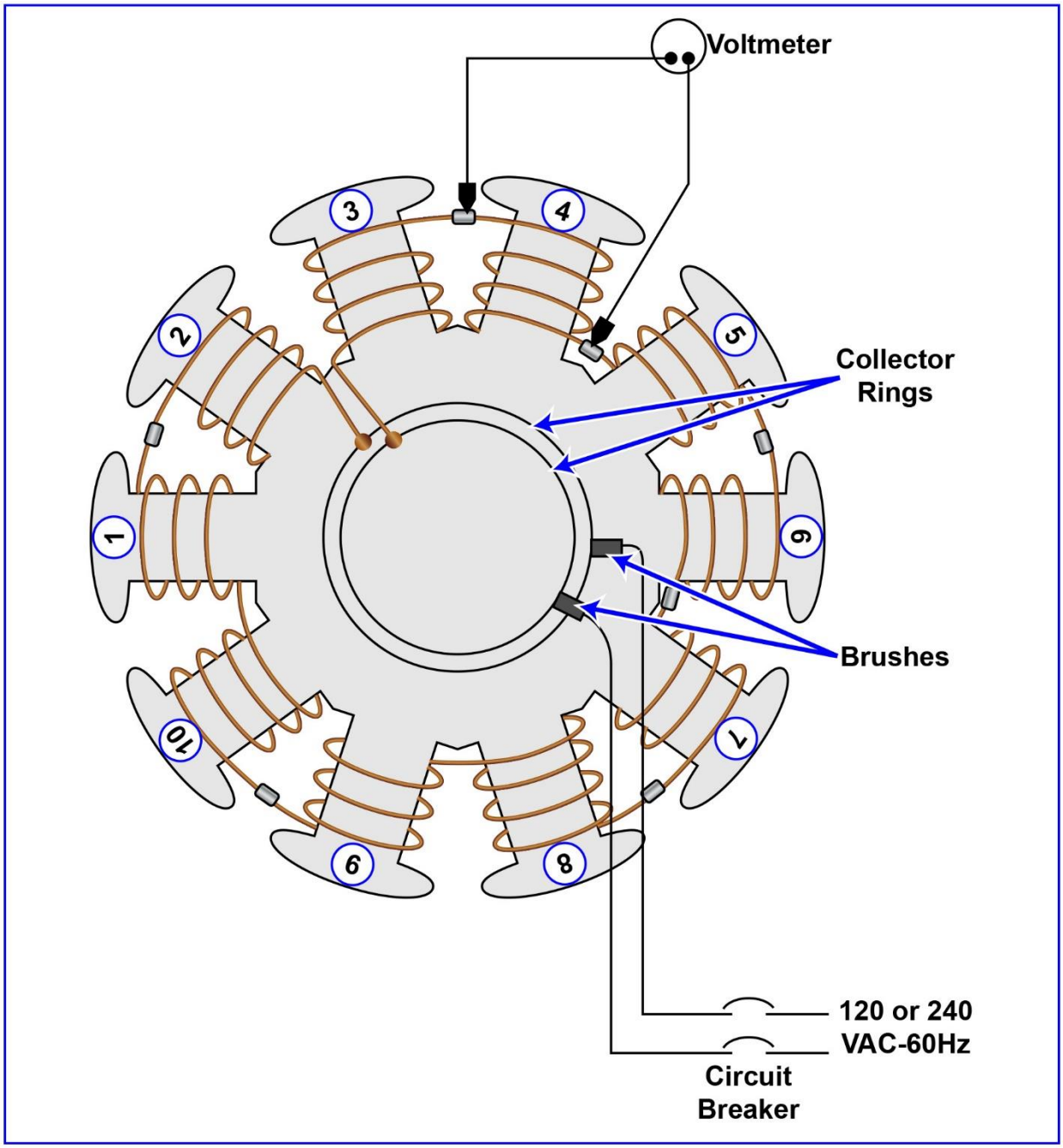


D



Adapted for testing purposes only
Further reproduction prohibited without permission

EL-0202



Adapted for testing purposes only from HUBERT, Operating, Testing and Preventive Maintenance of Electrical Power Apparatus
Copyright © 2003 Pearson Education
Further reproduction prohibited without permission

EL-0223

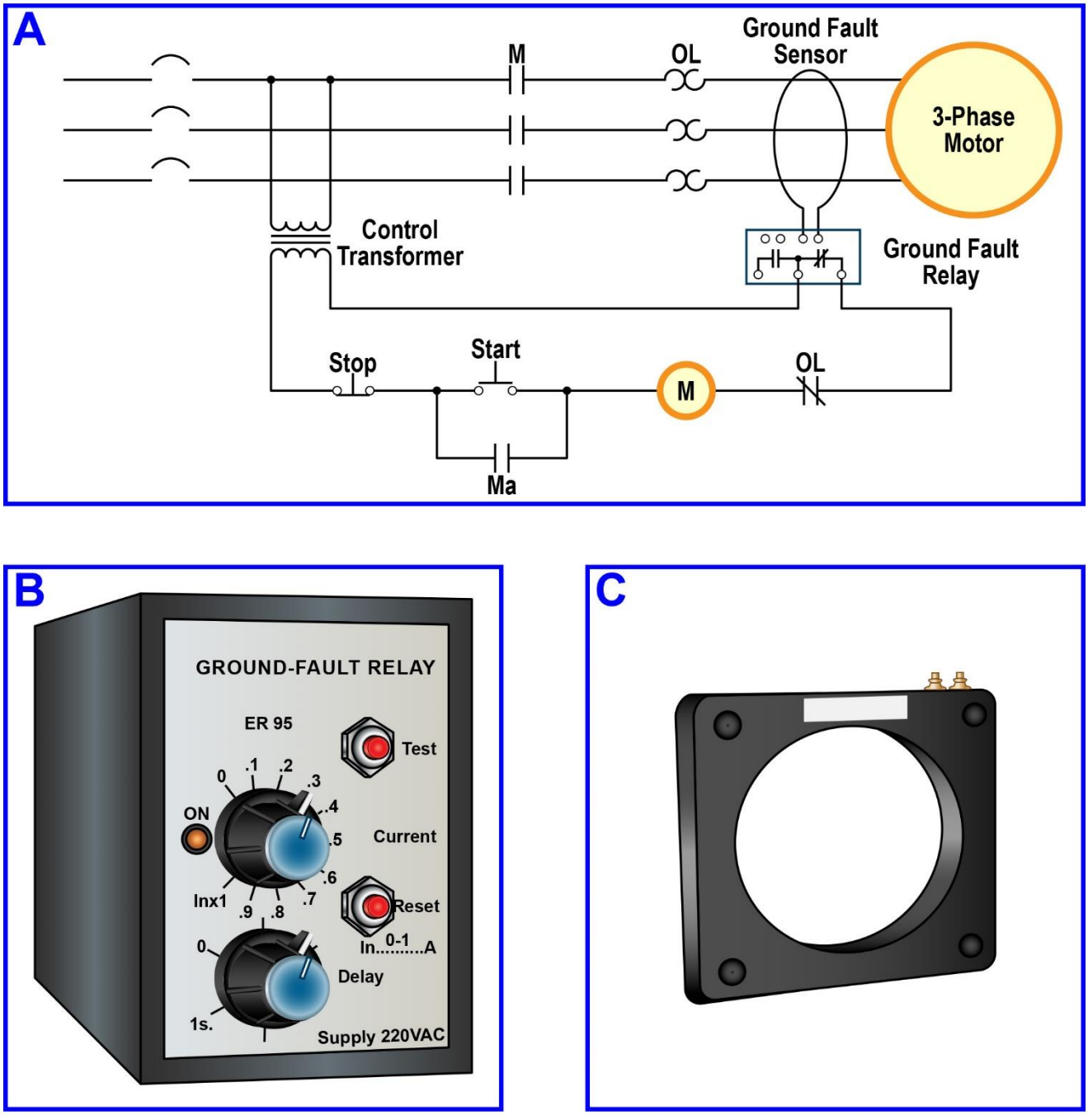


Figure A: Adapted for testing purposes only from MILLER, Industrial Electricity and Motor Controls

Copyright © 2008 by The McGraw-Hill Companies, Inc.
Further reproduction prohibited without permission