

U.S.C.G. Merchant Marine Exam  
Third Assistant Engineer, Unlimited  
Q536 Electrical-Electronic-Control Engineering  
(Sample Examination)

**Choose the best answer to the following Multiple Choice Questions.**

**1.** Why should battery rooms be well ventilated during the charging of storage batteries?

- (A) without ventilation the battery will not take a full charge
- (B) without ventilation excessive gassing will occur
- (C) highly explosive gases will otherwise accumulate
- (D) highly poisonous gases are released

*If choice C is selected set score to 1.*

**2.** 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)

*If choice C is selected set score to 1.*

**3.** The turns ratio of the tapped step-down transformer shown in figure "C" of the illustration is four to one and all taps are evenly spaced. If 120 volts were applied to terminals "H1" and "H3", what would appear at "X1" and "X2"? Illustration EL-0082

- (A) 15 volts
- (B) 30 volts
- (C) 480 volts
- (D) 960 volts

*If choice A is selected set score to 1.*

**4.** After prior isolation and lock-out/tag-out procedures are performed, which electrical device requires discharging any stored electrical energy before any work may safely begin?

- (A) potential transformer
- (B) capacitor
- (C) resistor bank
- (D) choke coil

*If choice B is selected set score to 1.*

- 5.** What is the primary means by which an electrical maintenance worker is protected from electrical hazards while performing work on an electrical circuit?
- (A) shutting down the necessary equipment
  - (B) using the appropriate personal protective equipment
  - (C) posting of safety warning signs
  - (D) performing a lock-out/tag-out procedure

*If choice D is selected set score to 1.*

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

*If choice B is selected set score to 1.*

- 7.** Besides the fluorescent lamp itself and possibly a starter, which of the following components is included in a fluorescent lighting fixture?
- (A) Magnetic resonator
  - (B) Magnetron
  - (C) Laser
  - (D) Ballast (choke coil)

*If choice D is selected set score to 1.*

- 8.** 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) De-energize the applicable switchboard bus.
  - (C) Bypass the interlocks.
  - (D) Station a man at the circuit supply switch.

*If choice A is selected set score to 1.*

9. No.1 SSDG was operating in parallel with No.2 SSDG in supplying the 480 VAC main bus while sharing the electrical load evenly. As a result of a problem, if No.1 SSDG begins to motorize, but the generator has not yet tripped out by the action of the reverse power relay, what would be the indication of this?
- (A) The kilowatt meter of No.1 SSDG would indicate a negative wattage (a reversed reading).
  - (B) The ammeter of No.1 SSDG would indicate a higher amperage than when the load was equally shared with No.2 SSDG.
  - (C) The power factor meter of No.1 SSDG would indicate unity (1.0).
  - (D) The kilowatt meter of No.1 SSDG would indicate a higher wattage than when the load was equally shared.

*If choice A is selected set score to 1.*

10. 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) Prevent any unintentional grounds in the main distribution system from affecting the refrigerated container distribution system.
  - (B) Step up the voltage from the main bus to the voltage required for the refrigerated container feeder bus.
  - (C) Step down the voltage from the main bus to the voltage required for the refrigerated container feeder bus.
  - (D) Prevent any unintentional grounds in the refrigerated container distribution system from affecting the main distribution system.

*If choice D is selected set score to 1.*

11. By what means is an AC generator prevented from becoming motorized?
- (A) over speed trip
  - (B) reverse power relay
  - (C) governor controls
  - (D) back pressure trip

*If choice B is selected set score to 1.*

12. Which of the following statements is TRUE concerning azipod propulsion systems?
- (A) The system uses electric motors located inside the ship's hull.
  - (B) The system requires the need for a separate rudder.
  - (C) The system integrates propulsion and steering into one function.
  - (D) The system requires the use of a controllable-pitch propeller.

*If choice C is selected set score to 1.*

- 13.** In order to properly set up programmable motor protection, it is necessary to know the locked-rotor current of a motor. Given the chart of code letters for locked-rotor kVA/HP and the necessary instructions shown in the illustration, calculate the estimated locked-rotor current for the motor represented by the illustrated motor nameplate using a mid-range value for the code letter, assuming the motor is to run at 440 VAC. Illustration EL-0175
- (A) 34.7 amps
  - (B) 43.7 amps
  - (C) 60 amps
  - (D) 75.6 amps

*If choice B is selected set score to 1.*

- 14.** A DC generator which is used to supply direct current in order to provide magnetizing current to an AC generator field is commonly known as what?
- (A) armature
  - (B) exciter
  - (C) stator
  - (D) rotor

*If choice B is selected set score to 1.*

- 15.** The torque-speed and current-speed curves for a three-phase induction motor with a squirrel-cage rotor are shown in figures "A" and "B" of the illustration. Which of the following statements is true concerning the depicted curves? Illustration EL-0056
- (A) Rated torque and rated current occur at approximately 20% slip.
  - (B) The starting current is nearly 1.5 times the normal full load current value.
  - (C) Starting current is approximately 4.75 times the normal full load current value.
  - (D) The pull-up point on the torque curve is about 20% of the normal full load torque value.

*If choice C is selected set score to 1.*

- 16.** Which of the electronic schematic symbols represents the capacitor illustrated in figure "1" of the illustration? Illustration EL-0015
- (A) A
  - (B) B
  - (C) C
  - (D) D

*If choice B is selected set score to 1.*

**17.** How may the unit "hertz" be best described?

- (A) revolutions per minute
- (B) cycles per second
- (C) coulombs per second
- (D) revolutions per second

*If choice B is selected set score to 1.*

**18.** What would be the total current in figure "A" of the circuit illustrated if the value of capacitor  $C_1$  was 100 microfarads, capacitor  $C_2$  was 200 microfarads and the power supply was 240 volts at 60 Hz?  
Illustration EL-0038

- (A) 27 amps
- (B) 37 amps
- (C) 47 amps
- (D) 57 amps

*If choice A is selected set score to 1.*

**19.** As shown in figure "D" of the digital power meter shown in the illustration, what type of single phase load is under test for power measurement? Illustration EL-0256

- (A) a resistive-capacitive load
- (B) an inductive-resistive load
- (C) a purely inductive load
- (D) a purely resistive load

*If choice B is selected set score to 1.*

**20.** Periodic testing using a special camera may be performed to detect potentially dangerous loose or corroded bus bar and controller connections. What is the name of this testing technology?

- (A) corrosion electrolysis
- (B) electric vibroanalysis
- (C) heat sensitive thermography
- (D) visual pyrotronics

*If choice C is selected set score to 1.*

**21.** Referring to the illustration of a steering gear hydraulic power unit motor controller, if the motor is drawing current no greater than full load current, what will the status of the overload relay contacts and the control relay contacts be? Illustration EL-0119

- (A) The overload relay contacts will be **OPEN**  
The control relay contacts will be **CLOSED**
- (B) The overload relay contacts will be **CLOSED**  
The control relay contacts will be **OPEN**
- (C) The overload relay contacts will be **CLOSED**  
The control relay contacts will be **CLOSED**
- (D) The overload relay contacts will be **OPEN**  
The control relay contacts will be **OPEN**

*If choice B is selected set score to 1.*

**22.** When a fluorescent lamp has reached the end of its useful life, it should be replaced immediately. If not, what condition could the resultant flashing cause?

- (A) tripping of the lamp's circuit breaker
- (B) exploding of the lamp, causing glass to fly in all directions
- (C) damaging the lamps starter and ballast circuit
- (D) short circuiting of adjacent lighting circuits

*If choice C is selected set score to 1.*

**23.** An open primary coil in a simple potential transformer will be indicated by which of the listed conditions?

- (A) An infinite resistance value on the secondary coil.
- (B) Overloaded secondary coil.
- (C) Low resistance value on the primary coil.
- (D) No voltage on the output of the secondary coil.

*If choice D is selected set score to 1.*

**24.** In testing a hand-cranked megger prior to use, what statement is true?

- (A) With the test leads shorted or open, the pointer should go to zero ohms.
- (B) With the test leads shorted or open, the pointer should go to infinite ohms.
- (C) With the test leads shorted, the pointer should go to zero ohms, and with the tests leads open, the pointer should go to infinite ohms.
- (D) With the test leads shorted, the pointer should go to infinite ohms, and with the tests leads open, the pointer should go to zero ohms.

*If choice C is selected set score to 1.*

**25.** To properly use a clamp-on-type ammeter to check current flow, what must be done FIRST?

- (A) de-energize the circuit to allow connection of the instrument in series
- (B) short the test leads and calibrate the instrument to zero
- (C) connect the voltage test leads to the appropriate terminals
- (D) hook the jaws of the instrument around the insulated single conductor

*If choice D is selected set score to 1.*

**26.** In order to definitively determine whether or not fuse "1", shown in the illustration is blown using an on-line testing technique, across what points would you connect the voltmeter leads? Illustration EL-0062

- (A) from the top of fuse "1" and the top of either fuse "2" or fuse "3"
- (B) from the top of fuse "1" and the bottom of either fuse "2" or fuse "3"
- (C) from the bottom of fuse "1" and the top of either fuse "2" or fuse "3"
- (D) from the bottom of fuse "1" and the bottom of either fuse "2" or fuse "3"

*If choice C is selected set score to 1.*

**27.** 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

*If choice A is selected set score to 1.*

**28.** 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

*If choice A is selected set score to 1.*

**29.** Referring to the sound-powered telephone circuit shown in illustration, what statement is true concerning the button on the handset as represented by the component labeled "A"? Illustration EL-0093

- (A) The push button is depressed for the purposes of listening and talking.
- (B) The push button is depressed only for the purposes of listening, and it should be released for talking.
- (C) The push button is depressed only for the purposes of conversing with multiple stations. For a conversation between two stations, it is not needed.
- (D) The push button is depressed only for the purposes of talking, and it should be released for listening.

*If choice A is selected set score to 1.*

**30.** AC circuits can possess characteristics of resistance, inductance, and capacitance. In terms of units of measure, how is the capacitive reactance of the circuit expressed?

- (A) farads
- (B) mhos
- (C) ohms
- (D) henrys

*If choice C is selected set score to 1.*

**31.** A thermal-magnetic circuit breaker for a 300 kW alternator is rated at 500 amperes at full continuous load. Which of the following conditions will trip the breaker?

- (A) Sustained current draw of 450 amperes for 2 hours.
- (B) Sustained current draw of 500 amperes for 10 minutes.
- (C) Momentary current draw of 1000 amperes for 3 seconds.
- (D) Instantaneous current draw of 5,000 amperes.

*If choice D is selected set score to 1.*

**32.** Which of the following statements concerning nickel-cadmium batteries is true?

- (A) Nickel-cadmium batteries can be stored for a long period of time while still keeping a full charge.
- (B) When mixing the electrolyte always add water to the acid.
- (C) When mixing the electrolyte always add acid to the water.
- (D) The electrolyte of an idle nickel-cadmium battery must be replaced monthly to maintain battery condition.

*If choice A is selected set score to 1.*

**33.** Which of the procedures or conditions listed could result in damaging a transistor beyond repair?

- (A) Installing a transistor whose current rating exceeds the design circuit current.
- (B) Applying silicone grease between the heat sink and the transistor mounting.
- (C) Providing insufficient voltage to the input circuit.
- (D) Providing incorrect polarity to the collector circuit.

*If choice D is selected set score to 1.*

**34.** What is "the voltage per millimeter of insulation thickness that the insulation can withstand without breaking down" called?

- (A) Tensile strength
- (B) Dielectric strength
- (C) Mechanical strength
- (D) Shear strength

*If choice B is selected set score to 1.*

**35.** As shown in figure "B" of the illustration, what statement is true concerning "regenerating" operation? Illustration EL-0162

- (A) by applying torque in the opposite direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly slows down the motor
- (B) by applying torque in the same direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly slows down the motor
- (C) by applying torque in the opposite direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly speeds up the motor
- (D) by applying torque in the same direction of rotation direction, the motor briefly regenerates power back into the mains, which rapidly speeds up the motor

*If choice A is selected set score to 1.*

**36.** When placed in a magnetic field, which of the materials listed will maintain the highest permeability?

- (A) Bakelite
- (B) Glass
- (C) Aluminum
- (D) Soft iron

*If choice D is selected set score to 1.*

**37.** 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 main contactor coil for continuity, replace as necessary
- (B) check the overload relay for tripped condition, reset as necessary
- (C) check the overload relay (OL) heaters for continuity, replace as necessary
- (D) check the disconnect switch open, open as necessary

*If choice B is selected set score to 1.*

**38.** What practice could potentially damage a multimeter?

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

*If choice B is selected set score to 1.*

**39.** As shown in figure "A" of the illustration, with the switch closed what statement is true if "R<sub>1</sub>" and "R<sub>2</sub>" have unequal resistance values? Illustration EL-0019

- (A) The energy dissipated in "R<sub>1</sub>" will be the same as the energy dissipated in "R<sub>2</sub>".
- (B) The voltage drop across "R<sub>1</sub>" will not be equal to the voltage drop across "R<sub>2</sub>".
- (C) The current flow through "R<sub>1</sub>" will equal the current flow through "R<sub>2</sub>".
- (D) The current flow through "R<sub>1</sub>" will differ from the current flow through "R<sub>2</sub>".

*If choice D is selected set score to 1.*

**40.** A split-phase induction squirrel-cage motor will not start and come up to speed, even though the rated voltage, rated frequency, and rated load are applied. Which of the following troubles would be suspected?

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

*If choice D is selected set score to 1.*

**41.** The leads from an ohmmeter are attached to the leads of the opposite ends of an AC motor stator field coil. If a reading of infinity is obtained, what does this indicate?

- (A) grounded field coil
- (B) shunted field coil
- (C) shorted field coil
- (D) open field coil

*If choice D is selected set score to 1.*

**42.** In accordance with 46 CFR Subchapter J (Electrical Engineering), which of the following starting aids is the ONLY method allowed to ease the starting of emergency diesel-generator engines?

- (A) Ether injection systems
- (B) Thermostatically controlled electric jacket water heaters
- (C) Electric, steam, or hot water heated lube oil heaters
- (D) Electric air intake heaters

*If choice B is selected set score to 1.*

**43.** Assuming the vessel has an engine control room, where is an engineers' assistance-needed alarm required to produce an audible signal?

- (A) The crew's and officers' mess
- (B) The engineers' accommodation spaces
- (C) The wheelhouse/navigational bridge
- (D) The engine room/machinery space

*If choice B is selected set score to 1.*

**44.** Some shipboard high voltage systems have the neutral point of the generators bonded to the ship's hull with a neutral grounding resistor. What is the purpose of this resistor?

- (A) To completely eliminate ground fault current
- (B) To maximize the magnitude of the ground fault current
- (C) To prevent nuisance ground fault trips
- (D) To minimize the magnitude of the ground fault current

*If choice D is selected set score to 1.*

**45.** Which of the following illustrated manual motor starters represents the wiring diagram illustrated in figure "A"? Illustration EL-0023

- (A) 1
- (B) 2
- (C) 3
- (D) 4

*If choice A is selected set score to 1.*

**46.** The current at which a magnetic-type overload relay tends to trip may be decreased by raising the plunger further into the magnetic circuit of the relay. What effect does this action have?

- (A) increases magnetic pull on the plunger and requires more current to trip the relay
- (B) reduces magnetic pull on the plunger and requires less current to trip the relay
- (C) increases magnetic pull on the plunger and requires less current to trip the relay
- (D) reduces magnetic pull on the plunger and requires more current to trip the relay

*If choice C is selected set score to 1.*

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

*If choice A is selected set score to 1.*

**48.** In figure "1" of the illustration, what type of circuit breaker trip element is featured? Illustration EL-0033

- (A) ambient compensated trip
- (B) shunt trip
- (C) magnetic trip
- (D) thermal trip

*If choice D is selected set score to 1.*

**49.** What is the most common and reliable type of circuit breaker used for high voltage practice aboard ship?

- (A) oil-break
- (B) gas-break
- (C) air-break
- (D) vacuum-break

*If choice D is selected set score to 1.*

**50.** What type of local area network physical topology features point-to-point interconnection between all communicating devices and is the least vulnerable to a break in communication?

- (A) Mesh
- (B) Bus
- (C) Star
- (D) Ring

*If choice A is selected set score to 1.*

**51.** Silicon diodes which are designed for a specific reverse breakdown voltage, and are most often used as electronic power supply voltage regulators, are specifically what type of diode?

- (A) Zener diodes
- (B) hot-carrier diodes
- (C) tunnel diodes
- (D) compensating diodes

*If choice A is selected set score to 1.*

**52.** Referring to figure "3" of the illustration, what type of logic gate is symbolized? Illustration EL-0035

- (A) AND gate
- (B) XOR gate
- (C) NOR gate
- (D) OR gate

*If choice A is selected set score to 1.*

**53.** Which of the methods listed below is used to provide the rotational torque to cause an AC generator to turn?

- (A) Residual magnetism remaining in the field.
- (B) Starting of the prime mover.
- (C) Providing current to the field from an external source.
- (D) Residual magnetism remaining in the armature.

*If choice B is selected set score to 1.*

**54.** Referring to figure "B" of the illustration, what statement is true? Illustration EL-0020

- (A) The order of resistors connected in the series string has no impact on the total resistance. The total resistance of the circuit will be less than any one of the individual resistances.
- (B) The order of resistors connected in the series string has an impact on the total resistance. If the largest resistance is last in the circuit, the total resistance will be more than if it is not.
- (C) The order of resistors connected in the series string has no impact on the total resistance. The sum of the resistances is the total resistance of the circuit.
- (D) The order of resistors connected in the series string has an impact on the total resistance. If the largest resistance is first in the circuit, the total resistance will be more than if it is not.

*If choice C is selected set score to 1.*

**55.** If a computer display is flickering, how may this be remedied?

- (A) Decrease the resolution bandwidth
- (B) Increase the resolution bandwidth
- (C) Increase the refresh rate
- (D) Decrease the refresh rate

*If choice C is selected set score to 1.*

**56.** 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) sulfation of the plates due to consistent undercharging or leaving the battery in a discharged state
- (D) lime accumulation on both the positive and negative terminal posts

*If choice B is selected set score to 1.*

**57.** When a self-excited alternator's field has lost its residual magnetism due to a prolonged idle period, it will fail to produce a voltage. Flashing the field is the procedure used to restore the residual magnetism. Using a 12 volt storage battery, how is this performed?

- (A) The S+ and S- leads are disconnected from the alternator stator. The S+ lead is connected to the positive terminal of the battery, and the S- lead is connected to the negative terminal.
- (B) The S+ and S- leads are disconnected from the alternator stator. The S+ lead is connected to the negative terminal of the battery, and the S- lead is connected to the positive terminal.
- (C) The F+ and F- leads are disconnected from the alternator field. The F+ lead is connected to the negative terminal of the battery, and the F- lead is connected to the positive terminal.
- (D) The F+ and F- leads are disconnected from the alternator field. The F+ lead is connected to the positive terminal of the battery, and the F- lead is connected to the negative terminal.

*If choice D is selected set score to 1.*

**58.** Occasionally a synchronous motor is configured without an external shaft to drive a load. In this case, the sole purpose of the synchronous motor is improving overall power factor of an electrical distribution system. What is the name of the synchronous motor so constructed?

- (A) Synchronous compensator
- (B) Motor-generator
- (C) Synchronous converter
- (D) Synchronous condenser

*If choice D is selected set score to 1.*

**59.** As shown in the illustration, by what means are all the "MS" contacts opened and closed?  
Illustration EL-0073

- (A) operating coils
- (B) magnets
- (C) solenoid switches
- (D) manual operation of the master switches

*If choice D is selected set score to 1.*

**60.** What type of electrical diagram for the autotransformer type motor controller is shown in the illustration? Illustration EL-0012

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

*If choice D is selected set score to 1.*

**61.** What will be the impact of reduced voltage applied to a motor during the starting period?

- (A) increase the starting current and decrease the acceleration time
- (B) decrease the starting current and decrease the acceleration time
- (C) increase the starting current and increase the acceleration time
- (D) decrease the starting current and increase the acceleration time

*If choice D is selected set score to 1.*

- 62.** 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 bonded to the hull.
  - (C) The protective anodes are made of lead or platinized titanium and are electrically insulated from the hull.
  - (D) The protective anodes are made of zinc and are electrically bonded to the hull.

*If choice C is selected set score to 1.*

- 63.** When troubleshooting a lead-acid storage battery, what is the best method for detecting a weak or dead cell?
- (A) comparing the specific gravity of the electrolyte in each cell
  - (B) taking an open circuit voltage test of individual cells
  - (C) taking each cell's temperature with a calibrated mercury thermometer
  - (D) visually inspecting the electrolyte levels of each cell

*If choice A is selected set score to 1.*

- 64.** What is the name of the type of motor control circuit that will not permit automatic restarting after power is restored, following a power failure?
- (A) low voltage protection
  - (B) overload lockout
  - (C) reduced voltage restart
  - (D) low voltage release

*If choice A is selected set score to 1.*

- 65.** Large machines undergoing a resistance insulation testing using a megohmmeter should be discharged to remove any accumulated electrostatic/capacitive charge stored. When should this discharge be performed?
- (A) prior to and after conducting the insulation resistance check
  - (B) after conducting the insulation resistance check only
  - (C) prior to conducting the insulation resistance check only
  - (D) while performing the insulation resistance check only

*If choice A is selected set score to 1.*

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

- (A) functions like an amplifier and controls relatively high load current
- (B) functions like a switching device and controls relatively high load current
- (C) functions like an amplifier and controls relatively low load current
- (D) functions like a switching device and controls relatively low load current

*If choice B is selected set score to 1.*

**67.** As shown in the illustration of an electrically operated watertight door controller, how is the motor stopped automatically when the door is wedged closed? Illustration EL-0115

- (A) Momentarily depressing open push button switch.
- (B) Action of door open limit switch (LSO).
- (C) Action of motor overload (OL).
- (D) Action of door closed limit switch (LSC).

*If choice D is selected set score to 1.*

**68.** What statement is true concerning the electrical diagrams for the motor controller shown in the illustration? Illustration EL-0007

- (A) Figure "A" is a pictorial drawing and figure "B" is a wiring diagram.
- (B) Figure "A" is a wiring diagram and figure "B" is a ladder or line diagram (schematic).
- (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).

*If choice B is selected set score to 1.*

**69.** In referring to figure "E" of the illustration, what statement is true concerning the functional purpose of the coupling transformer? Illustration EL-0075

- (A) The transformer functions as a filter by removing the DC component from the varying DC input to produce an AC output shifted  $90^\circ$  from the input.
- (B) The transformer functions as a filter by removing the DC component from the varying DC input to produce an AC output in phase with the input.
- (C) The transformer functions as a voltage transformer by changing the magnitude of the peak to peak AC voltage at the output proportional to the turns ratio.
- (D) The transformer functions as a filter by removing the DC component from the varying DC input to produce an AC output shifted  $180^\circ$  from the input.

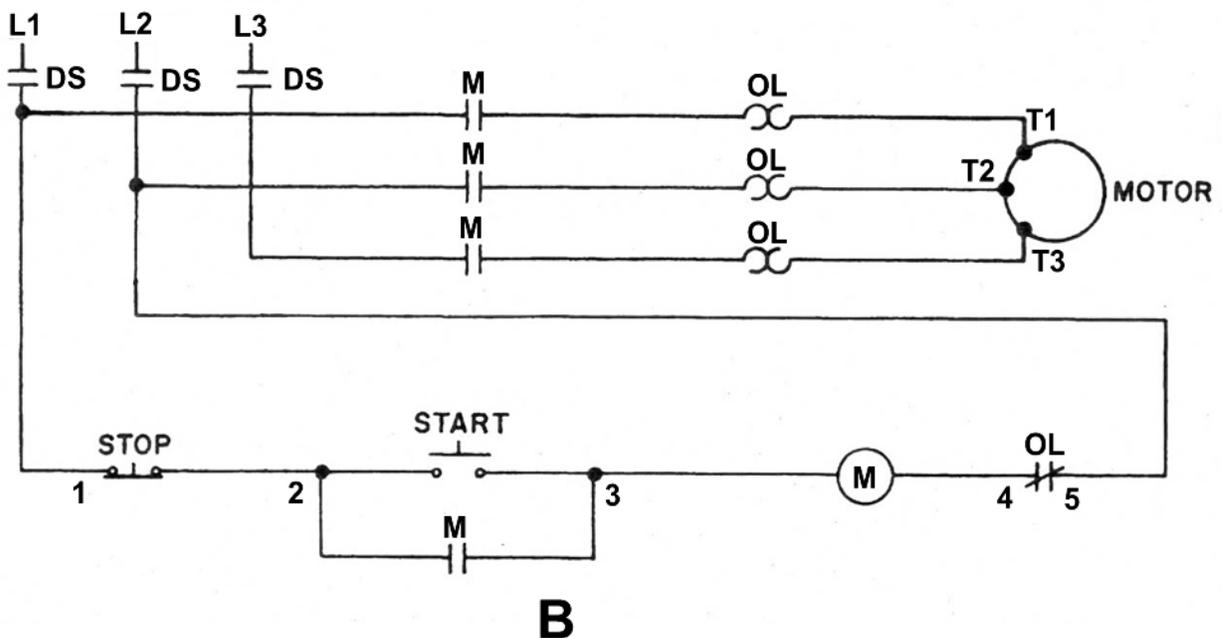
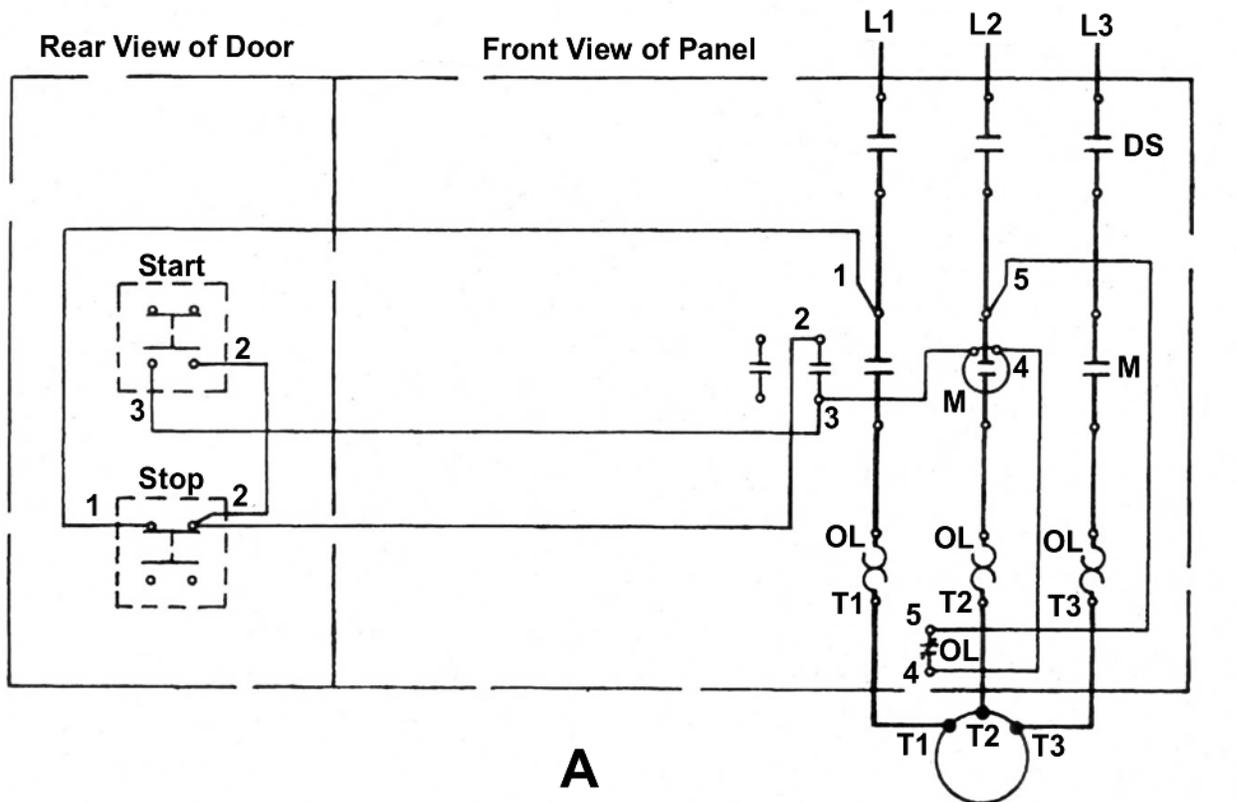
*If choice A is selected set score to 1.*

**70.** A degree of control over the speed of a slip ring induction motor can be obtained by what means?

- (A) inserting resistance into the stator circuit
- (B) adjusting governor linkage
- (C) inserting resistance into the rotor circuit
- (D) changing the number of phases to the motor

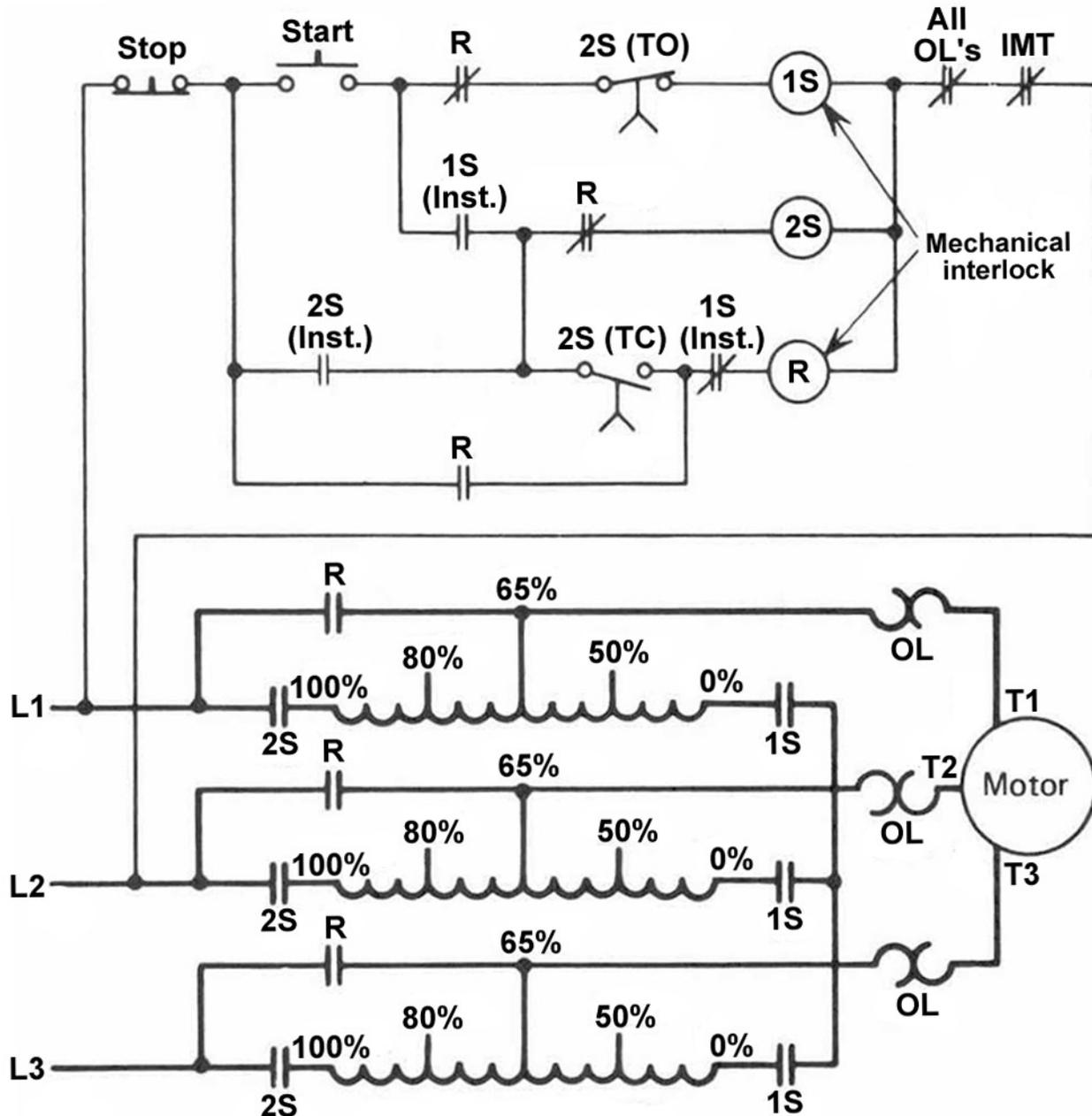
*If choice C is selected set score to 1.*

## EL-0007



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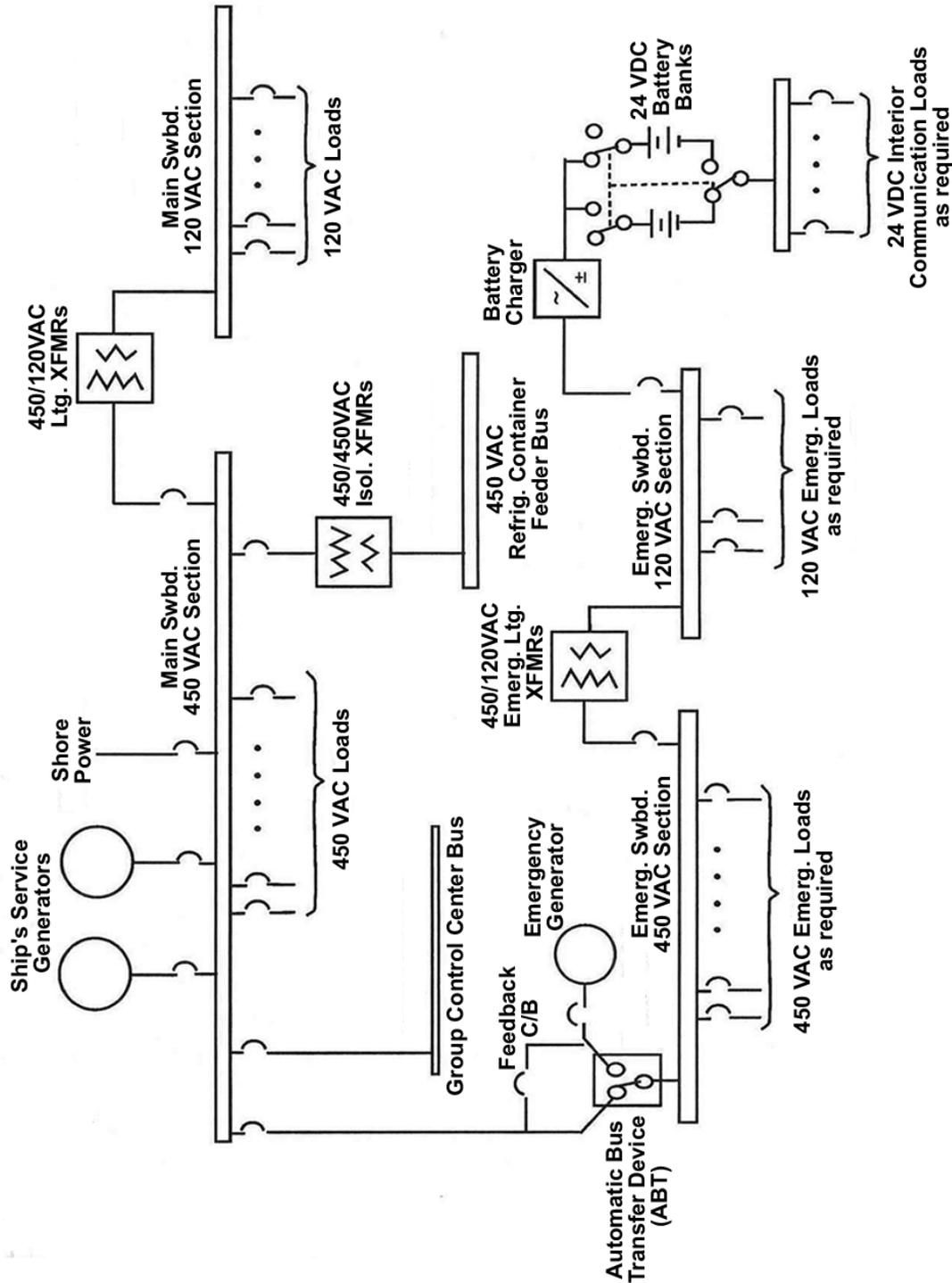
## EL-0012



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## EL-0014



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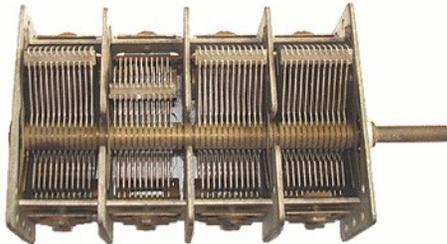
## EL-0015



1



2



3



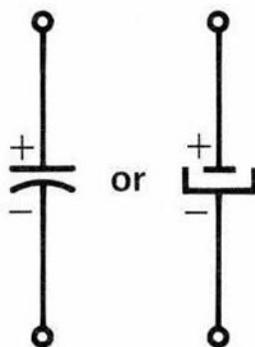
or



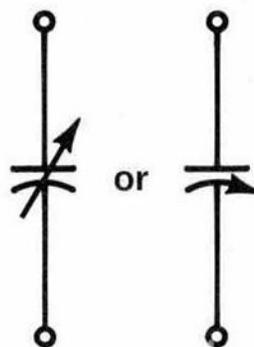
4



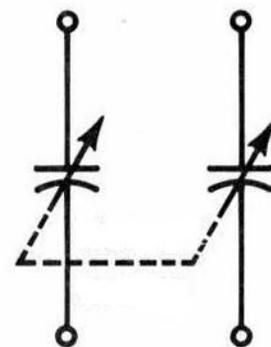
A



B



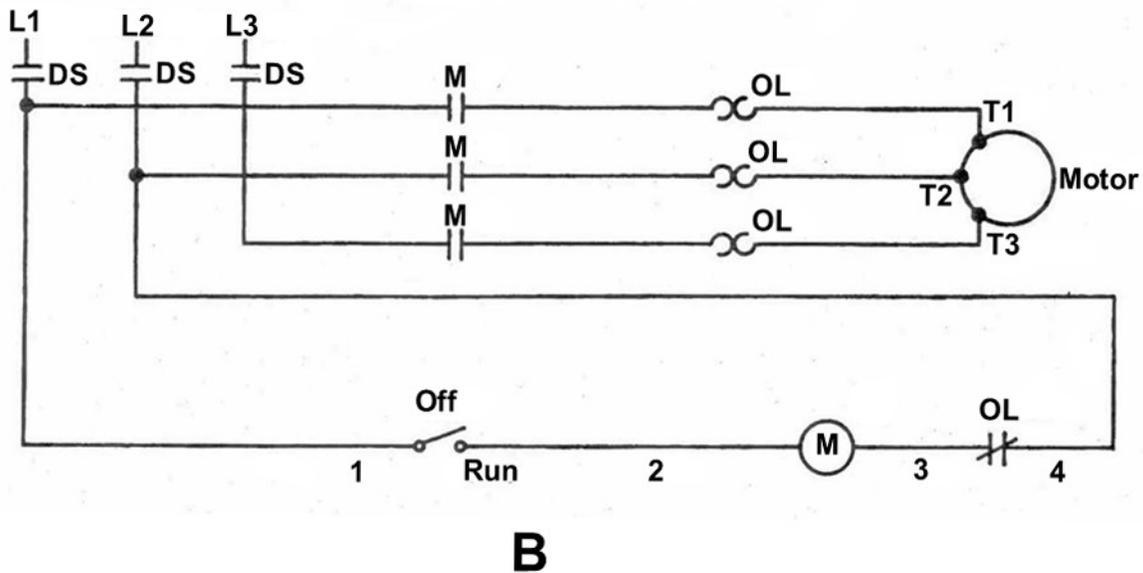
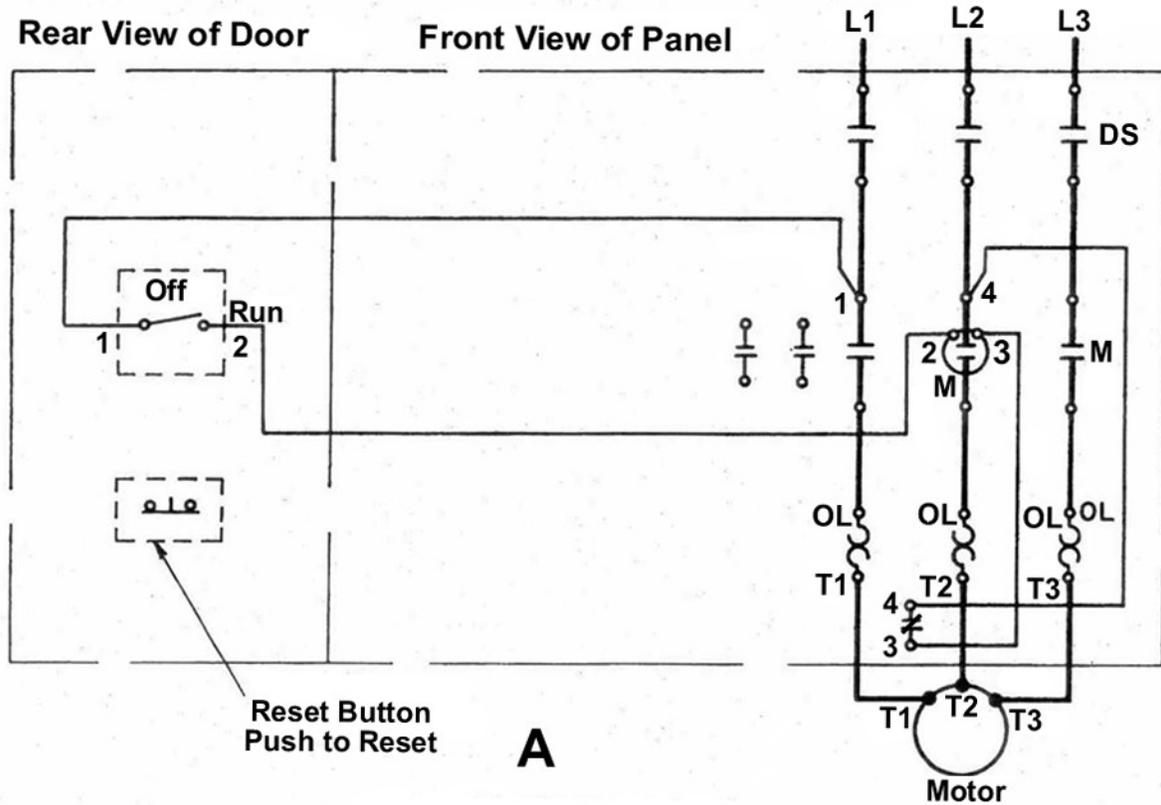
C



D

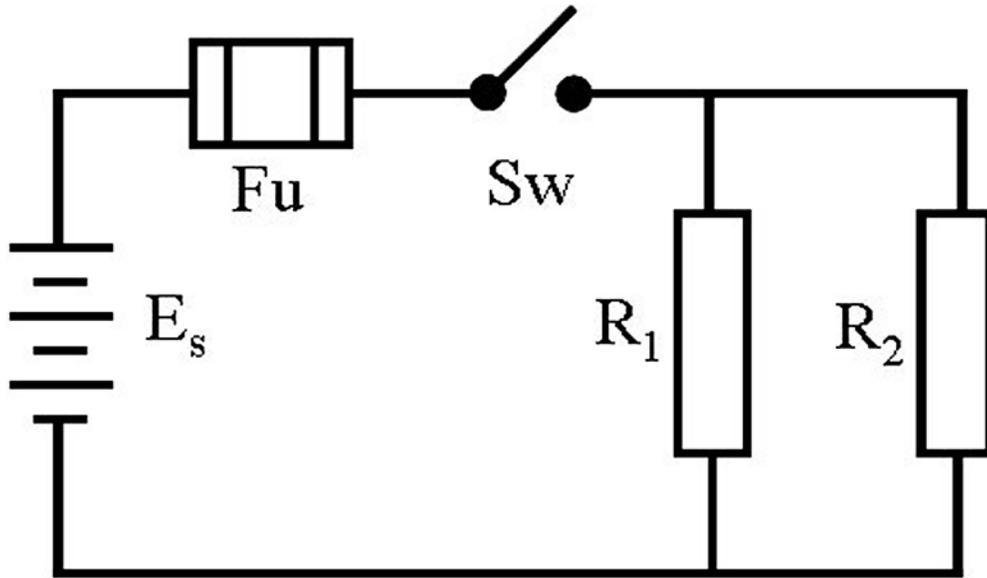
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## EL-0017

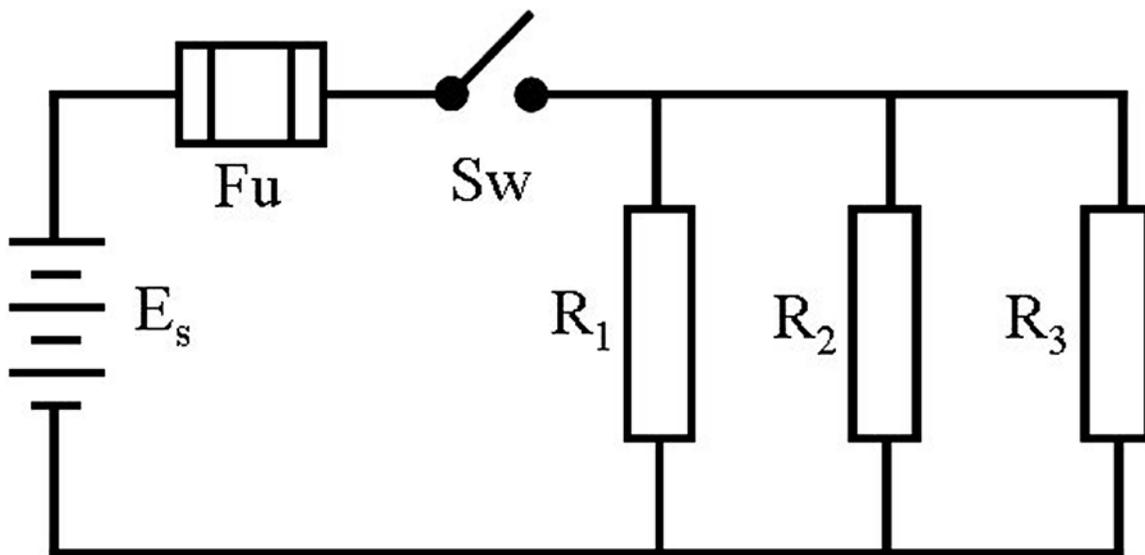


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EL-0019



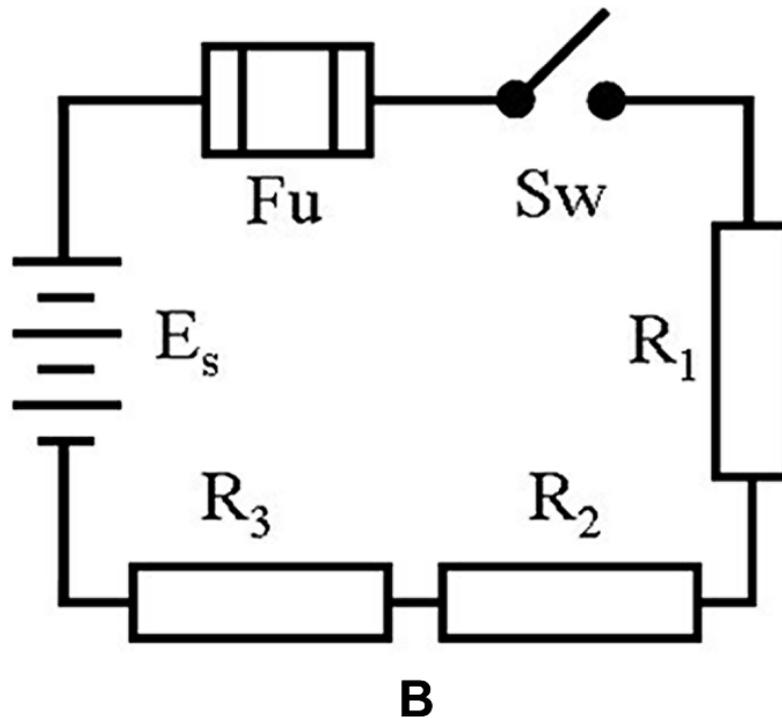
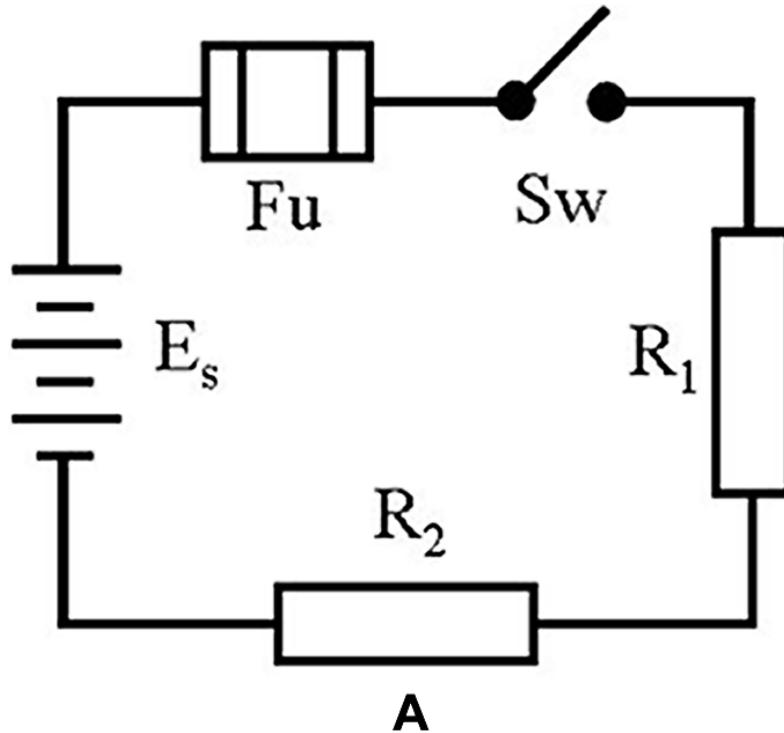
A



B

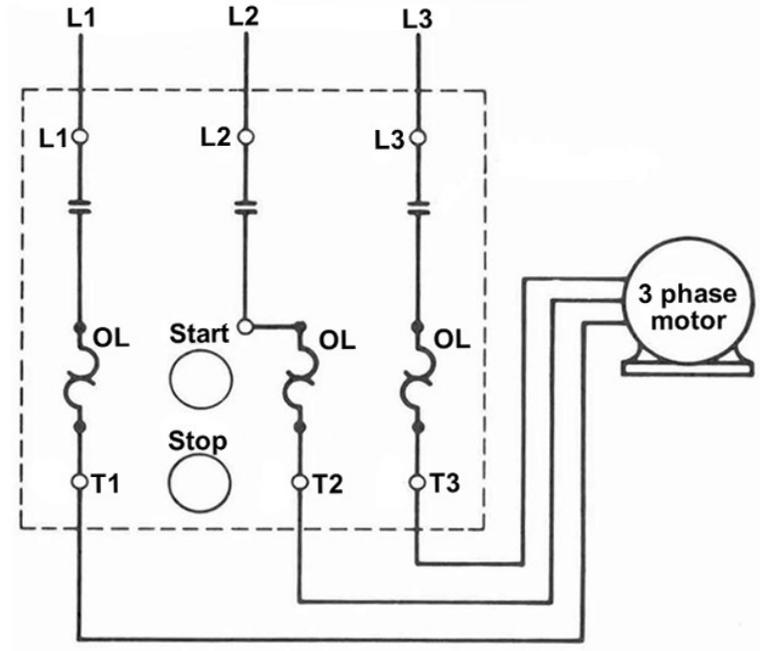
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## EL-0020



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## EL-0023



A



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## EL-0033



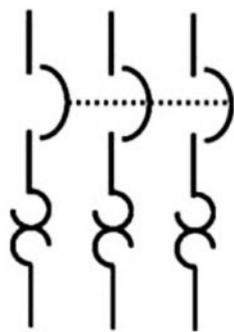
**A**



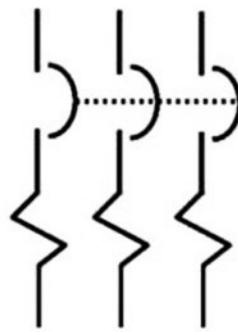
**B**



**C**



**1**



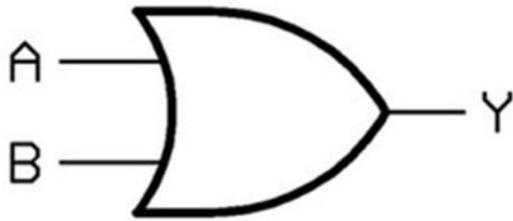
**2**



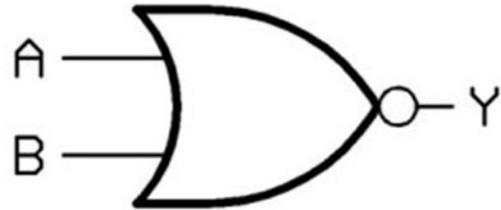
**3**

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## EL-0035



1



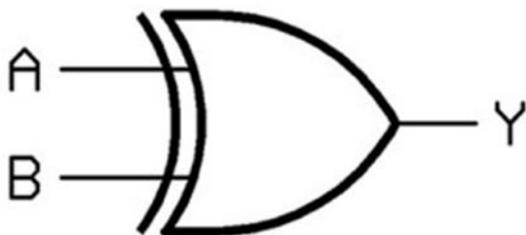
2



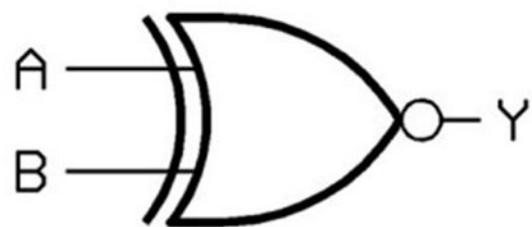
3



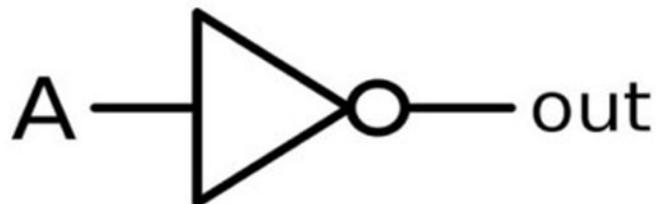
4



5



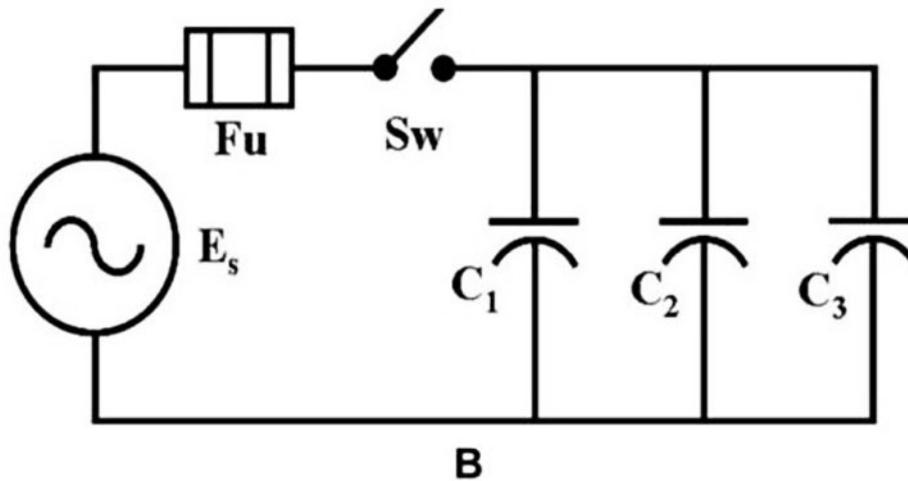
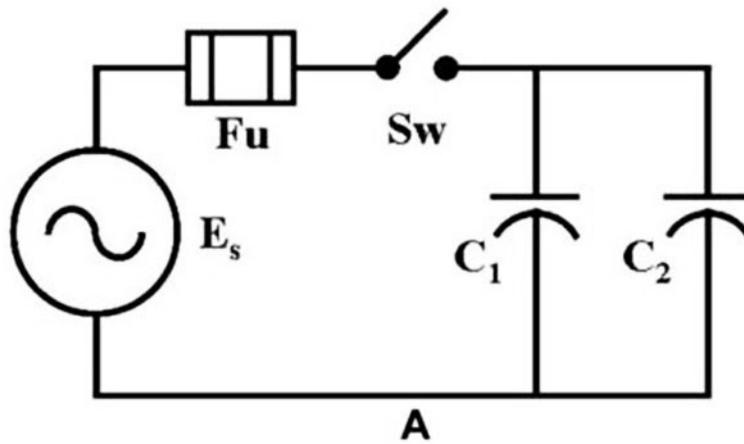
6



7

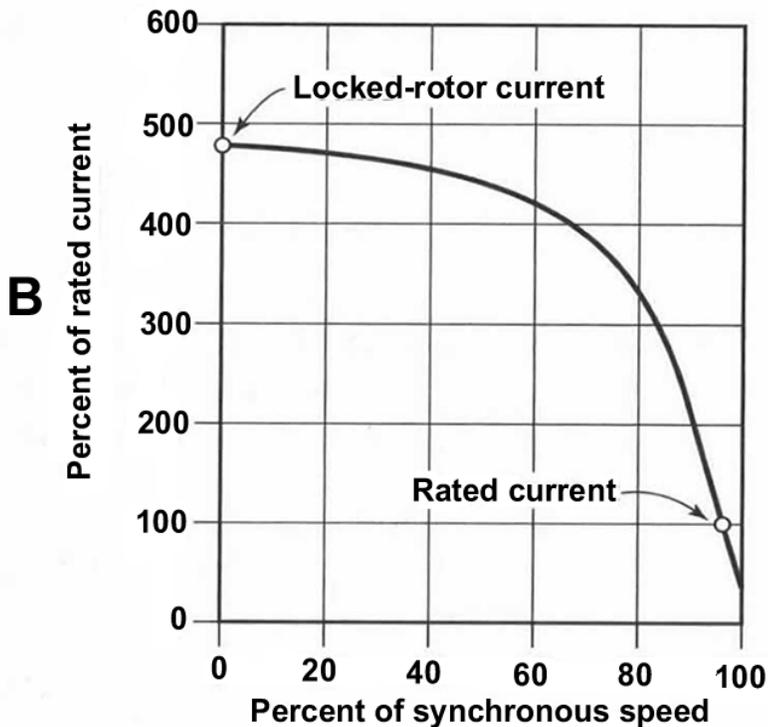
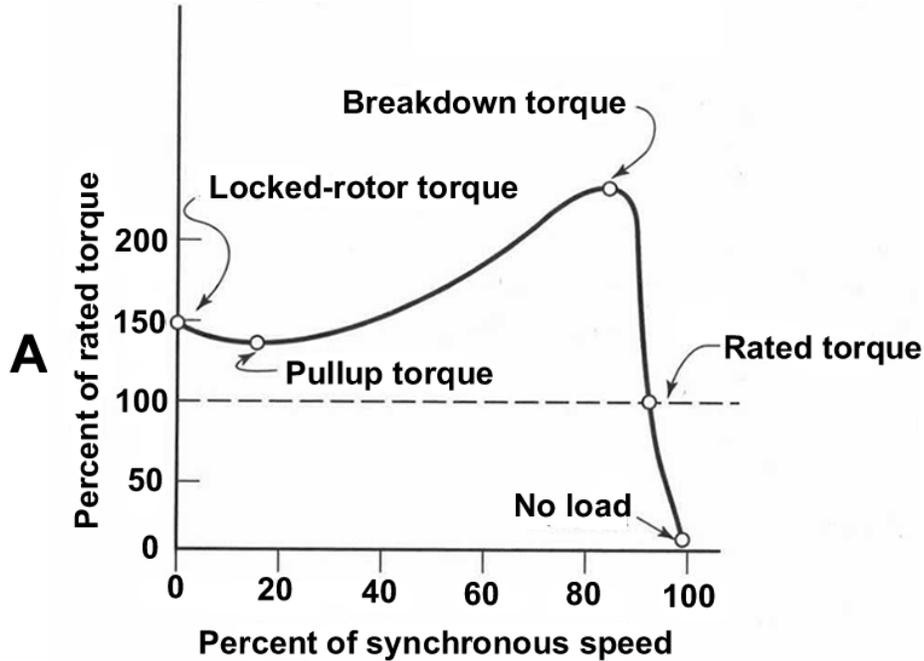
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## EL-0038



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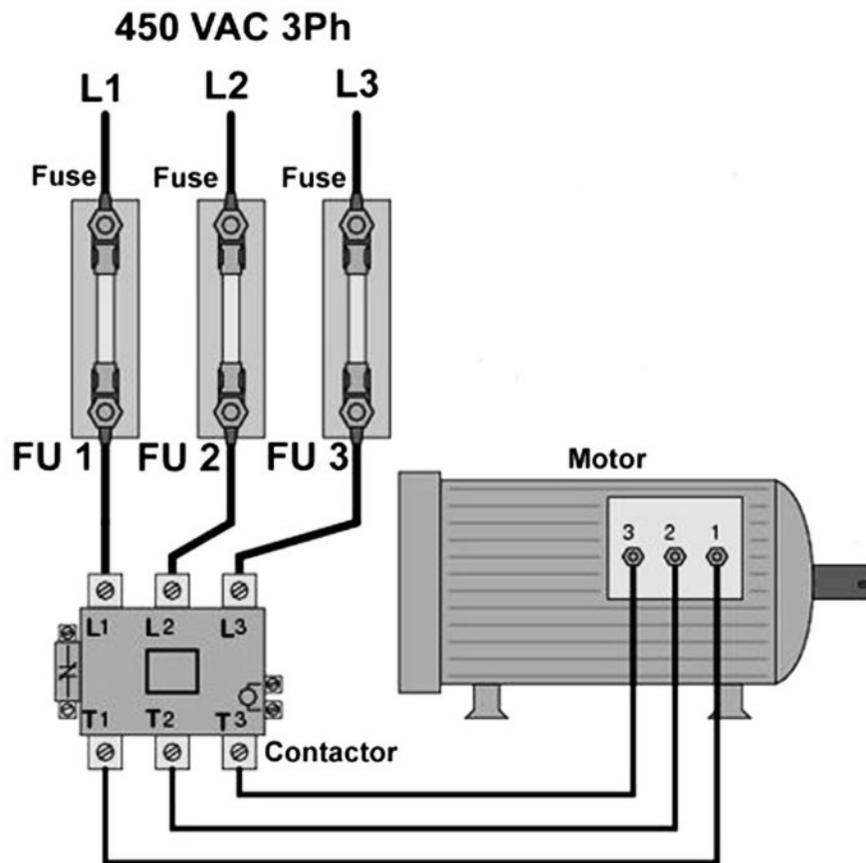
## EL-0056



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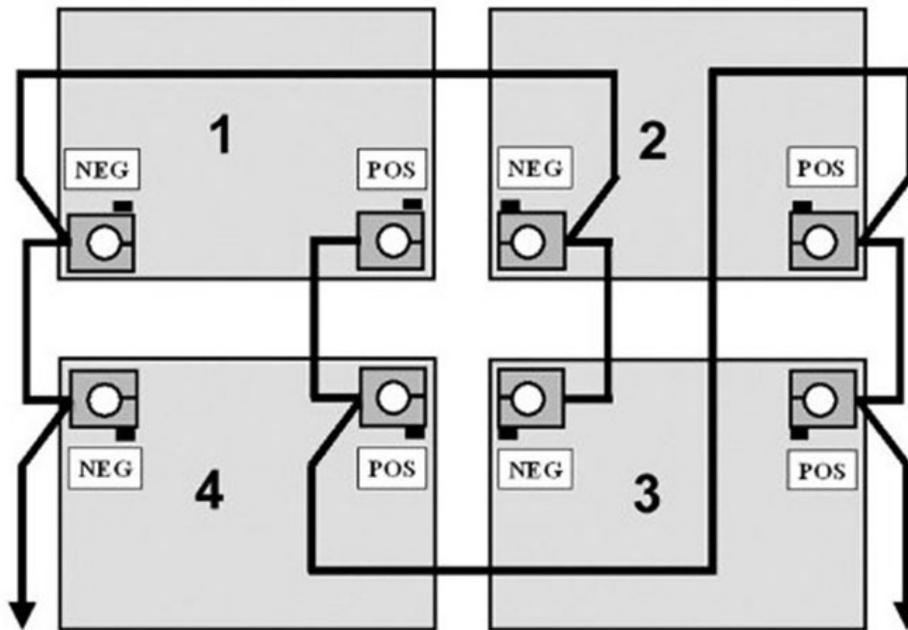
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## EL-0062



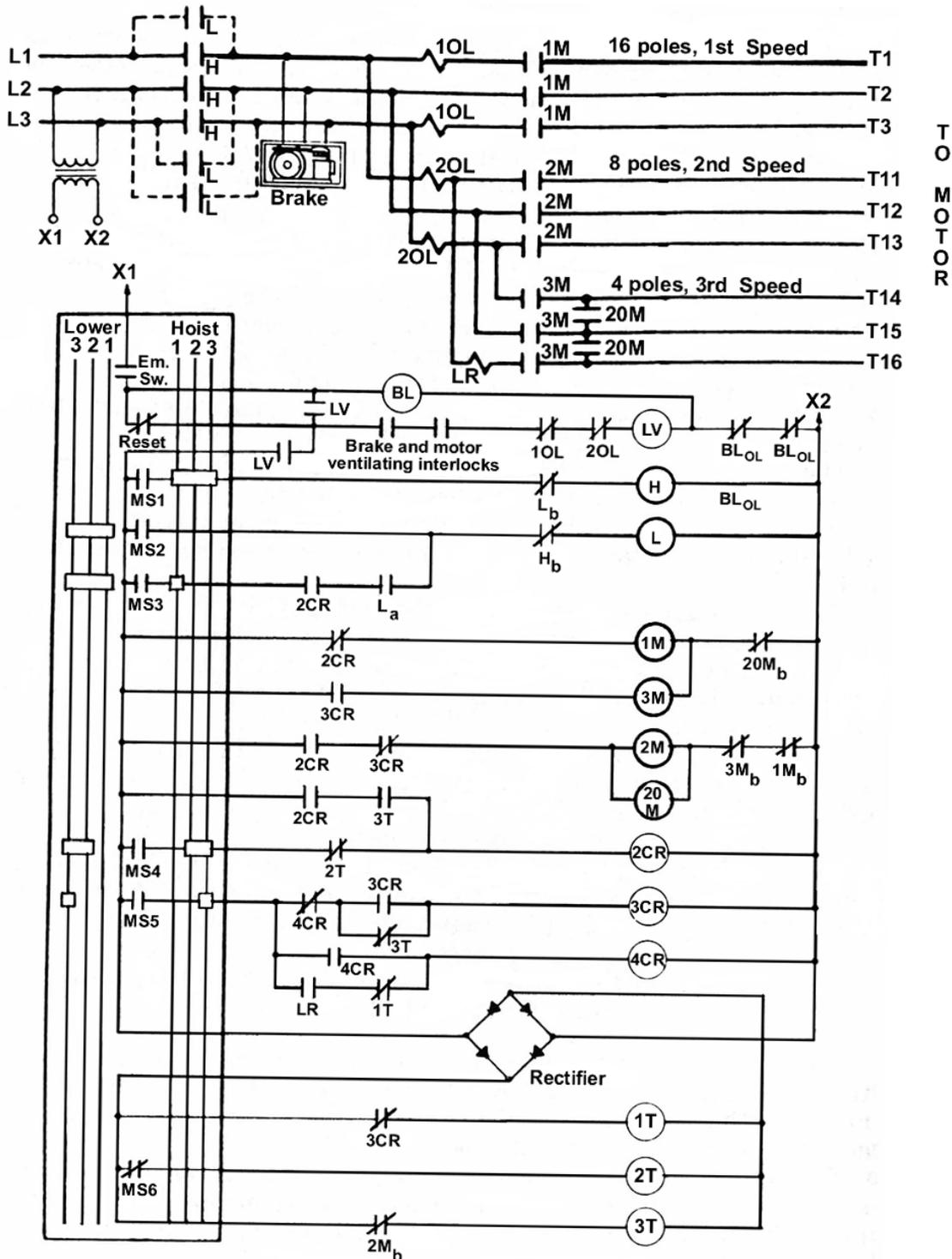
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## EL-0070



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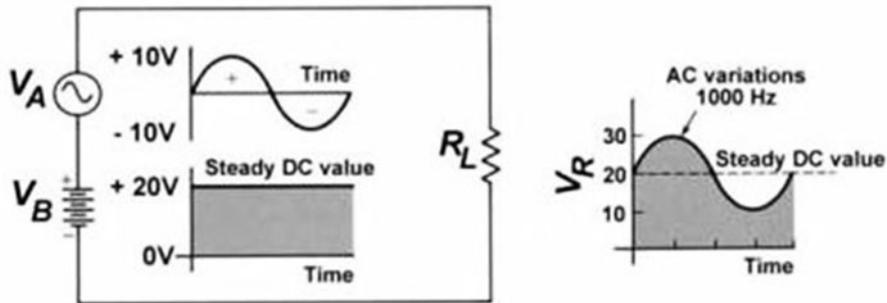
## EL-0073



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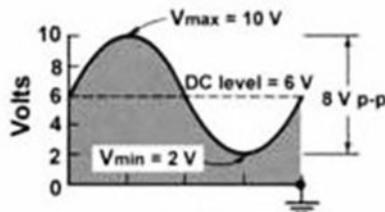
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## EL-0075

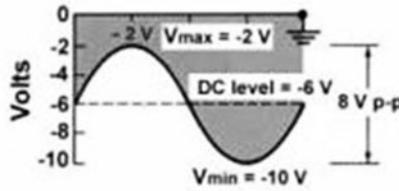


**A**

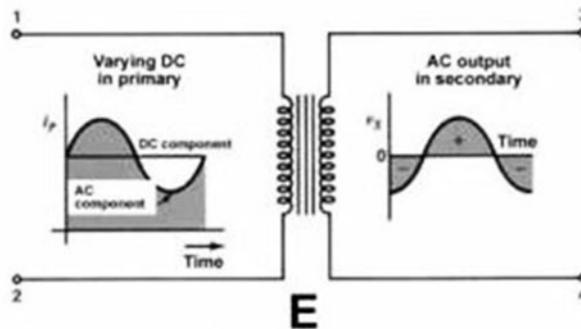
**B**



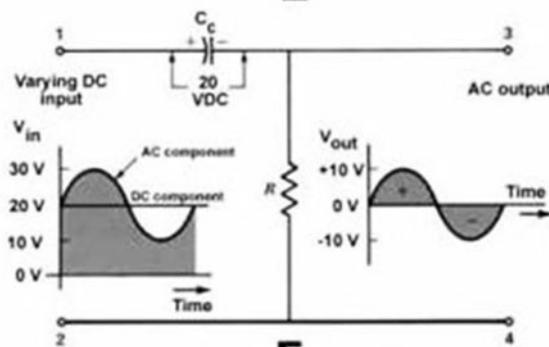
**C**



**D**



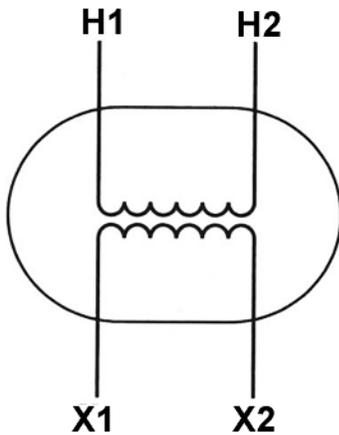
**E**



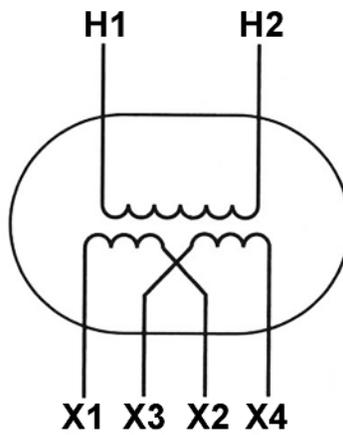
**F**

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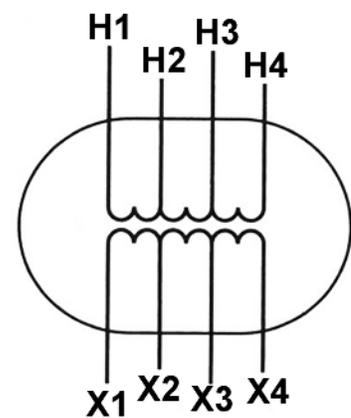
## EL-0082



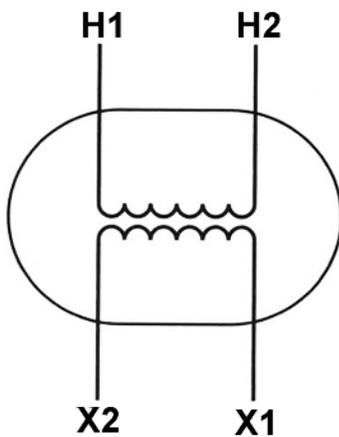
**A**



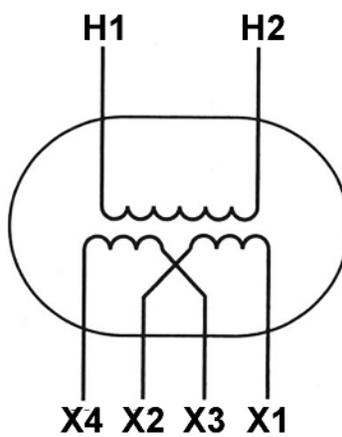
**B**



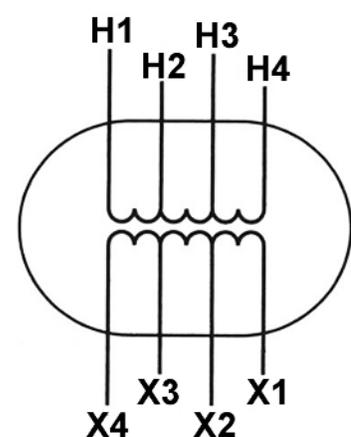
**C**



**D**



**E**

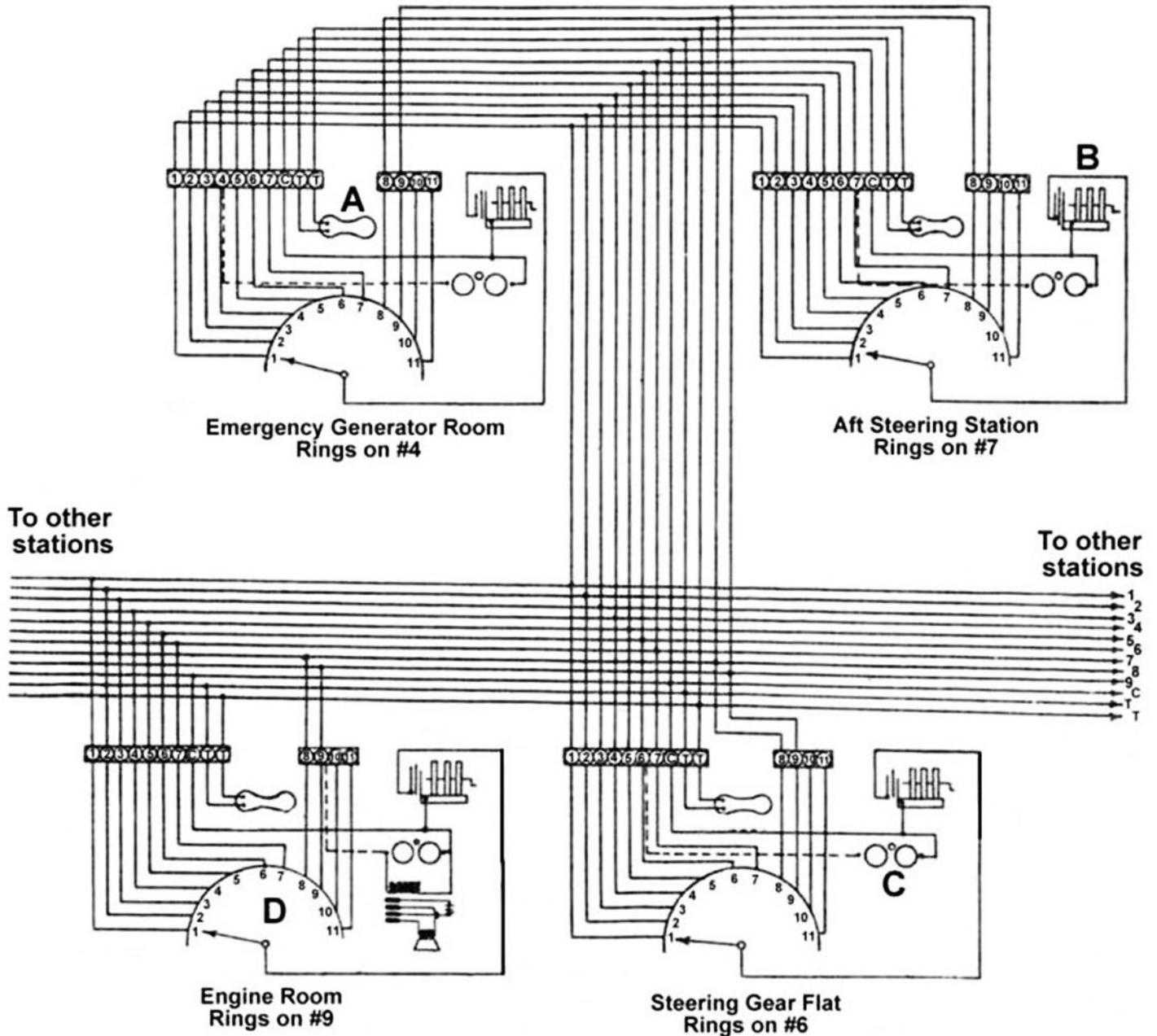


**F**

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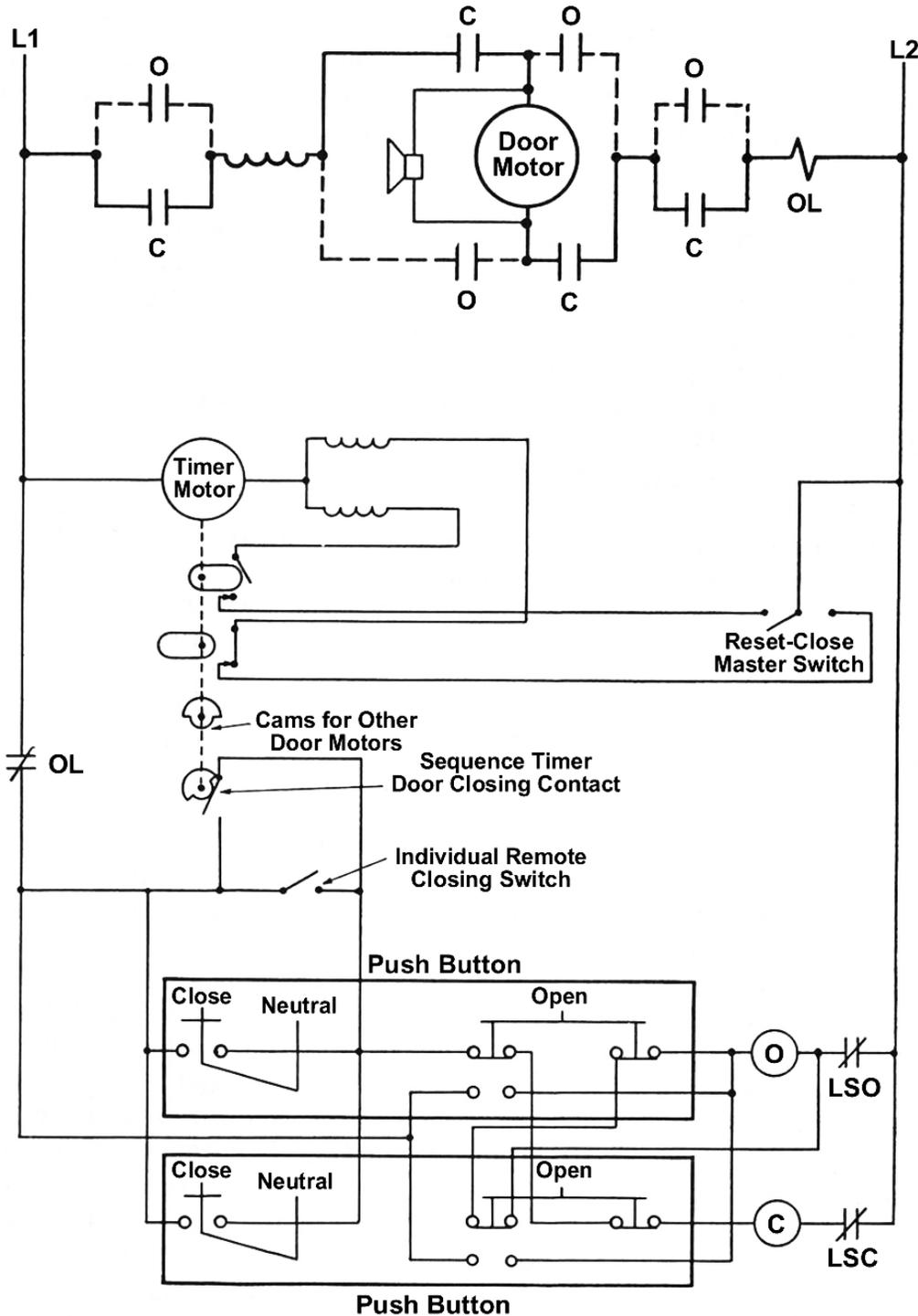
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## EL-0093



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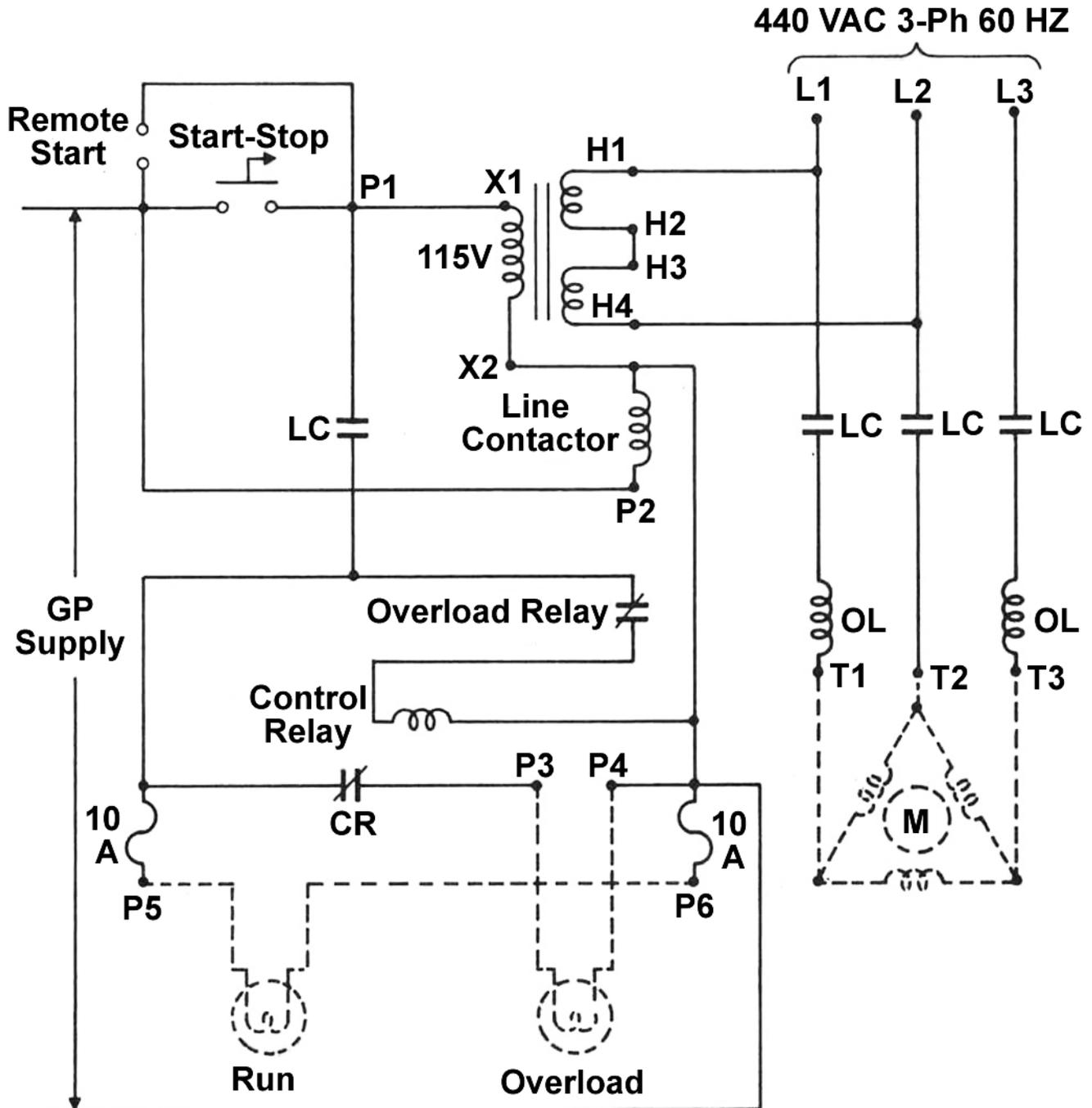
## EL-0115 Watertight Door Controller



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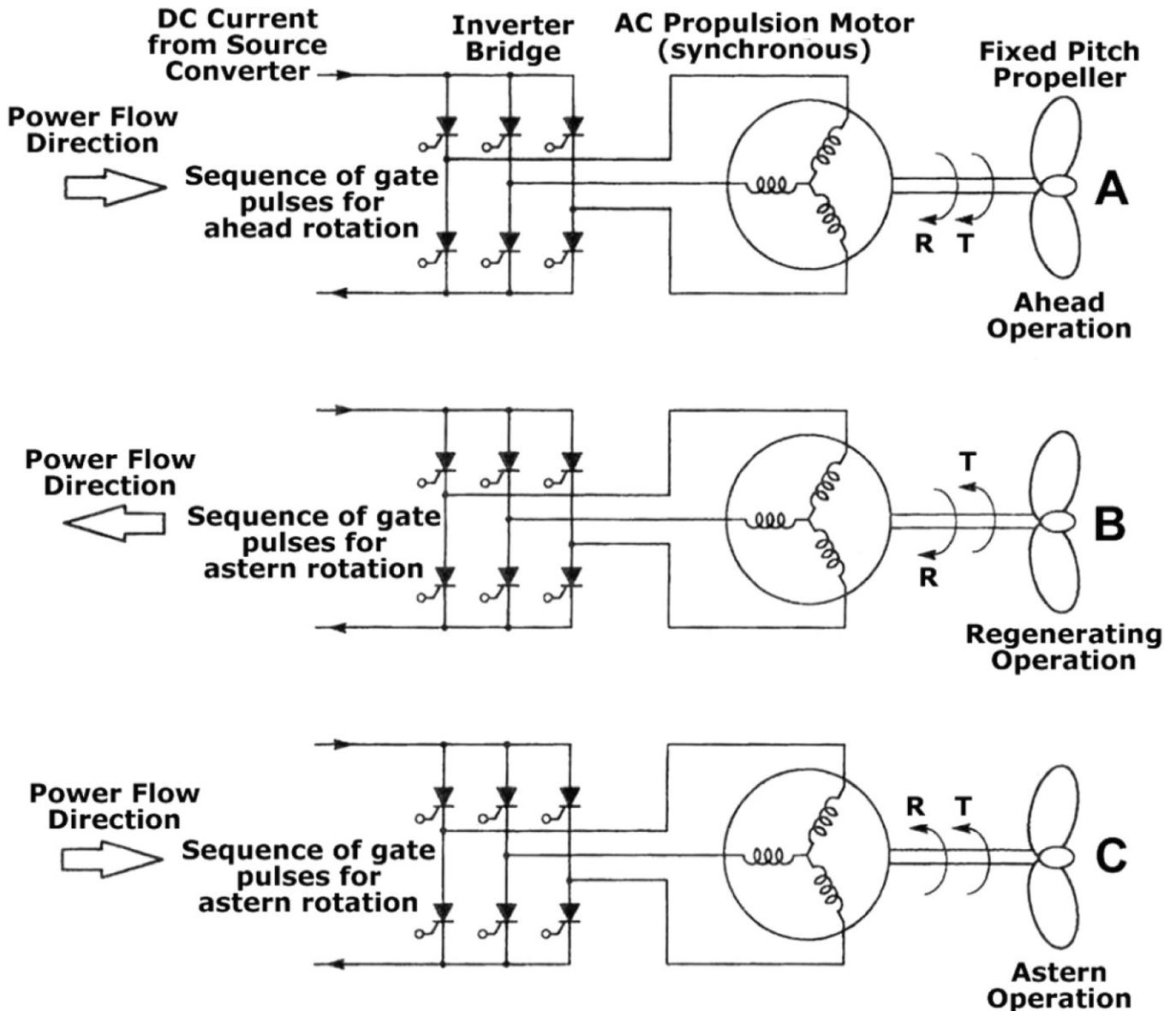
## EL-0119



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## EL-0162



Where R = Direction of actual rotation  
T = Direction of applied torque

## EL-0175

### Code Letters for Locked-Rotor kVA-Nameplate Marking\*

Letter Designation	kVA per Horsepower	Letter Designation	kVA per Horsepower
A	0-3.15	K	8.0-9.0
B	3.15-3.55	L	9.0-10.0
C	3.55-4.0	M	10.0-11.2
D	4.0-4.5	N	11.2-12.5
E	4.5-5.0	P	12.5-14.0
F	5.0-5.6	R	14.0-16.0
G	5.6-6.3	S	16.0-18.0
H	6.3-7.1	T	18.0-20.0
J	7.1-8.0	U	20.0-22.4
		V	22.4 and up

\*Locked kVA per horsepower range includes the lower figure up to, but not including, the higher figure. For example, 3.14 is designated by letter A and 3.15 by letter B.

To determine kVA per HP, use the following formula:

kVA/HP where:

$$kVA = (\text{Rated volts} \times \text{inrush current} \times 1.732 \text{ (square root of 3)}) / 1000$$

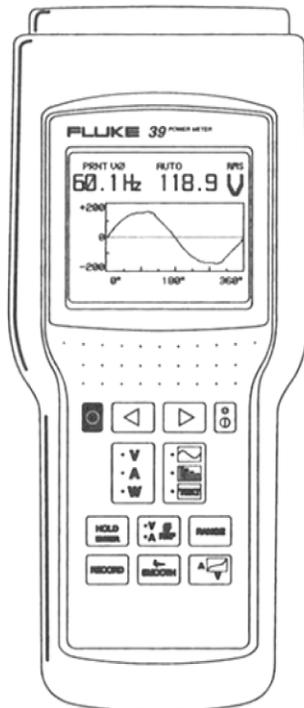
HP = Nameplate HP

This is a better way to compare the inrush current of different manufacturer's motors than % inrush current; the reason being that if a motor has a high full load current, the % inrush will be lower than a motor with the same inrush current but a lower full load current.

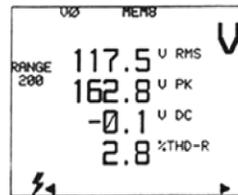
<b>• WESTINGHOUSE •</b>									
TYPE CSP		 INDUCTION MOTOR			CLASS 1				
FRAME	254				60 CYCLE		LOCKED KV-A CODE H		
H. P.	5				3 PHASE		STYLE 1442438		
							SERIAL 6406		
60 CYCLE		50 CYCLE		CONNECT FOR HIGHER VOLTAGE		CONNECT FOR LOWER VOLTAGE			
220/440	VOLTS			T4 T7 T5 T8 T6 T9	T4 T5 T6				
13.8/6.9	AMPS. PER LINE			┌───┐ ┌───┐ ┌───┐	┌───┐				
1750	R. P. M.			T1 T2 T3	T1 T7 T2 T8 T3 T9				
55	°C. RISE CONT.				└───┘ └───┘ └───┘				
				LINE		LINE			
○ 4577-B		WESTINGHOUSE ELECTRIC CORPORATION				MADE IN U. S. A. ○			

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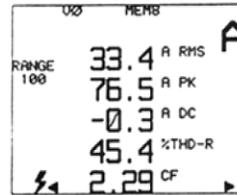
## EL-0256



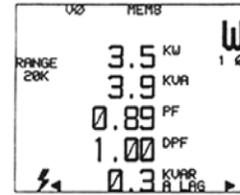
**A**



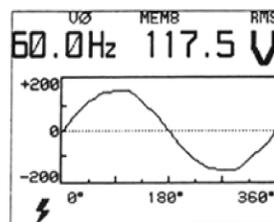
**B**



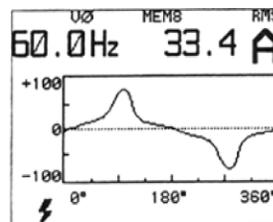
**C**



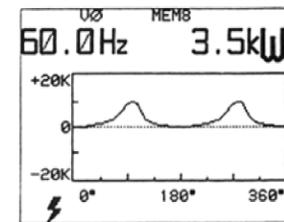
**D**



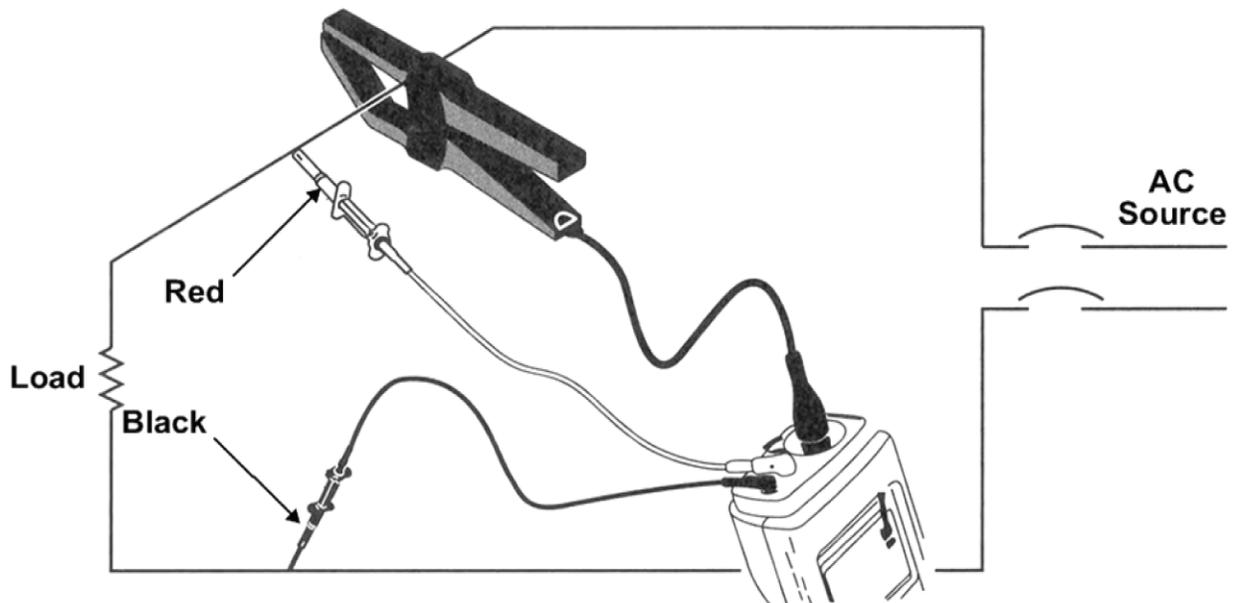
**E**



**F**



**G**



**H**

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