WESTERN ELECTRIC DRAWINGS

SYMBOLS

1. GENERAL

1.01 This practice is designed to acquaint plant and engineering personnel with Western Electric type wiring and drawing symbols.

1.02 Four types are used and are illustrated in the following parts of this practice:

Part 2 - Symbol Components

Part 3 - Primary Wiring Symbols

Part 4 - Primary Apparatus Symbols

Part 5 - Coaxial and Wave Guide Symbols

Part 6 - Index

1.03 In all cases the description of the symbol will be above the illustration except for special notes which will be located near the illustration.

1.04 The symbols illustrated are of the American Standards Association Standards.

1.05 Symbols illustrate the electrical functions rather than physical properties.

1.06 Hinged parts of terminals and apparatus terminals that have a number or letter printed or stamped on the apparatus are shown by a small circle. Where no terminal is shown the wiring is directly to the symbol.

1.07 In order to simplify the circuit layout, symbols may occasionally be shown in reverse or rotated. However, where a definite position is required to show left, right, top or bottom this will not be done. Where a definite position is required it will be considered viewed from the wiring side.

1.08 In each section the symbol designations will be in alphabetical order.

2. SYMBOL COMPONENTS

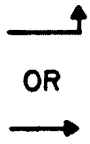
2.01 The symbol components listed in this practice represent the general method used on Western Electric drawings to depict features of a piece of apparatus and to indicate the presence of these features.

Attached-contact Schematic Symbols

2.02 Symbols used previously, which have been revised to conform with present standards, are indicated as Discontinued and will not be used on new schematic drawings.

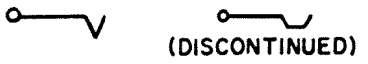
2.03 Contact

(a) Fixed, adjustable, or sliding contacts



(b) Moving contact or armature for relays, nonlocking keys, etc. (circle indicates pivot point and is always shown on moving contacts).

(c) Moving contact for locking keys, jacks, etc.



(d) Normally closed and normally open contact.

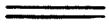
(1) Normally closed (break) contact (NC)

(2) Normally open (make) contact (NO)

Note: Whether a contact is normally open (NO) or normally closed (NC) depends on the position of the contact when the actuating device is in the de-energized or nonoperated position.

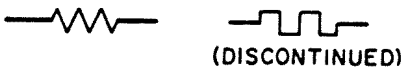
2.04 Core

(a) Core, magnetic (general)

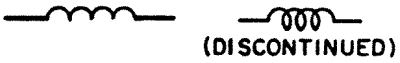


(b) Core for relays, magnets, etc.

2.05 Heating Resistor



2.06 Inductance - Repeating Coil, Inductor, Transformer, etc. (See 4.12)



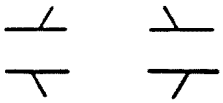
2.07 Thermal Element

2.08 Transistor (Semiconductor Devices) Components (See 4.17 and 4.65)

(a) Semiconductor region, for example the base region, with one ohmic contact

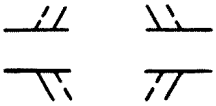
(b) Semiconductor region with a plurality of ohmic contacts

(c) Transition between P and N regions (either P to N or N to P)



(d) Intrinsic region between regions of similar conductivity type

(e) Intrinsic region between regions of dissimilar conductivity type



(f) P-emitter on N-region

(g) Plurality or P-emitters on N-region

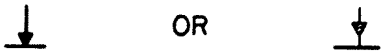
(h) N-emitter on P-region

(i) Plurality of N-emitters on P-region

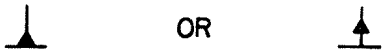
(j) Collector on semiconductor region

(k) Plurality of collectors on semiconductor region

(l) P-region rectifying junction



(m) N-region rectifying junction



(n) Notes

(1) Slant lines indicating transitions shall be appreciably shorter than collector and emitter lines. Note that the transition is along the horizontal line and that no ohmic connection is made at the slant line. See 4.65 (i), (k), and (p) as examples.

(2) The circle enclosing the device symbol is for recognition purposes and its use is recommended.

(3) The following more generally used device properties may be indicated with the aid of identifying letters placed adjacent or within the enclosure.

B - Breakdown device
ϒ - Storage device
T - Thermally-actuated device
λ - Light-actuated device

It is recognized that all semiconductor devices are light- and temperature-sensitive, and that they exhibit breakdown and storage characteristics. However, these letters are to be used only if these properties are essential to the operation of the circuit.

2.09 Tube, Electron Components (See 4.67)

(a) Collecting electrode

(1) Anode or plate (including collecting electrode and fluorescent target)

(2) Target or X-ray anode Drawn at about a 45-degree angle.

(b) Collecting and emitting electrode

(1) Dynode

(c) Alternately collecting and emitting

(1) Composite anode - photocathode

(2) Composite anode - cold cathode

(3) Composite anode - ionically heated cathode with provision for supplementary heating

(d) Controlling electrode

(1) Grid (including beam-confining or beamforming electrodes)

(2) Deflecting electrodes (used in pairs); reflecting or repelling electrode (used in velocity-modulated tube)

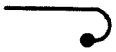
(3) Ignitor (in pool tubes) (should extend into pool)
Starter (in gas tubes)

(4) Excitor (contactor type)

(e) Coupling (See 5.04)

(1) Coupling by loop (electromagnetic type)

Coupling loop may be shown inside or outside envelope as desired, but if inside it should be shown grounded.



(f) Emitting electrode

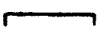
(1) Directly heated (filamentary) cathode

Leads may be connected in any convenient manner to ends of the ⌒ provided the identity of the ⌒ is retained.

Note: A diagram for a tube having more than one heater or filament shall show only one heater or filament symbol ⌒ unless they have entirely separate connections. If a heater or filament tap is made, either brought out to a terminal or internally connected to another element, it shall be connected at the vertex of the symbol, regardless of the actual division of voltage across the heater or filament.

(2) Indirectly heated cathode

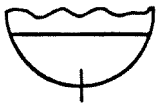
Lead may be connected to either extreme end of the ⌐¬ or, if required, to both ends, in any convenient manner.



(3) Cold cathode (including ionically heated cathode)

(4) Photocathode

(5) Pool cathode

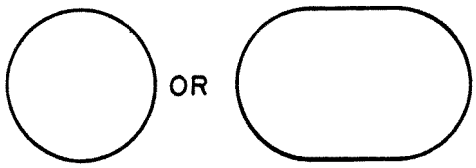


(6) Ionically heated cathode with provision for supplementary heating

(g) Envelope (shell)

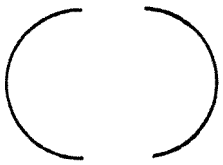
The general envelope symbol identifies the envelope or enclosure regardless of evacuation or pressure. When used with electron-tube component symbols, the general envelope symbol indicates a vacuum enclosure unless otherwise specified. A gas filled electron device may be indicated by a dot within the envelope symbol.

(1) General



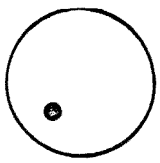
(2) Split envelope

If necessary, envelope may be split.



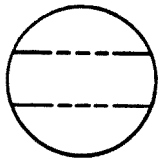
(3) Gas-filled

The dot may be located as convenient.

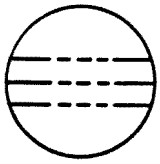


(h) Resonators (cavity type)

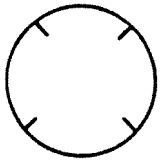
(1) Single-cavity envelope and grid-type associated electrodes.



(2) Double-cavity envelope and associated electrodes



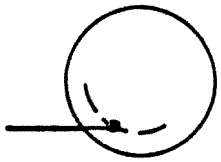
(3) Multicavity magnetron anode and envelope



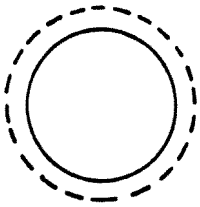
(i) Shield

This is understood to shield against electric fields unless otherwise noted.

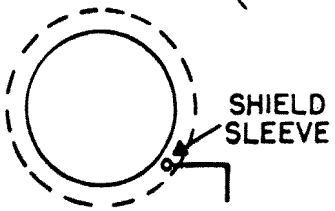
(1) Any shield against electric fields that is within the envelope and that is connected to an independent terminal.



(2) Outside envelope



(3) Shield sleeve [Also see 4.67(e)]

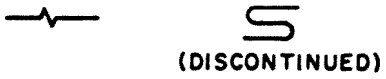


2.10 Variable - When used with normal symbol for capacitor, etc. See 4.08 (b) and (c) and 4.12 (b) (3), (4), and (5)

2.11 Windings

(a) Inductive winding for relays, electromagnets, etc

(b) Noninductive winding

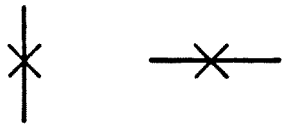


(c) Inner end for windings of relays, electromagnets, etc.

Detached-contact Schematic Symbols

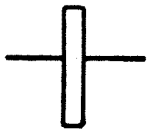
Note: The following are the basic symbols used on detached-contact schematics.

2.12 Make



2.13 Break

2.14 Core and Winding



3. PRIMARY WIRING SYMBOLS

3.01 Line Symbols

Transmission Paths (Talking & Telegraph)
Bus Bar Charge & Discharge Leads

Fundamental Circuit

Off-Normal Ground

Off-Normal Battery

Sequence Switch Rotary Magnetic Feed

Division Line Used Between Figures

Signaling & Power Control

Circuit Connections Shown on Other Dwgs.

Cross-Connection Wire

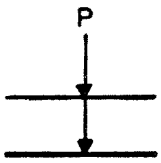
Boundary of Mechanical Grouping

Mechanical Linkage & Shielding

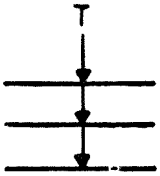
Symbols

3.02 Associated Conductors

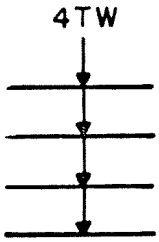
(a) Paired twisted wires



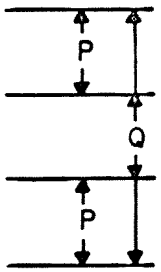
(b) Triple twisted wires



(c) 4-wire twist

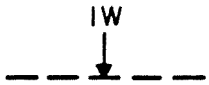


(d) Quad — (two pairs twisted)

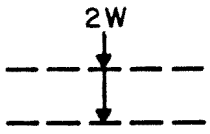


(e) Cross-connection wires

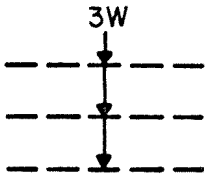
(1) 1 - conductor cross - connection wire



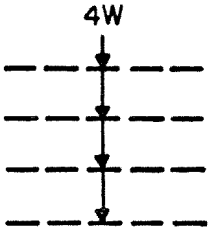
(2) 2 - conductor cross - connection wire



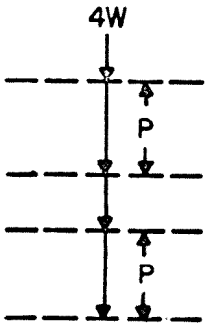
(3) 3 - conductor cross - connection wire



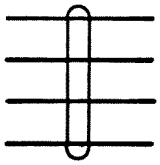
(4) 4 - conductor cross - connection wire (spiral)



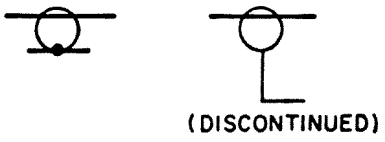
(5) Multiple twin cross-connection wire



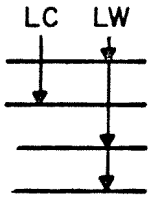
(f) Cable switchboard



(g) Cable coaxial (Also see 5)

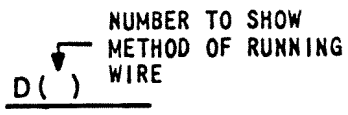


(h) Local cable or loose wiring



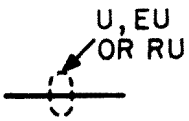
(i) Leads requiring segregation for crosstalk control, etc.

(j) Leads run from terminal to terminal

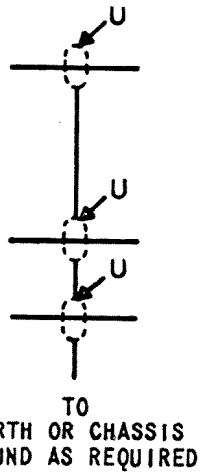


3.03 Methods of Shielding

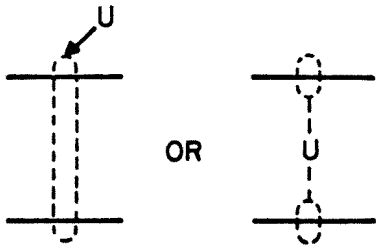
(a) Single shielded wire



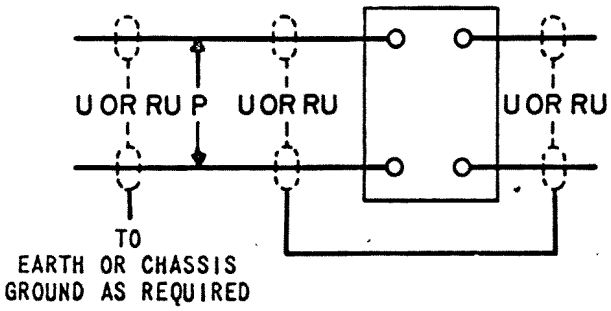
(b) Individually shielded wires with the shields connected together to ground



(c) Wires in same shield

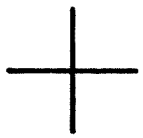


(d) Typical paired and shielded wiring

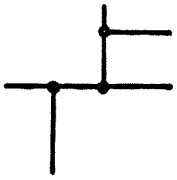


3.04 Paths and Path Junctions

(a) Crossed paths



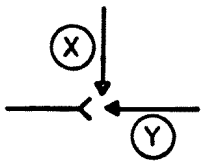
(b) Joined paths



(c) Spliced wires

(d) Multiple connection

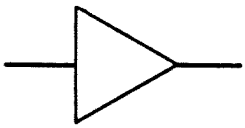
(e) Optional or alternate paths



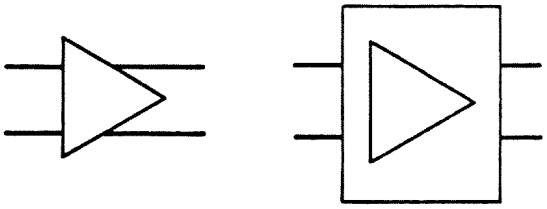
4. COMPLETE APPARATUS SYMBOLS

4.01 Amplifier

(a) Single line

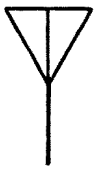


(b) Where more leads are shown

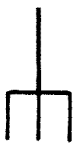


4.02 Antenna

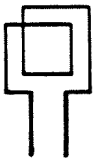
(a) Aerial



(b) Counterpoise



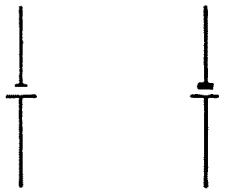
(c) Loop



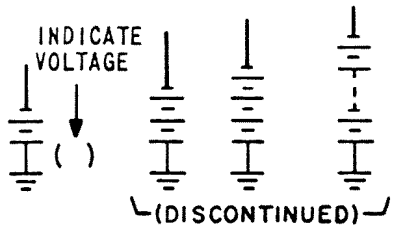
4.03 Autotransformer (See 4.12)

4.04 Batteries and Potential Supply

(a) One cell



(b) Multicell battery
(showing positive side grounded)



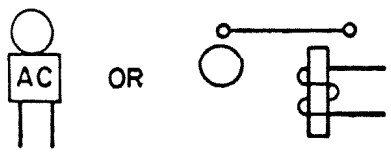
(c) CEMF cells

(d) Potential supply

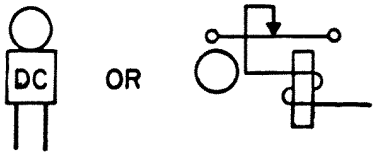
(e) Solar battery

4.05 Bells (Also see 4.50)

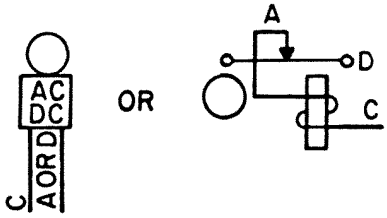
(a) AC bell



(b) DC bell



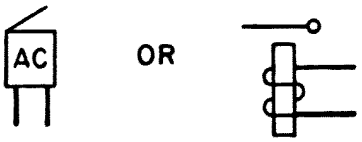
(c) AC-DC bell



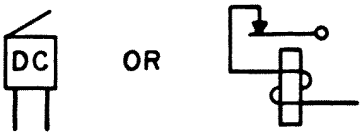
4.06 Binding Post

4.07 Buzzers

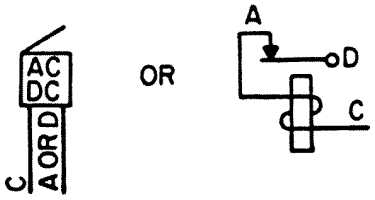
(a) AC buzzer



(b) DC Buzzer



(c) AC-DC buzzer



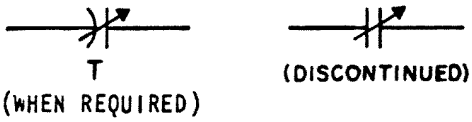
4.08 Capacitors

Note: When it is required to identify the capacitor electrodes on a circuit drawing, a note shall be placed at the symbol to indicate that the curved element represents the outside electrode in fixed-paper-dielectric and ceramic-dielectric capacitors, the negative electrode in electrolytic capacitors, and the moving element in adjustable and variable capacitors.

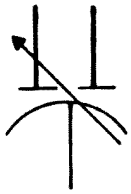
(a) Fixed capacitor (See note under 4.08)

(b) Variable or adjustable capacitor

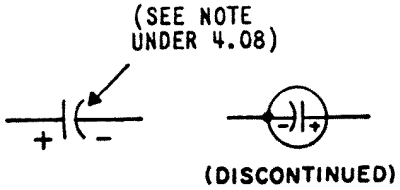
If it is necessary to identify trimmer capacitors, the letter T should appear adjacent to the symbol. (Also see note under 4.08.)



(c) Differential variable capacitor (see note under 4.08).

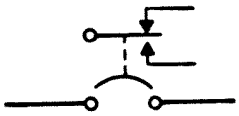


(d) Electrolytic capacitor

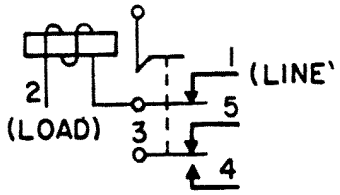


4.09 Circuit Breaker

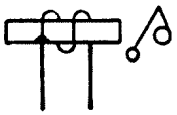
(a) Application



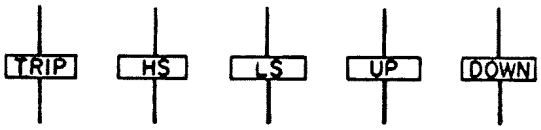
(b) Toggle switch type circuit breaker



4.10 Clock, Electric



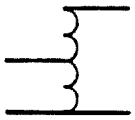
4.11 Clutch Magnets



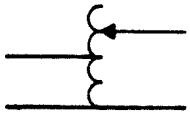
HS - High Speed
LS - Low Speed

4.12 Coils —— Autotransformer, -Induction Coil, Inductor, Repeating Coil, Transformer (Also see 2.06)

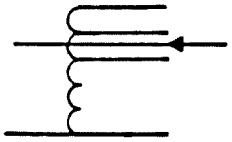
(a) Autotransformer



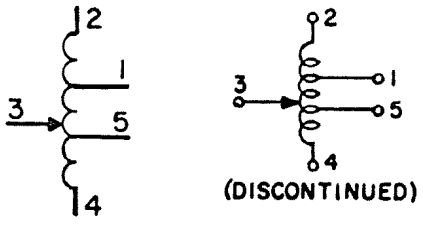
(1) Adjustable



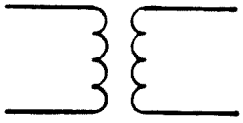
(2) Load-ratio control autotransformer



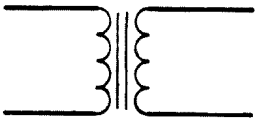
(3) Application
(Variable tap-type autotransformer)



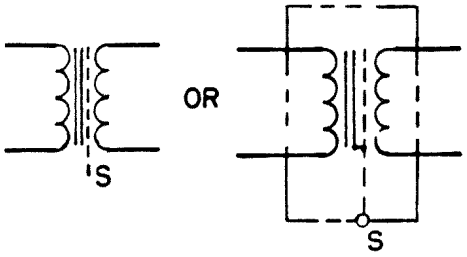
(b) Induction coil, repeating coil, transformer



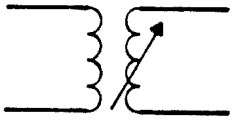
(1) With magnetic core



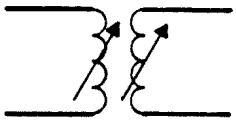
(2) With magnetic core and shield



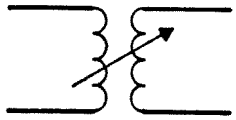
(3) Adjustable inductance winding



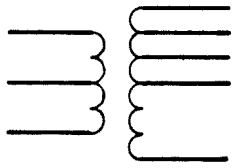
(4) Each winding with separately adjustable inductance



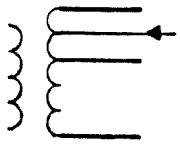
(5) Adjustable mutual inductor, constant-current transformer



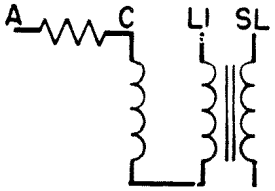
(6) With taps



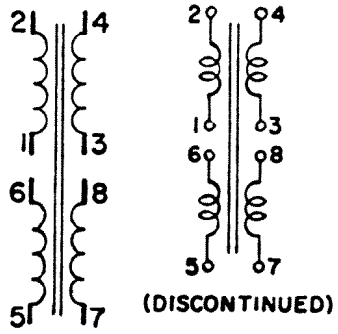
(7) Load-ratio control transformer with taps



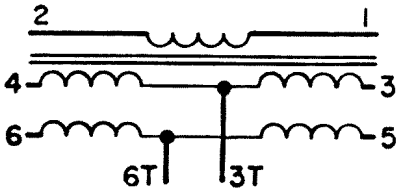
(8) Induction coil



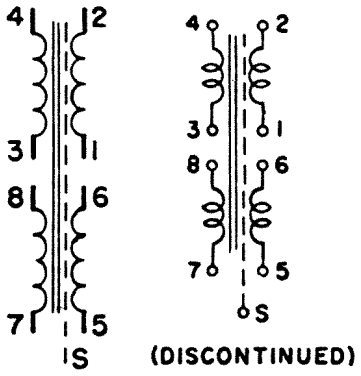
(9) Repeating coil



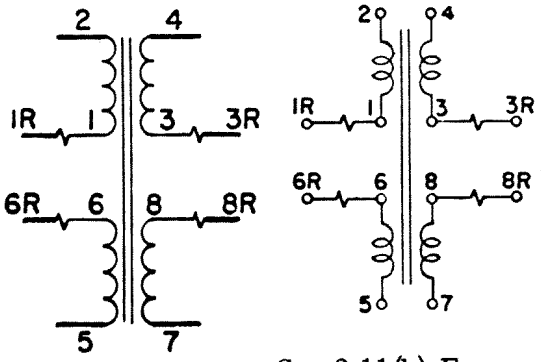
(10) Repeating coil (hybrid-type)



(11) Transformer with electrostatic shield

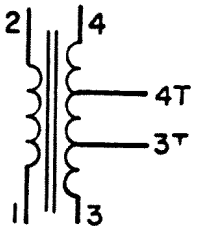


(12) Repeating coil with noninductive winding

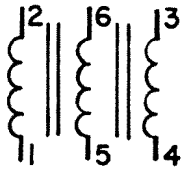


See 2.11(b) For Previously Used Noninductive Winding

(13) Repeating coil with taps



(14) Saturable reactor



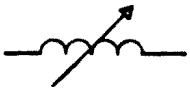
(c) Inductor

(1) With magnetic core

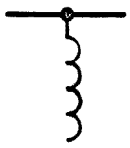
(2) With taps

(3) Adjustable inductor

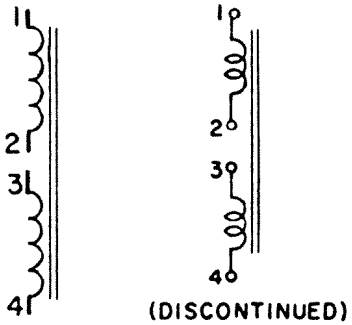
(4) Continuously adjustable inductor



(5) Shunt inductor



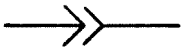
(6) Application



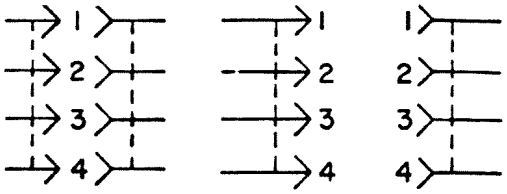
4.13 Connectors

Note: Use appropriate number of contact symbols.

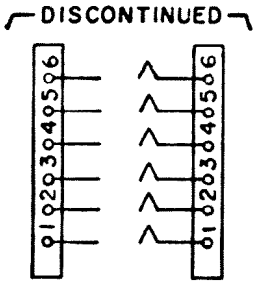
(a) Separable connectors showing female and male contacts engaged (See note)



(1) Engaged multiple conductor connector showing individual contact designations when required (See note)

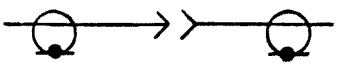


Repeat Numbers When Mates Are Separated on The Drawing

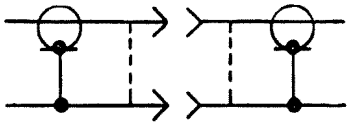


(b) Coaxial connectors

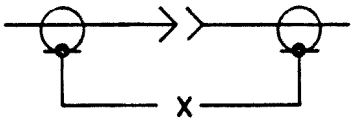
(1) Single line coaxial jack and plug



(2) Complete coaxial connectors

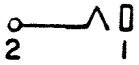


(3) Connector showing discontinuity symbol

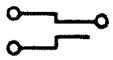


(c) Switchboard-type connectors (jacks and plugs)

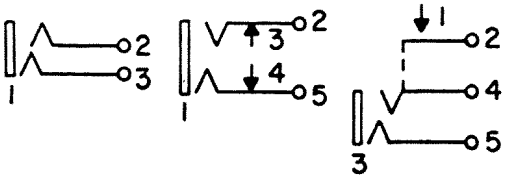
(1) 2-conductor jack



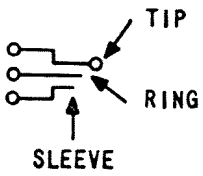
(2) 2-conductor plug



(3) 3-conductor jack

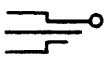


(4) 3-conductor plug

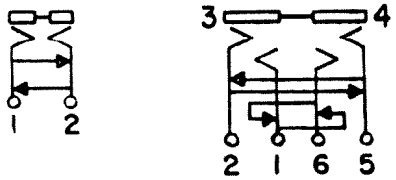


(5) Make-busy or shorting plugs

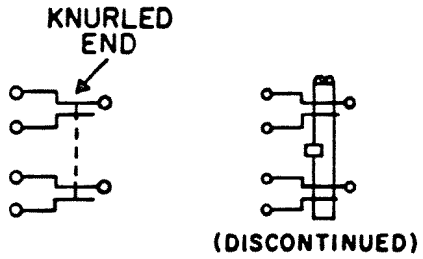
(6) Dummy plug



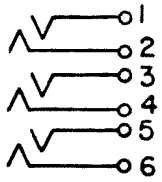
(7) Twin-type jacks



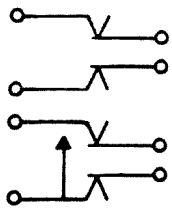
(8) Twin plug



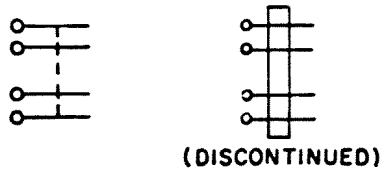
(9) Test-type jack



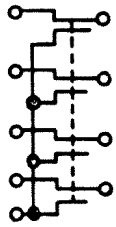
(10) Spring-type jack and plug (engaged)



(11) Test plug

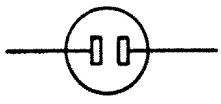


(12) 4-finger plug

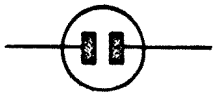


(d) Connectors commonly used for power supply (convenience outlets and mating connectors)

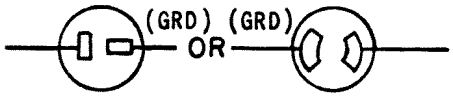
(1) 2-conductor nonpolarized (female contacts)



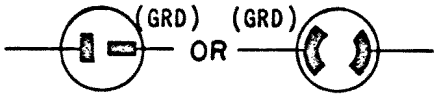
(2) 2-conductor nonpolarized (male contacts)



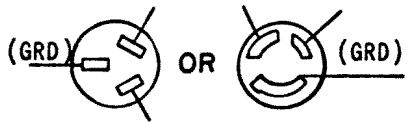
(3) 2-conductor polarized (female contacts)



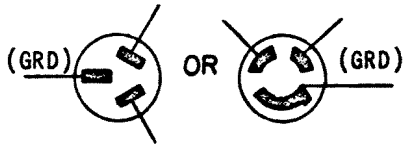
(4) 2-conductor polarized (male contacts)



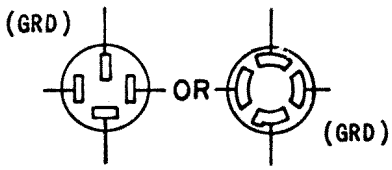
(5) 3-conductor polarized (female contacts)



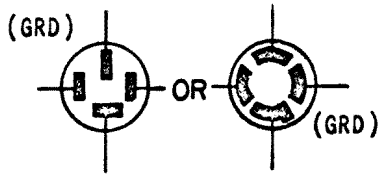
(6) 3-conductor polarized (male contacts)



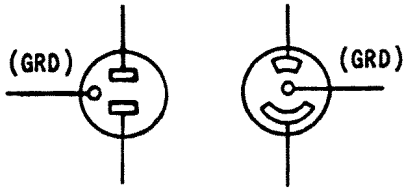
(7) 4-conductor polarized (female contacts)



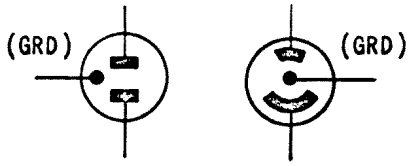
(8) 4-conductor polarized (male contacts)



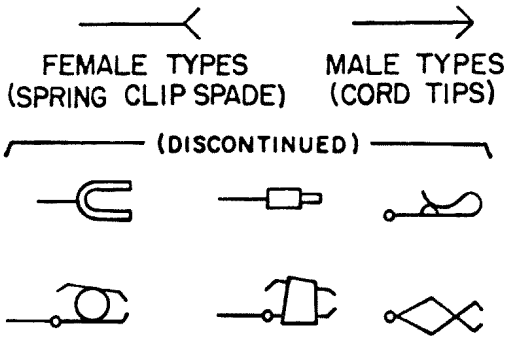
(9) 3-conductor grounding-type polarized (female contacts)



(10) 3-conductor grounding-type polarized (male contacts)

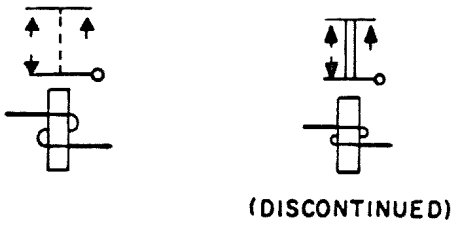


(e) Cord tip-type connector

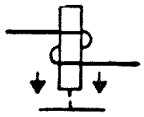


4.14 Contactors

(a) Relay (armature) -type

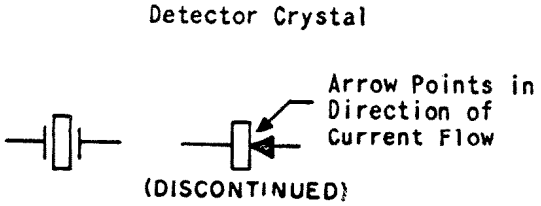


(b) Solenoid-type

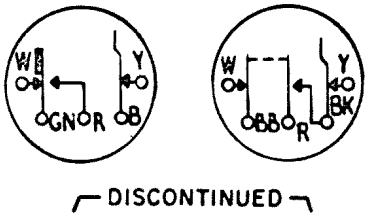


4.15 Crystal Units

(a) Piezoelectric

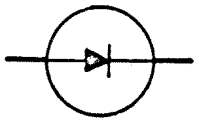


4.16 Dials

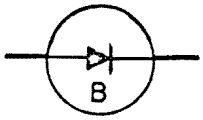


4.17 Diodes, (Semiconductor Devices) (Also see 2.08, 4.65, and 4.68)

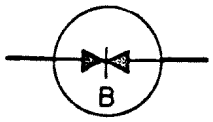
(a) P-N diode



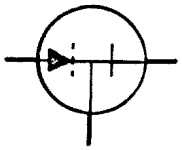
(b) P-N diode, breakdown



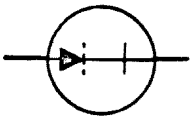
(c) Bi-polar voltage limiter



(d) P-I-N triode

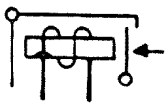


(e) P-I-N diode

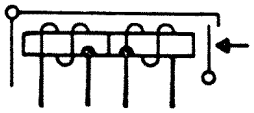


4.18 Drops

(a) Manually restored drop

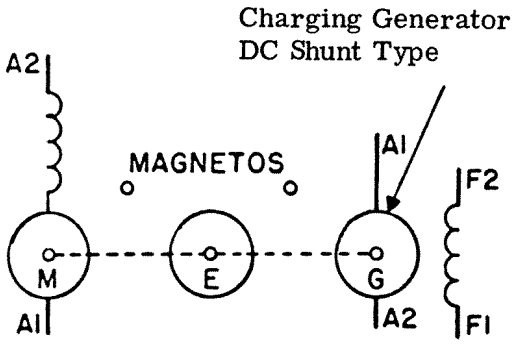


(b) Electrically restored drop



4.19 Electromagnet

4.20 Engine-Generator Set



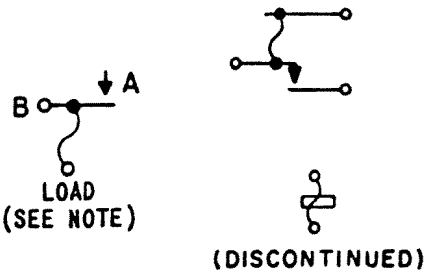
With Starting Motor and Magnetos

4.21 Fuses

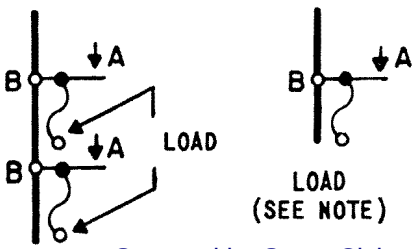
Note: When fuse blows, alarm bus A is connected to power bus B. Letters are for explanation and are not part of the symbol.

(a) Fuse (no alarm)

(b) Alarm-type fuse

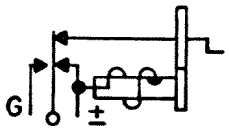


(c) Alarm-type fuse on bus bar



(d) Fuse in safety-type holder

4.22 Generator, Hand-type



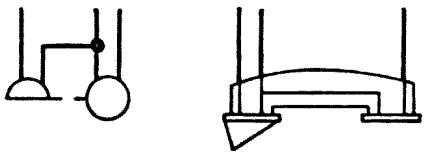
4.23 Ground Symbols

(a) Chassis or frame ground

(b) Earth ground

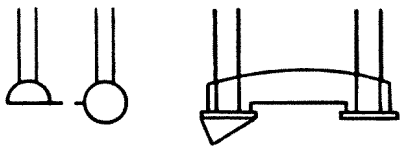
4.24 Handsets

(a) 3-conductor handset



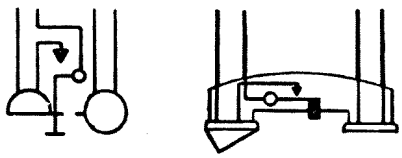
(DISCONTINUED)

(b) 4-conductor handset



(DISCONTINUED)

(c) 4-conductor handset with push-to-talk switch

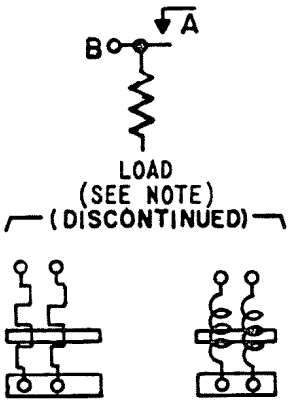


(DISCONTINUED)

4.25 Headset, Operator (Also see 4.43)

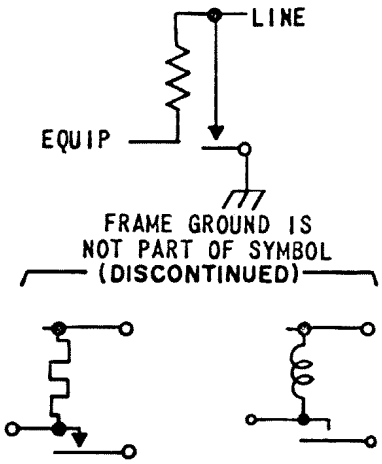
4.26 Heat Coils

(a) Alarm-type heat coil on bus bar



Note: When heat coil operates alarm bus A is connected to power bus B. Letters are for explanation and are not part of the symbol.

(b) Protector-type heat coil



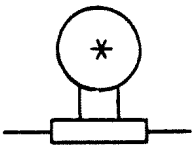
4.27 Horn or Howler (See 4.34)

4.28 Instruments and Meters

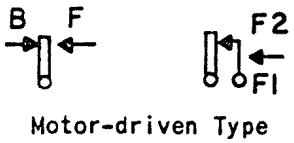
*Show abbreviations to identify the specific type of instrument or meter. For example:

A - Ammeter
AH - Ampere-hour
DB - Decibel
F - Frequency
G - Galvanometer
MA - Milliammeter
PF - Power factor
TT - Total time
UA - Microammeter
V - Voltmeter
VA - Volt-ammeter
VO - Volt-ohm
VU - Volume unit
W - Watt
WH - Watt-hour

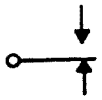
(a) Meter shunt



4.29 Interrupters



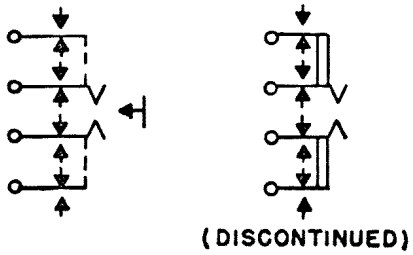
(a) Ringing interrupter



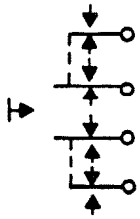
4.30 Jacks See 4.13 (c)

4.31 Keys

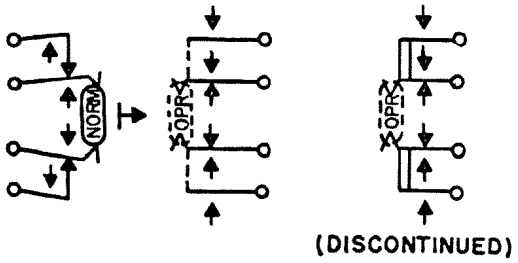
(a) Locking lever-type key



(b) Nonlocking lever-type key

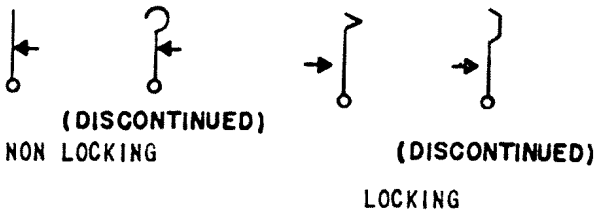


(c) Half of lever-type key normally operated



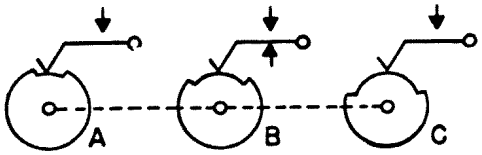
(d) Jack-type key

(e) Plunger-type key



(f) Telegraph-type key

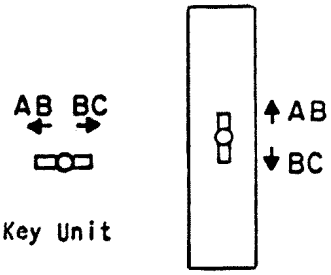
(g) Selector-type key

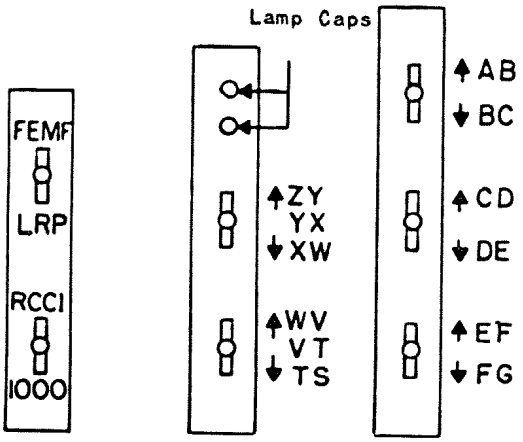


4.32 Keytop Diagrams

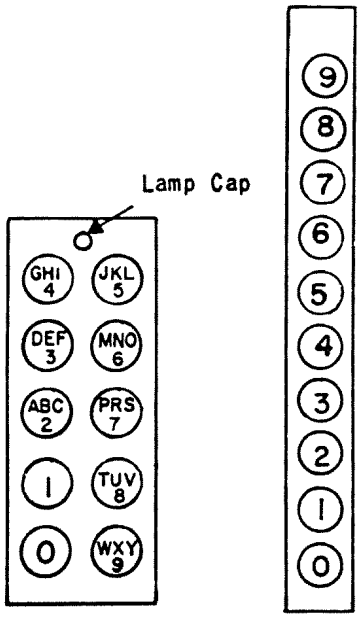
Note: Show designations within keytops only when engraved.

(a) Lever-type keytop diagrams (See note)

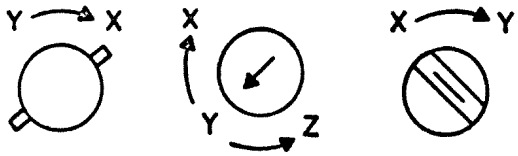




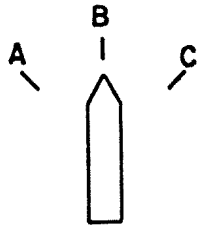
(b) Push-button-type keytop diagrams (See note)



(c) Turn button-type keytop diagrams

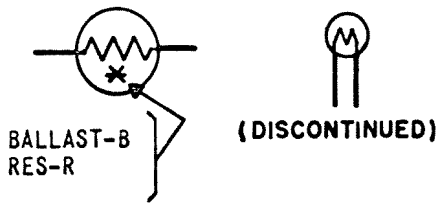


(d) Selector switch-type keytop diagram (other than Western Electric Company, keys)

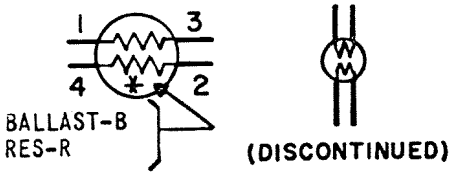


4.33 Lamps

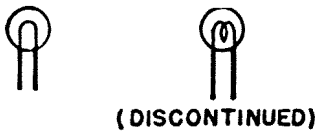
(a) Single-filament ballast or resistance lamp



(b) Double-filament ballast or resistance lamp

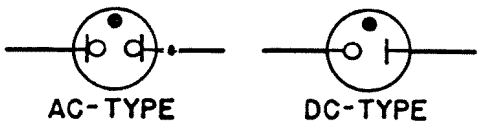


(c) Illuminating-type lamp



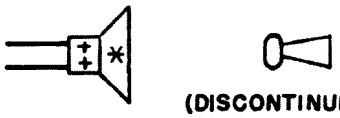
(d) Switchboard-type lamp

(e) Glow-type lamp



4.34 Loudspeakers, Horn, Howler, Telephone Receiver (Tone Ringer)

(a) General



(b) If specific identification of loudspeaker parts is required, the following letter combinations may be added. The * and ‡ are not part of the symbol

‡EM - Electromagnetic with moving coil (moving coil leads should be identified)

‡EMN - Electromagnetic with moving coil and neutralizing winding (moving coil leads should be identified)

*HN - Horn

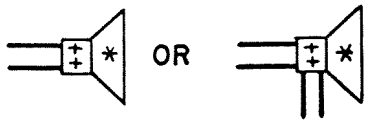
*HW - Howler

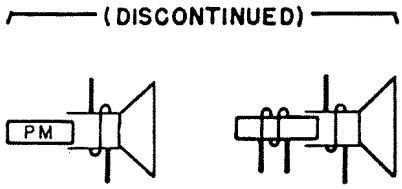
*LS - Loudspeaker

‡MG - Magnetic armature

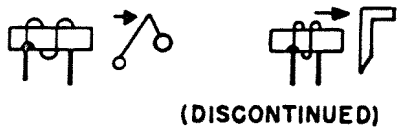
‡PM - Permanent magnet with moving coil

*TR - Telephone receiver (tone ringer)





4.35 Message Register

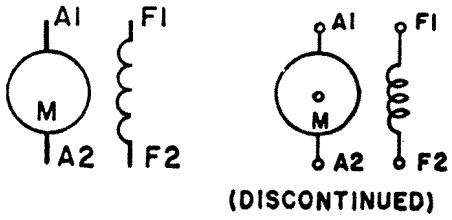


4.36 Meters (See 4.28)

4.37 Microphone

4.38 Motors

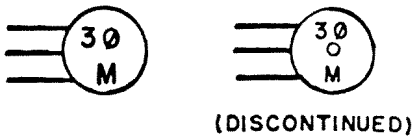
(a) DC shunt motor



(b) AC induction - type motor

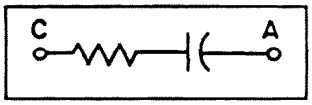
(1) 2-phase

(2) 3-phase



4.39 Networks

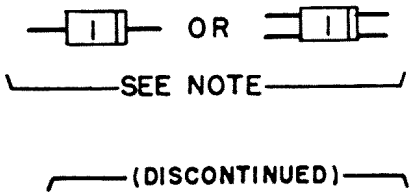
(a) Typical networks



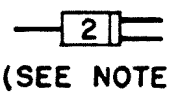
(b) Networks when used as contact protection

Note: A number, starting with 1, is assigned for each different coded network used in the circuit. The same number is used for each network of the same code used in the circuit. No number is used in connection with built-up type contact protection. The definition of the number is contained in a table on the circuit drawing.

(1) 2- or 4-terminal network when used as a contact protection



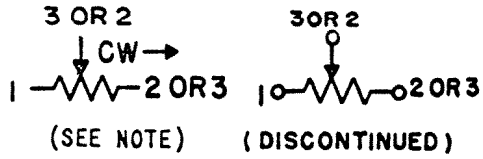
(2) 3-terminal network when used as contact protection



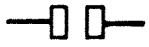
4.40 Plugs (See 4.13)

4.41 Potentiometers

Note: CW indicates position of adjustable contact at the limit of clockwise travel viewed from knob or actuator end, unless otherwise indicated.

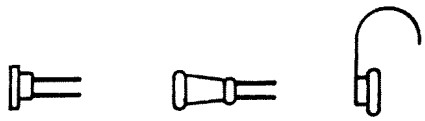


4.42 Protector Blocks

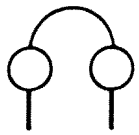


4.43 Receivers (Also see 4.24, 4.25, and 4.34)

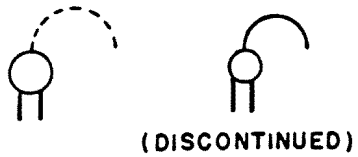
(a) General



(b) Double headset receiver



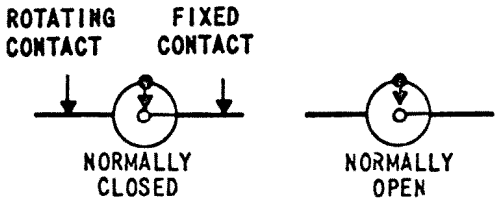
(c) Single headset receiver



4.44 Receptacles See 4.13(d)

4.45 Rectifier, Metallic (See 4.68)

4.46 Regulator



4.47 Relays (Also see 4.14)

Note: When relay symbols, showing top and bottom springs are rotated 90° on a drawing, the word top shall be placed in appropriate position.

Show abbreviations as follows for specific operating features, if required. On polarized relays used in telegraph circuits, the designations S and M indicate the "spacing" and "marking" contacts, respectively.

AC - Alternating current

D - Differential

DB - Double-biased - biased in both directions

DP - Dashpot

EP - Electrically polarized

FO - Fast operate

FR - Fast release

MG - Marginal

NB - No bias

NR - Nonreactance

P - Magnetically polarized using biasing spring or having magnetic bias

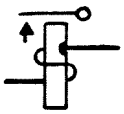
SA - Slow acting

SO - Slow operate

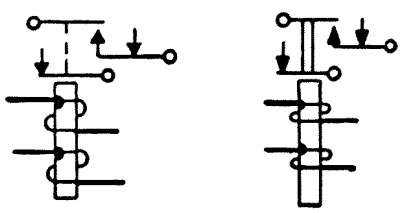
SR - Slow release

TS - Two-step

(a) Single-wound relay with make contact

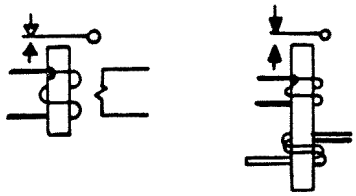


(b) Double-wound relay with break and make before-break contacts



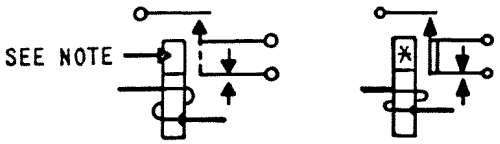
(DISCONTINUED)

(c) Relay with noninductive winding and transfer contacts



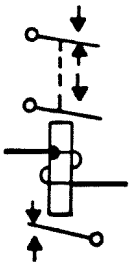
(DISCONTINUED)

(d) Relay with preliminary make contacts



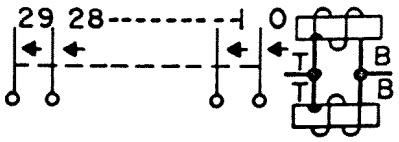
(DISCONTINUED)

(e) Relay in normally operated position

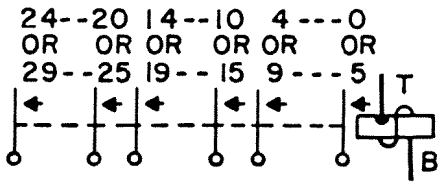


(f) Multicontact relay

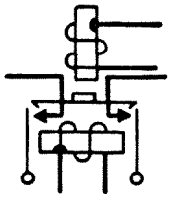
(1) Nonsplit multicontact relay



(2) Split multicontact relay

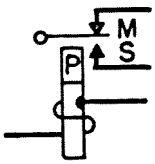


(g) Mechanically locking and electrically releasing relay

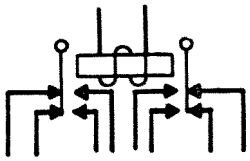


(h) Solenoid-type relay See 4.14(b)

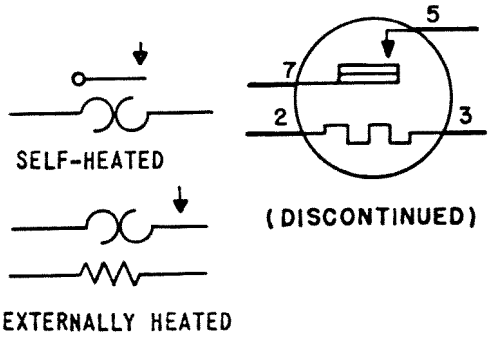
(i) Polarized telegraph-type relay



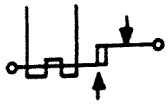
(j) Double contact-type relay



(k) Thermal delay relay (Also see 4.59)

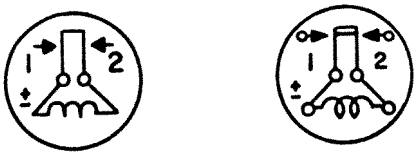


(l) Thermostat-type relay

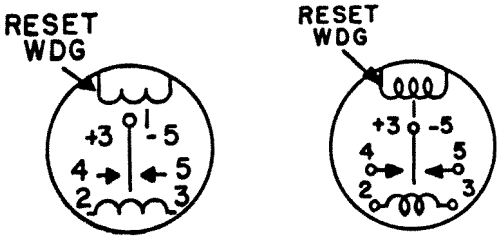


(DISCONTINUED)

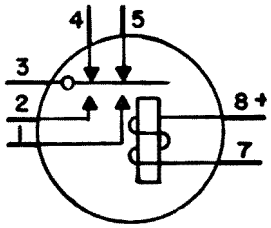
(m) Ammeter-type relay



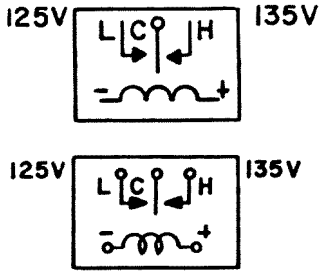
(n) Sensitrol-type relay



(o) Mercury contact type relay



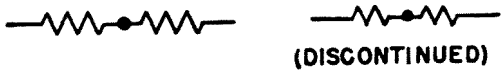
(p) Voltage-type relay



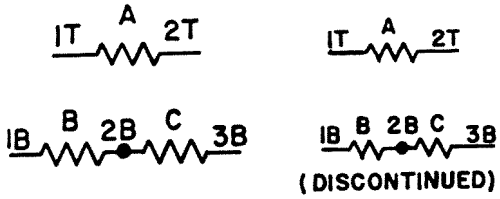
4.48 Resistors (Also see 4.41)

(a) Resistor with one winding

(b) Resistor with two windings and having one terminal common to both windings



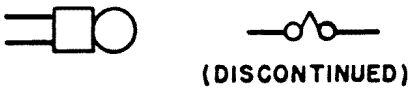
(c) Relay spool-type resistor



(d) Tapped windings

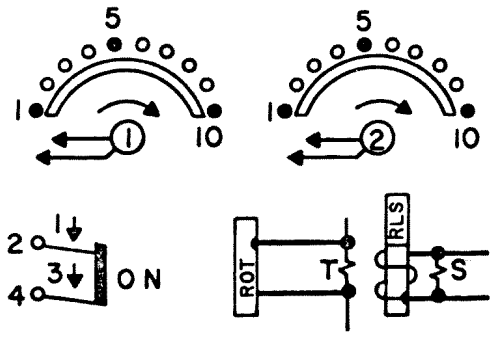
4.49 Rheostat or Adjustable Resistor

4.50 Ringer (Also see 4.05)

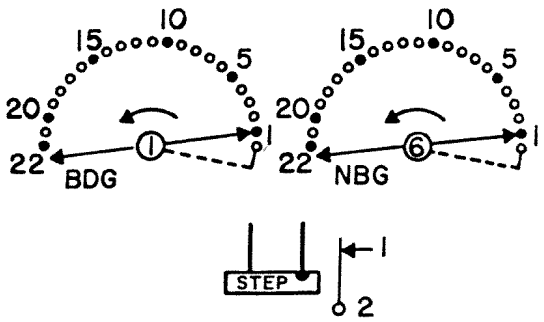


4.51 Selectors

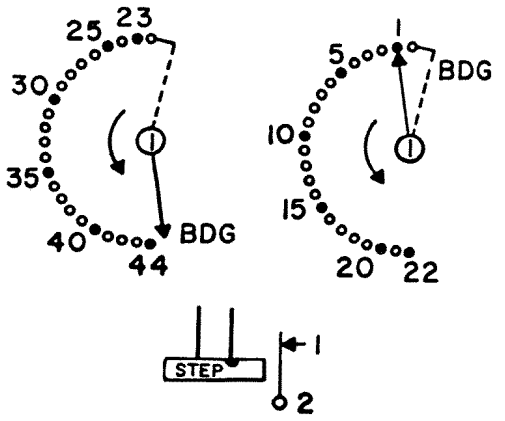
(a) 10-terminal rotary-type selector



(b) 22-terminal rotary-type selector



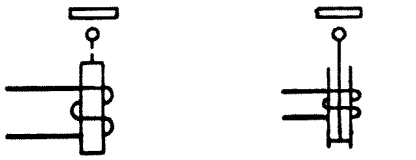
(c) 44-terminal rotary-type selector



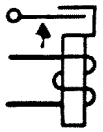
4.52 Signals

4.53 Sounders

(a) Chime, tone bar, etc, type sounder



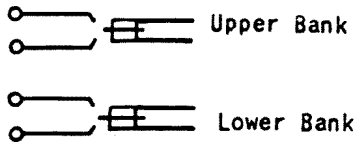
(b) Telegraph-type sounder



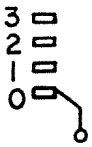
4.54 Switches

(a) Step-by-step system selector-type switches

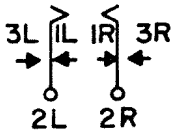
(1) Wipers and banks



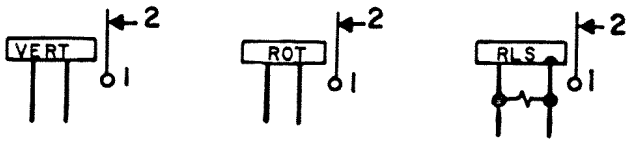
(2) Vertical commutator and wiper



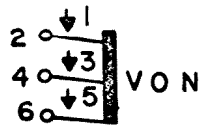
(3) Normal post springs



(4) Magnets

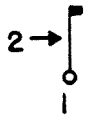


(5) Vertical off-normal springs

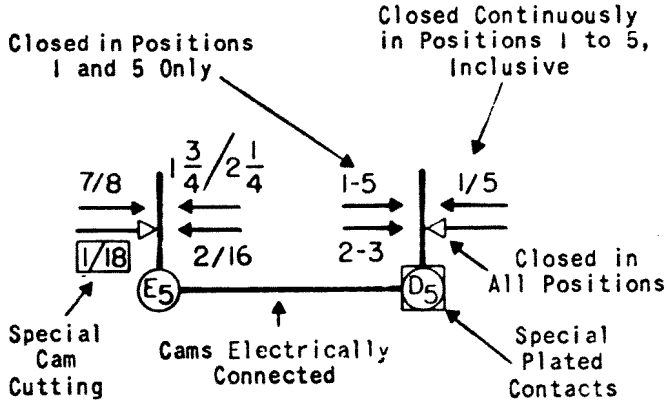


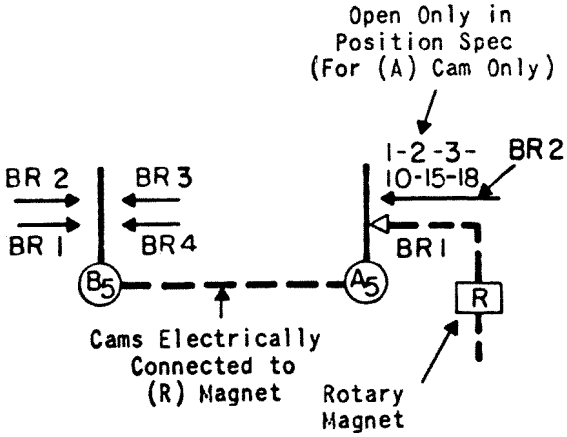
(6) Rotary off-normal springs

(7) 11th rotary step springs



(b) Sequence-type switches

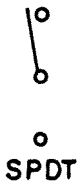




(c) Knife, rotary, snap, toggle, or tumbler-type switches

(1) Single-pole, single-throw switch

(2) Single-pole, double-throw switch



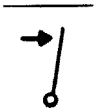
(3) Double-pole, single-throw switch

(4) Double-pole, double throw switch

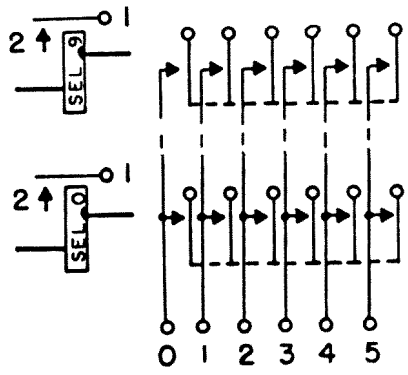
(d) Cover- or door-type switches

(1) Cover or door closed, switch opens when cover or door opens

(2) Cover or door closed, switch closes when cover or door opens



(e) Crossbar selector-type switch



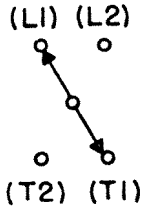
Notes:

A. SEL magnets may be placed on right or left of contacts as best suits wiring condition.

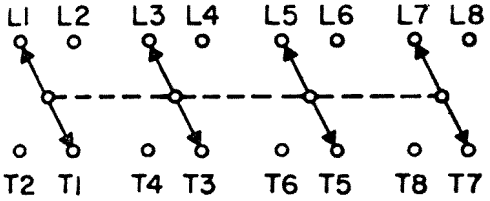
B. Contacts on SEL or HOLD magnets may be shown at either end of magnet core to suit schematic conditions.

C. HOLD magnets may be shown under SEL magnets where wiring from contact terminals is run vertically.

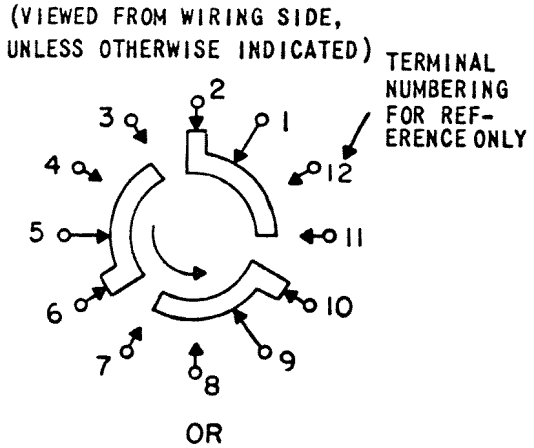
(f) Rotary-type (high voltage)



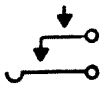
(1) Application



(g) Selector-type switches



4.55 Switchhook



4.56 Terminals

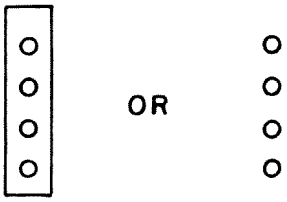
(a) Apparatus terminal

(b) Terminal strip or terminal punching

(c) Cross-connecting terminal

(d) Coaxial terminal

4.57 Terminal Strip



4.58 Test Point

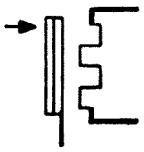
TEST POINTS SUCH AS A JACK, TERMINAL, ETC, SHALL BE DESIGNATED AND CODED

T.P.

(DISCONTINUED)

4.59 Thermal Devices

(a) External heater unit See 4.47(k)



(DISCONTINUED)

(b) Integral heater unit

(DISCONTINUED)

(c) Self-heated unit See 4.47(k)

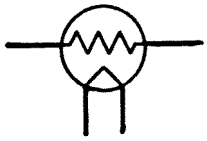
(DISCONTINUED)

4.60 Thermistors

(a) Directly heated thermistor

(DISCONTINUED)

(b) Indirectly heated thermistor

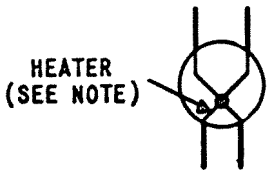


(DISCONTINUED)

4.61 Thermocouples

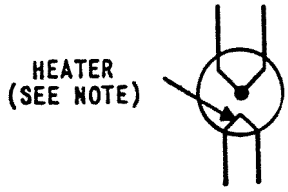
Note: Explanatory words and arrows not a part of the symbols shown.

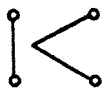
(a) Directly heated thermocouple



(DISCONTINUED)

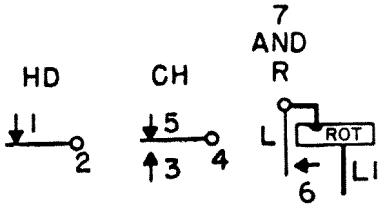
(b) Indirectly heated thermocouple



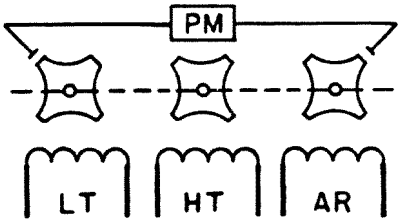


(DISCONTINUED)

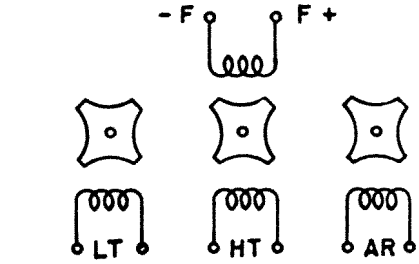
4.62 Timer



4.63 Tone Alternator



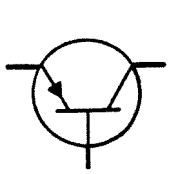
(DISCONTINUED)

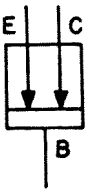


4.64 Transformer (See 4.12)

4.65 Transistor (Semiconductor Devices) (Also see 2.08 and 4.17)

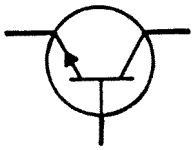
(a) P-N-P transistor (also P-N-I-P transistor if leaving out the intrinsic region does not result in ambiguity)



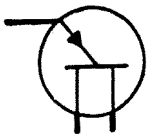


(DISCONTINUED)

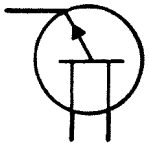
(b) N-P-N transistor (also N-P-I-N transistor if leaving out the intrinsic region does not result in ambiguity)



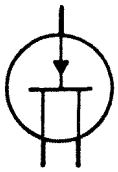
(c) P-N unijunction transistor (sometimes called double base diode or filamentary transistor)



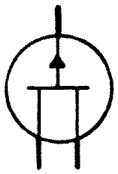
(d) N-P unijunction transistor (sometimes called double base diode or filamentary transistor)



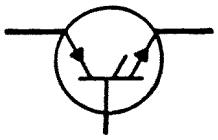
(e) P-type field-effects transistor



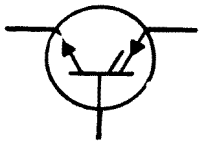
(f) N-type field-effects transistor



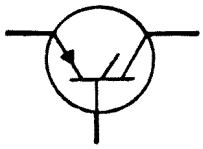
(g) P-N-P-N transistor (hook or conjugate-emitter connection)



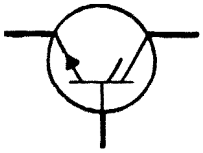
(h) N-P-N-P transistor (hook or conjugate-emitter connection)



(i) P-N-P-N transistor (remote base connection)

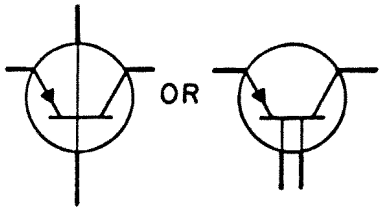


(j) N-P-N-P transistor (remote base connection)

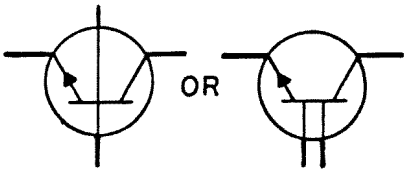


(k) P-N-P-N transistor without base connection

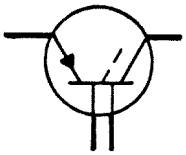
(l) P-N-P tetrode



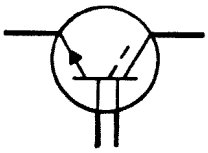
(m) N-P-N tetrode



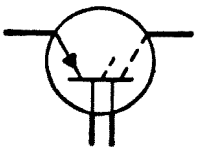
(n) P-N-I-P transistor with ohmic connection to the intrinsic region



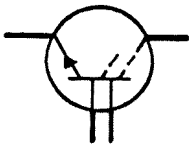
(o) N-P-I-N transistor with ohmic connection to the intrinsic region



(p) P-N-I-N transistor with ohmic connection to the intrinsic region



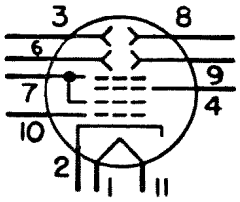
(q) N-P-I-P transistor with ohmic connection to the intrinsic region



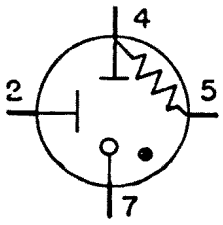
4.66 Transmitters

4.67 Tubes, Electron

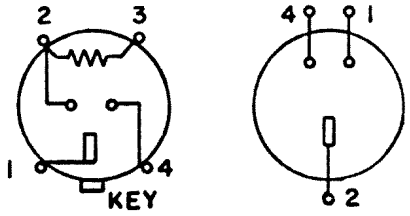
(a) Cathode-ray tube



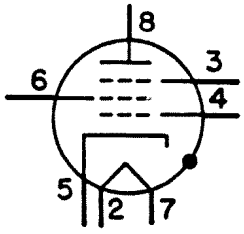
(b) Cold cathode tube



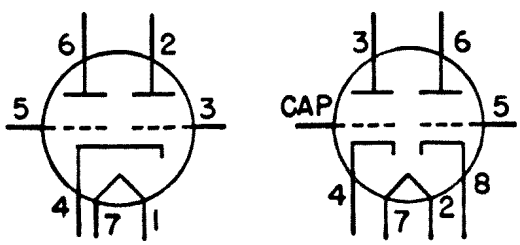
(DISCONTINUED)



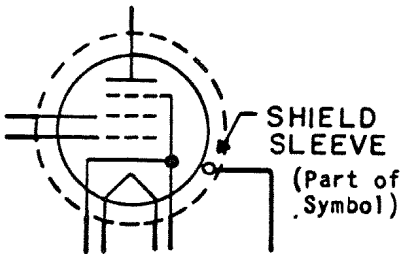
(c) Pentode tube



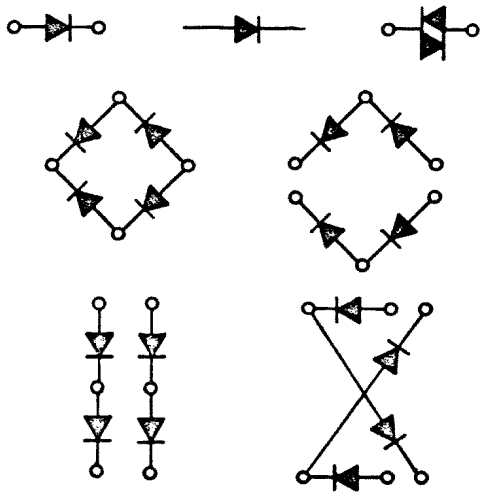
(d) Twin-triode tubes



(e) Tube, showing shield sleeve



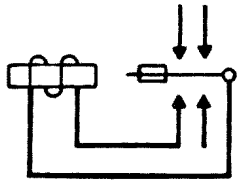
4.68 Varistors or Metallic Rectifiers (Also see Diodes 4.17)



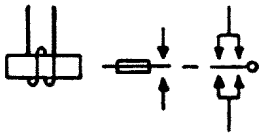
Note: Arrow indicates the direction of low resistance to positive current flow.

4.69 Vibrator

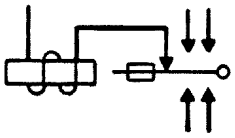
(a) Typical shunt drive (contacts as required)



(DISCONTINUED)



(b) Typical separate drive (contacts as required)



5. COAXIAL AND WAVEGUIDE SYMBOLS (Also see 4.13)

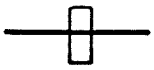
5.01 Transmission Path

Note: A single line represents a transmission path and extends for its entire length. The recognition symbol is used once, either at the beginning, end, or middle of the path unless needed at additional points for clarity. Continuity of all conductors in the path is understood, unless the schematic drawing carries a note to the contrary.

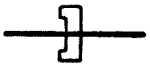
(a) Coaxial

(b) Waveguide, circular

(c) Waveguide, rectangular

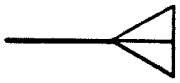


(d) Waveguide, ridged



(e) Connectors (See 4.13)

5.02 Antenna - General



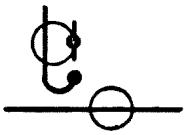
5.03 Attenuator

5.04 Coupling By Loop

(a) Coupling by loop to space

(b) Coupling by loop to guided transmission path

(c) Application: Coupling by loop from coaxial to circular wave guide



5.05 Coupling By Aperture With an Opening of Less Than Full Waveguide Size

(a) Designate E, H, or HE.

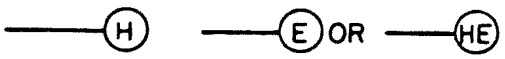
(1) E indicates that the physical plant of the aperture is perpendicular to the transverse component of the major E lines.

(2) H indicates that the physical plane of the aperture is parallel to the transverse component of the major E lines.

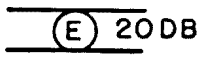
(3) HE indicates coupling by all other kinds of apertures.

(4) Transmission loss may be indicated.

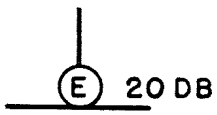
(b) Coupling by aperture to space.



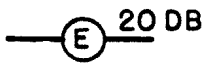
(c) Four ends of transmission path available



(d) Three ends of transmission path available



(e) Two ends of transmission path available

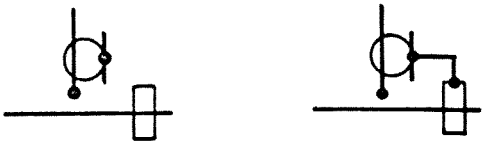


5.06 Coupling By Probe (See 5.13)

(a) Coupling by probe to space

(b) Coupling by probe to a guided transmission path

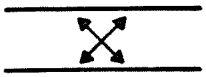
(c) Application: Coupling by probe from coaxial to rectangular waveguide



(DISCONTINUED)

5.07 Directional Coupler

(a) General

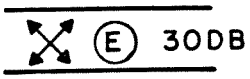


(1) Arrows indicate direction of power flow

(2) Number of coupling paths may be indicated.

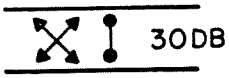
(3) Transmission loss may be indicated.

(b) Aperture coupling, designate E, H, or HE

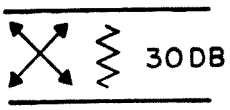


(c) Coaxial loop coupling, 30-db attenuation

(d) Coaxial probe coupling, 30-db attenuation



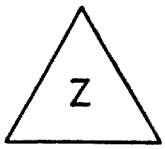
(e) Resistance coupling



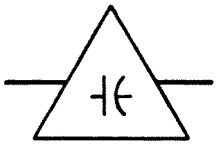
5.08 Discontinuity

(a) To be drawn for a component that exhibits the properties of one of the types of circuit elements throughout the frequency range of interest.

(b) Equivalent series element - general



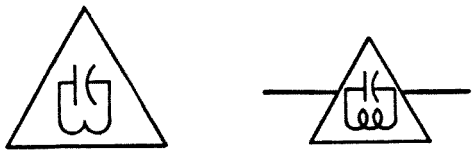
(1) Capacitive reactance



(2) Inductive reactance

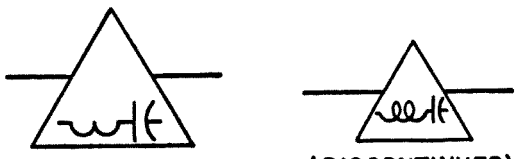
(DISCONTINUED)

(3) L-C circuit with infinite reactance at resonance



(DISCONTINUED)

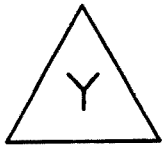
(4) L-C circuit with zero reactance at resonance



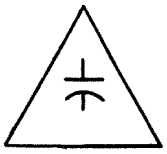
(DISCONTINUED)

(5) Resistance

(c) Equivalent shunt element - general

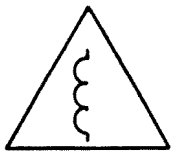


(1) Capacitive susceptance



(2) Conductance

(3) Inductive susceptance

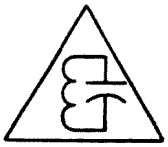


(DISCONTINUED)

(4) L-C circuit with infinite susceptance at resonance

(DISCONTINUED)

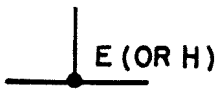
(5) L-C circuit with zero susceptance at resonance



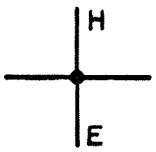
(DISCONTINUED)

5.09 Junction (Aperture Fully Open)

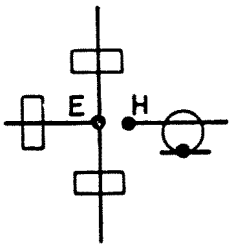
(a) Tee or wye

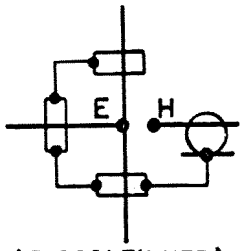


(b) Hybrid



(c) Application: Waveguide and coaxial couplings





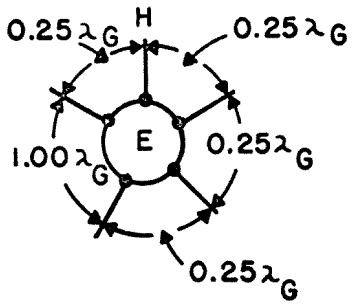
(DISCONTINUED)

(d) Hybrid, circular

(1) Letter inside circle indicates plane of the field in the ring is normal to the axis of the ring.

(2) Critical distances should be labeled in terms of guide wavelengths.

(e) Application: 5-arm circular hybrid

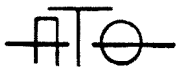


5.11 Mode Suppression

5.10 Mode Transducer

(a) Applications

(1) Transducer from rectangular to circular waveguide



5.12 Movable

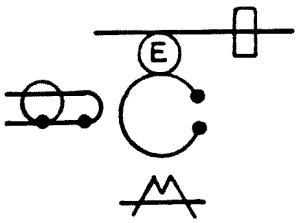
5.13 Open (See 5.06)

5.14 Phase Shifter

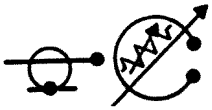
5.15 Resonator (Excluding Piezoelectric and Magnetostriction Devices)

(a) Applications

(1) Resonator coupled by an aperture to rectangular waveguide and by a loop to a coaxial. With mode suppression.

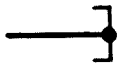


(2) Resonator coupled by a probe to a coaxial. With tuning. Variable Q.

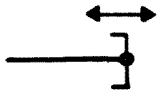


5.16 Rotation

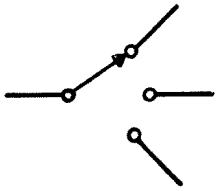
5.17 Short (Transmission Path Terminated in a Short)



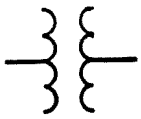
(a) Movable short

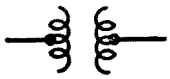


5.18 Switch (Any Number of Transmission Paths May Be Used)



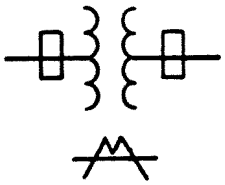
5.19 Transformation For Tapers and Step Transformers Without Mode Change

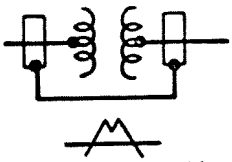




(DISCONTINUED)

(a) Application: Transformer with mode suppression





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