SYMBOLS FOR CIRCUIT SCHEMATIC DRAWINGS

CONTENTS PAGE

1. GENERAL

1.01 This section covers graphic symbols used in Bell System circuit schematic drawings.

1.02 This section is reissued so that the contents could be rearranged, to bring the symbols into agreement with the American Standard "Graphic Symbols for Electrical and Electronics Diagrams", Y32.2 and its supplement Y32.2a, and to add symbols of logic circuit elements. Since this reissue covers a general revision, arrows ordinarily used to indicate changes have been omitted.

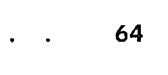
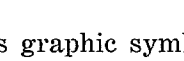
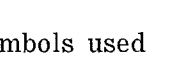
1.03 When new symbols are required for components not covered in this section, the matter shall be referred through normal lines of organization to the Bell Telephone Laboratories, Incorporated, New York, N. Y. (Head, Standards Engineering — Dept 6261)

(a) Other symbols considered to have little or no application in Bell System drawings may be found in the American Standard, "Graphic Symbols for Electrical and Electronics Diagrams", Y32.2 and its supplement Y32.2a.

(b) Cabling diagrams for schematic drawings shall conform with Section AA610.004.

(c) Section AA612.001 or 005-150-101 covers wiring symbols, wiring abbreviations, and definitions for wiring and cabling.

1.04 Detached-Contact circuit schematic representation methods are covered in Section 005-109-101.

1.05 Symbols of components consisting of contacting elements are represented in two ways in this section. Graphical representation using or  symbology for contacting elements are shown at the left and functional representation using  or  symbology are shown at the right. The latter representation came into practice with the introduction of the "Detached-Contact" method of circuit schematic representation. Numbers shown at symbol terminations are used as an aid in correlating associated symbol parts.

1.06 The standard symbol for a terminal (o) may be added to each point of attachment of conductors to any one of the graphical symbols, but such added terminal symbols should not be considered as part of the individual graphical symbol itself.

1.07 Symbols in Part 2 of this section are shown in the same size as that used on the original drawing. Logic symbols illustrated in Part 3 are also shown full size but may be shown on drawings to reduced or enlarged sizes. The sizes of symbols shown on prints in the field may be smaller due to print reduction.

1.08 The orientation of a symbol on a drawing does not alter the meaning of the symbol. In most cases, component symbols may be rotated or shown as a mirror image in order to simplify the circuit layout. Exceptions to this general rule are made for symbols that require orientation in a definite position in order to identify the top, bottom, left, or right side of the component.

2. SYMBOLS (General)

2.01 ***Adjustability (variability):*** These recognition symbols shall be drawn at about 45 degrees across the body of the symbol to which they are applied.

Note: Use only if essential to indicate special property.

(a) Adjustability (extrinisic adjustability)

(1) General

(2) Preset, general

(see preceding note)

(3) Linear [shown applied to 2.01(a)(1)].

(see preceding note)

(4) Nonlinear [shown applied to 2.01(a)(1)].

(see preceding note)

(b) Inherent variability (intrinsic variability)

(1) Linear

(see preceding note)

(2) Nonlinear

(see preceding note)

(c) Special features (shown applied to the general adjustability symbol)

(1) Continuous

(see preceding note)

(2) In steps

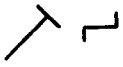
(see preceding note)

(d) Special features (shown applied to the general preset symbol)

(1) Continuous

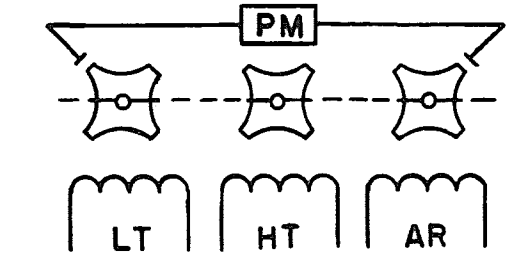
(see preceding note)

(2) In steps

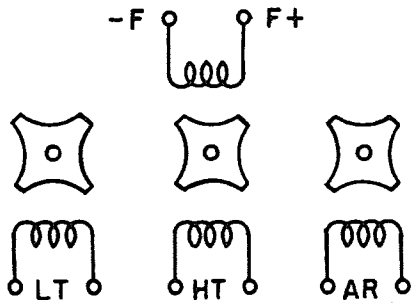


(see preceding note)

2.02 *Alternator, Tone*



(DISCONTINUED)



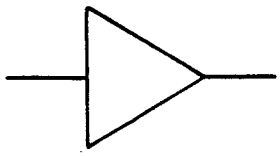
2.03 *Amplifier*

Note 1: The triangle is pointed in the direction of transmission.

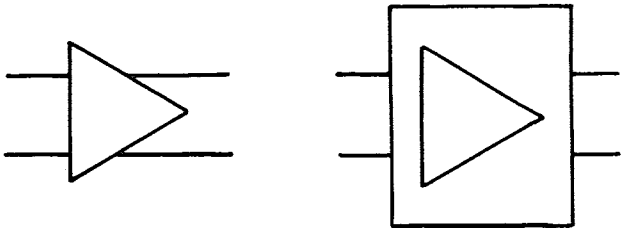
Note 2: The symbol represents any method of amplification (electron tube, solid state device, magnetic device, etc).

Note 3: Amplifier use may be indicated in the triangle by words, standard abbreviations, or a letter combination.

(a) Single line



(b) Where more leads are shown

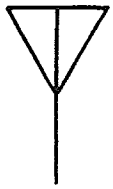


(DISCONTINUED)

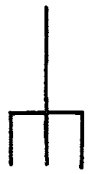
(c) Amplifier with adjustable gain (see preceding notes)

2.04 *Antenna*

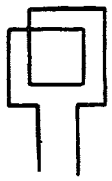
(a) General



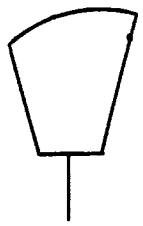
(b) Counterpoise



(c) Loop



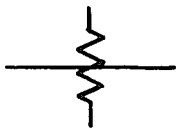
(d) Horn-type (microwave circuitry)



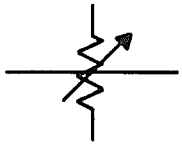
(e) Reflective type (microwave circuitry)
Paraboloid spherical
Parabolic cylinder,
Parabolic torus, etc

2.05 ***Attenuator*** (microwave circuitry)

(a) Fixed



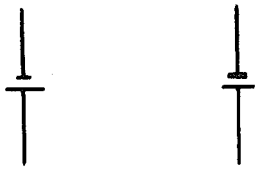
(b) Variable



2.06 ***Autotransformer*** [See 2.89(k)]

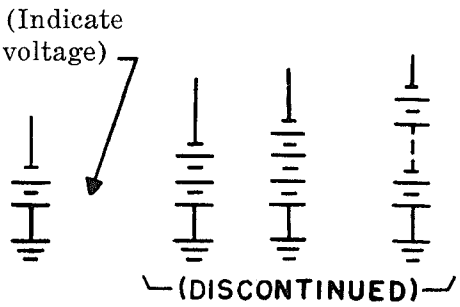
2.07 ***Battery and Potential Supply***

(a) One cell

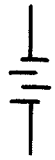


(DISCONTINUED)

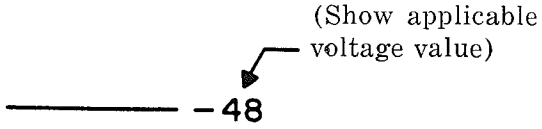
(b) Multicell battery (showing positive side grounded)



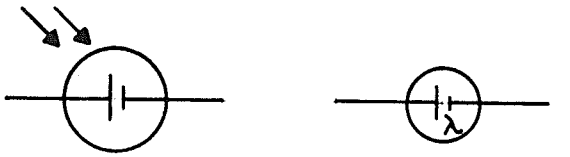
(c) CEMF cells



(d) Potential Supply

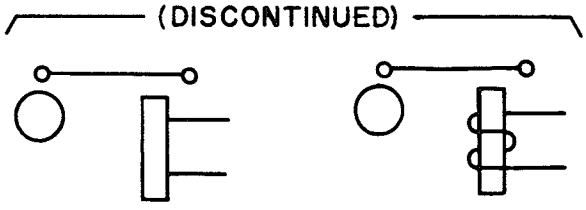


(e) Solar Cell

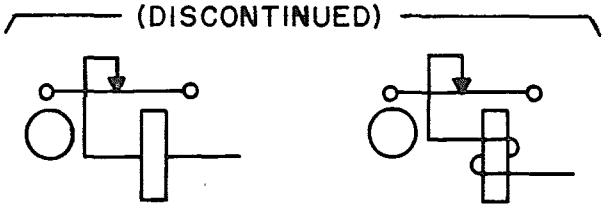


2.08 ***Bell*** (Also see 2.69)

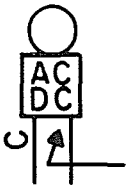
(a) AC bell



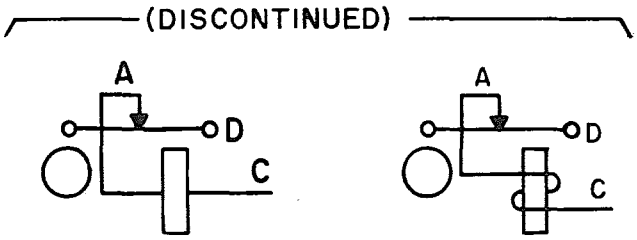
(b) DC bell



(c) AC-DC bell



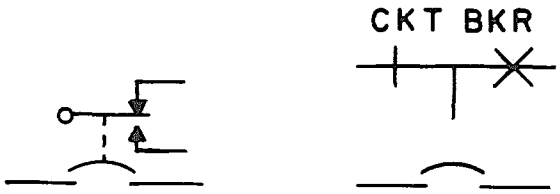
(Show D or A depending on whether DC or AC operation is intended)

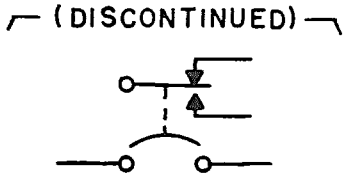


2.09 ***Breaker, Circuit***

(a) General

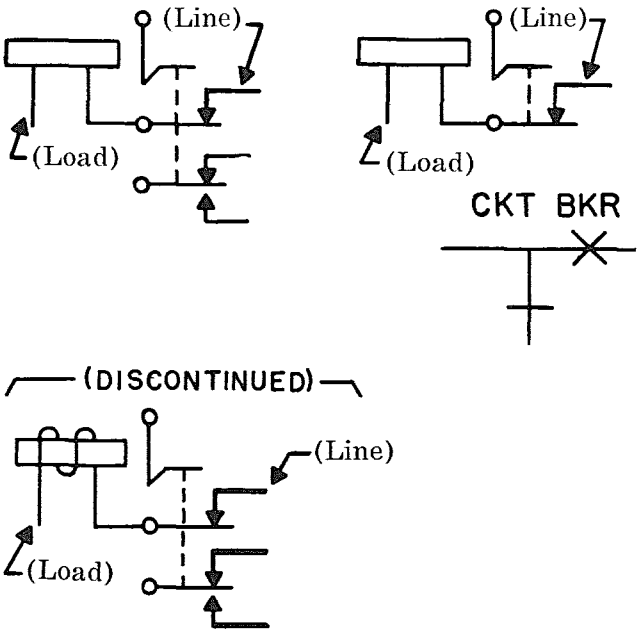
(1) Application





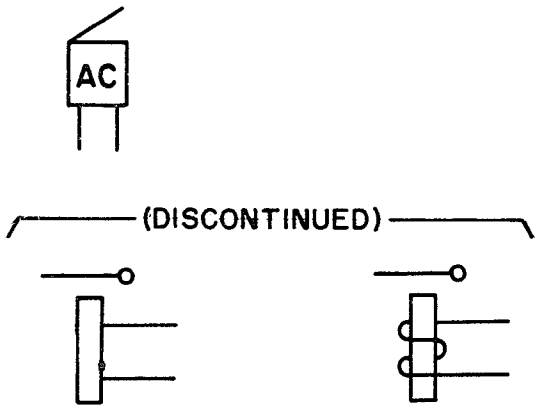
(b) Toggle switch type circuit breaker

Note: When this symbol is used, nontripped condition is shown.

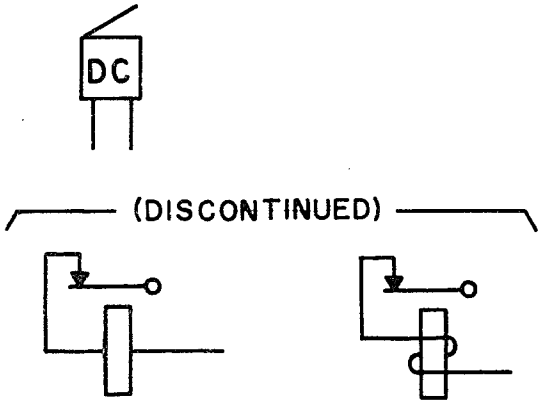


2.10 *Buzzer*

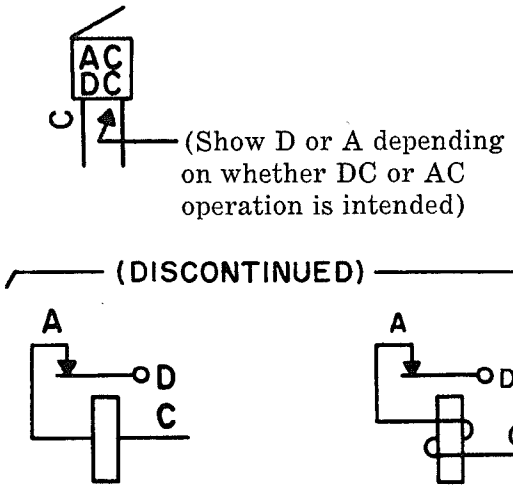
(a) AC buzzer



(b) DC buzzer



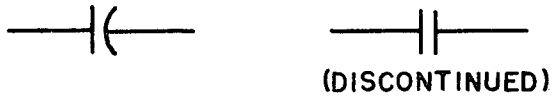
(c) AC-DC buzzer



2.11 *Capacitors*

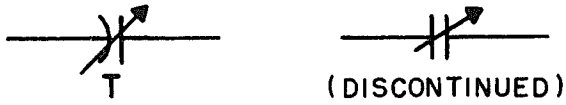
Note: The curved element represents the outside electrode in fixed-paper-dielectric and ceramic-dielectric capacitors, the negative electrode in polarized capacitors, and the moving element in adjustable capacitors.

(a) Fixed capacitor (See preceding note)



(b) Adjustable capacitor (see preceding note)

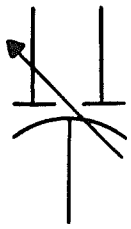
(1) General



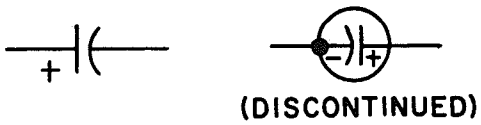
(2) Preset

Note: If it is necessary to identify trimmer capacitors, the letter T should appear adjacent to the symbol.

(c) Differential adjustable capacitor (See note under 2.11.)

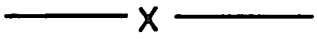


(d) Polarized (electrolytic) capacitor (See note under 2.11.)



(e) Feed-through capacitor (See note under 2.11.)

2.12 ***Circuit Discontinuity***



2.13 ***Circuit Return***

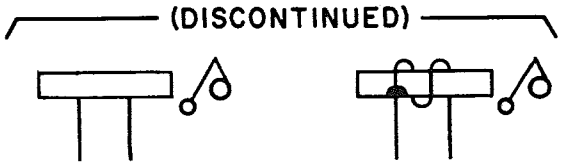
(a) Earth ground

(b) Chassis or frame connection

(c) Common connection

* The asterisk is not a part of the symbol. Identifying values, letters, numerals, or marks shall replace the asterisk.

2.14 ***Clock, Electric*** (See instruments 2.38)

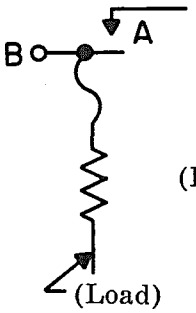


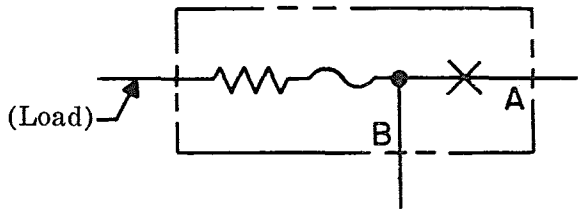
2.15 ***Coil*** (Also see 2.36, 2.37, 2.89)

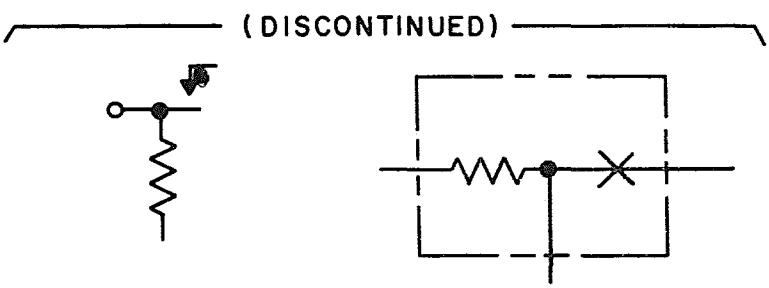
(a) Heat coil

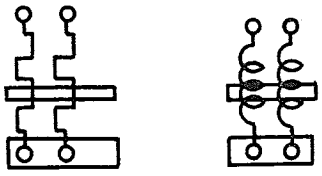
(1) Alarm-type heat coil on bus bar. (See note below.)

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.

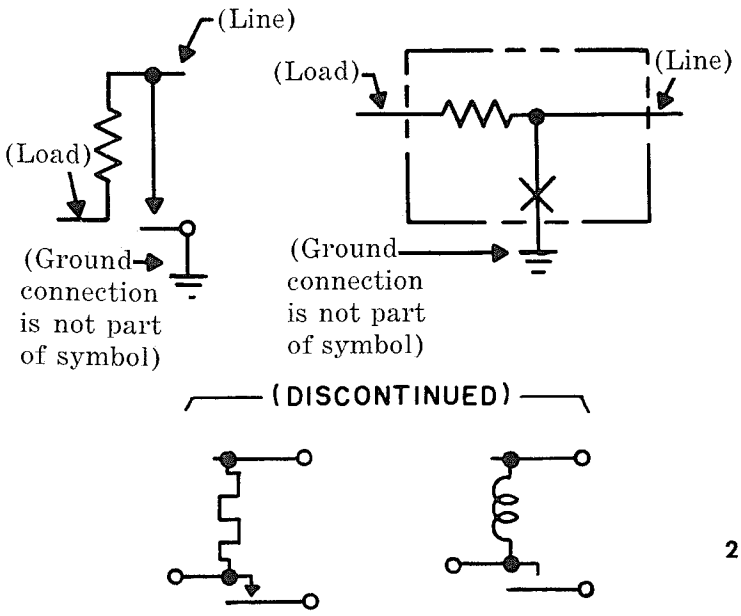






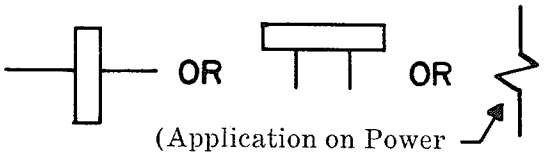


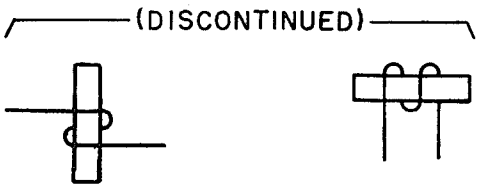
(2) Protector-type heat coil



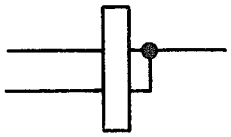
(b) Operating coil

(1) Inductive winding for relays, electromagnets, etc

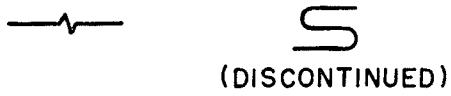




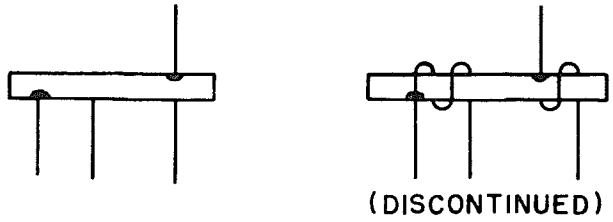
(2) Inductive series windings internally connected



(3) Noninductive winding



(4) Inner end for windings of relays, electromagnets, etc (shown only on multi-wound cores)

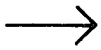


2.16 *Connector*

Note: Use appropriate number of contact symbols.

(a) Female element

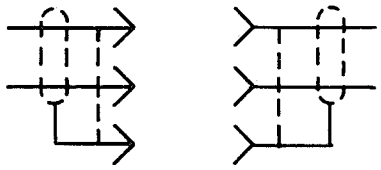
(b) Male element



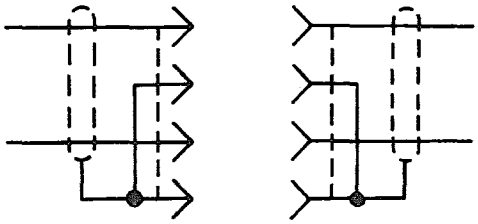
(c) Hermaphroditic

(d) Separable connectors showing male and female elements engaged (See note above.)

(1) Connector associated with balanced-pair transmission line

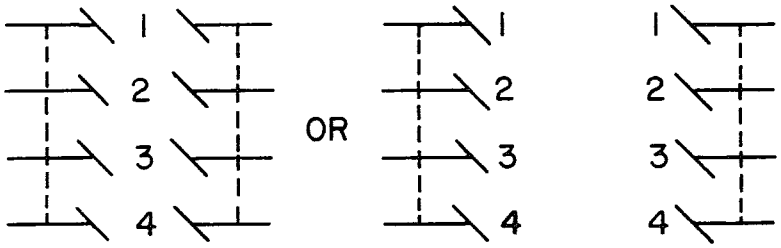


(2) Twin connector associated with balanced-pair transmission line



(e) Separable connectors showing hermaphroditic elements engaged

(1) Engaged multiple conductor connector showing individual hermaphroditic element designations when required

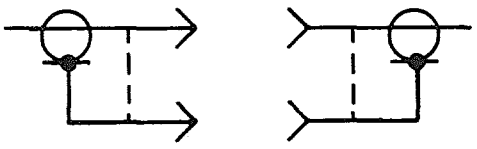


(Repeat numbers when mating elements are shown separated on the drawing)

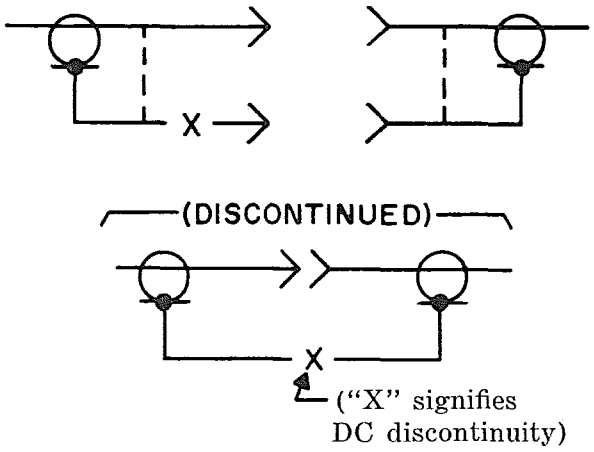
(f) Coaxial connectors associated with coaxial transmission line

(1) Coaxial jack and plug for single line diagram

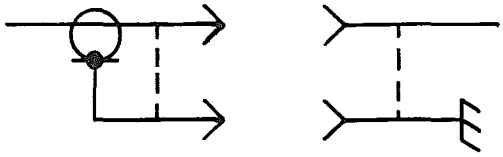
(2) Complete coaxial connectors



(3) Connector showing discontinuity symbol



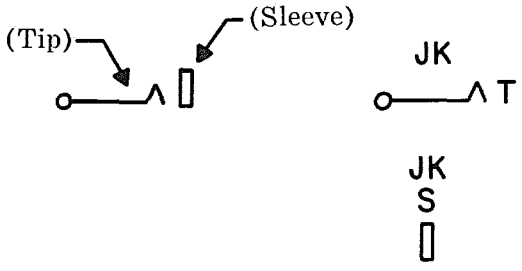
(4) Coaxial cable connected to a single conductor with outside conductor terminated on chassis



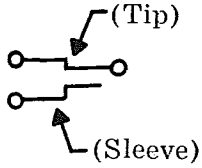
(g) Switchboard-type connectors (jacks and plugs)

Note: Symbol on the left is the preferred representation.

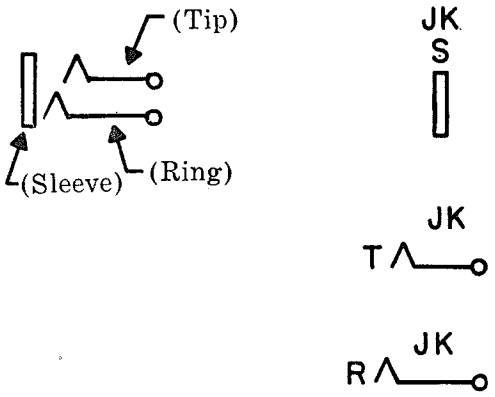
(1) 2-conductor jack

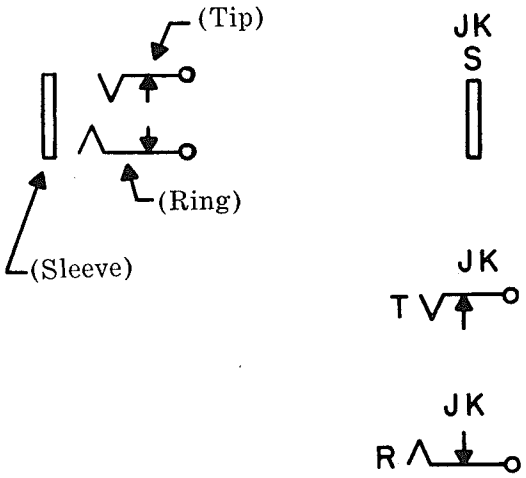


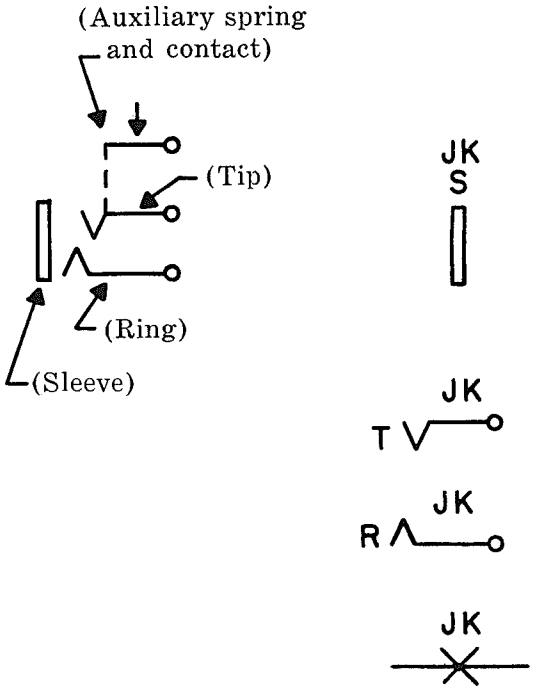
(2) 2-conductor plug



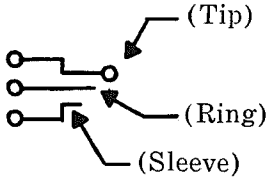
(3) 3-conductor jacks





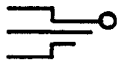


(4) 3-conductor plug

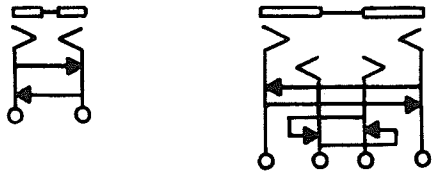


(5) Make-busy or shorting plugs

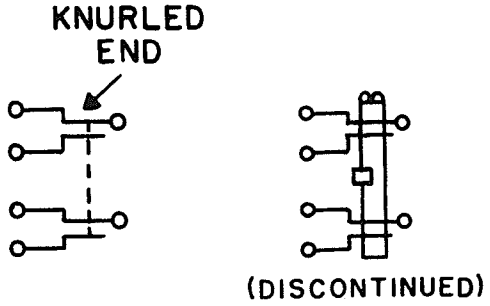
(6) Dummy plug



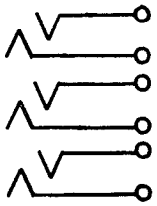
(7) Twin-type jacks



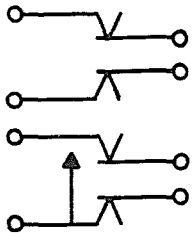
(8) Twin plug



(9) Test-type jack



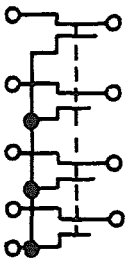
(10) Spring-type jack and plug (engaged)



(11) Test plug

(DISCONTINUED)

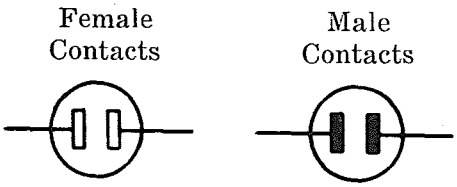
(12) 4-finger plug



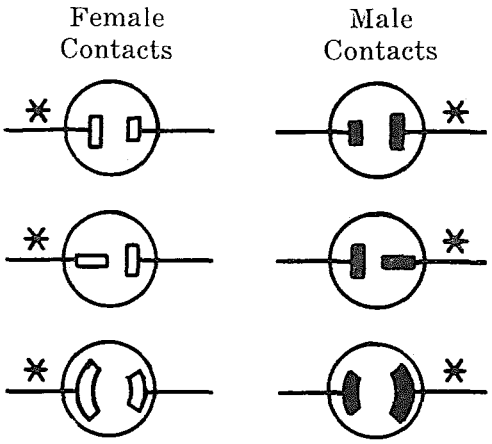
(h) Connectors commonly used for power supply (convenience outlets and mating connectors)

Note: The asterisk indicates that the terminal may be either nickel plated, white metal, or copper plated and represents the grounded side of the line. The specific type of terminal shall be indicated on the drawing.

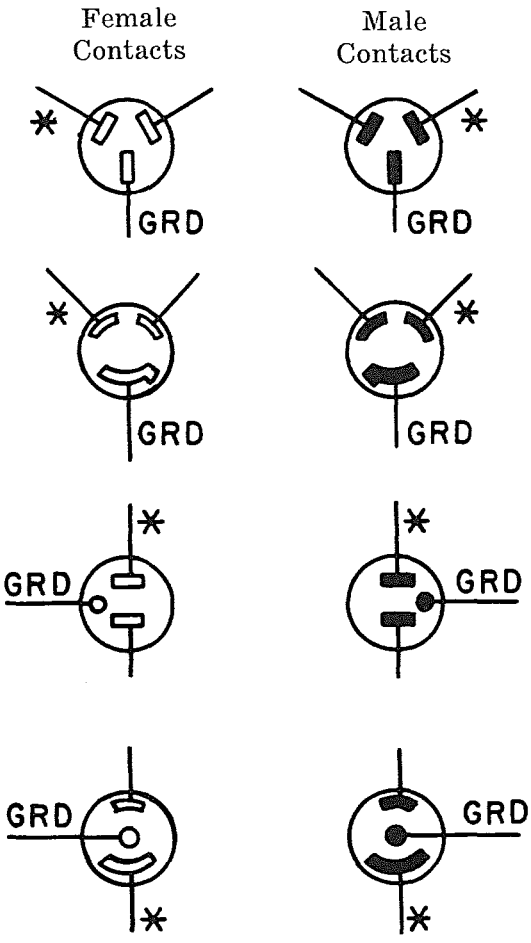
(1) 2-conductor nonpolarized



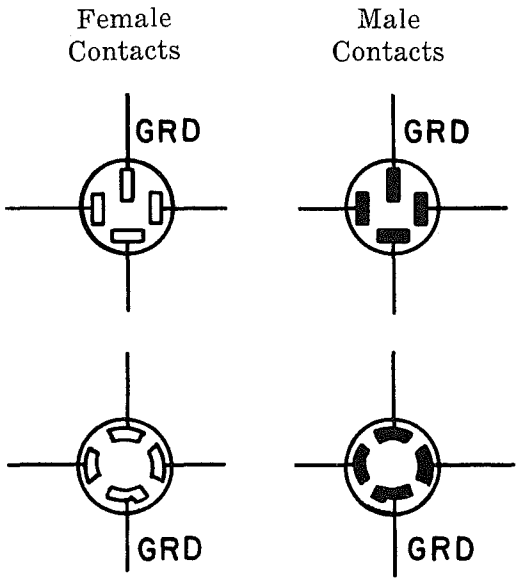
(2) 2-conductor polarized (See preceding note)



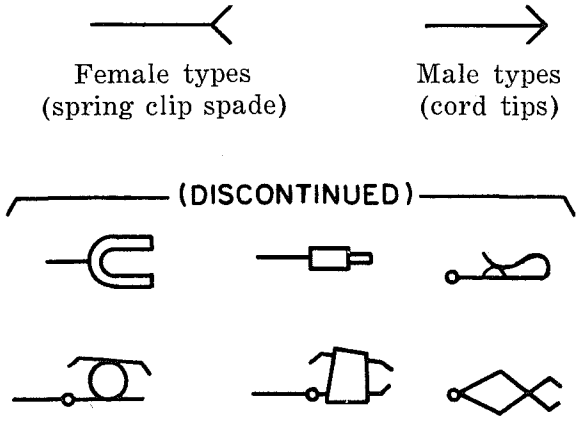
(3) 3-conductor grounding-type polarized (See preceding note)



(4) 4-conductor grounding-type polarized



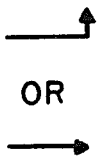
(i) Cord tip-type connector



2.17 ***Contact***

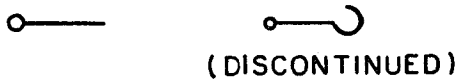
(a) Fixed

(1) Adjustable, indirectly actuated, or sliding

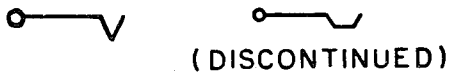


(b) Moving

(1) Nonlocking (relays, keys, jacks, etc)



(2) Locking (keys and jacks)

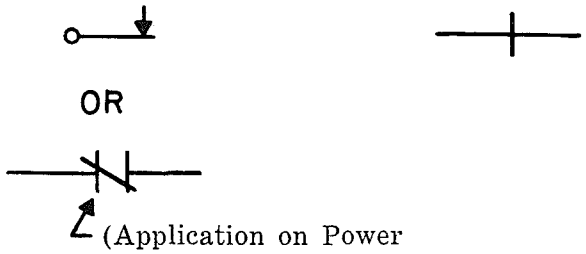


(3) Rotating contact (slip ring) and brush

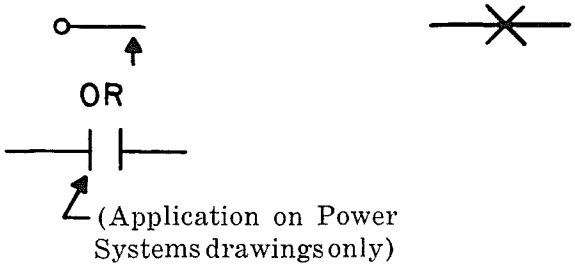
(c) Normally closed and normally open contact

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.

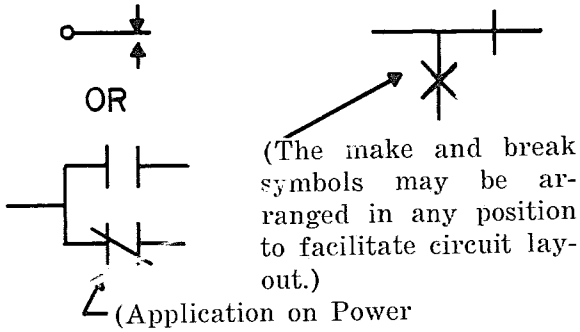
(1) Normally closed (break) contact (NC)



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



(3) Transfer

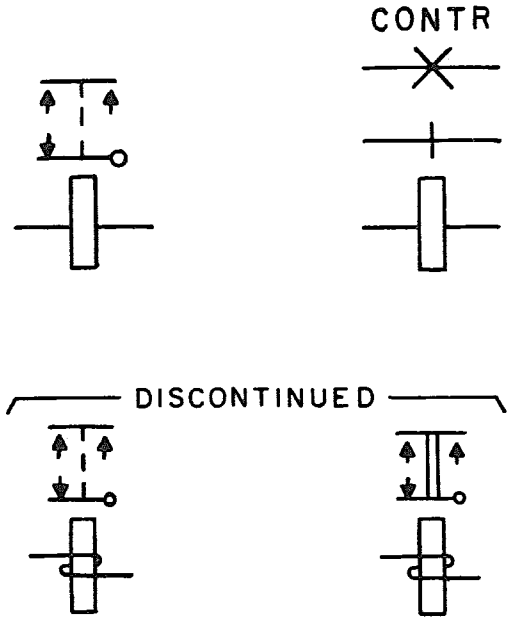


(The make and break symbols may be arranged in any position to facilitate circuit layout.)

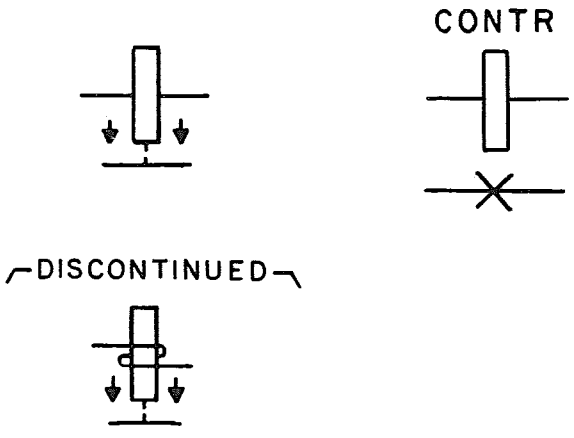
(Application on Power Systems drawings only)

2.18 *Contactor*

(a) Relay (armature-type)

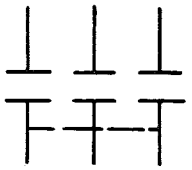


(b) Solenoid-type

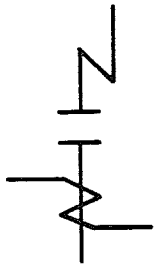


(c) Application on Power Systems drawings

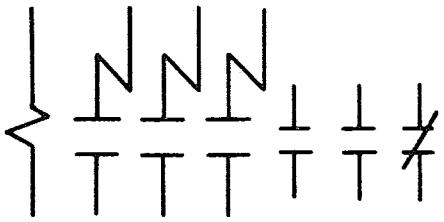
(1) Manually operated 3-pole contactor



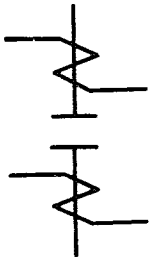
(2) Electrically operated 1-pole contactor with series blowout coil



(3) Electrically operated 3-pole contactor with series blowout coils; 2 open and 1 closed auxiliary contacts (shown smaller than main contacts)



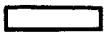
(4) Electrically operated 1-pole contactor with shunt blowout coil



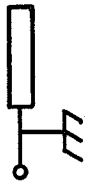
2.19 *Core*

(a) Magnetic (general)

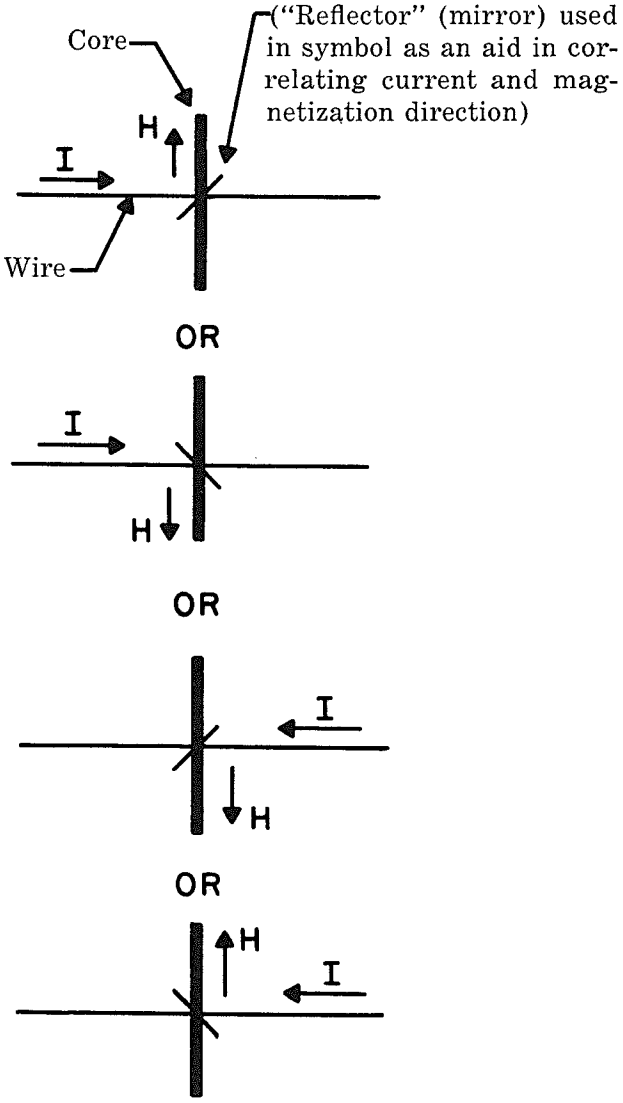
(b) For relays, magnets, etc



(c) Relay core with frame ground



(d) Magnetic core switching element (mirror symbol)



Note: H = Resultant magnetization direction
I = Current direction

The H, I, and directional arrows are not a part of the symbol.

2.20 ***Coupler, Directional*** (microwave circuitry)

(a) General

(1) Arrows indicate direction of power flow.

(2) Number of coupling paths may be indicated.

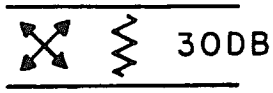
(3) Transmission loss may be indicated.

(b) Aperture coupling, designate E, H, or HE [Also see 2.21(b).]

(c) Coaxial loop coupling, 30-db attenuation

(d) Coaxial probe coupling, 30-db attenuation

(e) Resistance coupling

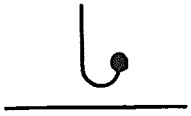


2.21 ***Coupling*** (microwave circuitry)

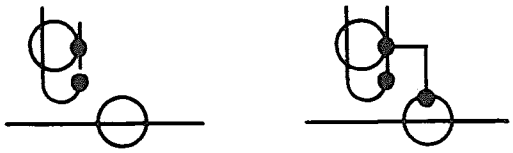
(a) Coupling by loop

(1) Coupling by loop to space

(2) Coupling by loop to guided transmission path



(3) ***Application:*** Coupling by loop from coaxial to circular waveguide



(b) Coupling by aperture with an opening of less than full waveguide size

(1) Designate E, H, or HE

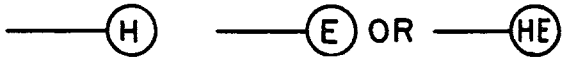
E indicates that the physical plane of the aperture is perpendicular to the transverse component of the major E lines.

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

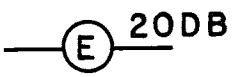
HE indicates coupling by all other kinds of apertures.

Transmission loss may be indicated.

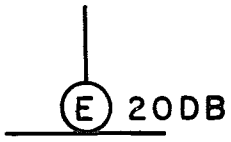
(2) Coupling by aperture to space



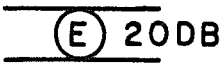
(3) Two ends of transmission path available



(4) Three ends of transmission path available



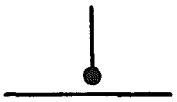
(5) Four ends of transmission path available



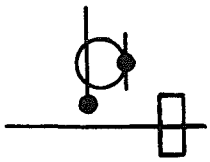
(c) Coupling by probe (See 2.54.)

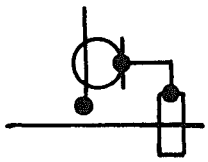
(1) Coupling by probe to space

(2) Coupling by probe to a guided transmission path



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



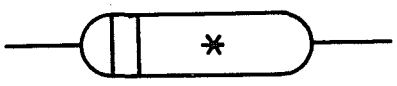


(DISCONTINUED)

2.22 ***Delay Function*** (slow-wave structure)

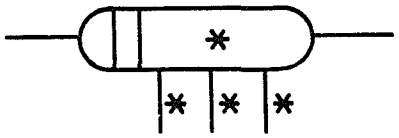
Note: Length of delay may be indicated. Asterisk is not part of symbol. If identification, electrical values, location data and similar information must be noted within a symbol, the size or the proportion of the original symbol may be altered providing its distinctive shape is retained. End with two vertical lines indicates input side.

(a) General



*See preceding note

(b) Tapped delay function

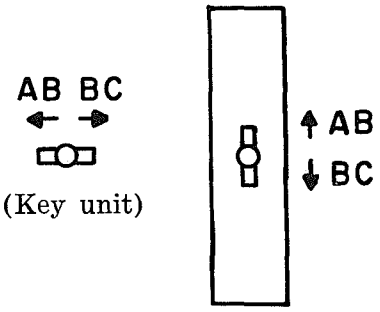


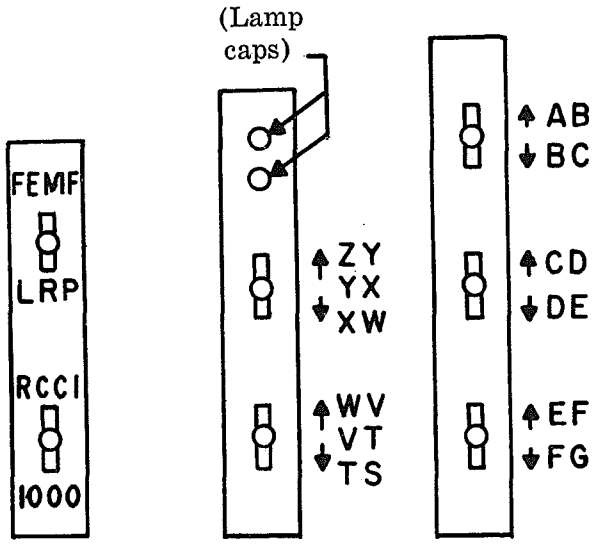
*See preceding note

2.23 ***Diagram, Keytop***

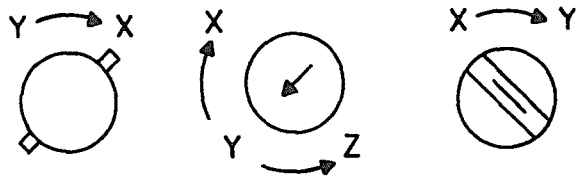
Note: Show designations within keytops only when engraved.

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



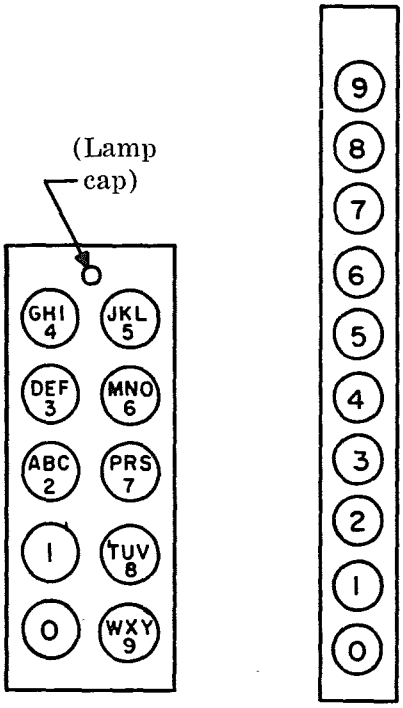


(b) Turnbutton-type keytop diagrams



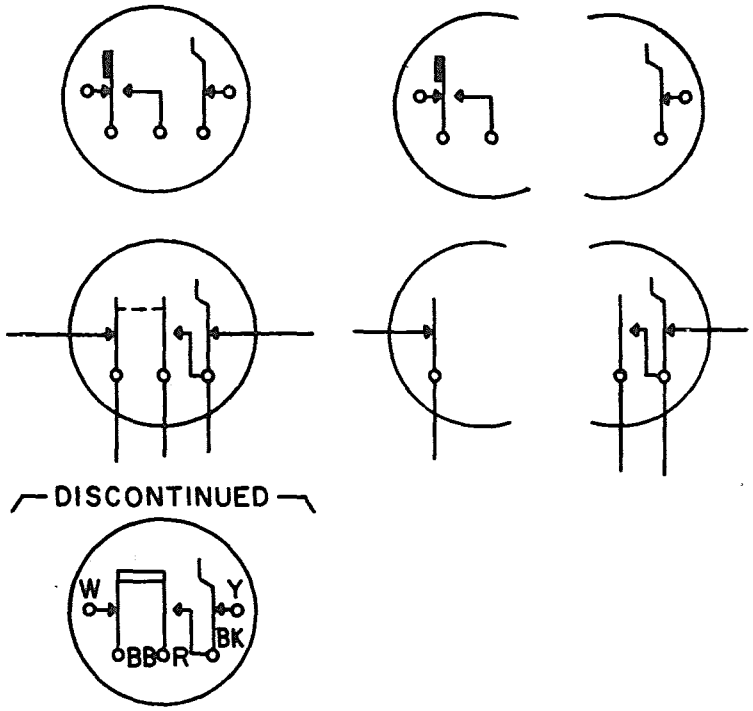
(c) Switch top diagram [See 2.80(m).]

(d) Pushbutton-type keytop diagrams (See note under 2.23)



2.24 ***Dial***

Note: Colors shall be shown as required



2.25 ***Direction of flow of power, signal, or information***

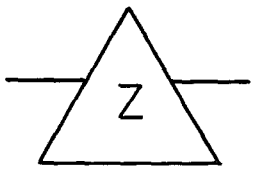
(a) One-way

(b) Both ways

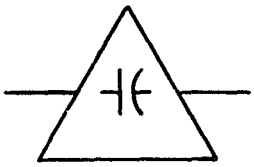
2.26 ***Discontinuity*** (microwave circuitry)

(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.

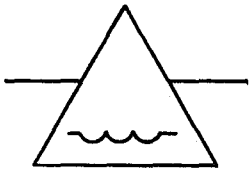
(b) Equivalent series element — general



(1) Capacitive reactance

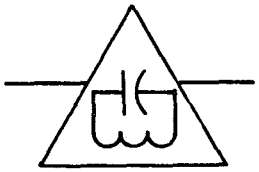


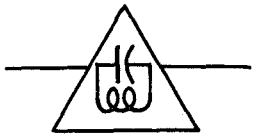
(2) Inductive reactance



(DISCONTINUED)

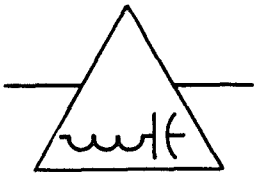
(3) Inductance-capacitance circuit with infinite reactance at resonance

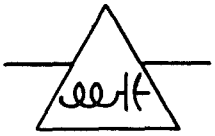




(DISCONTINUED)

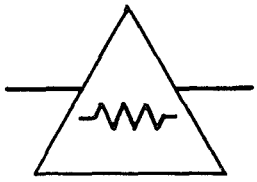
(4) Inductance-capacitance circuit with zero reactance at resonance



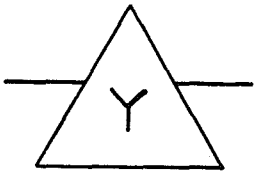


(DISCONTINUED)

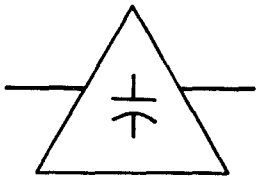
(5) Resistance



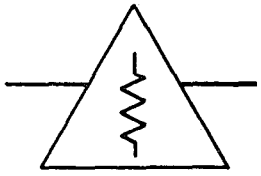
(c) Equivalent shunt element — general



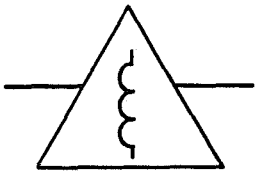
(1) Capacitive susceptance

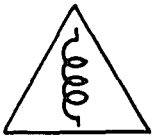


(2) Conductance



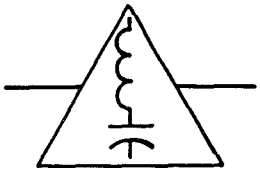
(3) Inductive susceptance

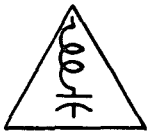




(DISCONTINUED)

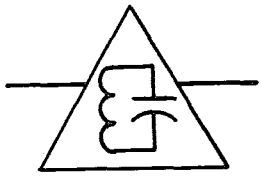
(4) Inductance-capacitance circuit with infinite susceptance at resonance





(DISCONTINUED)

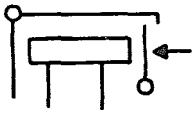
(5) Inductance-capacitance circuit with zero susceptance at resonance

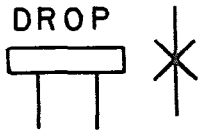


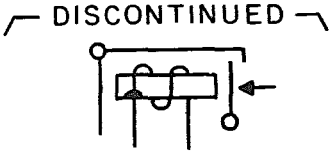
(DISCONTINUED)

2.27 ***Drop***

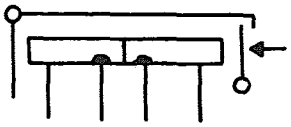
(a) Manually restored drop

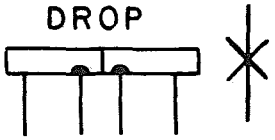


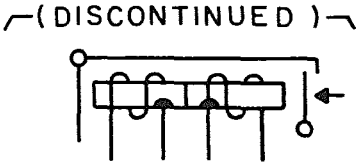




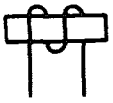
(b) Electrically restored drop







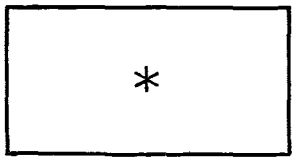
2.28 ***Electromagnet***



(DISCONTINUED)

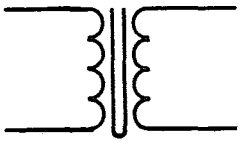
2.29 ***Element, Circuit***

Note: If identification, electrical values, location data and similar information must be noted within a symbol, the size or the proportion of the original symbol may be altered providing its distinctive shape is retained.



* Indicate the type of apparatus by words in the rectangle.

2.30 ***Fork, Tuning***

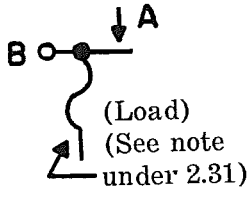


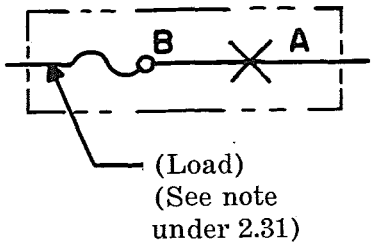
2.31 ***Fuse***

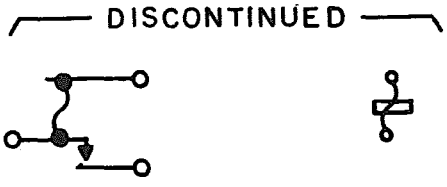
Note: When fuse blows, alarm bus A is connected to power bus B. Letters are for explanation and are not part of the symbol.

(a) Fuse (no alarm)

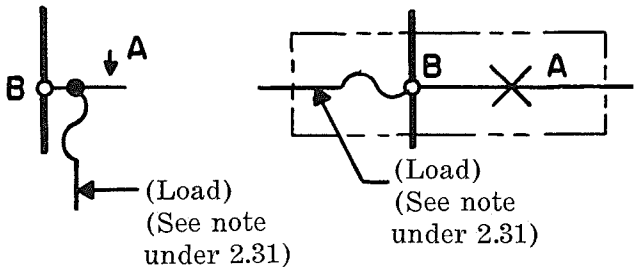
(b) Alarm-type fuse

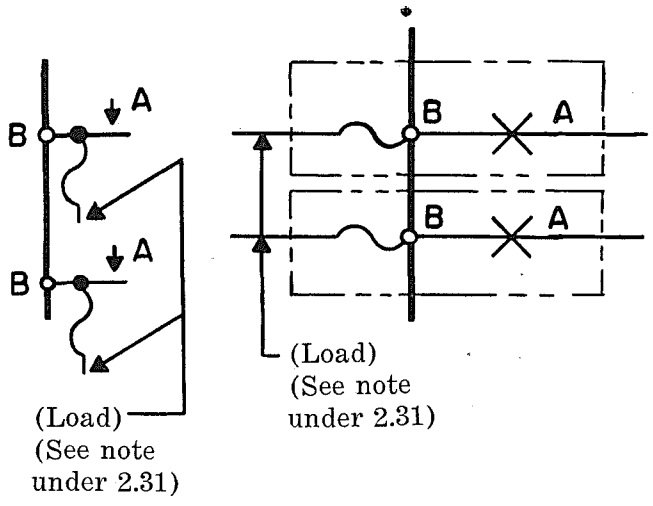




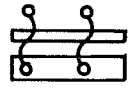


(c) Alarm-type fuse on bus bar

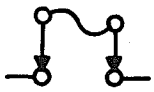




(DISCONTINUED)



(d) Fuse in safety-type holder



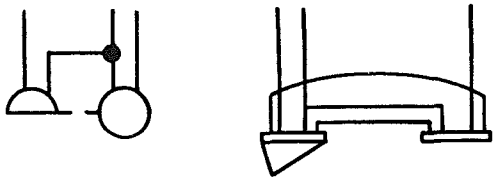
2.32 ***Gap*** (lightning arrestor)

(a) General

(b) Carbon block (protector)

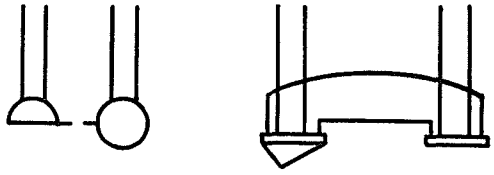
2.33 ***Handsets***

(a) 3-conductor handset



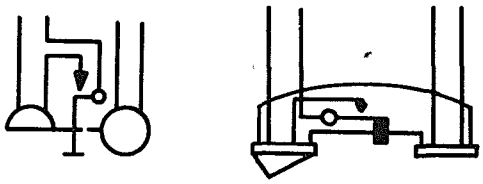
(DISCONTINUED)

(b) 4-conductor handset



(DISCONTINUED)

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



(DISCONTINUED)

2.34 ***Headset, Operator*** (Also see 2.61)

2.35 ***Horn or Howler*** (See 2.46)

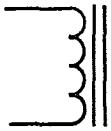
2.36 ***Inductance*** (repeating coil, inductor, transformer, etc)

(DISCONTINUED)

2.37 ***Inductor*** (coil)

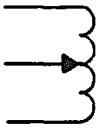
(a) General

(b) With magnetic core



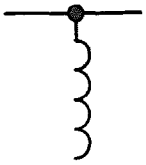
(c) With taps

(d) Adjustable

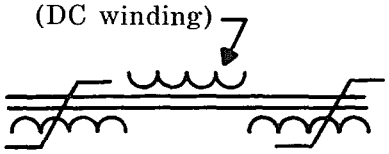


(e) Continuously adjustable

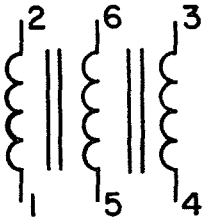
(f) Shunt



(g) Saturable reactor



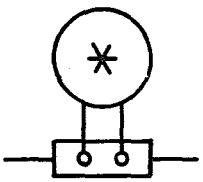
(DISCONTINUED)

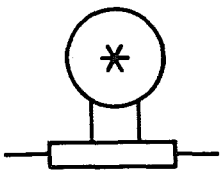


2.38 ***Instrument*** (Meters)

(Without shunt)

(DISCONTINUED)





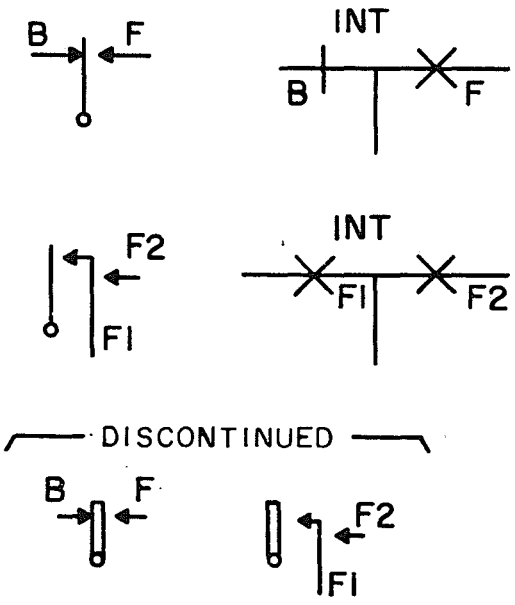
(With shunt)

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

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

2.39 ***Interrupter***

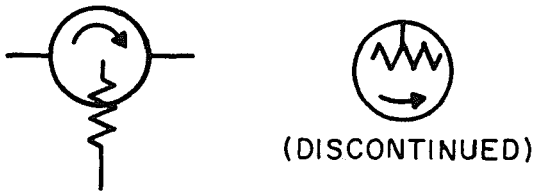
(a) Motor-driven type



(b) Ringing interrupter

2.40 ***Isolator*** (microwave circuitry)

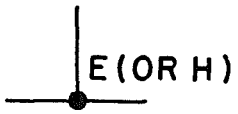
Note: Power flowing in direction of arrow is not intentionally attenuated.



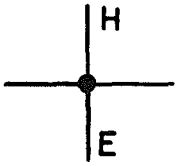
2.41 ***Jack*** [See 2.16(g).]

2.42 ***Junction*** (microwave transmission)

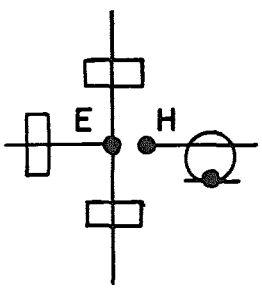
(a) Tee or wye

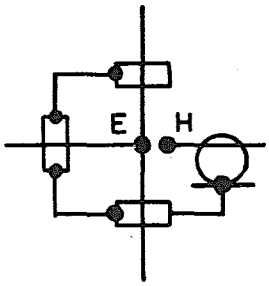


(b) Hybrid



(c) ***Application:*** Waveguide and coaxial couplings

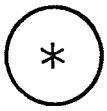




(DISCONTINUED)

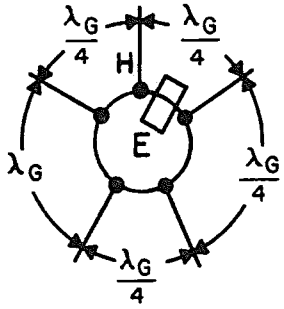
(d) Hybrid, circular (basic)

Note: The asterisk is not a part of the symbol. Always replace the asterisk by E, H, or HE. E indicates that there is a principal E transverse field in the plane of the ring. H indicates that there is a principal H transverse field in the plane of the ring. HE shall be used for all other cases. An arm that has coupling of a different type from that designated above shall be marked according to COUPLING (item 2.21). Critical distances should be labeled in terms of guide wavelengths.



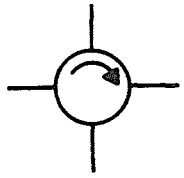
* SEE NOTE

(1) ***Application:*** 5-arm circular hybrid with principal coupling in the E plane and with 1-arm H coupling using rectangular waveguide.

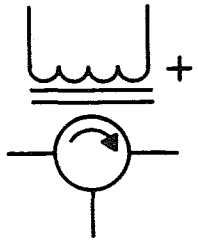


(e) Circulator, fixed direction

Note: Arrowhead indicates direction of power flow from any input to next adjacent arm but not to any other arm. Circulator may have three or more ports.



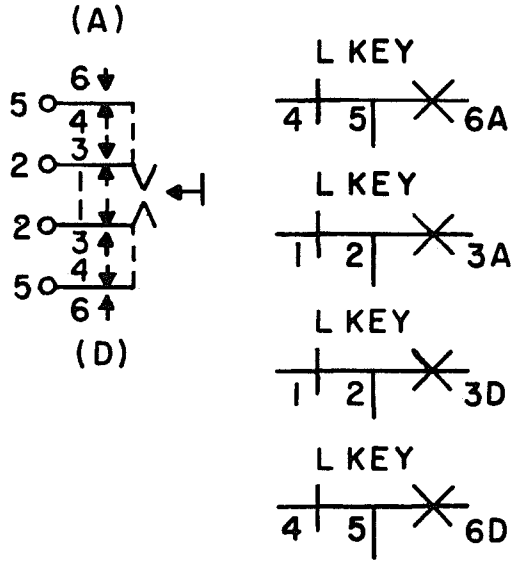
(1) ***Application:*** circulator, reversible direction. The polarity symbol must be used with the electromagnet symbol to indicate proper direction flow.



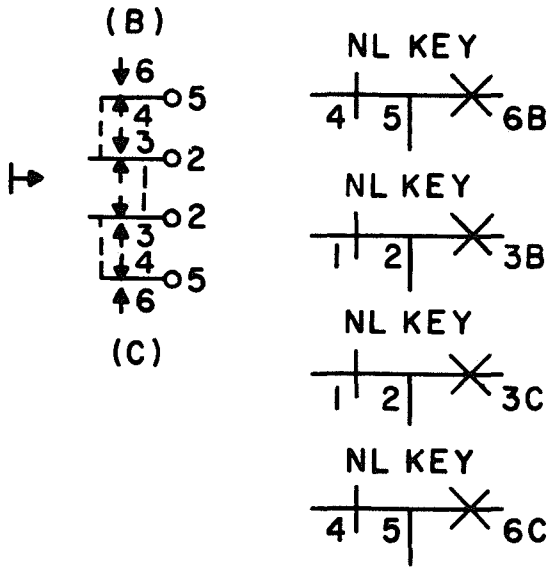
2.43 ***Key***

Note: Reference letters in parentheses (A), (B), (C), and (D) are used to identify each quadrant of the lever-type key symbol. Quadrant letter identifications are assigned in a clockwise direction when the key is viewed from the wiring side. Contacts and springs in the A and D quadrants are actuated when the key lever is operated toward that part of the key which is designated "front" for orientation purposes. Front and code marking side corresponds in lever-type keys.

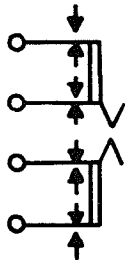
(a) Locking lever-type (See note under 2.43)

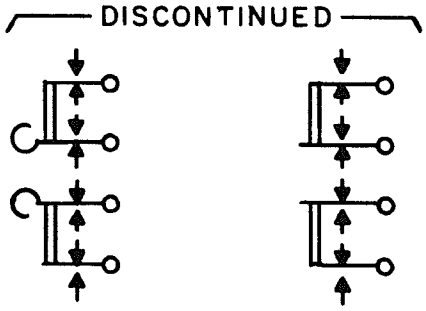


(b) Nonlocking lever-type (See note under 2.43)

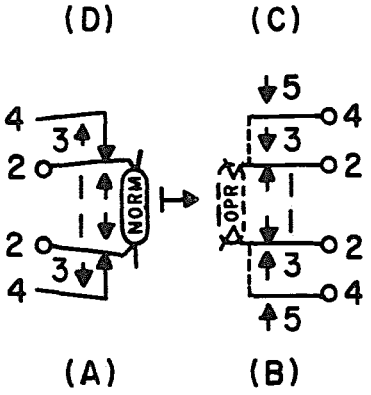


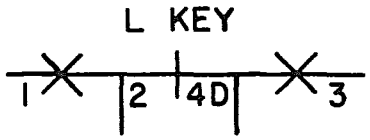
(DISCONTINUED)

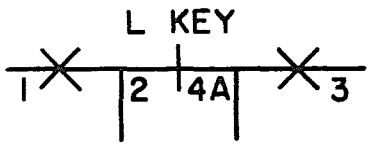


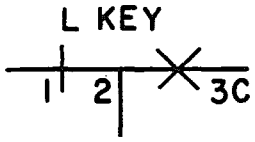


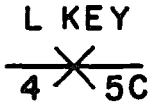
(c) Both halves of key actuated with single throw of lever (See note under 2.43)

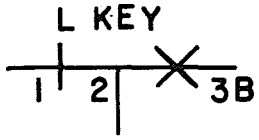


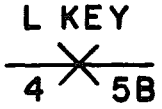












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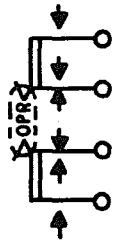
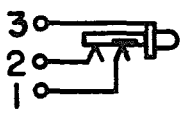
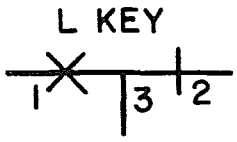


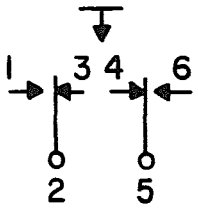
(d) Jack-type

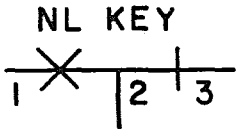


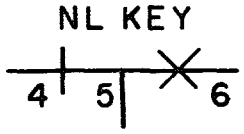


(e) Plunger-type

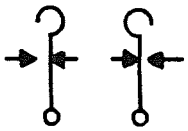
(1) Nonlocking



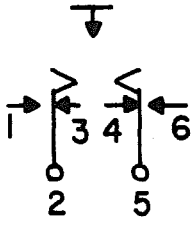


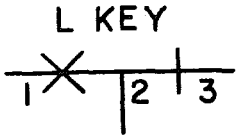


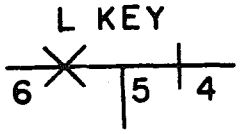
(DISCONTINUED)



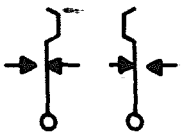
(2) Locking





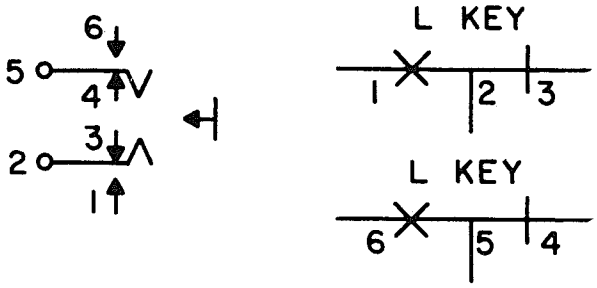


(DISCONTINUED)

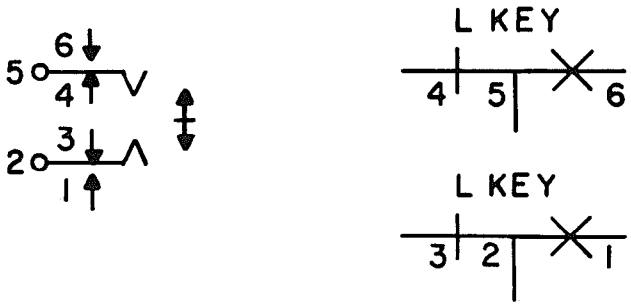


(f) Turnbutton type

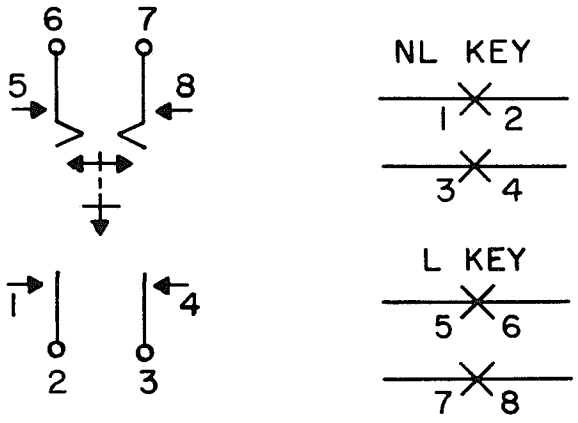
(1) One direction



(2) Two direction

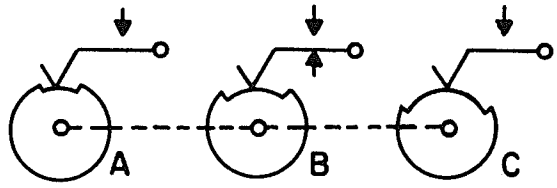


(g) Plunger — turnbutton type



(h) Telegraph-type

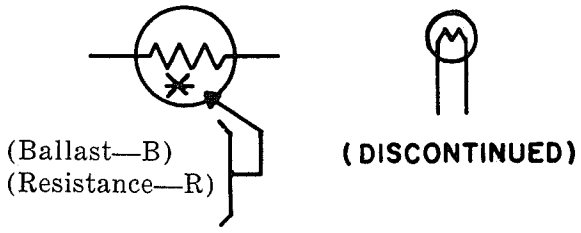
(i) Selector-type



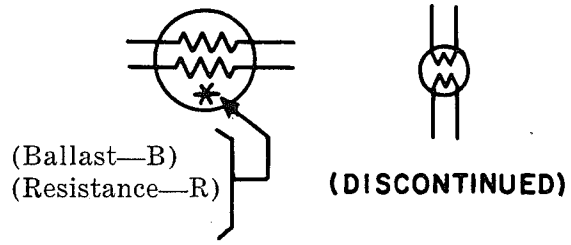
2.44 ***Keytop Diagram*** (See 2.23)

2.45 ***Lamp***

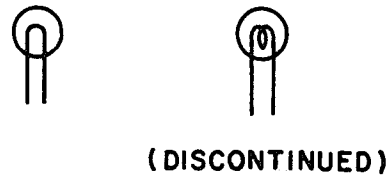
(a) Single-filament ballast or resistance



(b) Double-filament ballast or resistance

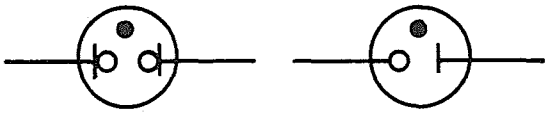


(c) Illuminating-type



(d) Switchboard-type

(e) Glow-type



AC type DC type

(DISCONTINUED)

2.46 ***Loudspeaker, Horn, Howler, Telephone Receiver*** (tone ringer)

Note: 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

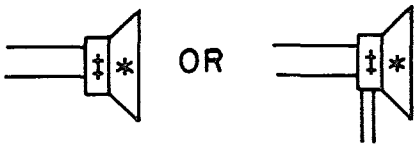
* HW — Howler

* LS — Loudspeaker

‡ MG — Magnetic armature

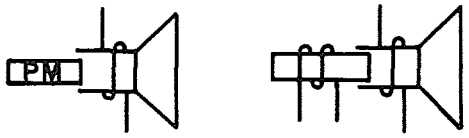
‡ PM — Permanent magnet with moving coil

* TR — Telephone receiver (tone-ringer)



See preceding note

(DISCONTINUED)



2.47 ***Machine, Rotating***

(a) Generator (general)

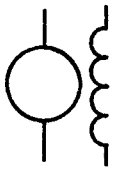
(b) Motor (general)

(c) Winding symbols

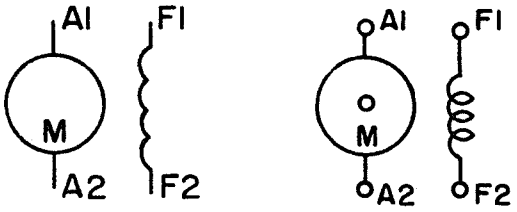
(1) 1-phase

(2) 3-phase wye (grounded)

(d) Separately excited direct-current generator or motor

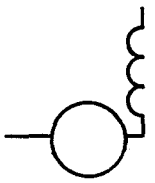


(DISCONTINUED)

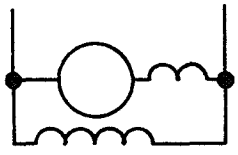


(e) Separately excited direct-current generator or motor; with commutating or compensating field winding or both

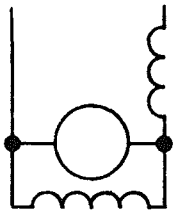
(f) Direct-current series motor or 2-wire generator



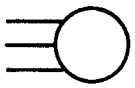
(g) Direct-current shunt motor or 2-wire generator; with commutating or compensating field winding or both



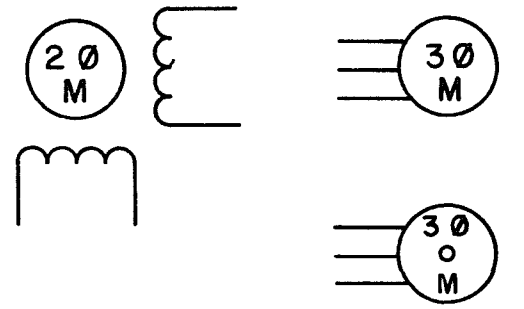
(h) Direct-current compound motor or 2-wire generator or stabilized shunt motor



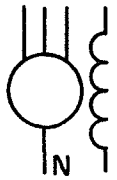
(i) Squirrel-cage induction motor or generator, split-phase induction motor or generator, or repulsion motor



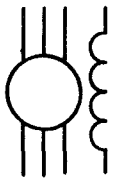
(DISCONTINUED)



(j) Synchronous motor or generator with neutral brought out



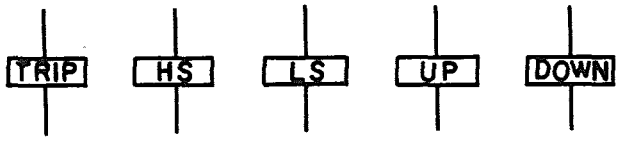
(k) Synchronous motor or generator with both ends of each phase brought out



(*l*) Hand-type generator

(DISCONTINUED)

2.48 ***Magnet, Clutch***



HS — High speed
LS — Low speed

2.49 ***Meters*** (See 2.38)

2.50 ***Microphone***

2.51 ***Motion***

(a) Translation, one direction

(b) Translation, both directions

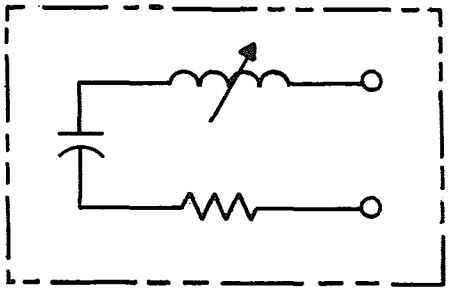
(c) Rotation, one direction

(d) Rotation, both directions

2.52 ***Motors*** (See 2.47)

2.53 ***Network***

(a) Typical network



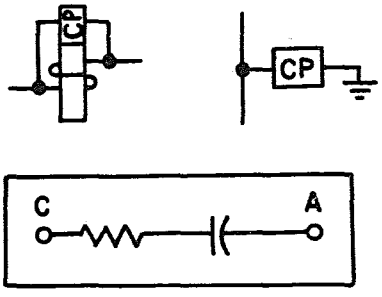
(b) Networks when used as contact protection

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. Polarity is not intended by the double line side of the symbol.

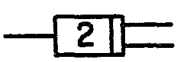
(1) 2- or 4-terminal network when used as contact protection

(See preceding note.)

(DISCONTINUED)



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



(See preceding note.)

2.54 ***Open*** (coaxial and waveguide application) [See 2.21(c).]

2.55 ***Oscillator***

2.56 ***Paths (transmission), Conductors, Wiring, etc***

Note: A single line represents the entire group of conductors or the transmission path needed to guide the power or the signal. For coaxial and waveguide work, the recognition symbol is used at the beginning and end of each kind of transmission path and at intermediate points as needed for clarity. In waveguide work, mode may be indicated.

(a) Line thickness

Transmission paths (talking and telegraph), bus bar charge and discharge leads

Fundamental circuit

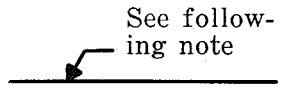
Off-normal ground

Off-normal battery

Sequence switch rotary magnetic feed

Division line used between figures

Symbols, signaling, and power control



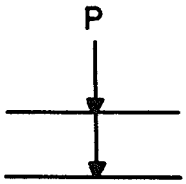
Circuit connections shown on other drawings, mechanical linkage, and shielding

Cross connection wire

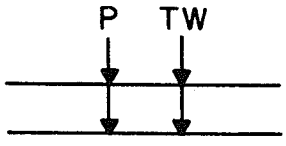
Boundary of mechanical grouping

Note: Symbols drawn in ink may be shown with a thinner line.

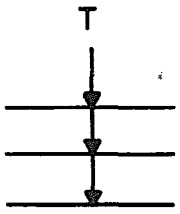
(b) Paired twisted wires



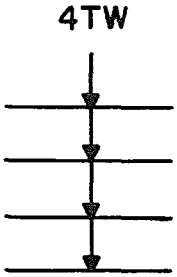
(c) Paired wires with other than frequency of twist obtained when pairing (P) symbol only is specified.



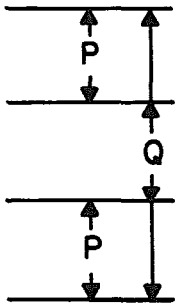
(d) Triple twisted wires



(e) 4-wire twist

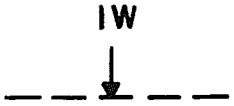


(f) Quad — (two pairs twisted)

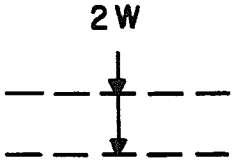


(g) Cross-connection wires

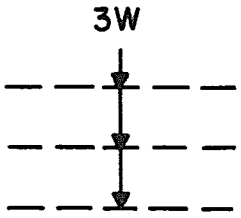
(1) 1-conductor cross-connection wire



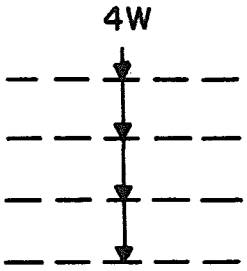
(2) 2-conductor cross-connection wire



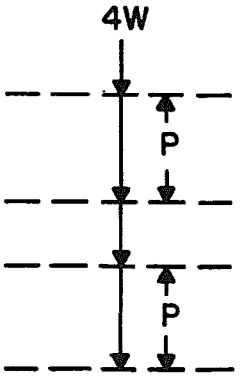
(3) 3-conductor cross-connection wire



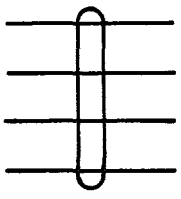
(4) 4-conductor cross-connection wire (spiral)



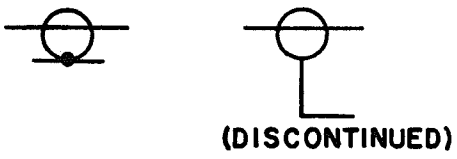
(5) Multiple twin cross-connection wire



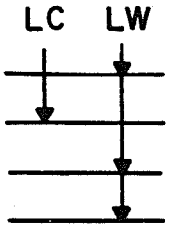
(h) Cable, switchboard



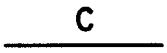
(i) Cable, coaxial



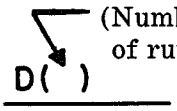
(j) Local cable or loose wiring



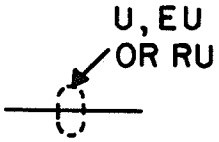
(k) Leads requiring segregation for crosstalk control, etc



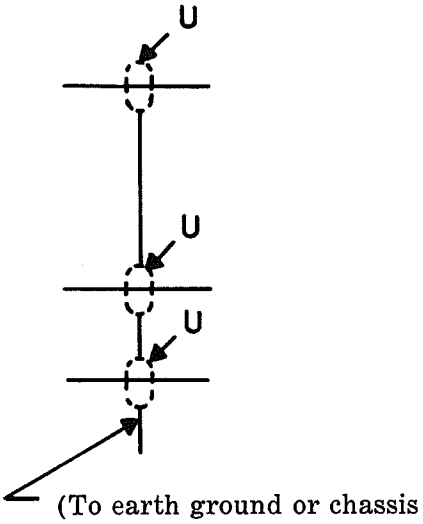
(*l*) Leads run from terminal to terminal



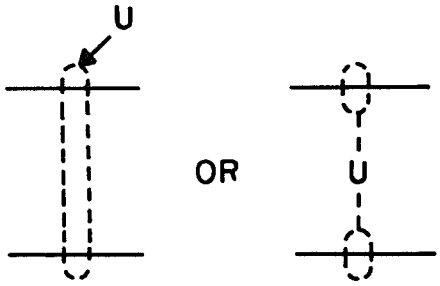
(m) Shielded single wire



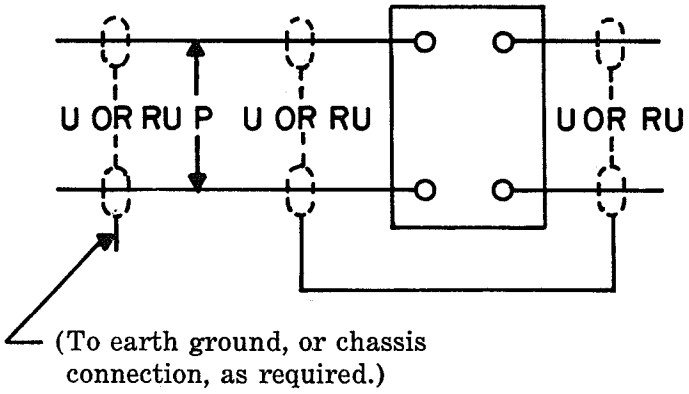
(n) Individually shielded wires with the shields connected together to earth ground or chassis connection



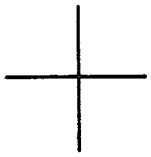
(o) Wires in same shield



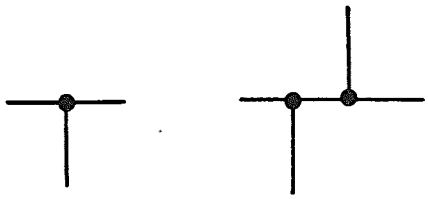
(p) Typical paired and shielded wires



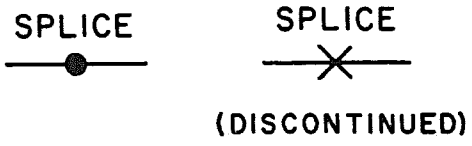
(q) Crossover (no junction)



(r) Single junction

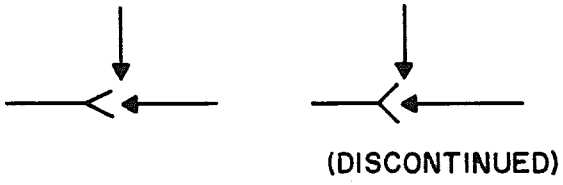


(s) Spliced wires



(t) Multiple connection

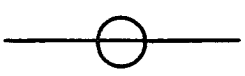
(u) Optional or alternative paths



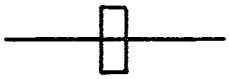
(v) Looping (detached contact application)

(w) Waveguide, transmission path (See note under 2.56)

(1) Circular waveguide



(2) Rectangular waveguide



(3) Ridged waveguide

2.57 ***Plug*** [See 2.16(g).]

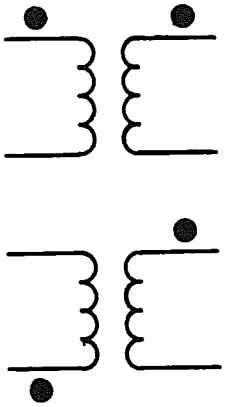
2.58 ***Point, Test***

Test points such as a jack, terminal, etc, shall be designated TP and, when required, shall be coded.

2.59 ***Polarity Mark***

Note: Dots adjacent to windings indicate instantaneous similar polarity in windings at points where dots are shown.

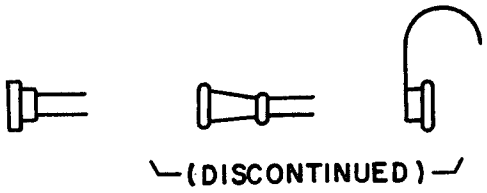
(a) Application



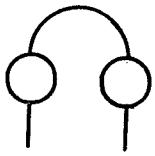
2.60 ***Post, Binding***

2.61 ***Receiver*** (Also see 2.33, 2.34, and 2.46.)

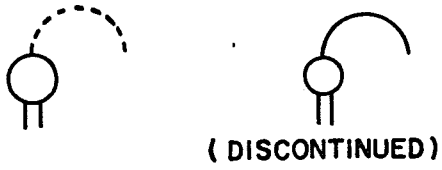
(a) General



(b) Double headset receiver



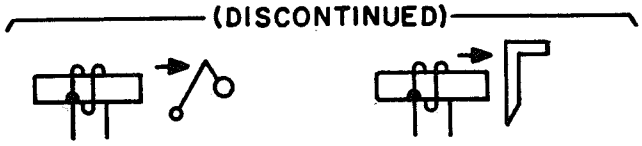
(c) Single headset receiver



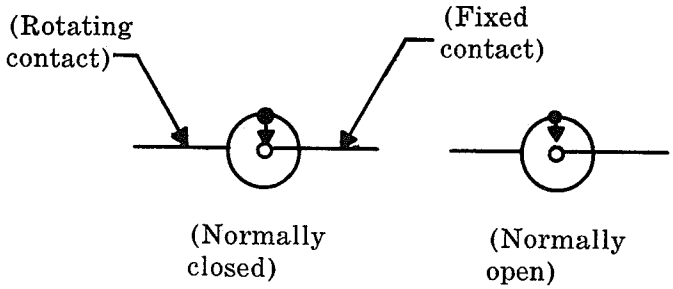
2.62 ***Receptacle*** [See 2.16(h).]

2.63 ***Rectifier, Metallic*** (See 2.93.)

2.64 ***Register, Message***



2.65 ***Regulator***



2.66 ***Relays*** (Also see 2.18.)

Note: 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

ML — Magnetic latching

NR — Nonreactance

P — Magnetically polarized using biasing spring or having magnetic bias

SA — Slow acting

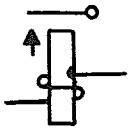
SO — Slow operate

SR — Slow release

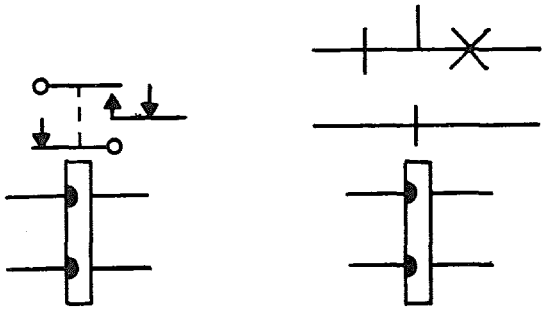
TS — Two-step

(a) Single-wound relay with make contact

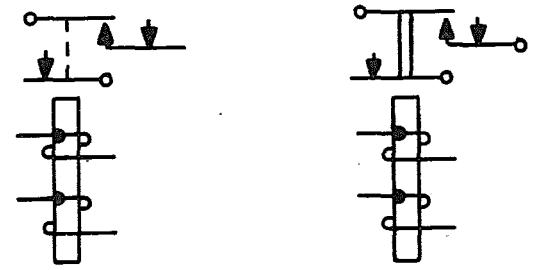
(DISCONTINUED)



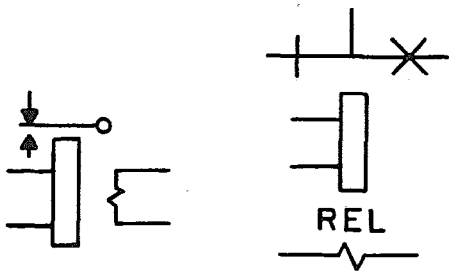
(b) Double-wound relay with break and make-before-break contacts



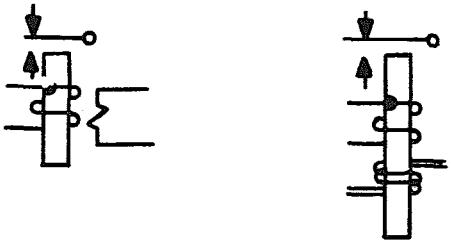
(DISCONTINUED)



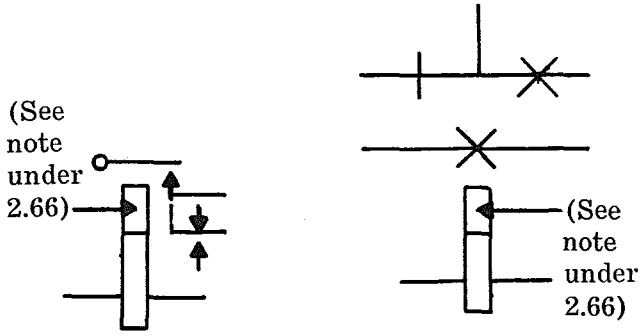
(c) Relay with noninductive winding and transfer contacts



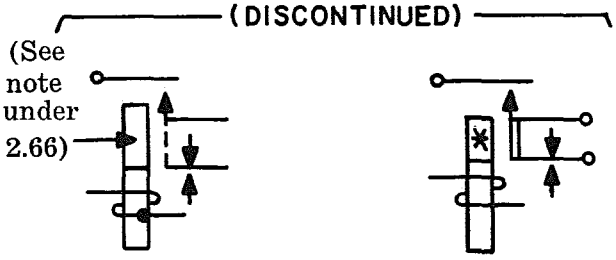
(DISCONTINUED)



(d) Relay with preliminary make contact

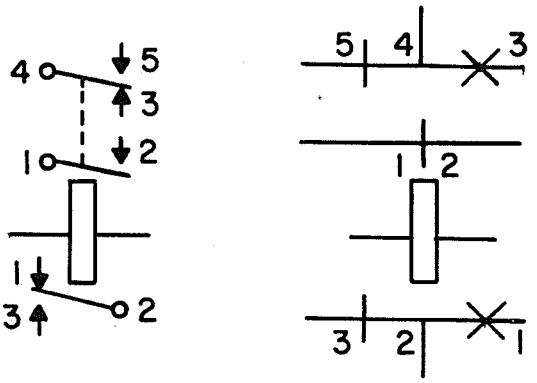


(DISCONTINUED)

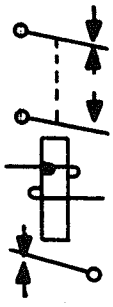


(e) Relay in normally operated position

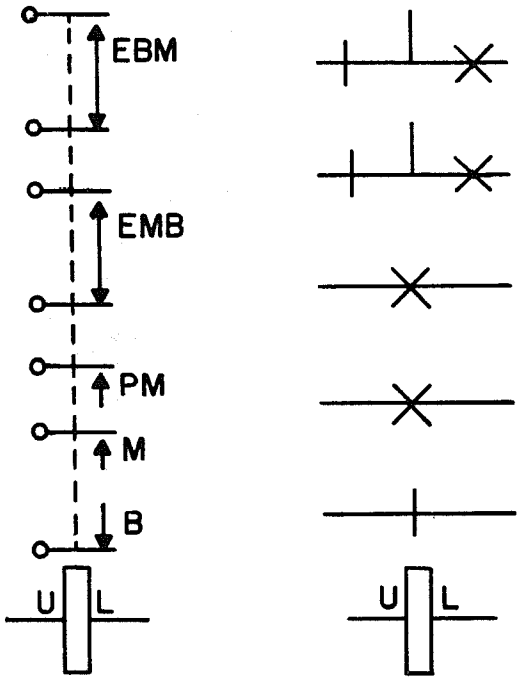
Note: Numbers are shown for correlation only.



(DISCONTINUED)

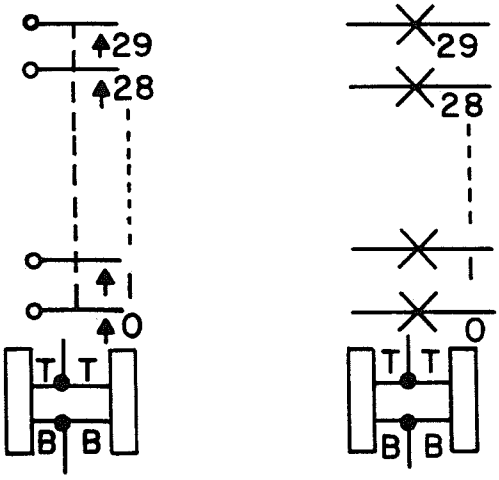


(f) Wire-spring relay

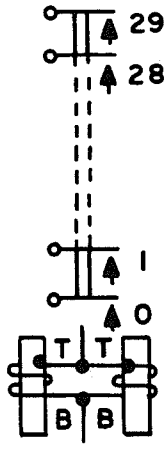


(g) Multicontact relay (flat-spring type)

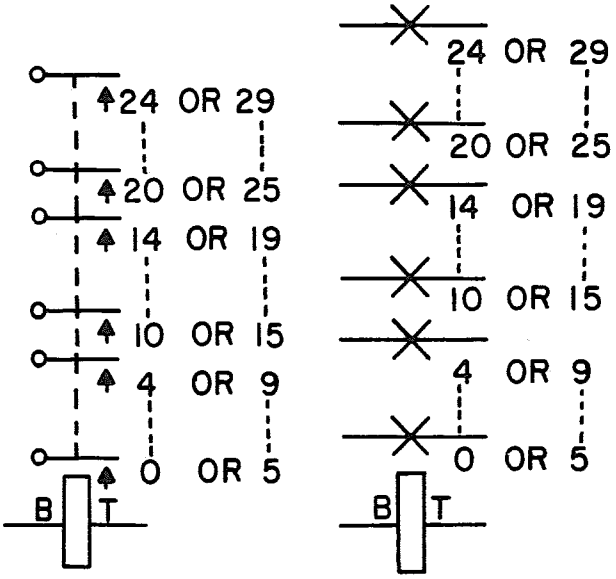
(1) Nonsplit multicontact relay



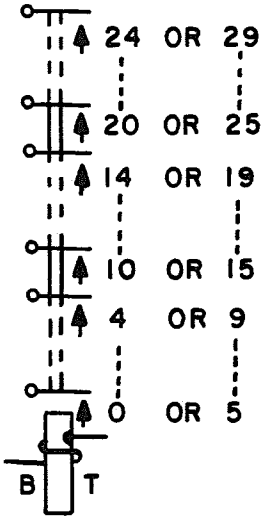
(DISCONTINUED)



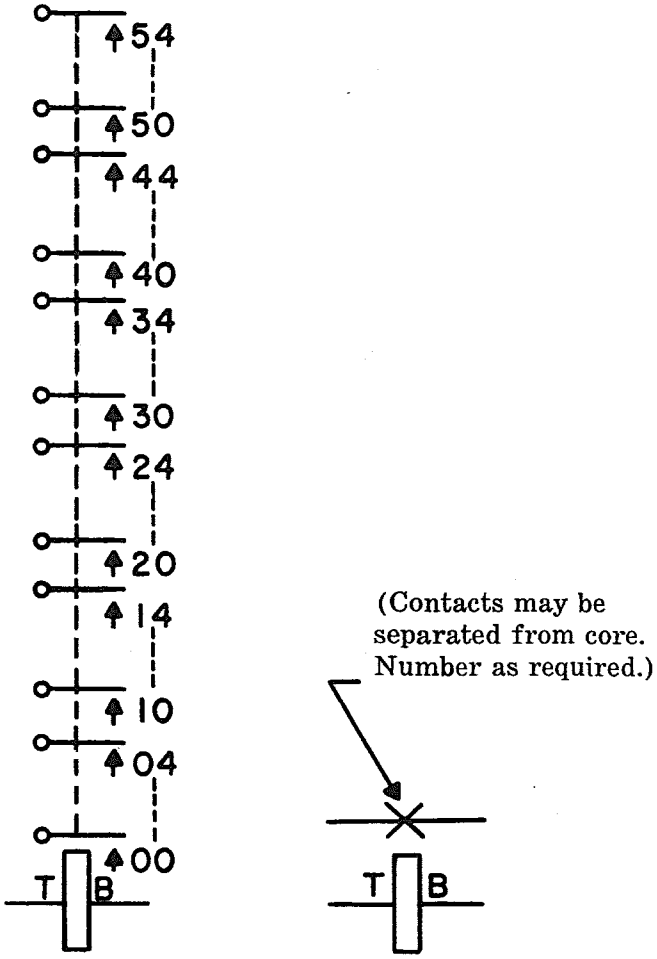
(2) Split multicontact relay (flat-spring type)



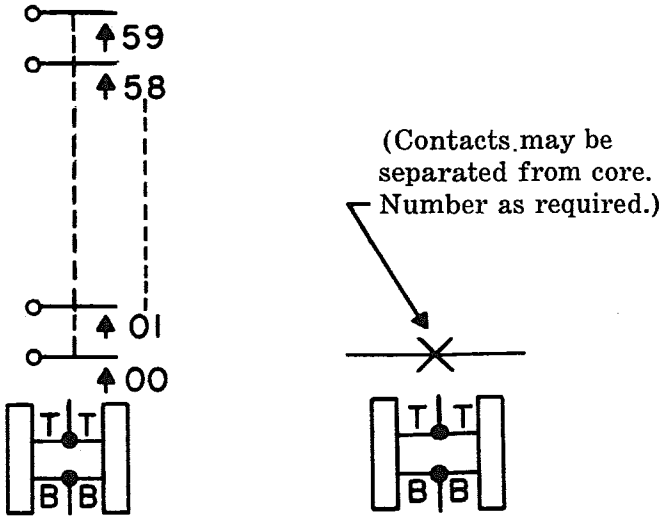
(DISCONTINUED)



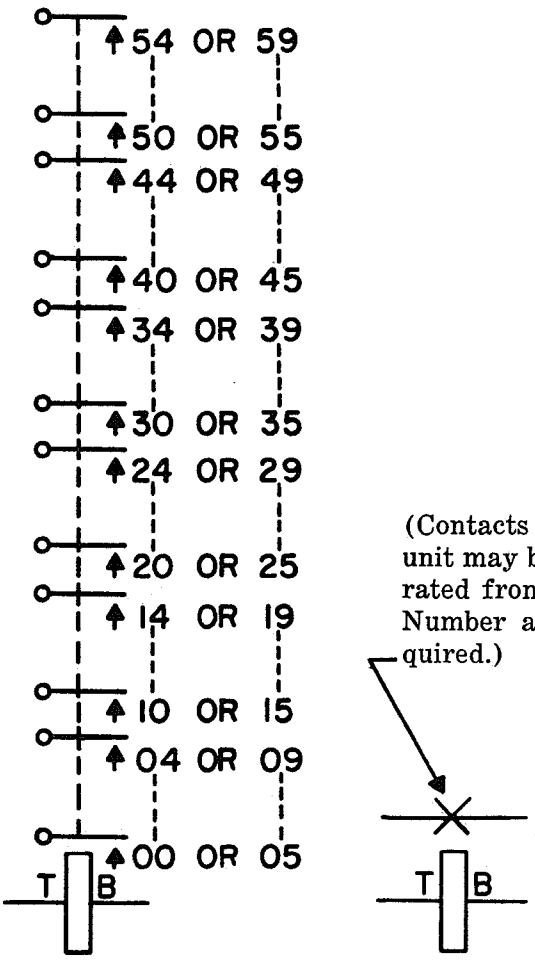
(3) Single unit multicontact relay—30 contacts (wire-spring type)



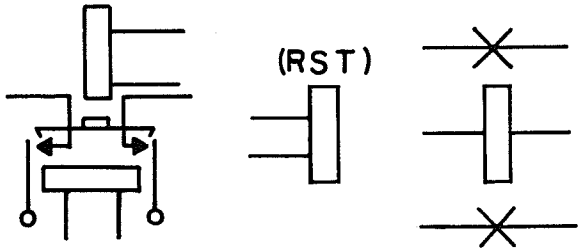
(4) Nonsplit double unit multicontact relay — 60 contacts (wire-spring type)



(5) Split double unit multicontact relay—30 contacts per unit (wire-spring type)



(h) Mechanically locking and electrically releasing relay



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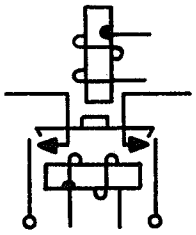
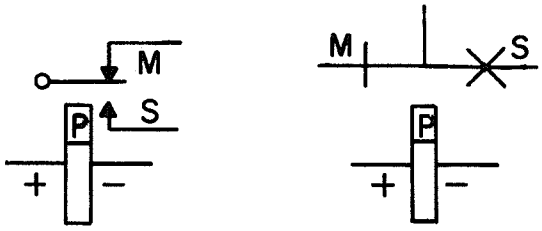


(i) Solenoid-type relay [See 2.18(b).]

(j) Polarized telegraph-type relay (See note under 2.66)



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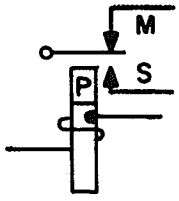
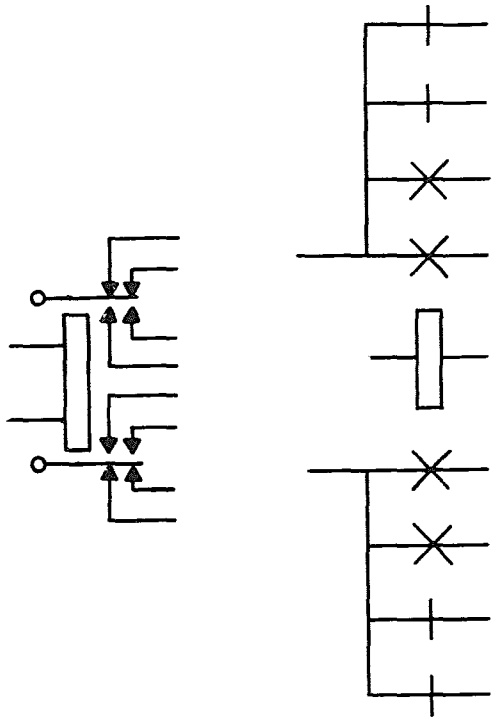
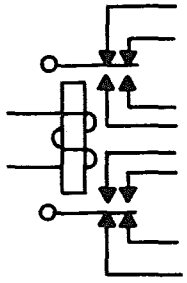


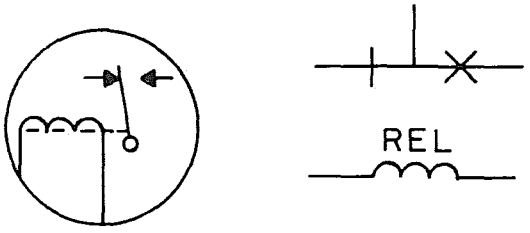
(k) Double contact-type relay



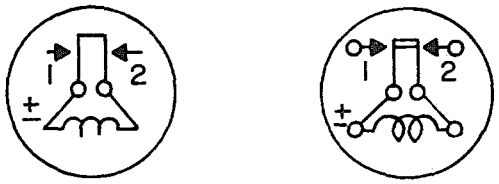
DISCONTINUED



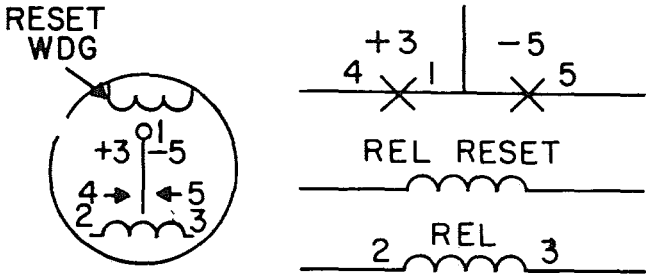
(*l*) Ammeter-type relay



(DISCONTINUED)



(m) Sensitrol-type relay



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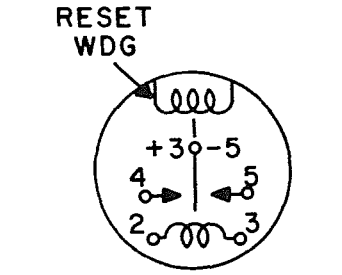
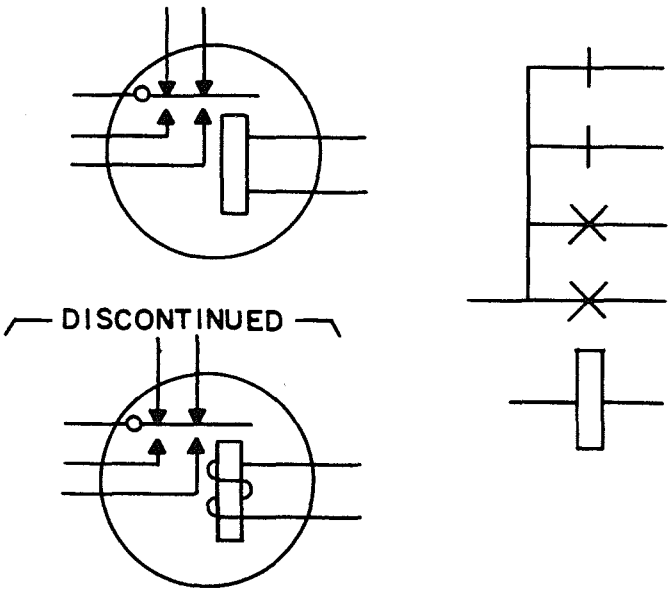
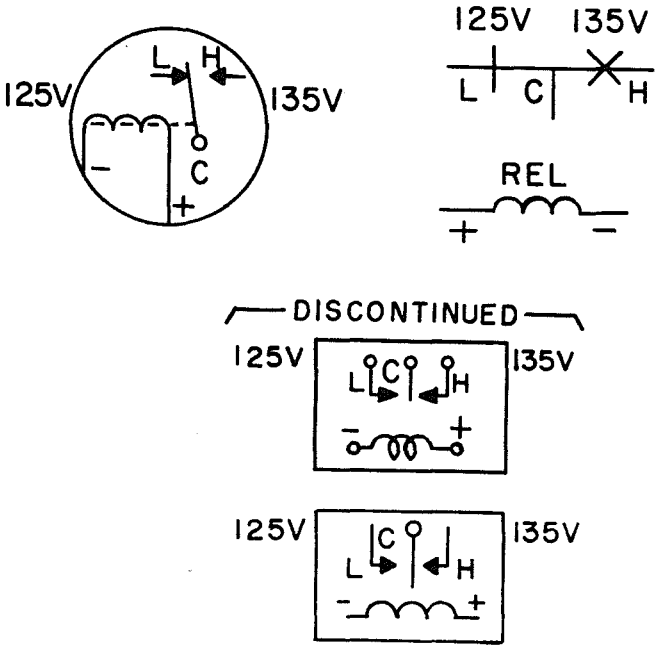


(n) Mercury contact-type relay



(o) Voltage-type relay

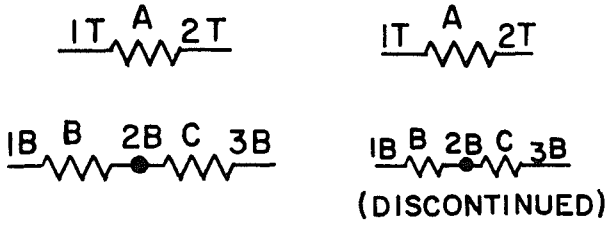


2.67 ***Resistor***

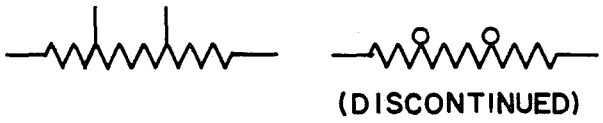
(a) Resistor with one winding

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

(c) Relay spool-type resistor



(d) Tapped windings

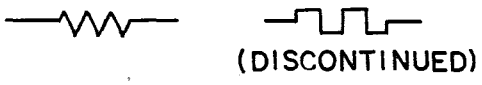


(e) Adjustable (rheostat and potentiometer)

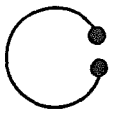
Note: CW indicates position of adjustable contact at the limit of clockwise travel viewed from knob or actuator end, unless otherwise indicated.

(See preceding note.)

(f) Heating resistor

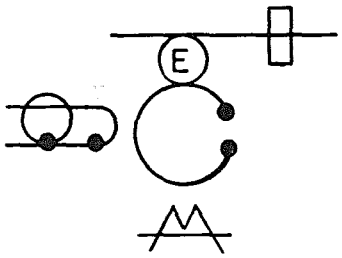


2.68 ***Resonator*** (excluding piezoelectric and magnetostriction devices) (microwave circuitry)

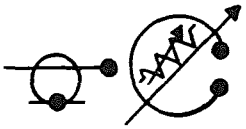


(a) Applications

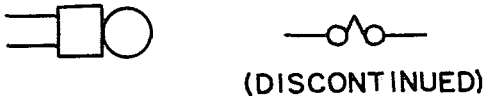
(1) Resonator coupled by an aperture to rectangular waveguide and by a loop to a coaxial (with mode suppression)



(2) Resonator coupled by a probe to a coaxial (with tuning, variable Q)



2.69 ***Ringer*** (Also see 2.08.)



2.70 ***Rotary joint*** (waveguide circuitry)

(a) General (with rectangular waveguide system)

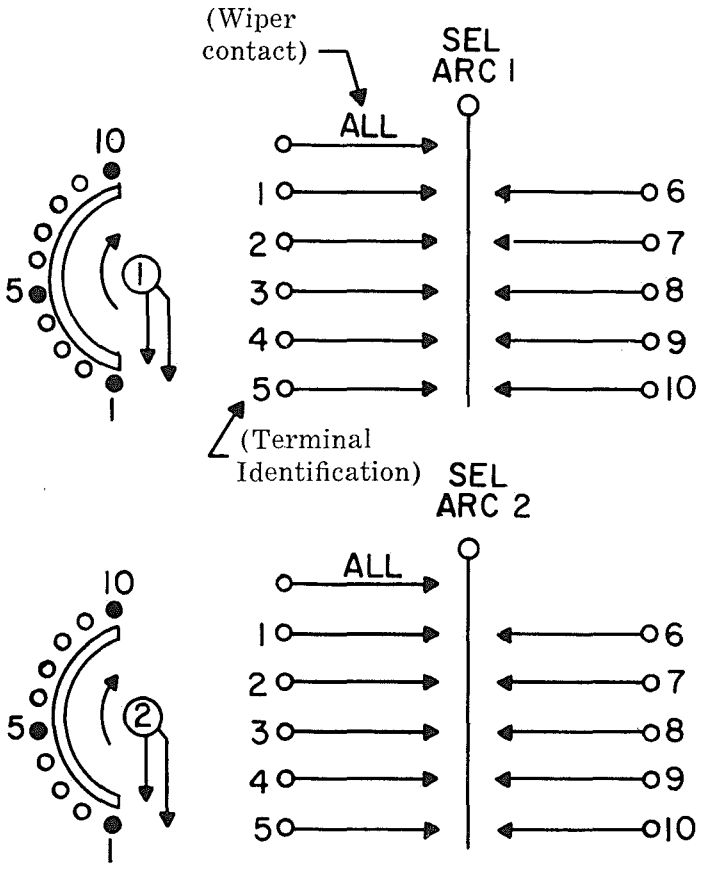
(b) Coaxial type in rectangular waveguide system

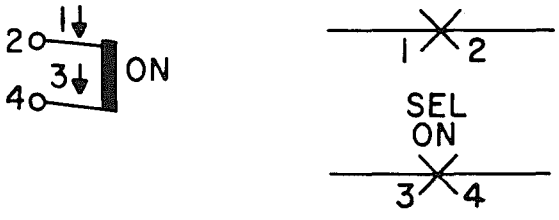
(c) Circular waveguide type in rectangular waveguide system

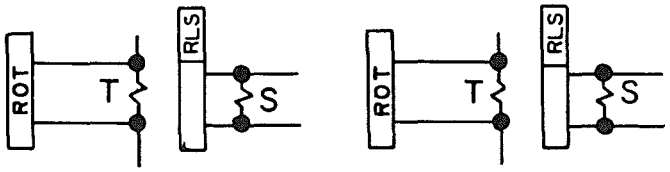
2.71 ***Selector***

Note: Terminal and position identifications are for illustration only.

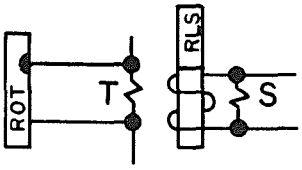
(a) 10-terminal rotary-type selector



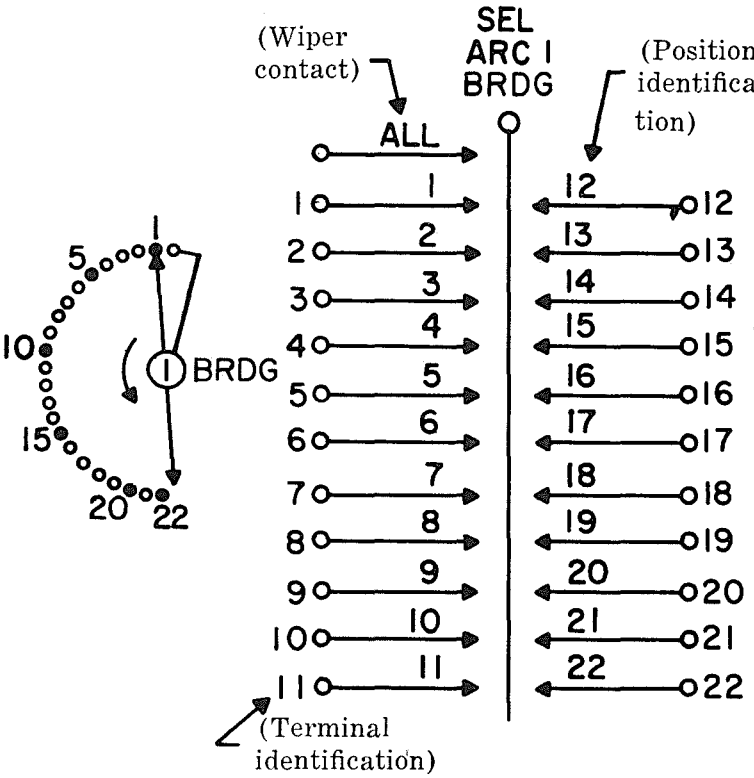


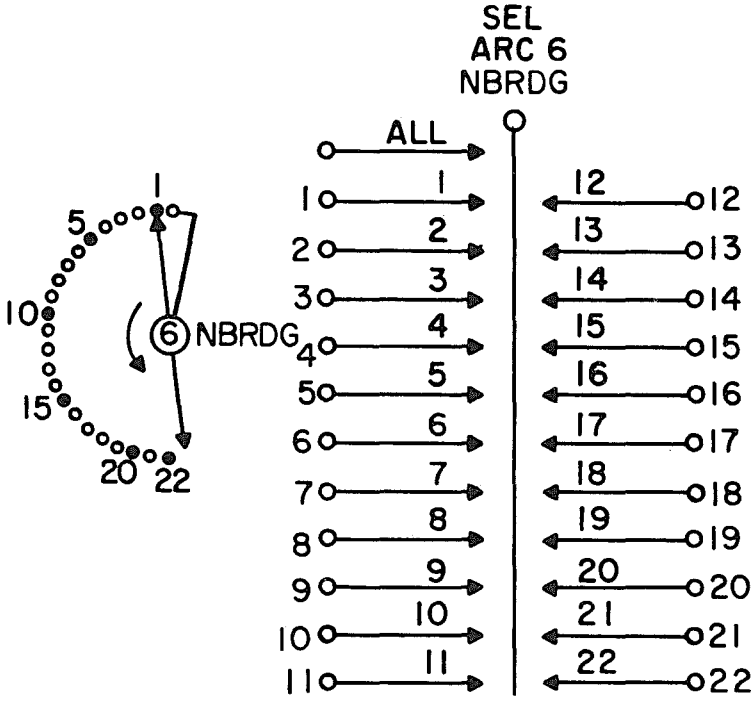


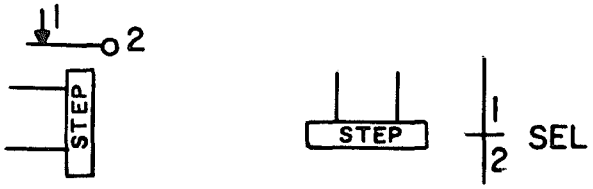
DISCONTINUED



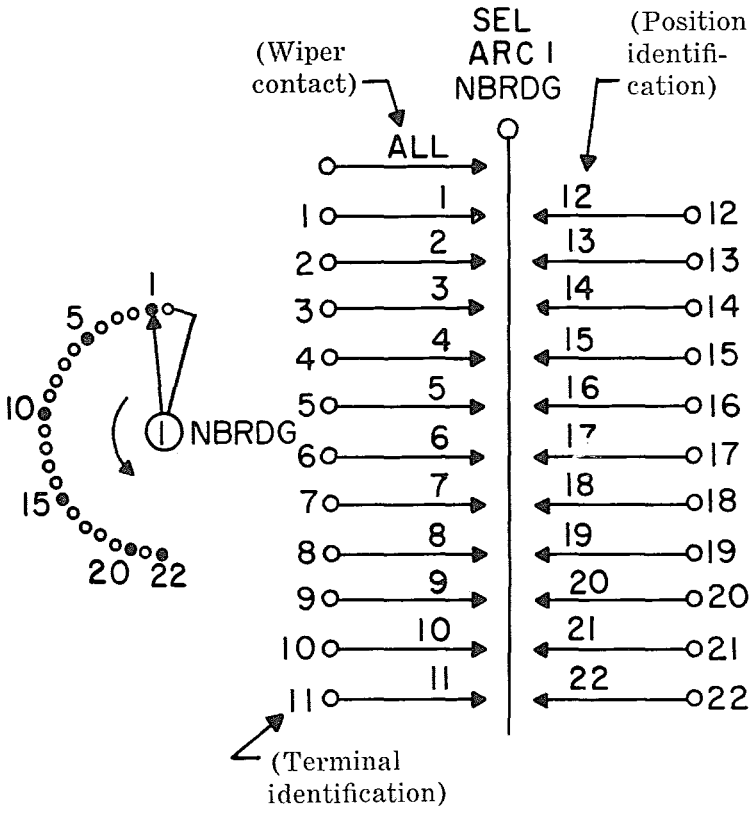
(b) 22-terminal rotary-type selector

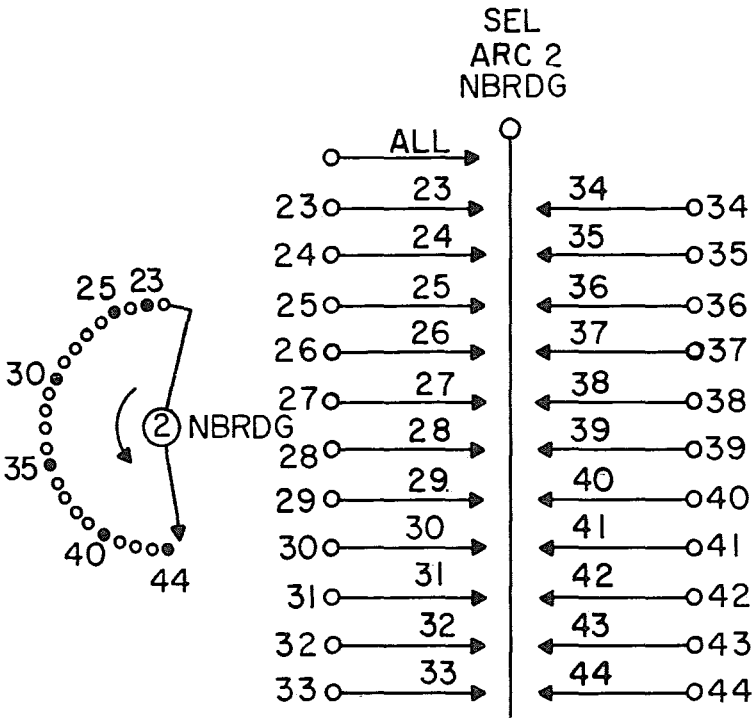


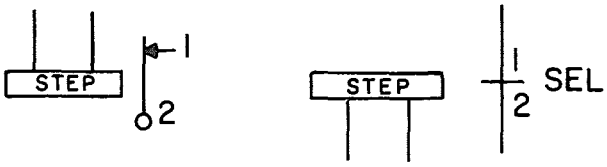




(c) 44-terminal rotary-type selector







2.72 *Semiconductor Devices*

(a) Semiconductor region with one ohmic connection (as shown, the horizontal line is the semiconductor region and the vertical line is the ohmic connection)

(b) Semiconductor region with a plurality of ohmic connections

(c) P region on N region (rectifying junction)

(d) N region on P region (rectifying junction)

(e) P emitter on N region

(f) N emitter on P region

(g) Collector on semiconductor region

(h) Transition between regions of dissimilar conductivity types either P to N or N to P (The short slant line indicates point of change along the horizontal line from P to N or N to P. No connection shall be made to the short line)

(i) Special properties

Note: If necessary, a special function or property essential for circuit operation may be indicated by a supplementary symbol placed adjacent to the symbol

(1) Light dependence

(DISCONTINUED)

λ

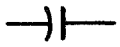
(2) Temperature dependence

t°

(DISCONTINUED)

T

(3) Capacitive device



(DISCONTINUED)

τ

(4) Tunneling device

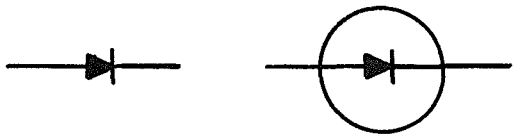
(5) Breakdown device

(DISCONTINUED)

B

(j) Applications; two terminal devices

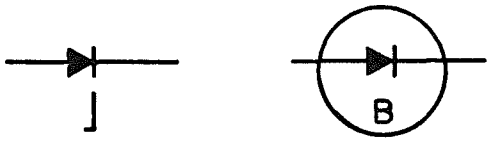
(1) Semiconductor diode (PN diode) Semiconductor rectifier diode



(DISCONTINUED)

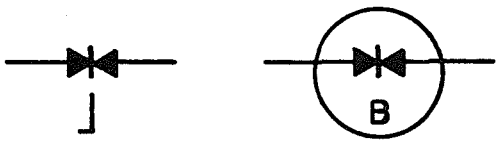
(2) Capacitive diode (varactor)

(3) Breakdown diode, unidirectional (also backward diode)



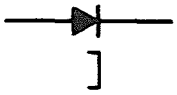
(DISCONTINUED)

(4) Breakdown diode, bidirectional

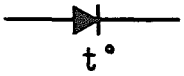


(DISCONTINUED)

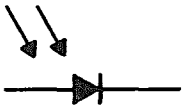
(5) Tunnel diode



(6) Temperature dependent diode

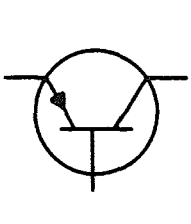


(7) Photodiode



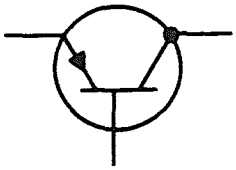
(k) Applications; three or more terminal devices

(1) PNP transistor (also PNIP transistor, if omitting the intrinsic region will not result in ambiguity)

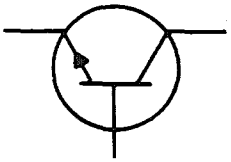


(DISCONTINUED)

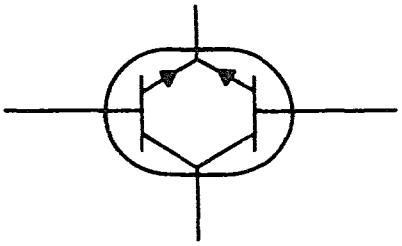
(2) PNP transistor with one electrode connected to envelope (in this case the collector electrode)



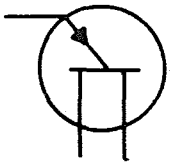
(3) NPN transistor (also NPIN transistor, if omitting the intrinsic region will not result in ambiguity)



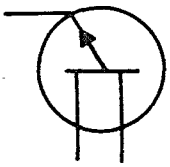
(4) Double NPN transistor



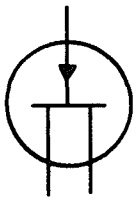
(5) Unijunction transistor with N type base



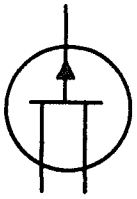
(6) Unijunction transistor with P type base



(7) Field-effect transistor with N type base

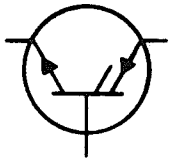


(8) Field-effect transistor with P type base

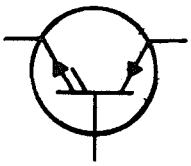


(9) NPNP or PNPN transistor

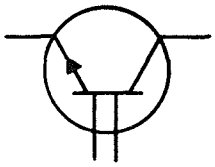
(P turn on)



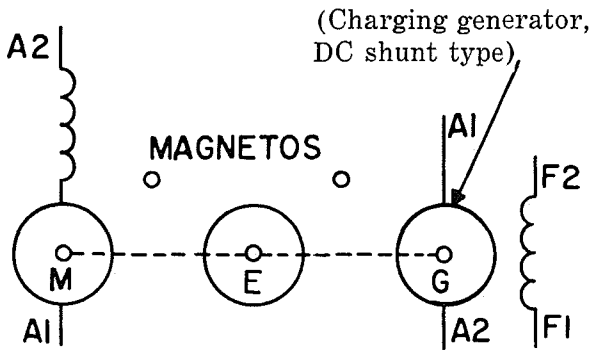
(N turn on)



(10) NPN transistor with transverse-biased base

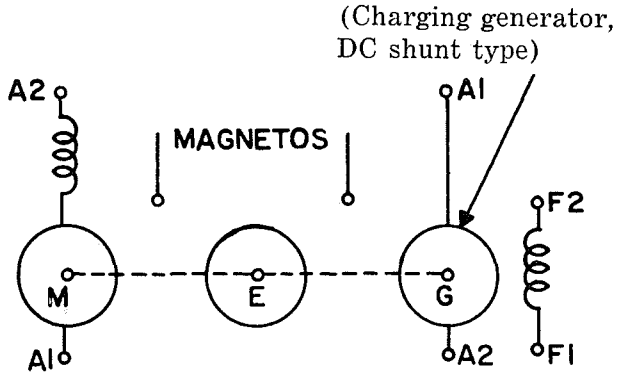


2.73 ***Set, Engine-Generator***



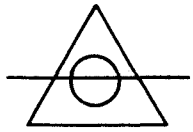
(With starting motor and magnetos)

DISCONTINUED



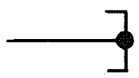
(With starting motor and magnetos)

2.74 ***Shifter, Phase*** (microwave circuitry)

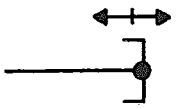


2.75 ***Short*** (microwave circuitry)

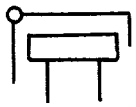
(a) Transmission path terminated in a short

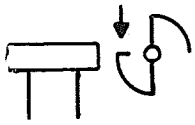


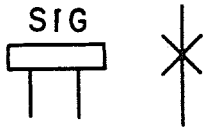
(b) Movable short

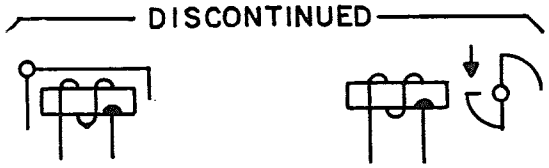


2.76 ***Signal***



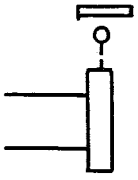


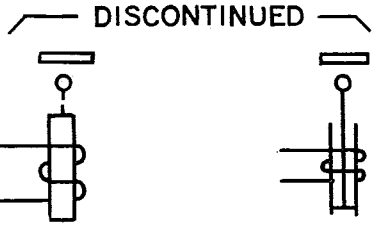




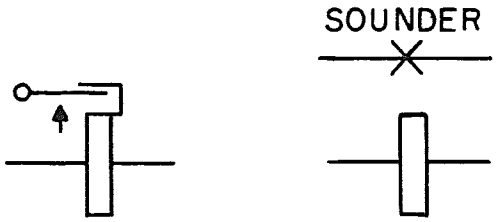
2.77 ***Sounder***

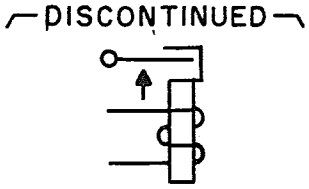
(a) Chime, tone bar, etc, type sounder



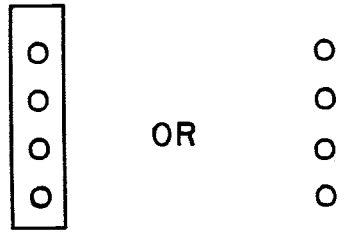


(b) Telegraph-type sounder





2.78 ***Strip, Terminal***

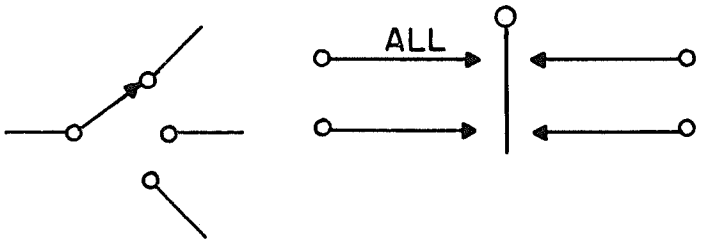


2.79 ***Suppression, Mode*** (microwave circuitry)

2.80 ***Switch***

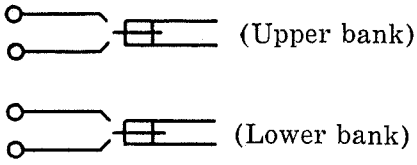
Note: The standard method of showing switches is in a position with no operating force applied. For those switch symbols where alternative contact representations are shown, the use of —×— and —|— symbols to indicate "make" and "break" is recommended only when the contacts are shown at different locations on the drawing.

(a) Coaxial or waveguide (any number of transmission paths may be used)



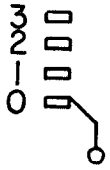
(b) Step-by-step system selector-type switch

(1) Wipers and banks

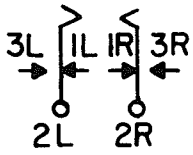


(Wipers) (Banks)

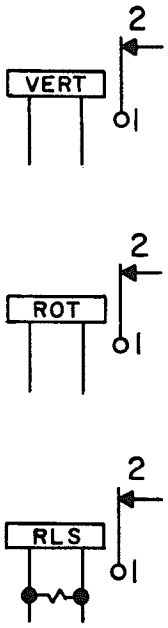
(2) Vertical commutator and wiper



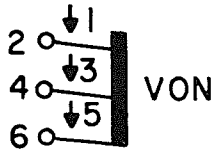
(3) Normal post springs



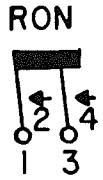
(4) Magnets



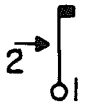
(5) Vertical off-normal springs



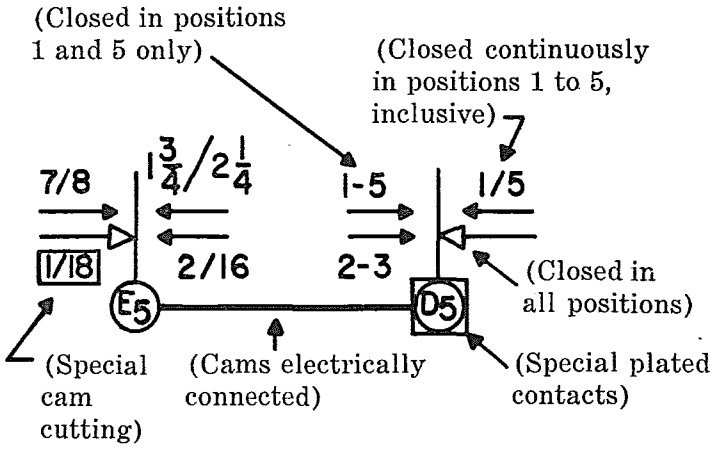
(6) Rotary off-normal springs

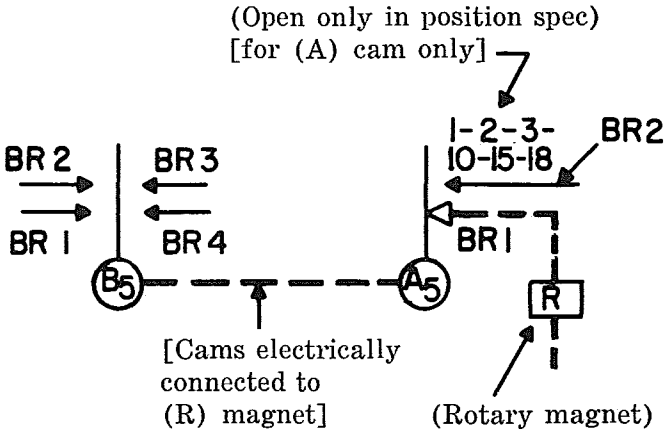


(7) 11th rotary step springs



(c) Sequence-type switch

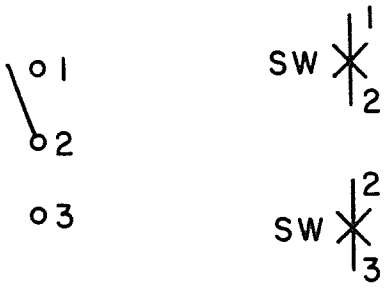




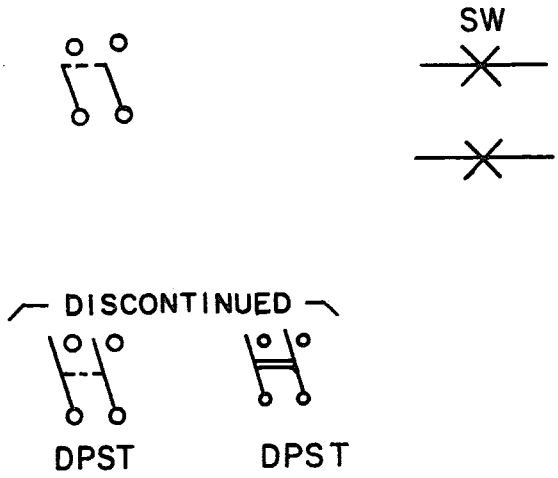
(d) Knife (See note under 2.80)

(1) Single pole, single-throw

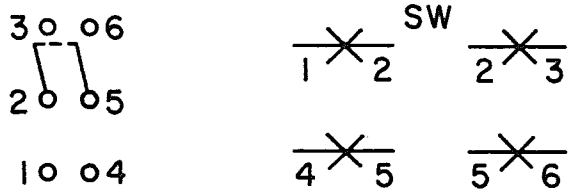
(2) Single pole, double-throw

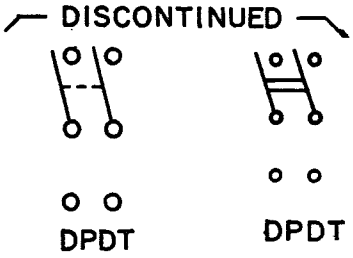


(3) 2-pole, single-throw



(4) 2-pole, double-throw



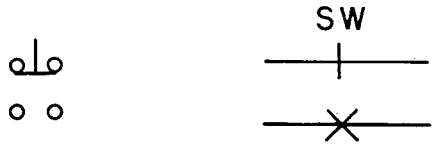


(e) Pushbutton, momentary (See note under 2.80)

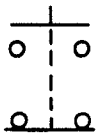
(1) Circuit opening (break)

(2) Circuit closing (make)

(3) Two-circuit



(DISCONTINUED)

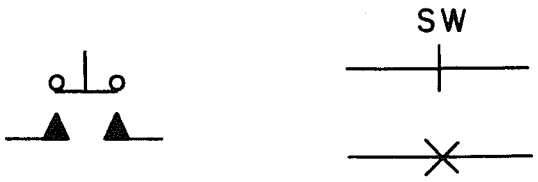


(f) Toggle, momentary (See note under 2.80)

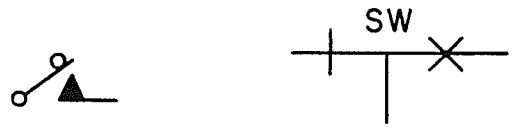
(1) Circuit closing (make)

(2) Circuit opening (break)

(3) Two-circuit



(4) Transfer



(g) Toggle, locking (See note under 2.80)

(1) Circuit closing (make)

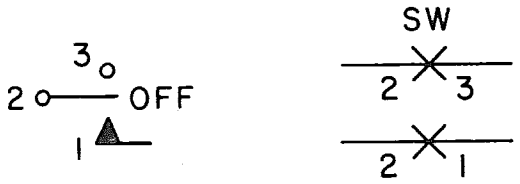
(2) Circuit opening (break)

(3) Transfer

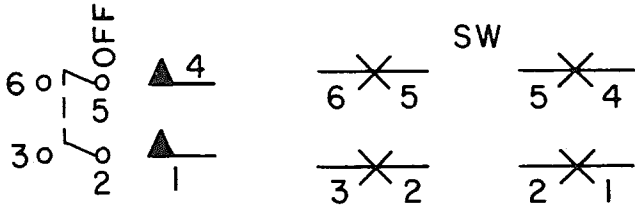
(4) 3-position

(h) Toggle, combination locking and momentary (See note under 2.80)

(1) 3-position, 1-pole: circuit closing, off, momentary circuit closing



(2) 3-position, 2-pole: circuit closing, off, momentary circuit closing

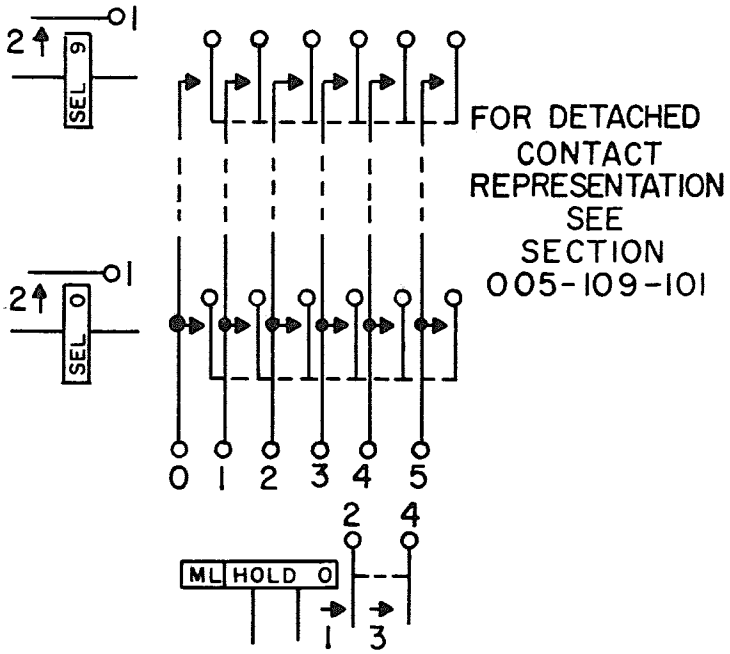


(i) Cover- or door-type switch

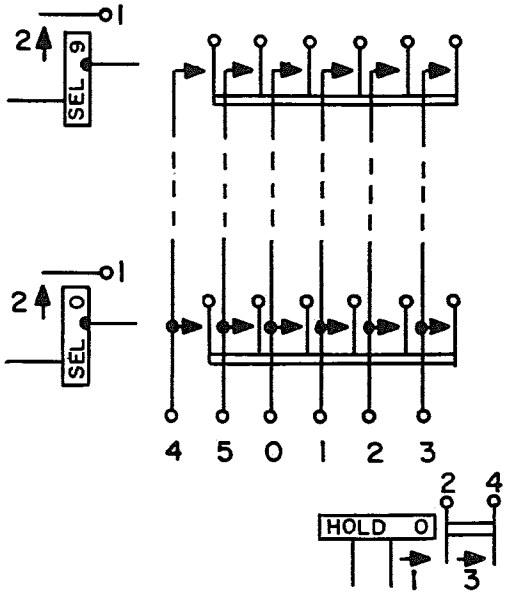
(1) Cover or door closed, switch opens when cover or door opens

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

(j) Crossbar selector-type switch

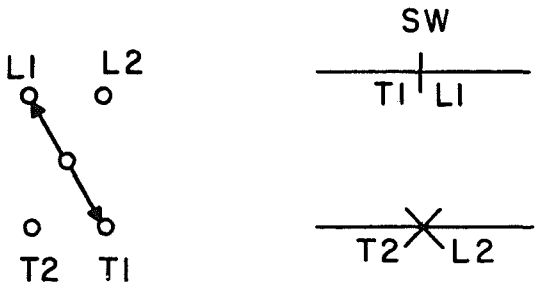


DISCONTINUED

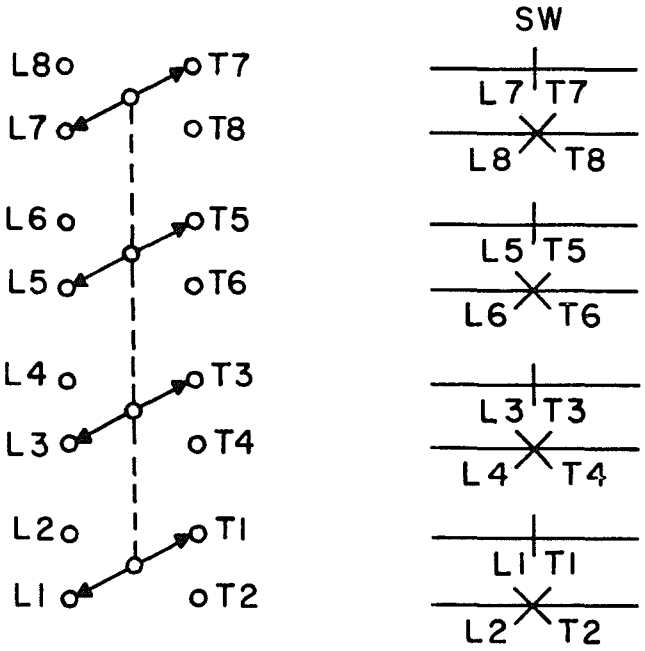


Note 1: SEL magnets may be placed on right or left of contacts as best suits wiring condition.
Note 2: Contacts on SEL or HOLD magnets may be shown at either end of magnet core to suit schematic conditions.
Note 3: HOLD magnets may be shown under SEL magnets where wiring from contact terminals is run vertically.

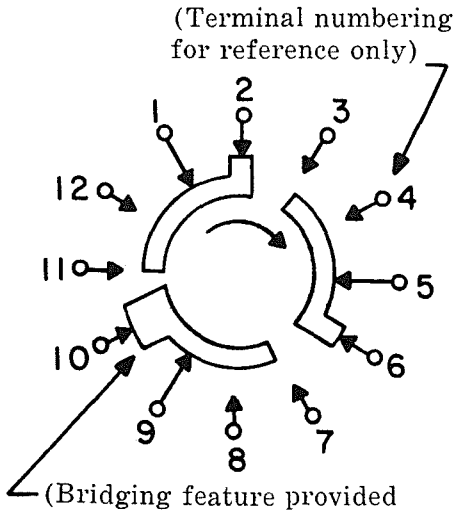
(k) Rotary-type (high voltage)



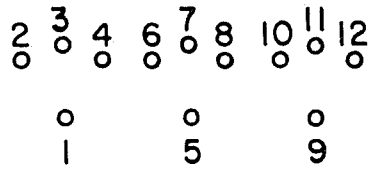
(1) Application



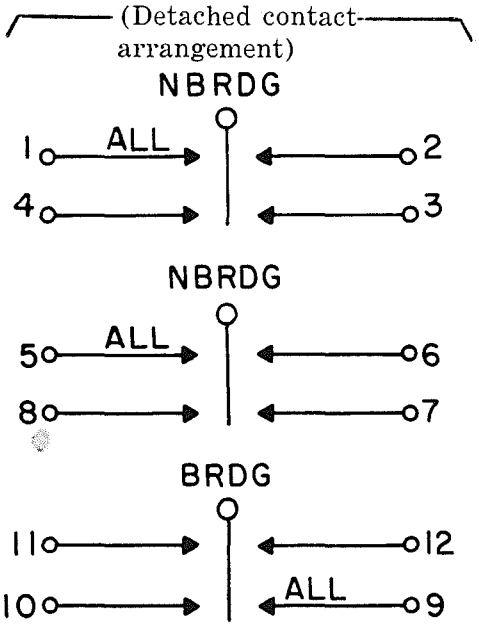
(*l*) Rotary-type (selector) switch (viewed from knob side, unless otherwise indicated)

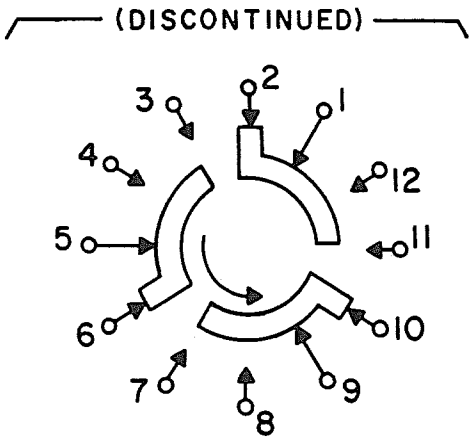


OR



(Terminal numbers in both illustrations correspond)



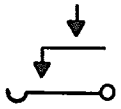


(m) Switch top diagram

(1) Rotary

(2) Toggle

2.81 ***Switchhook***



2.82 ***Terminal***

(a) Component terminal

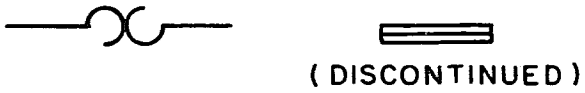
(b) Terminal strip or terminal punching

(c) Cross-connecting terminal

(d) Coaxial terminal

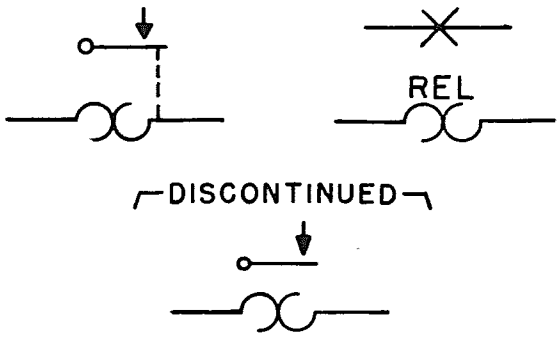
2.83 ***Thermal Element***

(a) Actuating device



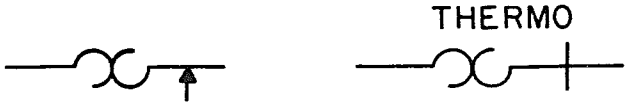
(b) Thermal cutout; flasher

(c) Thermal relay

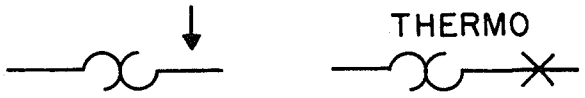


(d) Thermostat

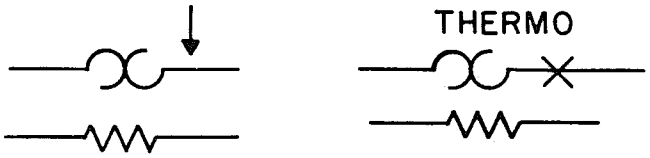
(1) With break contact

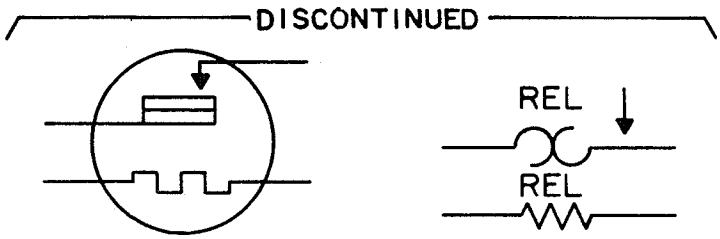


(2) With make contact

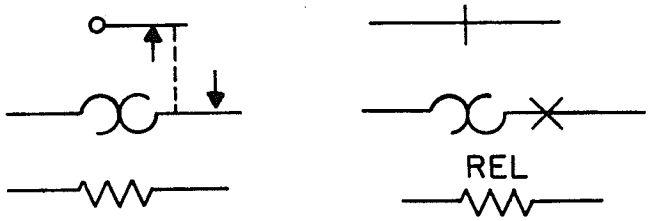


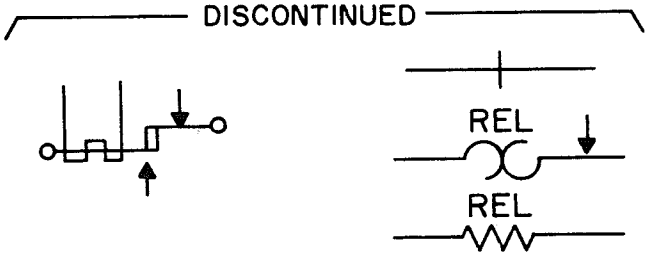
(3) With heater unit





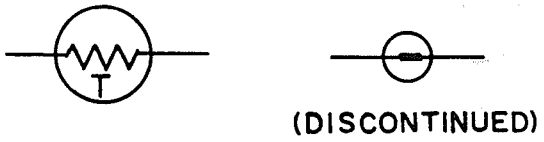
(4) Thermostat-type relay



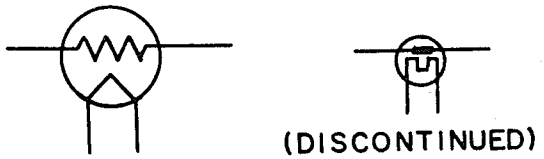


2.84 ***Thermistor***

(a) Directly heated thermistor



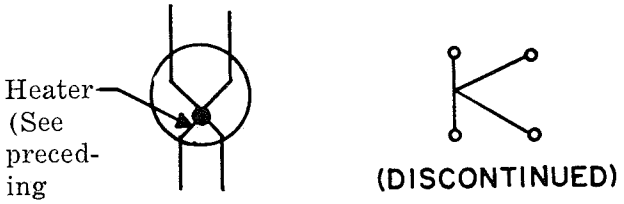
(b) Indirectly heated thermistor



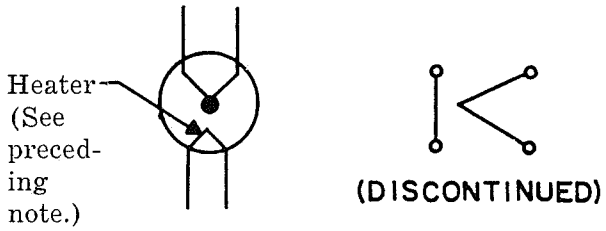
2.85 ***Thermocouple***

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

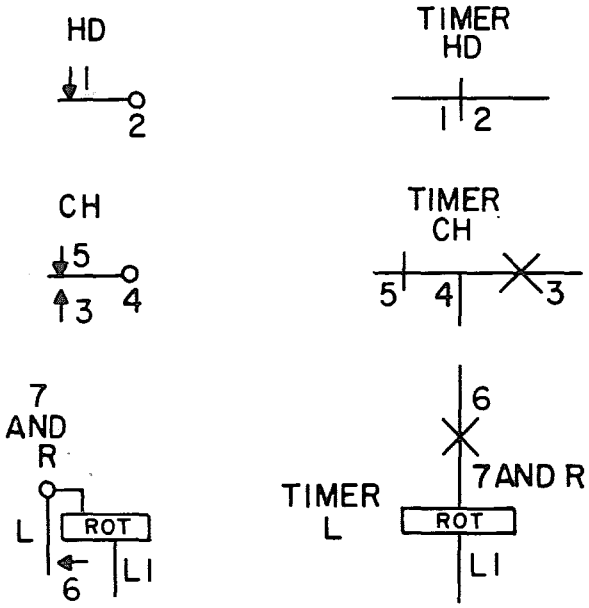
(a) Directly heated thermocouple



(b) Indirectly heated thermocouple



2.86 *Timer*

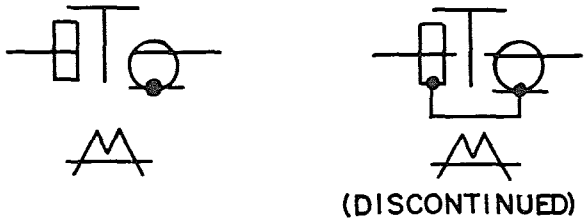


2.87 *Transducer, Mode* (microwave circuitry)

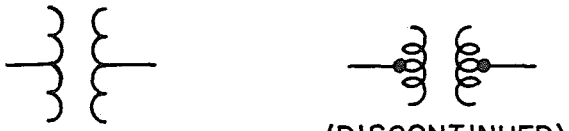
(a) Applications

(1) Transducer from rectangular to circular waveguide

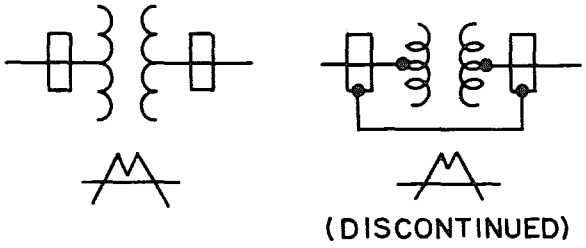
(2) Transducer from rectangular waveguide to coaxial with mode suppression



2.88 *Transformation For Tapers and Step Transformers Without Mode Change* (microwave circuitry)

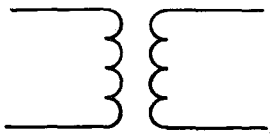


(a) *Application:* Transformer with mode suppression

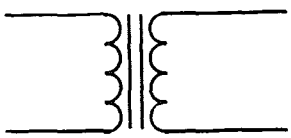


2.89 *Transformer* (Induction coil, repeating coil)

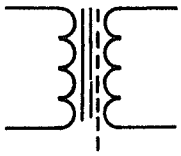
(a) General



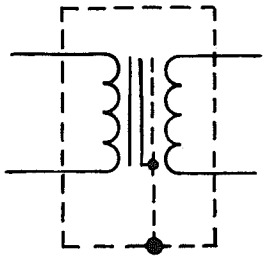
(b) With magnetic core



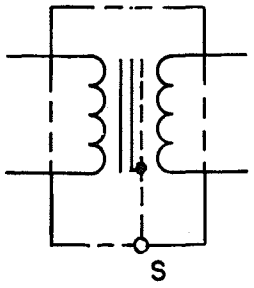
(c) With magnetic core and shield



OR

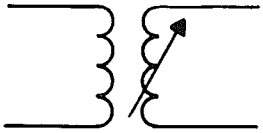


(Shield connected internally to core and case)

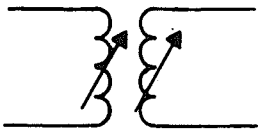


(DISCONTINUED)

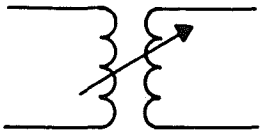
(d) With adjustable inductance winding



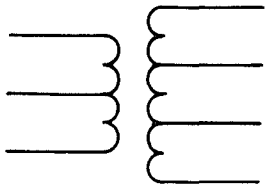
(e) With separately adjustable inductance in each winding



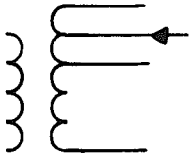
(f) Adjustable mutual inductor, constant-current transformer



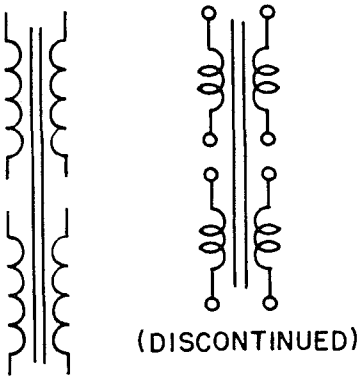
(g) With taps



(h) Load-ratio control transformer with taps

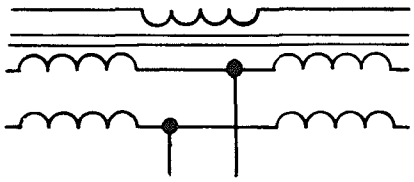


(i) Multiple winding

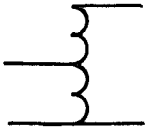


(DISCONTINUED)

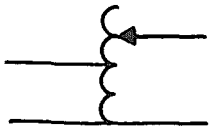
(j) Hybrid-type



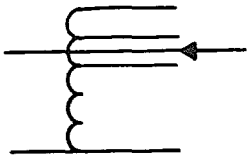
(k) Autotransformer



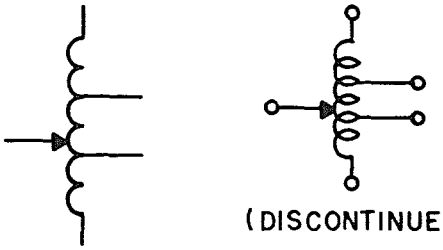
(1) Adjustable



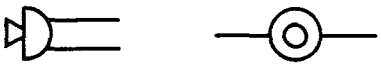
(*l*) Load-ratio control autotransformer



(m) Adjustable tap-type autotransformer



2.90 *Transmitter*



2.91 *Tube, Electron*

(a) Collecting electrode

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

(2) Target or X-ray anode (drawn at a 45-degree angle)

(b) Collecting and emitting electrode

(1) Dynode

(c) Alternately collecting and emitting

(1) Composite anode — photocathode

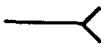
(2) Composite anode — cold cathode

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

(d) Controlling electrode

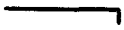
(1) Grid (including beam-confining or beam-forming electrodes)

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



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

(4) Excitor (contactor type)



(e) Coupling (See 2.21.)

(1) Coupling by loop (electromagnetic type)

Note: 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

Note 1: Leads may be connected in any convenient manner to ends of the ∧ provided the identity of the ∧ is retained.

Note 2: 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.

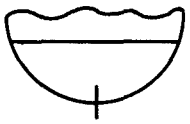
(2) Indirectly heated cathode

Note: 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

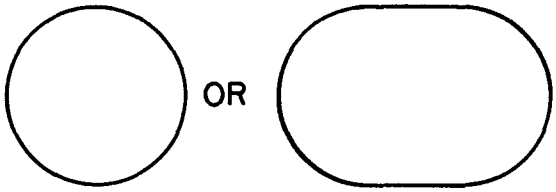


(6) Ionically heated cathode with provision for supplementary heating

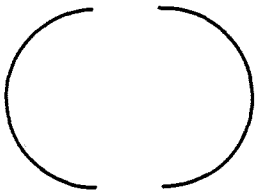
(g) Envelope (shell)

Note: 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

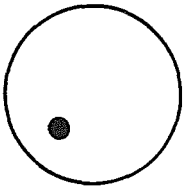


(2) Split envelope



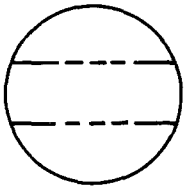
(3) Gas-filled

Note: The dot may be located as convenient.

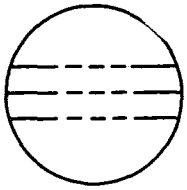


(h) Resonators (cavity type)

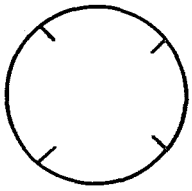
(1) Single-cavity envelope and grid-type associated electrodes



(2) Double-cavity envelope and grid-type associated electrodes

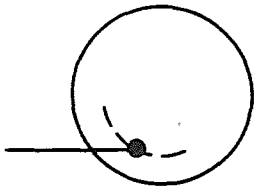


(3) Multicavity magnetron anode and envelope

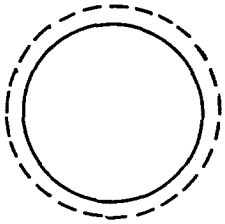


(i) Shield (against electric fields unless otherwise noted)

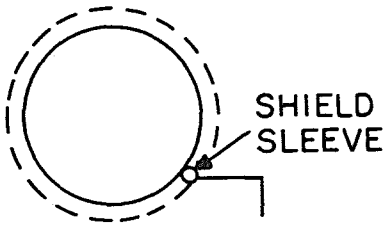
(1) Any shield against electric fields that is within the envelope and that is connected to an independent terminal



(2) Outside envelope

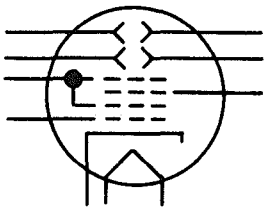


(3) Shield sleeve

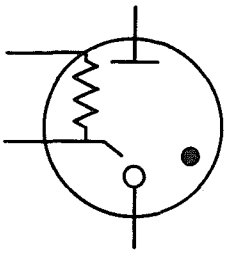


(j) Typical applications

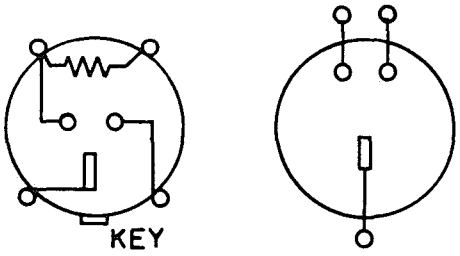
(1) Cathode-ray tube

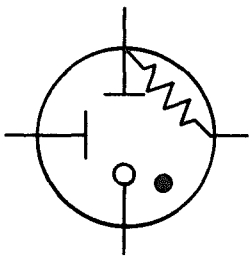


(2) Cold cathode tube

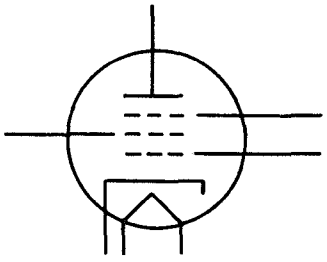


(DISCONTINUED)

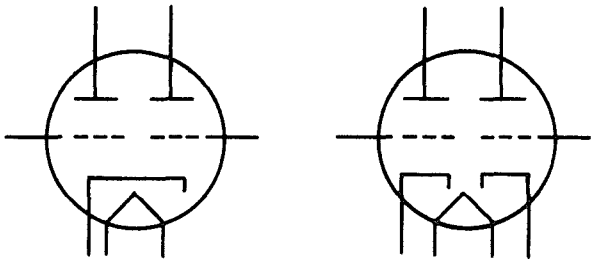




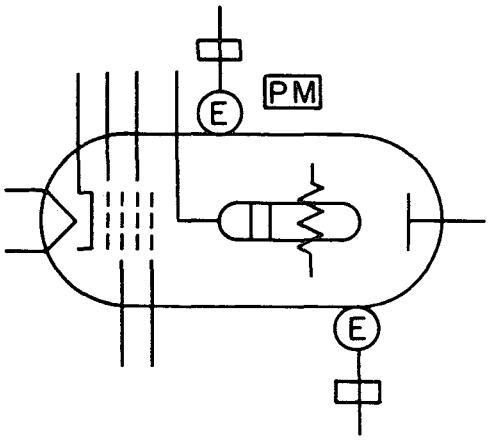
(3) Pentode tube



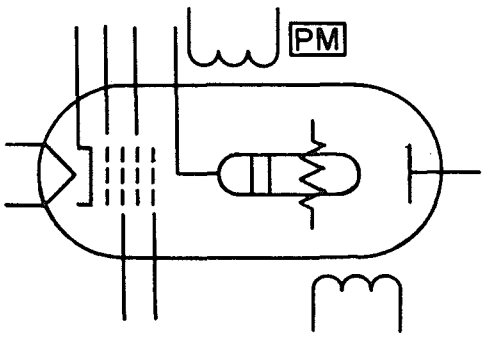
(4) Twin-triode tubes



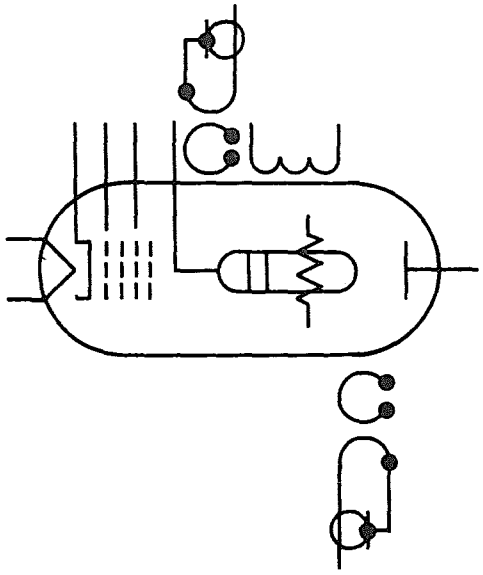
(5) Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling each by E-plane aperture to external rectangular waveguide



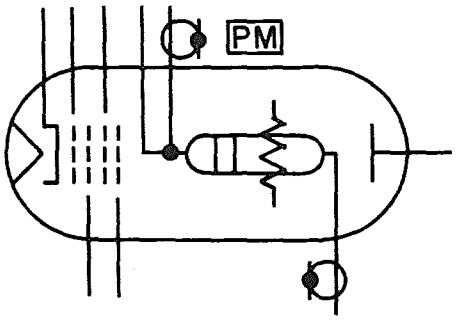
(6) Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling each by inductive coupling



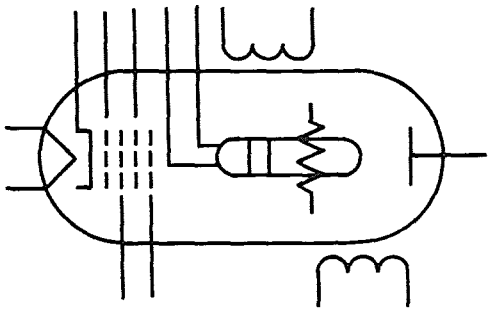
(7) Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, external electromagnetic focusing, rf input and rf output coupling each by external cavity and loop coupling to a coaxial path



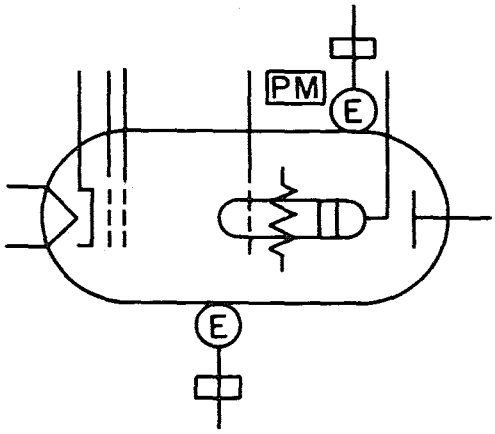
(8) Forward-wave traveling-wave-tube amplifier shown with four grids, having slow-wave structure with attenuation, magnetic focusing by external permanent magnet, rf input and rf output coupling each by direct connection from slow-wave structure to a coaxial path



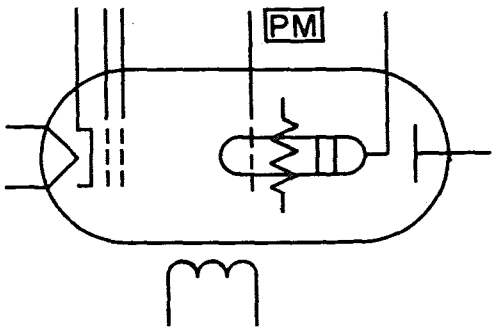
(9) Forward-wave traveling-wave-tube amplifier shown with four grids, having bifilar slow-wave structure with attenuation, electrostatic focusing, rf input and rf output coupling each by inductive coupling



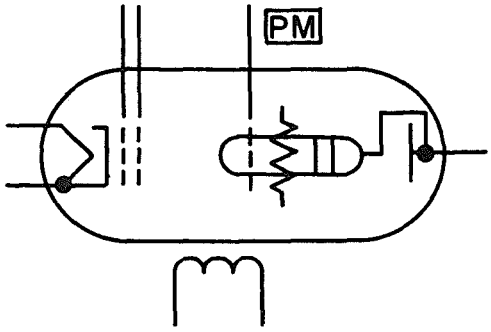
(10) Backward-wave traveling-wave-tube amplifier shown with two grids, having slow-wave structure with attenuation, sole (beam-aligning electrode), magnetic focusing by external permanent magnet, rf input and rf output coupling each by E-plane aperture to external rectangular waveguide



(11) Backward-wave traveling-wave-tube oscillator shown with two grids, having slow-wave structure with attenuation, sole (beam-aligning electrode), magnetic focusing by external permanent magnet, rf output coupling by inductive coupling

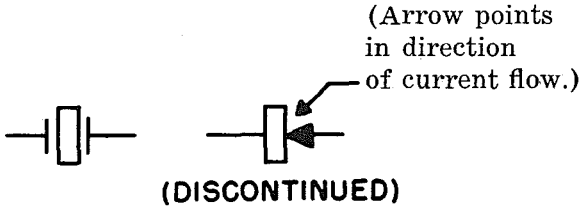


(12) Backward-wave traveling-wave-tube oscillator shown with two grids, having slow-wave structure with attenuation; sole (beam-aligning electrode), magnetic focusing by external permanent magnet, rf output coupling by inductive coupling, with slow-wave structure connected internally to collector



2.92 ***Unit, Crystal*** (piezoelectric)

Detector crystal



2.93 ***Varistor or Metallic Rectifier*** [Also see diode 2.72(j)]

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

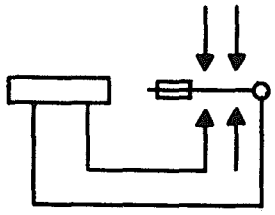
(a) Asymmetrical type

(b) Symmetrical type

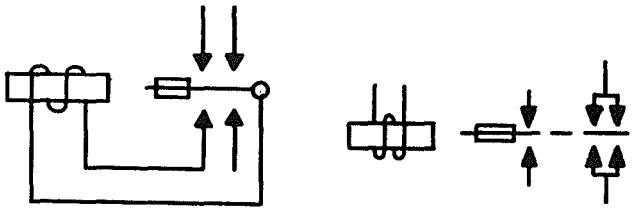
(DISCONTINUED)

2.94 ***Vibrator***

(a) Typical shunt drive (contacts as required)

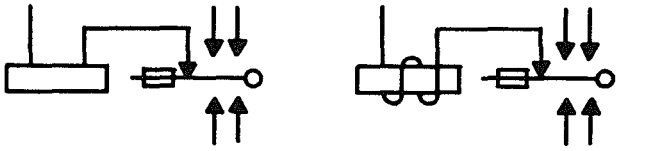


(DISCONTINUED)



(b) Typical separate drive (contacts as required)

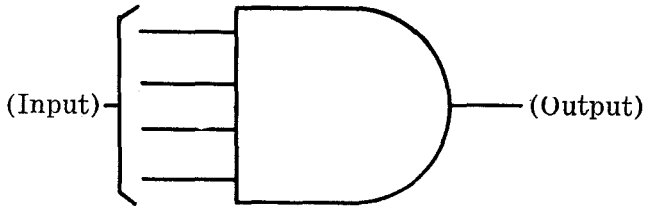
(DISCONTINUED)



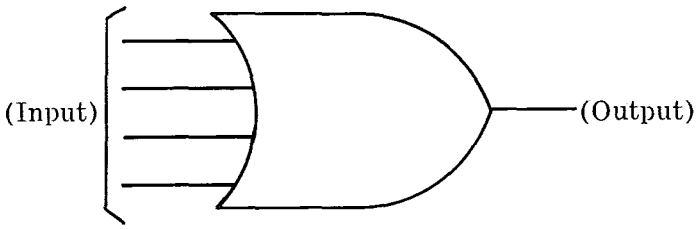
3. LOGIC SYMBOLS

3.01 ***Logic Element***

(a) AND



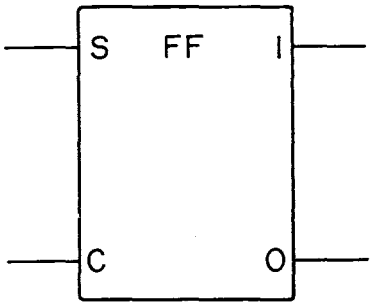
(b) OR



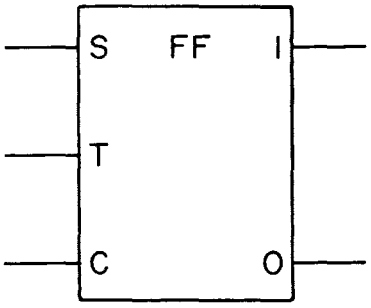
(c) Negation

3.02 *Multivibrator*

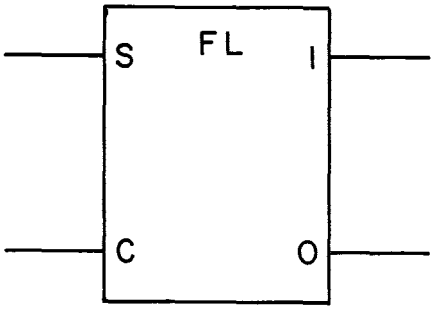
(a) Flip-flop Complimentary



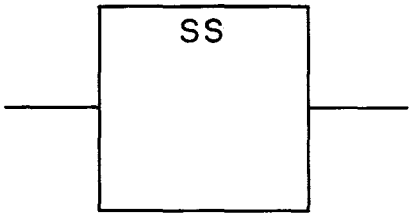
(b) Flip-flop Complimentary with toggle input



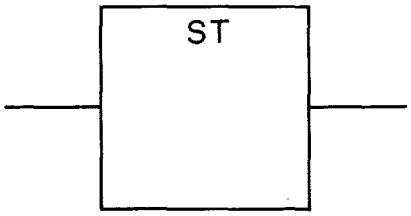
(c) Flip-flop Latch



(d) Single Shot



(e) Schmitt Trigger



4. ALPHABETICAL INDEX