INSTRUCTIONS

SWITCHGEAR DIAGRAMS

Switchgear

GENERAL ELECTRIC
SCHENECTADY, N.Y.

www . ElectricalPartManuals . com

SWITCHGEAR DIAGRAMS

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

INTRODUCTION

It is the object of this publication to provide a practical guide which will enable those who install, operate, or maintain General Electric switchgear, to make the best use of the electrical diagrams which we customarily supply with such equipment.

Four types of electrical diagrams, one or more of which are supplied with each G-E switchgear equipment, are defined and explained herein:

"One Line Diagrams"
"Elementary Diagrams"
"Connection Diagrams"
"Interconnection Diagrams"

ONE LINE DIAGRAMS

DEFINITION

A one-line diagram is one which indicates, by means of single lines and simplified symbols, the course and component devices or parts of an electric circuit or system of circuits. It depicts the path of energy transfer and the identification of circuit components with their ratings.

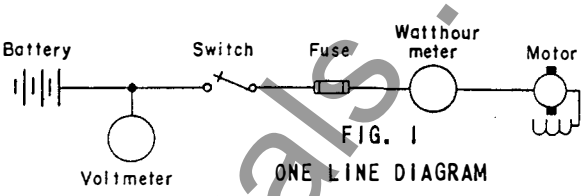


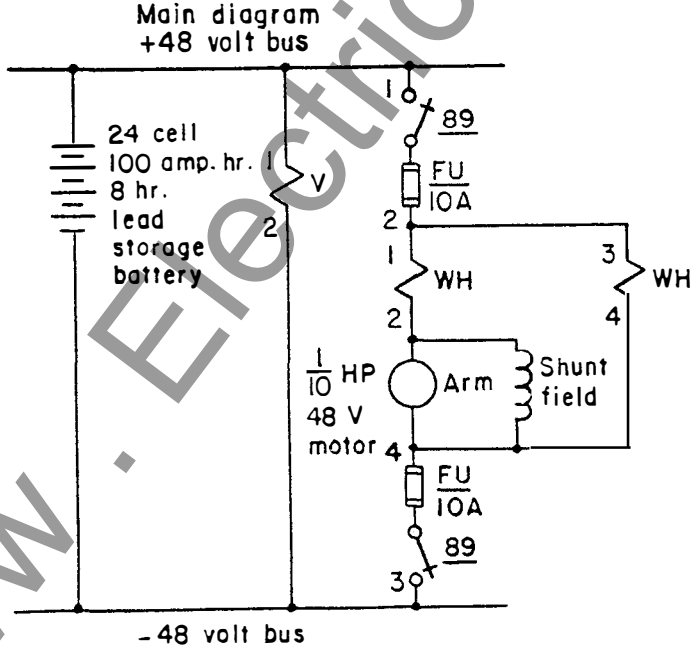
FIG. 1
ONE LINE DIAGRAM

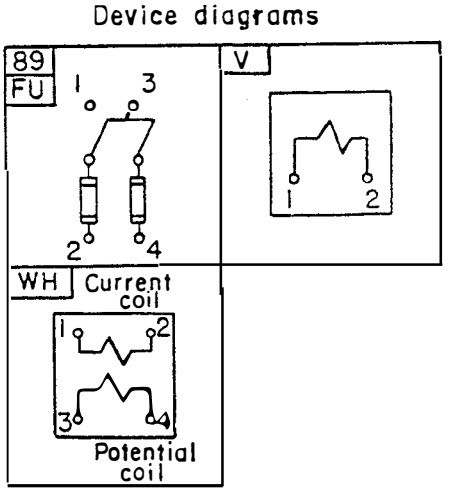
One-line diagrams for General Electric switchgear may be prepared as finished drawings when the equipment is so complex as to require several elementary diagrams, or where the over-all function and performance of several units of switchgear equipment can be more clearly understood from a one-line diagram than from the elementary diagram. However, practical experience has shown that the more complicated circuits of control apparatus can be much more clearly and accurately indicated by elementary diagrams.

ELEMENTARY DIAGRAMS

DEFINITION

An elementary diagram is one which shows, in straight-line form without regard for physical relationships, all circuits and device elements,* of an equipment and its associated apparatus or any clearly defined portion thereof. Where the circuits function inherently in a definite sequence, they are so arranged on the diagram as to indicate that sequence. (*The term "device element" as used here is defined as: Any portion of a device whose purpose is to open or introduce any impedance into a circuit.)





FU Fuse
V Voltmeter
WH Watthour meter
89 Line switch

FIG. 2
ELEMENTARY DIAGRAM

www.ElectricalPartManuals.com

The following characteristics of this diagram should be noted:

1. Each circuit is drawn in the so-called "straight line" form; that is, in the most direct line from one polarity of its source of power to the other.

2. In order to produce the foregoing characteristic the two poles of the double-pole line switch, 89, have been entirely disassociated; that is, the physical relationship of these two elements has been disregarded.

3. The approximate physical relation of device terminals, and the connections to their internal elements, are shown as device diagrams, separate from the main diagram.

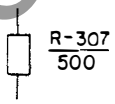
4. The electrical details of the connections of the devices are definitely defined by cross-reference between the numbers on the device element symbols in the main diagram and corresponding numbers on the device diagrams. For example, the fact that the left-hand pole of the line switch is connected in the positive side of the circuit is established by this means, as is the fact that the left-hand coil studs of the watthour meter and voltmeter are connected to positive polarity.

The elementary diagram of a G-E switchgear equipment shows every device element and all circuits of the equipment, together with its associated apparatus, such as generators, motors, transformers, etc. Because the elementary diagram is concerned with the elements of devices, and their electrical interconnections, the symbols used are those representing device elements rather than complete devices.

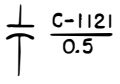
Familiarity with the conventions followed in the identification of the various elements of the elementary diagram, while not essential to an understanding of the diagram, will be very helpful.

1. The ampere rating of a fuse is placed below the abbreviation, thus:

2. The identifying number of a resistor following the R is usually the mark or item number on the summary or bill of material. The total ohmic value is placed below the line, thus:



3. The identifying number of a capacitor following the C is usually the mark or item number on the summary or bill of material. The micro-farad capacitance is placed below the line, thus:



4. Wherever applicable, devices are designated by standard ASA function numbers and the elements are identified by these numbers, thus:

The following is a complete list of ASA device-function numbers, with which reasonable familiarity is a great aid to quick determination of the performance of the equipment from the diagram:

1 Master Element
2 Time-delay Starting or Closing Relay
3 (Reserved for future application.)
4 Master Contactor or Relay
5 Stopping Device
6 Starting Circuit Breaker, Contactor or Switch
7 Anode Circuit Breaker
8 Control Power Switch
9 Reversing Device
10 Unit Sequence Switch
11 Control Power Transformer
12 Overspeed Device
13 Synchronous-speed Device
14 Underspeed Device
15 Speed Regulating Device
16 Battery-charging Control Device
17 Series Field Shunting Circuit Breaker or Contactor
18 Accelerating or Decelerating Circuit Breaker, Contactor, or Relay
19 Starting to Running Transition Contactor or Relay
20 Electrically Operated Valve
21 Impedance Relay
22 Equalizer Circuit Breaker or Contactor
23 Temperature Regulating Device
24 Bus Tie Circuit Breaker, Contactor, or Switch
25 Synchronizing or Paralleling Device
26 Apparatus Thermal Device
27 A-c Undervoltage Relay
28 Resistor Thermal Device
29 Isolating Circuit Breaker, Contactor, or Switch
30 Annunciator Relay
31 Separate Excitation Device
32 D-c Reverse Power Relay or Device
33 Position Switch
34 Motor-operated Sequence Switch
35 Brush-operating or Slip-ring Short-circuiting Device
36 Polarity Device
37 Undercurrent or Underpower Relay
38 Bearing Thermal Device
39 Field Reducing Contactor
40 Field Relay
41 Field Circuit Breaker, Contactor, or Switch
42 Running Circuit Breaker, Contactor, or Switch
43 Transfer Device
44 Unit Sequence Starting Contactor or Relay
45 D-c Overvoltage Relay
46 Reverse-phase, Phase-balance Current, or Power Rectifier Misfire Relay
47 Single- or Reverse-phase Voltage Relay
48 Incomplete Sequence Relay
49 A-c Thermal Relay or Device
50 Short-circuit Selective Relay or Device
51 A-c Overcurrent Relay
52 A-c Circuit Breaker or Contactor
53 Exciter or Generator Relay
54 High-speed Circuit Breaker
55 Power-factor Relay
56 Field Application Relay or Device

www.ElectricalPartManuals.com

57 (Reserved for future application.)
58 (Reserved for future application.)
59 A-c Overvoltage Relay
60 Voltage Balance Relay
61 Current Balance Relay
62 Time-delay Stopping or Opening Relay
63 Fluid Pressure, Level, or Flow Relay
64 Ground Protective Relay
65 Governor
66 Notching Relay
67 A-c Power Directional or A-c Power Directional Overcurrent Relay
68 D-c Thermal Relay or Device
69 Permissive Control Device
70 Electrically Operated Rheostat
71 D-c Line Emergency Circuit Breaker or Contactor
72 D-c Line Circuit Breaker or Contactor
73 Load Resistor Circuit Breaker or Contactor
74 Alarm Relay
75 Position Changing Mechanism
76 D-c Overcurrent Relay
77 Impulse Transmitter
78 Phase-angle Measuring Relay
79 A-c Reclosing Relay
80 D-c Undervoltage Relay or Device
81 Frequency Device
82 D-c Reclosing Relay
83 Selective Control, or Transfer, Contactor or Relay
84 Operating Mechanism
85 Carrier or Pilot-wire Receiver Relay
86 Locking-out Relay or Device
87 Differential Current Relay
88 Auxiliary Motor or Motor Generator
89 Line Switch
90 Regulating Device
91 D-c Voltage Directional Relay
92 D-c Voltage and Current Directional Relay
93 Field-changing Contactor or Relay
94 Tripping or Trip-free Relay or Contactor
95, 96, 97, 98, 99 (Reversed for special application.)

The above numbers are used to designate device functions on all types of manual and automatic switchgear, except automatic reclosing feeder equipments. For such equipments a similar series of numbers, starting with 101 instead of 1, is used for the functions which apply.

Letter suffixes are used with device-function numbers for various purposes, as follows:

1. To denote separate auxiliary devices such as:

X, Y, Z --Auxiliary Relay or Contactor
R --Raising Relay or Contactor
L --Lowering Relay or Contactor
O --Opening Relay or Contactor
C --Closing Relay or Contactor
CS --Control Switch
CL --"a" Auxiliary-switch Relay
OP --"b" Auxiliary-switch Relay
U --"Up" Position-switch Relay
D --"Down" Position-switch Relay
PB --Push Button

2. To indicate the medium, or condition, or electrical quantity to which the device responds, such as:

A --Air
C --Current
E --Electrolyte
F --Frequency, or Flow
L --Level
P --Power, or Pressure
PF --Power Factor
O --Oil
S --Speed
T --Temperature
V --Voltage, or Vacuum
VAR --Reactive Power
W --Water

3. To denote the location of the main device in the circuit, or the type of circuit in which the device is used or with which it is associated, or otherwise identify its application in the circuit or equipment, such as:

A --Alarm
B --Battery, Blower, or Bus
BP --Bypass
BT --Bus Tie
C --Capacitor, or Condenser, or Compensator
E --Exciter, or Emergency
F --Feeder, or Field, or Forward
G --Generator, or Ground
H --Heater, or Housing
L --Leading, or Line
M --Motor, or Metering
N --Neutral
R --Reactor, or Reverse, or Rectifier
S --Synchronizing
T --Transformer, Test, or Trailing
TH --Transformer (High-voltage Side)
TL --Transformer (Low-voltage Side)

4. (a) To denote parts of the main device (except auxiliary contacts as covered under (b), such as:

A --Accelerating Device
BB --Bucking Bar
BK --Brake
C --Coil, or Condenser, or Capacitor
CC --Closing Coil
HC --Holding Coil
IS --Inductive Shunt
L --Lower Operating Coil
LS --Limit Switch
M --Operating Motor
MF --Fly-ball Motor
ML --Load-limit Motor
MS --Synchronizing Motor
S --Solenoid
TC --Trip Coil
U --Upper Operating Coil
V --Valve

(b) To denote parts of the main device, such as auxiliary contacts (except limit-switch (LS) contacts as covered under (a) which move as part of the main device and are not actuated by external means). These auxiliary switches, for contactors,

www.ElectricalPartManuals.com

circuit breakers, safety-enclosed trucks, removable circuit-breaker units, housings, enclosures, etc., are designated as follows:

"a" Closed when main device is in energized or operated position* (See note below).

"b" Closed when main device is in de-energized or nonoperated position* (See note below).

*Note: As applied to circuit breakers, an auxiliary switch is designated as "a" (shown on drawings as normally open) if it is closed when the circuit breaker is closed, or as "b" (shown on drawings as normally closed) if it is closed when the circuit breaker is open.

"aa" Closed when operated mechanism of main device is in energized or operated position.

"bb" Closed when operated mechanism of main device is in de-energized or nonoperated position.

"lc" Latch-checking switch, closed when circuit breaker-mechanism linkage is relatched.
Letters e, f, h, etc., ab, ac, ad, etc., or ba, bc, bd, etc., are special auxiliary switches. Lower-case (small) letters are used for auxiliary switches in all cases. If several similar auxiliary switches are present on the same device, they are designated numerically 1, 2, 3, etc., when necessary.
As applied to a removable circuit breaker unit, or housing, or enclosure, a (or b) is an auxiliary contact which is closed (or open) when the unit is in the connected position.

5. To indicate special features, or characteristics, or the conditions when the contacts operate, or are made operative, or placed in circuit such as:

A --Accelerating, or Automatic
C --Close, or Cold
D --Decelerating, or Down
H --Hot, or High
HR --Hand Reset
IT --Inverse Time
L --Left, or Low, or Lower
M --Manual
O --Open
R --Right, or Raise
T --Test, or Trip
TDC--Time-delay Closing
TDO--Time-delay Opening
U --Up

In order to prevent any possible conflict, one letter or combination of letters has only one meaning on an individual equipment. All other words beginning with the same letter are written out in full each time, or some other distinctive abbreviation is used.

Descriptions of auxiliary devices with suffixe CL, OP, X, Y and Z in the device list of the dia gram indicate the nature of the auxiliary function a few words suffice for such a description; other wise, the term "auxiliary" is used. For example:

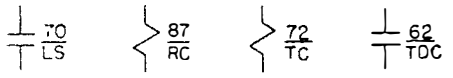
52X --Closing relay for 52
52Y --Cut-off relay for 52
52CL --"a" auxiliary switch relay for 52
52CSW--Control switch for 52
27X --Auxiliary relay for 27

In order to prevent any possible conflict, on letter or combination of letters has only one mean ing on an individual equipment. Furthermore, it meaning is clearly designated in the device functio list of the drawing. All other words beginning wit the same letter are written out in full each time o some other distinctive abbreviation is used.

5. Devices to which function numbers are not appli cable, such as meters and instruments, are give abbreviations; i.e., WH for watthour meter, an elements are indicated thus:

6. Device numbers are underscored to distinguis them from device-terminal or device-element num bers.

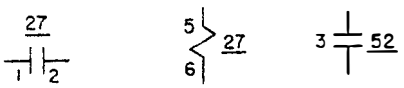
7. Distinguishing features of device elements ar frequently placed beneath the function number thus



the abbreviations being descriptive of the featur indicates, as:

LS --Limit switch
RC --Restraining coil
TC --Trip coil
TDC--Time delay closing

8. Device terminal or element numbers, derive from the device diagram, are usually placed at th left of, or below the element symbol, thus:



9. Main power circuits, and their component de vice elements, a r e usually drawn separate fro control circuits, and placed at the beginning of th drawing.

www.ElectricalPartManuals.com

CONNECTION DIAGRAMS

DEFINITION

A connection diagram is one which shows the connections of an installation or its component devices and equipment.

G-E switchgear connection diagrams show the general physical arrangement of devices and accessory items such as terminal blocks, fuse blocks resistors, etc.

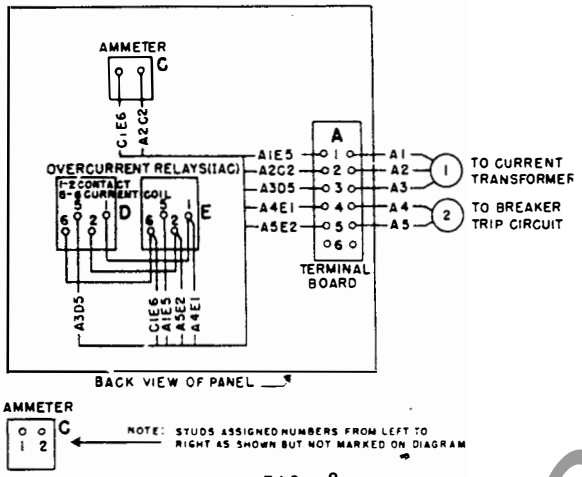


FIG. 3

CONNECTION DIAGRAM

It will be noted that diagram Fig. 3 shows the relative location of the devices on the panel, the origin and destination of the actual wires used in making the connections between devices, and the terminal board provided for the purpose of joining the connections on the panel to those leading from the panel to the external apparatus.

The connection diagram is primarily an instrument of manufacture. While it has some value to the user of switchgear as a record of the general physical arrangement of the connections of a switchgear equipment assembly, including such accessory items as terminal blocks, fuse blocks, resistors, etc., it is not intended nor adaptable as a means of tracing circuits through various device elements. Such tracing of circuits is nearly always accomplished much more readily and accurately from the elementary diagram.

There are, however, a number of conventions which promote uniformity and facilitate reading the connection diagram.

1. Each device on a unit of a switchgear assembly, such as a metal-clad switchgear unit or a panel of a duplex board, is assigned an arbitrary letter or pair of letters. Such letters are also assigned to each terminal board, fuse block, resistor, or other accessory device to which wires are attached. The letters are usually assigned consecutively from left to right and top to bottom. First letters of the alphabet are assigned to terminal boards a few letters between terminal board and device designations remain unassigned depending upon the size of the equipment, for designating terminal boards which may be added in the future. After all the letters of the alphabet have been used, double letters. AB, AC, AD, etc. are used. Referring to Fig. 3 as an example, the terminal board is assigned the letter "A" and the devices letters "C", "D", and "E".

Fuse blocks, that are not part of device assemblies, are designated by letter combinations beginning with "U", and resistors are designated by letter combinations beginning with "R". Indicating lamps associated with a control switch are designated by the switch letter followed by letters representing the lamp's color; for example, if the switch letter is D the red lamp is DR, and the green lamp is DG. Lamps that are not associated with a switch may be given separate letters, or a group of lamps may be given a letter with colors designated as above.

2. Each stud on a device is assigned a number from left to right and top to bottom. On simpler devices, such as indicating instruments and meters, the numbers may be omitted from the symbol. However, on some devices, for manufacturing reasons, the stud identification is not in the above stated order; in these cases the stud numbers are as indicated on the internal device diagram as shown in Fig. 3.

3. A lead connecting point #1 of terminal board "A" to stud #5 of overcurrent relay "E" is designated A1E5, the terminal board letter and number always preceding the device letter and number. Similarly the lead connecting stud #1 of the ammeter "C" to stud #6 of the overcurrent relay "E" would be designated C1E6, the letter and stud number of the device located higher on the panel preceding the letter and stud number of the device located lower on the panel. The advantage of this procedure is evident when tracing a connection having its origin at about the middle section of a more complicated panel, the lead designation giving the indication to either go up or down the panel for its destination thus eliminating about one half of the area covered by the entire panel diagram.

Short jumpers, such as between adjacent overcurrent relays "D" and "E", Fig. 1, need bear no lead marking.

Terminal boards provided for shipping breaks of a structure too large to be handled as one complete unit are not given identification letters and are therefore not used as such for lead identification combinations, and furthermore, may not appear on the wiring diagram. Temporary identification is provided by means of tags, to facilitate reconnection in the field.

The method outlined for tracing out a circuit on the simple diagram of Fig. 3 also holds for more complicated diagrams. With the aid of the respective elementary diagram while tracing through circuits of the wiring diagram a marked proficiency in reading the diagrams will result and a better knowledge of circuits will follow.

www.ElectricalPartManuals.com

INTERCONNECTION DIAGRAMS

DEFINITION

An interconnection diagram is one which shows the complete connections between equipment units, or unit assemblies, and associated apparatus. The internal connections of the units or unit assemblies are omitted.

Interconnections from one panel or unit to another are identified by adding panel or unit numbers to the lead combination as shown in Fig. 4. For illustration, a wire connecting from terminal point 3 of terminal board designated 'X' of unit or panel #7 to terminal point 5 of terminal board designated 'X' of unit or panel #8, would be marked 7X3-8X5.

Where interconnections are not completely shown on the interconnection diagram they are indicated as terminating in numbered circles as shown in Fig. 5. These numbered circles are merely convenient lead groupings and do not necessarily represent conduits. The destination of outgoing connections is indicated by note or reference to other drawings placed near the numbered circle.

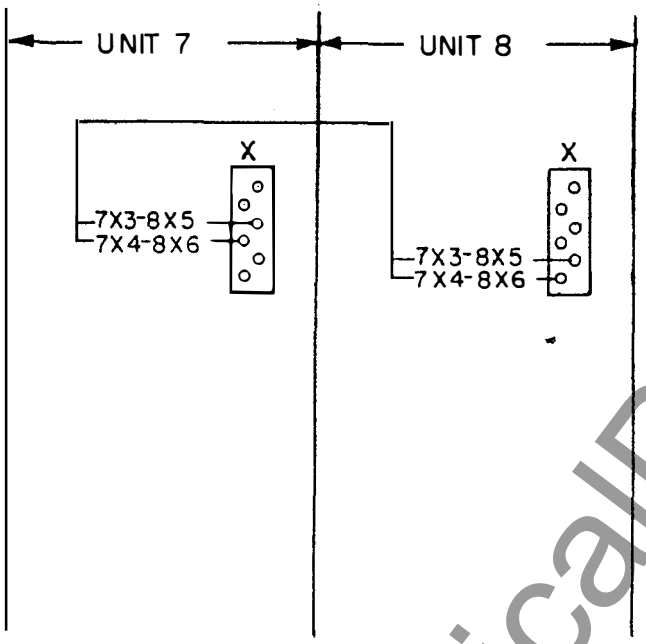


FIG. 4
INTERCONNECTION DIAGRAM

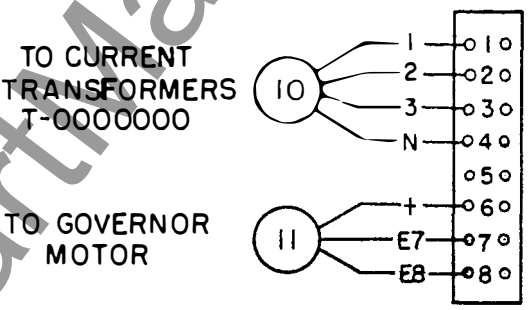


FIG. 5
OUTGOING CONNECTION DIAGRAM

www . ElectricalPartManuals . com

WHEN SERVICE IS REQUIRED

GENERAL ELECTRIC operates 23 apparatus service shops strategically located and competently manned by trained personnel. Each shop is a complete service unit with modern equipment for repairing, reconditioning, and rebuilding G-E apparatus to factory specifications. The services of these shops are available at any time of day or night for work in the shops or on purchaser's premises.

GENERAL ELECTRIC APPARATUS SERVICE SHOPS

SERVICE SHOP	*ADDRESS*	*DAY PHONE*	*NIGHT PHONE*
Atlanta, Ga.	496 Glenn Street, S.W.	WAlnut-9667	WAlnut-7859
Buffalo 11, N. Y.	318 Urban Street	HU-5849	RI-7579
Charleston 28, W. Va.	306 MacCorkle Avenue, S.E.	2-6177	3-1244
Chicago 7, Ill.	849 South Clinton St.	Wabash-5611	Wabash-5654
Cincinnati 2, Ohio	215 West Third Street	Parkway-3433	Parkway-3433
Cleveland 4, Ohio	4966 Woodland Avenue	EN-4464	EN-4464
Dallas 2, Texas	1801 North Lamar St.	R-9121	L-4111
Detroit 2, Mich.	5950 Third Avenue	TRinity-2-2600	TRinity-2-2606
Houston 1, Texas	1312 Live Oak Street	C-9711	C-9714
Kansas City 8, Mo.	819 East 19th Street	Victor-9745	WAbash-3850
Los Angeles 54, Calif.	733 Banning Street	Madison-7381	Madison-1813
Milwaukee 3, Wis.	940 W. St. Paul Ave.	Marquette-5000	Marquette-5002
Minneapolis 1, Minn.	410 Third Ave., N.	Main-2541	Main-2546
New York 14, N. Y.	416 West 13th Street	Wickersham-2-1311	Chelsea-2-8390
Philadelphia 23, Pa.	429 N. Seventh St.	Pennypacker-9000	Pennypacker-8448
Pittsburgh 6, Pa.	6519 Penn Avenue	Atlantic-6400	Atlantic-6408
St. Louis 1, Mo.	1110 Delmar Avenue	Chestnut-8505	Chestnut-3899
Salt Lake City 9, Utah	141 South Third West St.	4-1892	6-4448
San Diego 1, Calif.	2045 Kettner Blvd.	Franklin-7684	Glencove-5-3675
San Francisco 7, Calif.	361 Bryant Street	DO-3740	DO-3748
Seattle 4, Wash.	1508 4th Ave., South	Elliott-1778	CA-3679
West Lynn 3, Mass.	920 Western Avenue	Ly-3-6000	Ly-3-6008
Youngstown 3, Ohio	121 East Boardman St.	Youngstown-44331	Youngstown-44331

APPARATUS DEPARTMENT

GENERAL ELECTRIC

SCHENECTADY, N. Y.

PRINTED IN U.S.A.

Supersedes GEI-11374D

www.ElectricalPartManuals.com