

PICTORIAL WIRING DIAGRAMS METHODS USED

CONTENTS	PAGE	CONTENTS	PAGE
1. GENERAL	2	Straps, PT Leads, and Loop Leads	8
2. POINT-TO-POINT METHOD	2	Interconnecting Leads	9
3. HIGHWAY METHOD	2	Designations for Feed Lines and Interconnecting Leads	9
A. General Description	2	5. SIMPLIFIED AIRLINE METHOD	9
B. Detail Description	5	A. General Description	9
Component Layout	5	B. Detail Description	11
Component Symbols	5	Component Layout	11
Highways	5	Component Symbols	11
Designations for Highways	5	Component Location Numbers	13
Feed Lines	5	Base Lines	13
Straps	6	Feed Lines	13
Interconnecting Leads	6	Straps, PT Leads, and Loop Leads	14
Designations for Feed Lines and Interconnecting Leads	6	Interconnecting Leads	14
4. AIRLINE METHOD	6	Designations for Feed Lines and Interconnecting Leads	14
A. General Description	6	6. MANUFACTURING SCHEMATIC METHOD	14
B. Detail Description	8	7. CRITICAL WIRING	16
Component Layout	8	REASONS FOR REISSUE	16
Component Symbols	8		
Component Location Numbers	8		
Base Lines	8		
Feed Lines	8		

FIGURES

1. Typical Point-to-Point (Full Line) Method Wiring Diagram	3
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CONTENTS	PAGE
2. Typical Highway Method Wiring Diagram	4
3. Typical Airline Method Wiring Diagram	7
4. Typical Simplified Airline Method Wiring Diagram	10
5. Guide to Terminology Used With the Simplified Airline Method	12
6. Typical Manufacturing Schematic Method Wiring Diagram	15
7. Typical Wiring Diagram Associated With Critical Wiring	17

1. GENERAL

1.01 This section describes the point-to-point (full line) method, the former highway method, the present airline and simplified airline methods, and the manufacturing schematic method of showing connections on wiring diagrams. It also includes a description of critical wiring. Refer to Section 005-105-102 for description of tabular wiring diagrams.

1.02 This section is reissued to reflect current practices and terminology and to record past practices for the Simplified Airline Method. Detailed reasons for reissue will be found at the end of the section.

1.03 This section contains explanatory information on methods used on pictorial wiring diagrams and is not intended to be used as instructive

information on how to prepare wiring diagram drawings. Refer to Section 005-150-101 for current wiring symbols, wiring abbreviations, and definitions.

2. POINT-TO-POINT (FULL LINE) METHOD

2.01 The point-to-point or full line method was the original method used in the preparation of wiring diagrams. It derives its name from its basic method of tracing a connection between two points by the use of a separate and continuous line for each wire. This method is illustrated in Fig. 1.

2.02 The component layout used with this method is arranged with the individual components, represented by rectangles or circles, proportionately spaced to permit showing the terminal-to-terminal connection and approximating the physical equipment arrangement as viewed from the wiring side. The paths of the lines representing the individual wires do not indicate the actual arrangement of wires on the unit.

3. HIGHWAY METHOD

A. General Description

3.01 The highway method, as illustrated in Fig. 2, represented the first step in the improvement of the original point-to-point method of preparing wiring diagrams and was used for a limited period of time. This method, devised as a means of obtaining greater compactness on wiring diagrams, eliminated the use of separate and continuous lines for every connection by terminating component wiring at a common line, called a highway. In this way, component symbols were able to be shown adjacent and in line with each other.

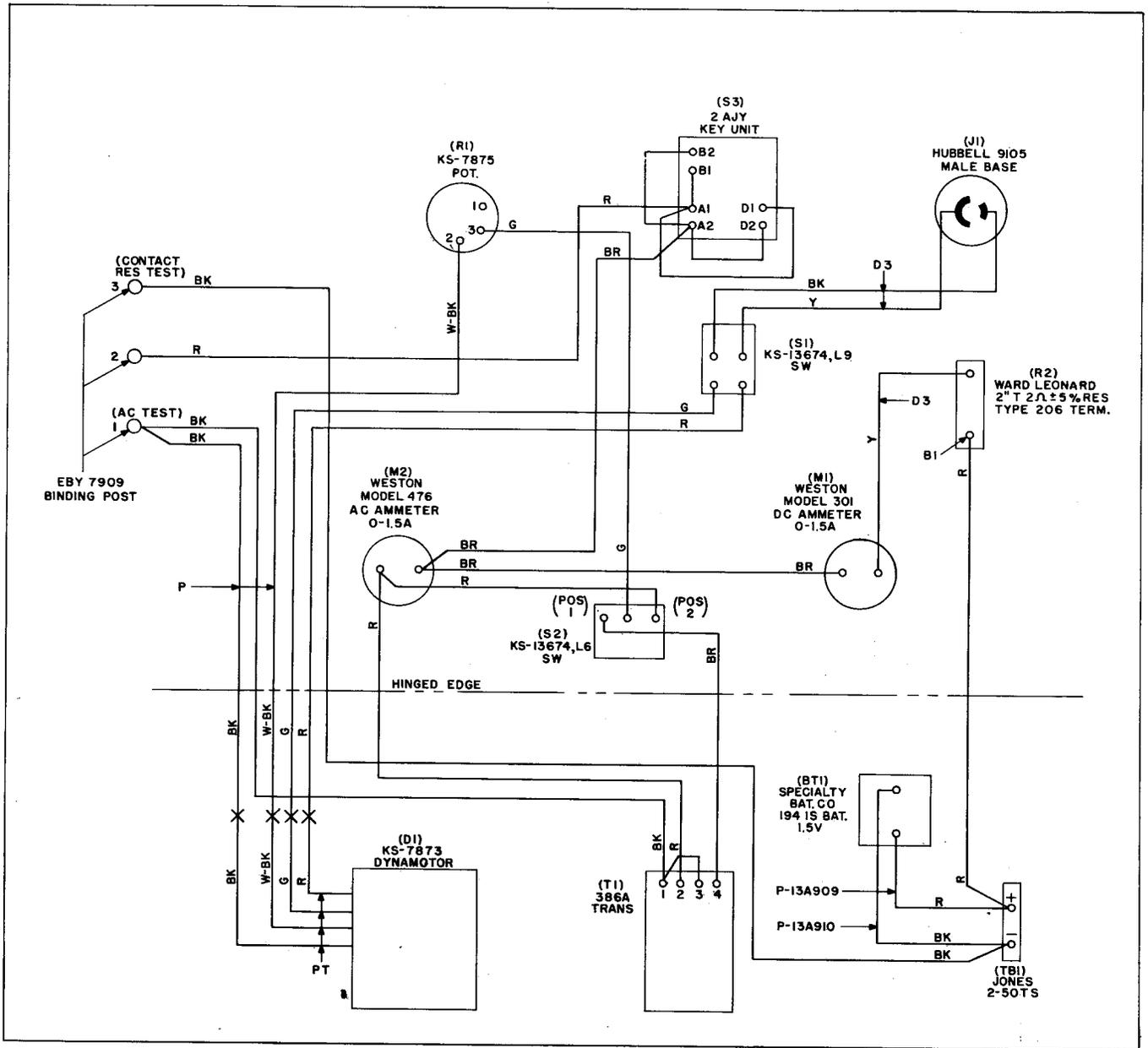


Fig. 1—Typical Point-to-Point (Full Line) Method Wiring Diagram

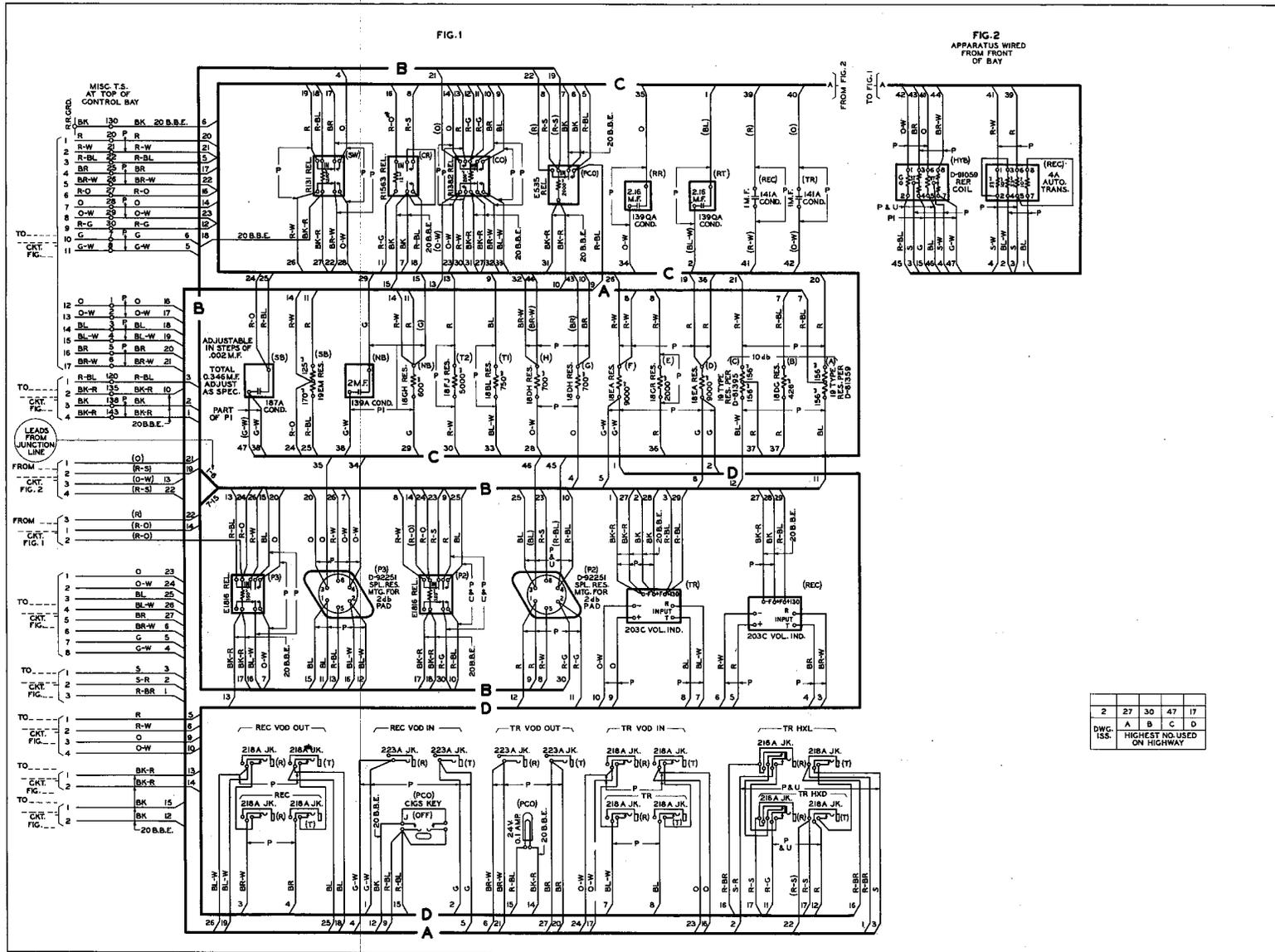


Fig. 2—Typical Highway Method Wiring Diagram

3.02 The lines representing the individual wires from each component (called feed lines) are carried a short distance and then merged into a common line, called a highway. The feed lines merge into the highway at an angle of 60 degrees and in such a manner as to indicate the direction of travel through the highway. The feed lines are arbitrarily numbered, the same number appearing at the two feed lines representing the originating and terminating ends of a particular connection. By observing the identification number as well as the direction in which the feed lines merge into the highway, a connection may be followed from beginning to end via the highway. No component identification numbers are used for the various component symbols.

B. Detail Description (Highway Method)

Component Layout

3.03 The individual components, shown by means of symbols, are arranged in rows approximating the physical arrangement of the equipment, as viewed from the wiring side.

3.04 The components and wiring on a particular drawing are arranged in one or more figures, as required.

Component Symbols

3.05 In general, component symbols are shown as rectangles drawn with a heavy line. Windings, filaments, contacts, and spring combinations are shown within the rectangle. The functional or reference designations and code numbers are shown close to the component symbols.

Highways

3.06 One or more highways per figure is used, as required. One highway may serve all feed lines of a particular row or group of components or only a part of them, depending on the total number of feed lines involved and the particular layout. In general, not over 99 feed lines are merged into the same highway. In many cases, two or more highways are used even though the total number of feed lines involved does not require it. This is done to simplify the tracing of leads through the highways on certain drawings, particularly where a fairly large group of wires of one figure

have a common destination either within the figures or to other figures or drawings.

3.07 Relatively simple and small figures did not require the use of a highway method.

3.08 Wiring between figures on the same drawing may be via the highways or the individual feed lines depending on the following conditions. As illustrated in Fig. 2, the capacity (see 3.06) of highway C was such that it could serve the smaller figure as well as a part of the main figure, and the tracing of connections between these two figures is via the highway. However, if there had been insufficient capacity in the highways of the main figure, a separate highway would have been used for the smaller figure. In the latter case, the association of figures would have been via the individual feed lines.

3.09 Drawings including figures having two or more highways also include a table indicating the highest-numbered feed line in each highway. This table, which is generally located above the title box of the drawing, is used in connection with the revision of drawings to facilitate the future assignment of feed line numbers.

3.10 The highway lines are shown heavier than the feed lines.

3.11 The horizontal lines representing the highways are shown joined at one end or the other by vertical lines, as required, to complete their continuity.

Designations for Highways

3.12 When more than one highway per figure is used, the highways are prominently designated A, B, C, etc. When a highway is common to two figures, its continuity between figures is broken and the open ends are assigned an arbitrary letter designation and bracketed. The destination of the highway is indicated at the brackets.

Feed Lines

3.13 Feed lines represent the individual wires or leads (except straps) between terminals of components within a figure or between figures when terminal strip terminals are not interposed. Feed lines of a particular figure terminating on

SECTION 005-105-101

terminals of a terminal strip forming a part of the same figure are understood to end at that point.

3.14 Feed lines from terminals of components approach the highway at an angle of 90 degrees but merge into the highway at an angle of 60 degrees and in such a manner as to indicate their individual direction of travel through the highway. Likewise, where they leave the highway, the 60-degree angle is shown so as to indicate the direction from which they came.

3.15 Feed lines between figures emerge from the highway in the conventional manner described above, are carried a short distance, and bracketed.

Straps

3.16 Straps between terminals of the same or adjacent components are not run into the highway, but instead are run direct.

Interconnecting Leads

3.17 Interconnecting leads represent individual wires run between two figures. They are also used for connections between the terminal strips of different figures.

Designations for Feed Lines and Interconnecting Leads

3.18 The feed lines in each group common to a particular highway are arbitrarily numbered from 1 to 99, inclusive. Not over 99 feed lines are served by one highway (see 3.06). The same number appears at both originating and terminating feed lines of a particular connection. This identification number is placed on the feed lines at a point nearest the highway.

3.19 In addition to the identification number, the color of the wire is also shown at each feed line, at a point between the highway and the component or the bracket.

3.20 Colors are shown on each feed line or interconnecting lead and are enclosed in

parentheses on the noncontrolling end of those leads running between figures on the same drawing or on different drawings.

3.21 Feed lines and interconnecting leads, when terminating in brackets, are given number or letter designations, as required, in addition to color and identification numbers. This is necessary for the proper association of leads between figures on the same or different drawings. Such designations appear at the ends of these leads.

3.22 Information showing type and gauge of wire, pairing, shielding, etc, is shown at both ends of the individual feed lines and interconnecting leads. Switchboard cable symbols are shown only on the controlling end of the connection.

3.23 When two or more similarly colored wires appear on the same component and from the same stitch, they are distinguished by "F" stitch designations. Where two or more such wires terminate on the same terminal, the "F" stitches are not used, except where optional wiring is involved and then a change of color is preferred. "F" stitch designations are consecutively assigned (except for the first wire of the color) F, F1, F2, etc, for each group of wires and these designations are placed on the feed line apart from the color and as near as possible to the component.

4. AIRLINE METHOD

A. General Description

4.01 The airline method, as illustrated in Fig. 3, was devised as a means of simplifying the highway method which was formerly used. This simplification was obtained by the addition of component location numbers which made it possible to directly locate terminating ends of wire connections. This addition also made it feasible to reduce the highways to a common base line. Although the airline method was later replaced by the simplified airline method, it is still used on circuit labels.

SECTION 005-105-101

4.02 Each individual component (each group in some cases) is numbered and the lines representing the individual wires from each component are carried a short distance and terminated at a common or base line, at an angle of 90 degrees. These individual lines between component and base line (called feed lines) are numbered to correspond with the location number of the component at which the other end of the connection terminates. It is not necessary to follow a connection through the base line and no provision is made for doing so. However, by observing the color and location number on the feed line, it is possible to jump directly between components, hence the term "airline."

B. Detail Description (Airline Method)

Component Layout

4.03 The components, shown by means of symbols, are arranged to approximate the physical arrangement of the equipment as viewed from the wiring side.

4.04 The components and wiring on a particular drawing are arranged in one or more figures, as required.

Component Symbols

4.05 In general, components are represented by rectangular symbols which show windings, filaments, contacts, spring combinations, etc, within the rectangle. The functional or reference designations and code numbers of each component are shown close to the component symbols.

Component Location Numbers

4.06 Location numbers are arbitrary assignments intended for identification purposes only and have no connection with standard position numbers on mounting plates, jack strips, etc.

4.07 Each component or separate stitch of a component is designated with a location number. In general, these numbers are assigned consecutively for the entire drawing, from left to right, and top down for each figure. Miscellaneous apparatus, such as cord fasteners, terminal punchings, etc, are not assigned individual location numbers, but, instead, are arranged in groups and the extent of each group indicated by a bracket. Each

bracketed group is considered as one component and given one location number.

4.08 The location number is usually placed to the left and above the component it identifies. Where two numbers are needed, the second number may be placed at the right or in the center, as convenience may have dictated.

4.09 When a series of wiring diagrams are made from the same circuit schematic, connections between components shown on separate wiring diagram drawings are made direct, from point to point without the use of brackets, through assignment of location numbers to each drawing, for example, 1 to 99 assigned to the first drawing, 100-199 to the second drawing, etc. This same method is used between figures on the same drawing except in those cases where the bracket method is used.

Base Lines

4.10 Base lines are used for the termination of all feed lines. To preserve the unity of figures, separate base lines are used for each figure. Base lines of one figure on the wiring diagram are not joined with base lines on another figure on the same wiring diagram.

Feed Lines

4.11 Feed lines represent the connecting wires (except straps) between terminals of components within a figure or between figures. Feed lines of a particular figure terminating on terminals of a terminal strip forming a part of the same figure are understood to end at that point. A single connection is actually represented by two feed lines, one at the originating end and the other at the terminating end.

4.12 Feed lines are carried a sufficient distance from the component terminals to include colors and destinations along the feed lines before terminating at the base line at an angle of 90 degrees. Feed lines between figures start at the base line and are extended and bracketed.

Straps, PT Leads, and Loop Leads

4.13 Straps and, in general, PT (pigtail) leads between terminals of the same or adjacent components are not carried to the base line but, instead, are run direct. However, when pigtail

wires are run into the base line, they are identified as PT leads. Loop leads are always carried to the base line.

Interconnecting Leads

4.14 Interconnecting leads represent individual wires run between two figures. Connections to other wiring diagrams are shown in brackets; however, connections to other wiring diagrams in the same series using the same circuit schematics are sometimes made through the base line.

4.15 When connections are required between two figures, one basic and the other optional, the figure from which the wires originate is termed the "controlling" figure (optional figure), and the figure at which the wires terminate is the "noncontrolling" figure (basic figure).

4.16 Connection between controlling and noncontrolling figures are shown either by the base line method or by the bracket method. If the bracket method is used, the bracket on leads of the controlling figure is designated "to" and the bracket on leads of the noncontrolling figure is designated "from."

4.17 Brackets grouping one or more feed lines for destination to another figure are assigned a location number, the same as for a component. (See 4.07.)

Designations for Feed Lines and Interconnecting Leads

4.18 Terminating feed line numbers, shown near the base line, indicate the component or components to which the feed line is directed.

4.19 Separate from and in line with the terminating feed line number, the color of the wire is shown. In certain cases where distinctive colors are not used, such as switchboard cable leads, arbitrary designations are used instead, generally A, B, C, etc.

4.20 Colors are shown on each feed line or interconnecting lead and are enclosed in

parentheses on the noncontrolling end of those leads running between figures on the same drawing or on different drawings.

4.21 When two or more similarly colored wires appear on the same component and from the same stitch, they are distinguished by "F" stitch designations. When two or more such wires terminate on the same terminal, "F" stitches are not used except where optional wiring is involved and then a change of color is preferred. "F" stitch designations are consecutively assigned (except for the first wire of the color) F, F1, F2, F3, etc. for each group of wires, and these designations are placed on the feed line apart from the color and as near as possible to the component.

4.22 Feed lines and interconnecting leads, when terminating in brackets, are given number or letter designations, as required, in addition to colors and terminating numbers. This is necessary for the proper association of leads between figures on the same or different drawings. Such designations appear at the ends of these wires.

4.23 Information showing type and gauge of wire, pairing, shielding, etc, is shown at both ends of the individual feed lines and interconnecting leads. Switchboard cable symbols are shown only on the controlling end of the connection.

5. SIMPLIFIED AIRLINE METHOD

A. General Description

5.01 The simplified airline method, of the type illustrated in Fig. 4, was devised as a means of further simplifying the airline method. This was made possible by the adoption of the practice of marking terminal numbers on the relay and other component symbols to agree with the circuit schematic and omitting the winding and spring combination details. This simplification of the component symbols also has made it feasible to apply the simplified airline method to surface wiring.

5.02 The simplified airline method follows, in general, the airline method outlined in 4.02 with the following simplifications:

- (a) Component symbols are simplified by the omission of winding, spring, and contact symbols. Component symbols are generally shown as rectangles with small circles representing the terminals within the rectangles. This type of component symbol makes it practicable in many cases to join the rectangles together in strips to represent the physical arrangement on a mounting plate, as viewed from the wiring side.
- (b) One feed line generally represents all wires, both surface and local cable wiring, connected to a terminal.
- (c) Where the usual symbols to indicate pairing of leads cause congestion, pairing may be shown in a table of paired leads.
- (d) "F" stitch designations are shown along the feed lines and close to the symbol so that they can readily be seen.

B. Detail Description (Simplified Airline)

5.03 Refer to Fig. 5 as a guide to terminology used in the details of the simplified airline method, as described below.

Component Layout

5.04 In most cases, the symbols for the individual components are represented by rectangles sometimes joined together in rows approximating

the physical arrangement of the equipment as viewed from the wiring side.

5.05 The components and wiring on a particular drawing are arranged in one or more figures, as required. The figures are, where possible, numbered to correspond with the circuit or apparatus figure of the schematic drawing. This is not always practicable and the agreement of figures should not be taken for granted.

Component Symbols

5.06 In general, components are shown as rectangular symbols with small circles representing the terminals within the rectangle. Terminals are arranged in the order in which they appear on the component, viewed from the wiring side and are designated to agree with the circuit schematic drawing.

5.07 Terminals of terminal strips are shown as circles arranged in a horizontal line. Within the horizontal line, terminals are grouped in sets of those normally served by one stitch.

5.08 In addition to the component location number, the functional or reference designation and code number are shown for each component within the component symbol (rectangle). In some cases, such as terminal strips, these designations are shown close to the component convention.

5.09 In the case of relays connected to cable arms in horizontal positions, vertical division lines (see Fig. 5) are shown between the terminals of separate stitches. Separation of stitches on relays connected to cable arms in vertical positions are indicated by horizontal division lines between the terminals.

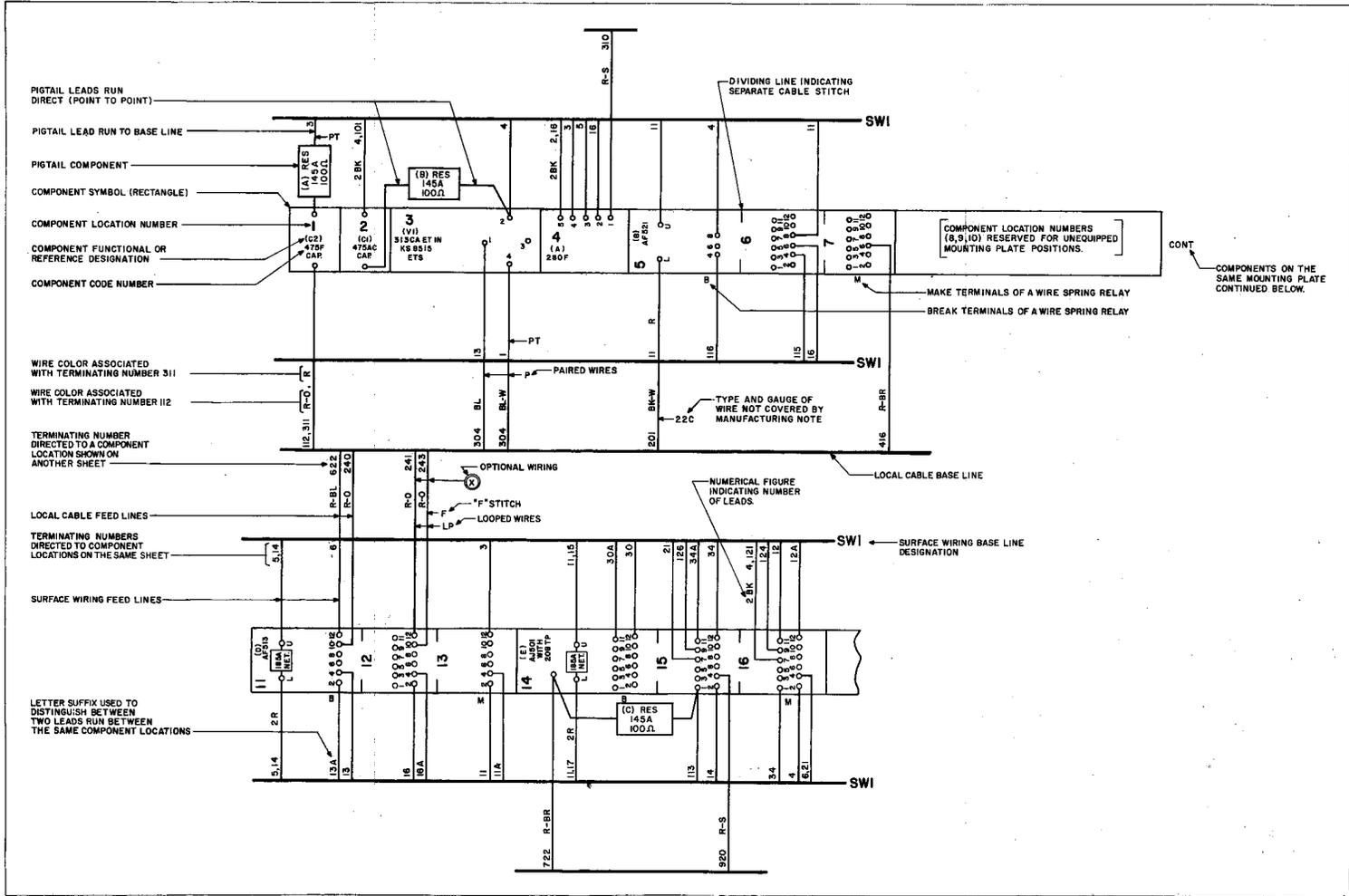


Fig. 5—Guide to Terminology Used With the Simplified Airline Method

Component Location Numbers

5.10 Location numbers are arbitrary assignments intended for identification purposes only and have no connection with standard position numbers on mounting plates, jack strips, etc.

5.11 Each component or separate stitch of a component is designated with a location number. In general, these numbers are assigned consecutively for the entire drawing, from left to right, and top down for each figure. Miscellaneous apparatus, such as cord fasteners, terminal punchings, etc, are not assigned individual location numbers, but instead are arranged in groups and the extent of each group indicated by a bracket. Each bracketed group is considered as one component and given one location number.

5.12 Each component location number includes all terminals within a stitch. In order to provide for the possible replacement of a relay by a different relay having an additional stitch, a component location number is sometimes reserved. A typical example of a reserve location number for wire spring relays having two stitches can be seen on Fig. 4, RT and S relays. Component location numbers are also reserved for unequipped mounting plate positions.

5.13 Component location numbers are generally placed in the upper left-hand corners of the component symbols (rectangles). When singly-mounted or grouped components are not represented by a rectangle, the location number is placed to the left and above the component convention.

5.14 Prior to the multisheet drawing format when a series of wiring diagrams were made from the same circuit schematic, connections between components shown on separate wiring diagram drawings were made direct, from point to point without the use of brackets, through assignment of location numbers to each drawing; for example: 1 to 99 assigned to the first drawing, 100-199 to the second drawing, etc. This same method is used between figures on the same drawing except in those cases where the bracket method is used.

5.15 For those drawings using the multisheet drawing format, the component location numbers are assigned from 11 to 99 on each B sheet. Connections between components are made direct, from point-to-point without the use of

brackets by listing the number of the sheet followed by the component location number on the feed line; for example: a feed line with a terminating number 3319 indicates a connection at component location 19 on sheet B33.

Base Lines

5.16 Base lines are used for the termination of all feed lines. To preserve the unity of figures, separate base lines for surface wiring and local cable are used for each figure. Base lines of one figure on the wiring diagram are not joined with the base lines of another figure on the same wiring diagram.

5.17 Where both surface wiring and local cable are used on the same drawing, the surface wiring base line is designated "SW1." Manufacturing notes on the drawing will explain the gauge and type wiring used.

Feed Lines

5.18 All wires, surface and local cable, terminating at one component terminal are represented by one feed line. Additional feed lines are sometimes shown where gauge and type of wires differ or when congestion results from attempting to show complete information on the one feed line.

5.19 Feed lines are carried a sufficient distance from the component terminals to include color and destinations along the feed lines before terminating at either/or both of the base lines (surface wiring or local cable) at an angle of 90 degrees.

5.20 A single wire connection on the same figure or between figures can be traced by means of corresponding location numbers, located on the feed line, one number at the originating end and the other at the terminating end. A single wire connection is then actually represented by the two feed lines.

5.21 A single wire connection between figures is sometimes accomplished by means of brackets. The terminating numbers, located on the feed lines of one figure are directed to feed lines extended from the base line of the same figure. These extended feed lines are bracketed and directed to other brackets on other figures.

Straps, PT Leads, and Loop Leads

5.22 Straps and, in general, PT (pigtail) leads between terminals of the same or adjacent components are not carried to the base line but instead are run direct, often within the rectangles. However, when pigtail wires are run into the base line, they are identified as PT leads. Loop leads are always carried to the base line.

Interconnecting Leads

5.23 Interconnecting leads represent individual wires run between two figures. Connections to other wiring diagrams are shown in brackets; however, connections to other wiring diagrams in the same series using the same circuit schematics are sometimes made through the base line.

5.24 When connections are required between two figures, one basic and the other optional, the figure from which the wires originate is termed the "controlling" figure (optional figure) and the figure at which the wires terminate is the "noncontrolling" figure (basic figure).

5.25 Connection between controlling and noncontrolling figures are shown either by the base line method or by the bracket method. If the bracket method is used, the bracket on leads of the controlling figure is designated "to" and the bracket on leads of the noncontrolling figure is designated "from."

5.26 Brackets grouping one or more feed lines for destination to another figure are assigned a location number the same as for a component. (See 5.11.)

Designations for Feed Lines and Interconnecting Leads

5.27 Terminating feed line numbers shown near the base line, indicate the component or components to which the feed line is directed.

5.28 Separate from and in line with the terminating feed line, the color of the wire is shown. Where more than one wire is represented by one feed line, the terminating number nearest the base line is associated with the color nearest the base line, etc.

5.29 Colors are shown on each feed line or interconnecting lead and are enclosed in parentheses on the noncontrolling end of those

leads running between figures on the same drawing or on different drawings.

5.30 When two or more similarly colored wires appear on the same component and from the same stitch, they are distinguished by "F" stitch designations. Where two or more such wires terminate on same terminal, the "F" stitches are not used, except in cases where optional wiring is involved and then a change of color is preferred. "F" stitch designations are consecutively assigned (except for the first wire of the color) F, F1, F2, etc, for each group of wires and these designations are placed on the feed line apart from the color and as near as possible to the component.

5.31 When several wires of the same color are represented by one feed line, a numerical figure representing the number of wires precedes the color designation.

5.32 Suffix letter designations A, B, C, etc, are added to terminating numbers to distinguish between two or more leads of the same type run between the same component locations, having the same colors or where color designations are not shown on the feed line.

5.33 Feed lines and interconnecting leads, when terminating in brackets, are given number or letter designations, as required, in addition to colors and terminating numbers. This is necessary for the proper association of leads between figures on the same or different drawings. Such designations appear at the ends of these wires.

5.34 Information showing the gauge of wire, pairing, shielding, etc, is shown at both ends of the individual feed lines and interconnecting leads. Switchboard cable symbols are shown only on the controlling end of the connection.

5.35 Where "D" wiring is involved, the "D" leads are designated D, D1, D2, or D3, as required, on the airline diagram. However, a separate view is usually shown for D2 wiring to indicate the position in which the leads are actually wired.

6. MANUFACTURING SCHEMATIC METHOD

6.01 Manufacturing schematic wiring diagrams, as illustrated in Fig. 6, are wiring diagrams prepared in schematic form to facilitate the tracing of connections and are used only for step-by-step and PBX switch units.

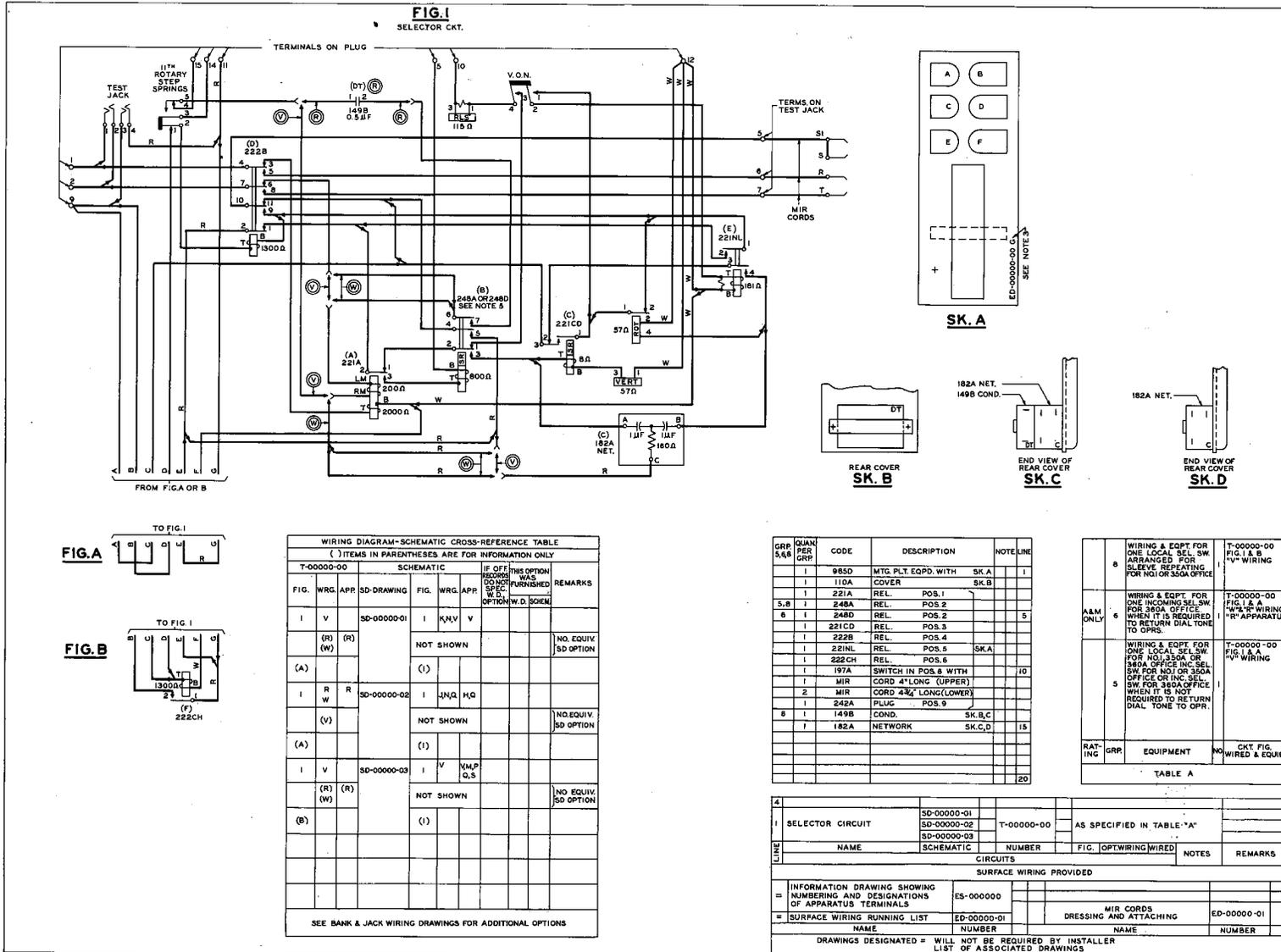


Fig. 6—Typical Manufacturing Schematic Method Wiring Diagram

SECTION 005-105-101

6.02 In this method, the schematic conventions and terminal numbering for components are used. Optional components and wiring are shown schematically except that the letter designating the option is enclosed in a double circle.

6.03 The point-to-point (full line) method of showing wiring is used and the sequence of connecting terminals and doubling-up points is shown by means of arrows.

7. CRITICAL WIRING

7.01 Critical wiring figures or drawings were devised as a supplementary means of showing critical wiring, that is, wiring (including pigtail leads) which require special treatment as to path and/or length due to mechanical or electrical reasons. It also includes critical positioning of pigtail components. This method is illustrated in Fig. 7 with its associated wiring diagram.

7.02 The component layout for critical wiring differs from other wiring diagrams in that the physical dimensional relation between components, as viewed from the equipment wiring side, is drawn to a definite scale. In some cases, the 3-dimensional delineating of component location, as well as the representation of terminal-to-terminal connection, is sometimes shown.

7.03 Individual components to which critical wiring is connected are shown as they actually appear on the wiring side of the equipment unit. Pigtail components are only shown on critical wiring figures when the positioning of the pigtail body or the path and/or length of one or both of the pigtail leads requires special treatment.

REASONS FOR REISSUE

1. 1.03 Section 005-150-101 read A804.009
2. 2.01 last sentence reworded
3. 4.06 renumbered, was 4.09
4. 4.07 renumbered, was 4.06
5. 4.09 (formerly 4.07) "When a series of wiring diagrams" read "Where more than one wiring diagram"
6. 4.14 the second sentence changed and read "Connections to other circuit drawings are shown in brackets; however, connections to other wiring diagrams of the same circuit are sometimes made thru the base line."
7. 5.10 renumbered, was 5.14
8. 5.11 renumbered, was 5.10
9. 5.12 renumbered, was 5.13
10. 5.13 renumbered, was 5.12
11. 5.14 (formerly 5.11) "Prior to the multisheet drawing format when a series of wiring diagrams" read "Where more than one wiring diagram"
12. 5.15 added, covers drawings using the multisheet format.
13. 5.16 to 5.22 renumbered, were 5.15 to 5.21
14. 5.23 (formerly 5.22) same change as in 4.14
15. 5.24 to 5.35 renumbered, were 5.23 to 5.34
16. 6.03 "The point-to-point (full line) method" read "The point-to-point method."

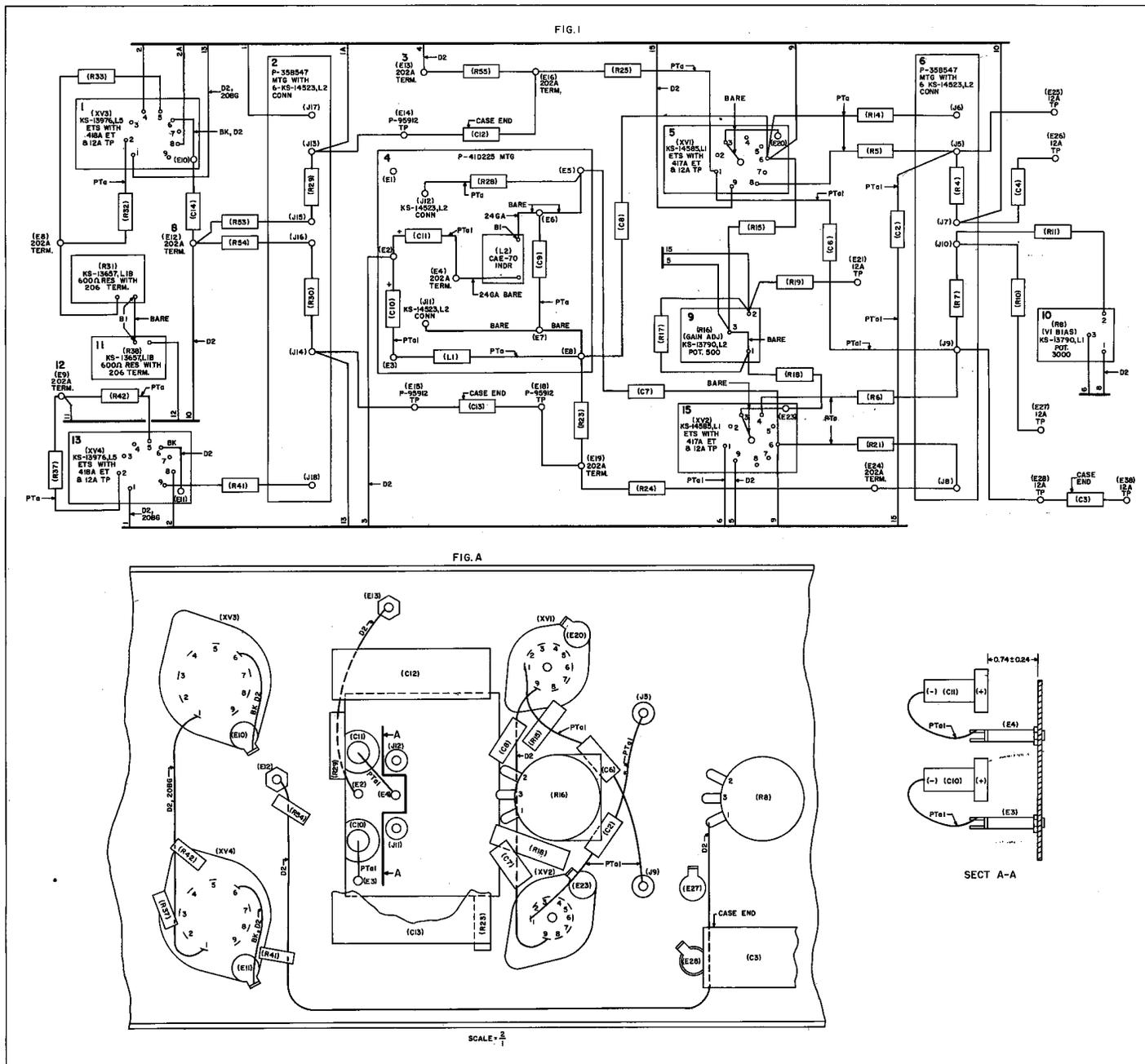


Fig. 7—Typical Wiring Diagram Associated With Critical Wiring