pwo.

X-62724
ISSUE 5

STANDARD DRAFTING PRACTICES FOR THE PREPARATION OF CIRCUIT DRAWINGS

BELL TELEPHONE LABORATORIES
INCORPORATED
SYSTEMS DEVELOPMENT DEPARTMENT
463 WEST STREET
NEW YORK

E-1084-(5-36)

PRINTED IN U. S. A.

BELL TELEPHONE LABORATORIES, INC.
SYSTEMS DEVELOPMENT DEPARTMENT

X-62724, ISSUE 5
SEPTEMBER 6, 1939
REPLACING ISSUE 4
MARCH 5, 1937

STANDARD DRAFTING PRACTICES FOR THE PREPARATION OF CIRCUIT DRAWINGS

1. GENERAL

1.01 This specification together with the supplementary information herein referred to, covers the standard drafting practices for the preparation of all circuit drawings.

Engineer's Responsibility

1.02 The engineer will be responsible for furnishing new and revised drawing information to the draftsman. This information should be originated in the form of a standard drawing order, properly approved. The drawing order may include complete information with or without reference to other drawings, and it may transmit marked prints or rough sketches as required. The information, however, should be sufficiently comprehensive so that the draftsman may proceed without unnecessary loss of time.

1.03 On circuit requirements tables the circuit engineer will furnish a short title and the equipment engineer will furnish an equipment designation.

1.04 After a drawing order has been originated, all subsequent changes made by the engineer should be covered by supplementary drawing orders. Where such changes are made verbally, they should be confirmed by supplementary drawing orders.

Draftsman's Responsibility

1.05 The draftsman shall be responsible for the form and arrangement of drawings in accordance with the requirements herein covered. All deviations from this procedure shall first be approved by the drafting supervisor.

1.06 Particular care shall be taken in checking all apparatus conventions and in checking the apparatus details such as; spring combinations, winding arrangements, resistances, and capacities.

1.07 After completion of a drawing, the draftsman shall send the drawing together with the drawing order (and supplements if any) and all attachments thereto to the drafting checker.

Supplementary Information

Data Books

Relay Data Book
Power Data Book

Drawings for Reference

ES-392666	Form for Tracing Circuit Requirements Tables
ES-392667	Form for Tracing Transmission Test Requirements Tables
ES-436870	Form for Tracing Keysheets
ES-455944	Form for Tracing Current Drain Tables for Keysheets
ES-534459	Form for Tracing Keysheet Title Page

Specifications for Reference

X-62604	Drafting Practices for the Preparation of Assembly, Equipment, and Cabling Drawings
X-62725	Drafting Information for Wiring Diagrams
A804.001	Description of Circuit Requirements Tables
A804.003	Description of Transmission Test Requirements Tables
A804.007	Winding and Spring Designations
AA610.004	Cross-Connections and Cabling Diagrams on "SD" Drawings
AA613.001	Abbreviations and Symbols used for Telephone Equipment

Other Sources of Reference

Apparatus Card Catalog
Relay Card File
Circuit Schematic Convention Book
Special Convention File
Inspection and Maintenance of Relays Book

2. GENERAL REQUIREMENTS

Form

2.01 Drawings shall be so planned that they may be accommodated by the standard tracing forms provided for this purpose.

2.02 The title box, notes, and approval column for the first sheet and sheets other than a first sheet of a schematic drawing shall be arranged as shown on Pages 18 and 19.

Drawing Layouts

2.03 Apparatus shall be arranged on the drawing with a view to obtaining the shortest and most direct wiring consistent with good general appearance. An exception to this general rule is found in the case of panel sender circuits. In these circuits the relation to each other of the various equipment units involved has become standard through long usage and, therefore, no extensive changes in arrangement of these circuits shall be made without consulting the engi-

neer. Care should be taken to avoid crossing one lead twice with another lead. In general, the tip and ring talking circuit leads shall run across the top of the circuit and shall have no apparatus placed above them with the possible exception of lamps or supplementary figures.

2.04 Leads connecting to another figure or drawing are bracketed and designated. Single leads are designated but not bracketed. Leads between connecting figures on the same sheet shall be lined up wherever possible. When the figures appear on separate sheets the leads shall face each other in the same order but not necessarily with the same spacing. Leads shall be designated at the right or top side except where a vertical lead is designated with lettering reading in a vertical position, in which case the lettering shall be on the left side. In congested cases, it is permissible to place the designation on a line with the lead. See Fig. 1.

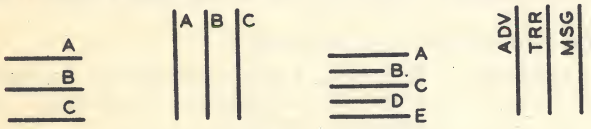


Fig. 1

2.05 For leads between figures on the same sheet, the connecting information at the brackets shall be parallel to the bracket only when the figures are thereby brought closer together. In all other cases, the bracket information shall read horizontally. Leads to other circuits shall be brought to that edge of the circuit which faces the corresponding leads on the associated circuit and shall be arranged so that the same sequence of leads appears on both drawings.

Line Characteristics

2.06 The weights of lines to be used on circuit drawings are standardized by comparison with Leroy pens as shown in Fig. 2. All lines shall be clean and black so that the tracing will yield good copy.

2.07 On all application schematics and wherever apparatus is enclosed in a box, the weight of the box lines shall be the same as the No. 1 Leroy pen. The dash-dot line shall be used for enclosing apparatus, for units, panels, etc., and for enclosing apparatus shown in another circuit. The solid line shall be used on application schematics where a circuit is represented by a box.

2.08 On all application schematics and wherever apparatus is shown enclosed in a box, with leads running into the box and terminating at punchings or terminals, these punchings or terminals shall be 3/32" diameter. This also applies should these punchings be shown unwired. Desk stands, hand telephone sets, and subscriber sets are not included in this practice.

Titling and Lettering

2.09 Lettering shall be done with the letters fairly close together. Spacing between words shall be approximately the same as the height of the letters.

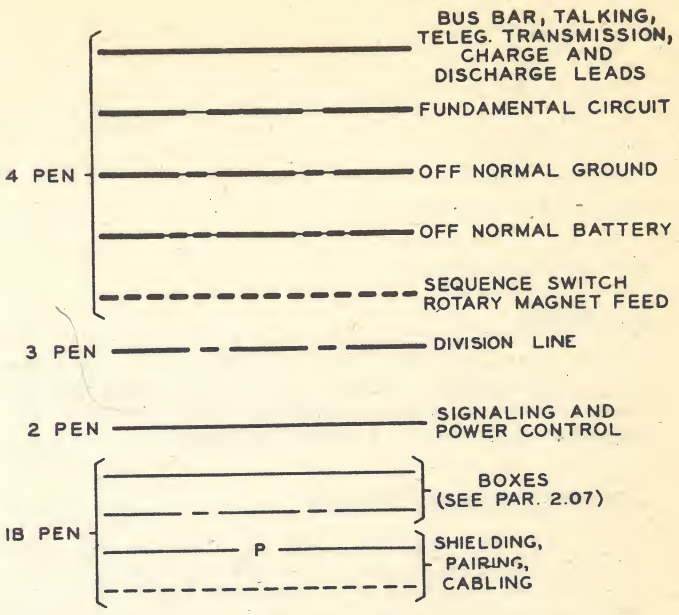


Fig. 2

2.10 Where work is intended for reduction, extreme care shall be exercised in the selection of letter sizes and spacing. This is imperative in order to preserve the clarity of the reduced size copy.

2.11 The requirements for the arrangement of titles for circuit drawings are shown on Pages 18 and 19, for handbook drawings on Pages 20 and 21, and for keysheets on Pages 22 and 23.

Abbreviations

2.12 Abbreviations and symbols may be used when space does not permit the use of words in full or in cases where the abbreviations or symbols are so well known that their use will not be confusing.

2.13 If a word appears in a note more than once and in one case is abbreviated, all other appearances of that word in the note shall be consistently abbreviated.

2.14 Abbreviations shown in X-62604 shall have preferential use in all places on the drawing except in those cases where the abbreviation is to be rubber stamped on equipment in which case the abbreviation shown in BSP section AA613.001 covering abbreviations and symbols used for telephone equipment shall be used.

2.15 The abbreviation "No." instead of the number symbol (#) shall be used.

Apparatus Names, Codes, and Designations

2.16 Apparatus which is in common use and readily recognized by its convention, need not be designated by name on the circuit. The following list covers all such apparatus. All other apparatus shall bear the descriptive name as well as the numerical code, such as, "95C repeating coil".

Condensers	Message Registers
Dials	Plugs
Drops	Receivers
Fuses	Relays
Handsets	Resistances
Interrupters	Retardation Coils
Jacks	Ringers
Keys	Transmitters
Lamps (Except Ballast)	Vacuum Tubes

2.17 Code numbers should be shown above and close to the associated apparatus. In cases where no room is available at this point, it will be satisfactory to place the code in some other location near the apparatus. Dashes shall be shown in "D" and "KS" specification apparatus codes only. All other apparatus codes shall not contain any dashes; for example, KS-6054, D-80553, E614, 584DG. Apparatus coded per "D" specifications shall also be designated by type as specified by the engineer, for example E per D-78342. When a piece of apparatus is coded by type only, the word "type" shall be shown only on Department 331 and 332 drawings.

2.18 Functional designations are given to practically all pieces of apparatus. These designations shall be enclosed in parenthesis and located above and close to the apparatus together with and above the code when shown. If it is not possible to place the designation and code together by a piece of apparatus such as a resistance, it is permissible to vary this practice as illustrated in Fig. 3.

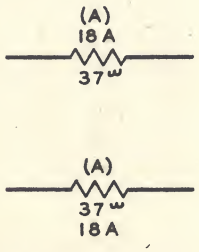


Fig. 3

Battery Variations, Working Limits, Tripping Ranges, and Current Drain Data

2.19 Battery variations giving the voltage limits of the various batteries used in the circuit are placed on the first sheet of all circuits containing batteries. The recommended location for this information is in the lower left corner outside the circuit proper. If working limits, tripping ranges and/or a current drain table is shown the battery variations shall be centered above this information.

2.20 Working limits, when required, shall be shown below the battery variation and shall follow the arrangement given by the engineer.

2.21 Tripping ranges, when required, shall be shown below the working limits or combined with the working limits if so combined by the engineer.

2.22 Current drain tables, when required, shall be shown below the tripping ranges and shall follow the arrangement given by the engineer. When this table is shown on a drawing, the symbol shown on Page 18 shall be shown in the rating box. Care should be taken to remove this symbol if the current drain table is removed. 1/8" dashes shall be shown in place of a current value when called for by the engineer. This dash indicates that the item has been considered.

Circuit Requirements Tables

2.23 These tables form a part of "ES" or "SD" drawings containing magnetic apparatus and cover the requirements for testing and adjusting these pieces of apparatus. The tables are arranged on 8-3/8" x 10-7/8" forms so that they may be cut off the print and used as pages in a folder. ES-392666 shall be used as a guide for tracing blank table forms in light lines on the reverse side of the tracing cloth.

2.24 Page 26 shows a typical single page of circuit requirements and Page 27 shows a typical multiple page arrangement. These pages may be shown either horizontally or vertically as desired. When relays of both the step-by-step dial equipment type and other types are interspersed on one circuit, the form used for step-by-step type relays shall be used and all relays accommodated on it in their standard arrangement, as described below, irrespective of type. A relay used as a retardation coil or resistance shall not be listed in the circuit requirements table but shall have its code placed at the relay in the circuit.

2.25 Testing requirements are usually given for the following pieces of apparatus:

(a) As listed under "Magnets"

*Bells
*Buzzers
Crossbar Switches
*Electric Clocks
*Panel Selector Magnets
*Ringers
*Rotary Selectors
*Sequence Switches
*Sounders
Timer Magnets

*Listed only when special requirements are necessary.

(b) As listed under "Relays"

Drops
Message Registers
Relays
Signals

(c) As listed under "Miscellaneous"

Keys and other non-magnetic apparatus where it is necessary to list special requirements.

2.26 The apparatus listed in the table shall be listed under the figure number in which it appears in the circuit and shall be subdivided into the three aforementioned equipment groups under each figure number. If the entire drawing contains apparatus of only one of the three groups, this group shall be used as a major heading and on figures listed under it. One group heading shall apply to all like apparatus listed in order under that heading even though this apparatus may be listed under succeeding figure headings. Figures shall be listed numerically and lettered figures shall be listed immediately after the numbered figure with which it is associated; for example, Figure 1, A, B,

2, C, D. Optional circuit equipment shall be listed under its proper figure number at the end of all other regular apparatus in that figure and shall have a heading denoting its condition, as "X apparatus". When necessary such optional apparatus shall have its own apparatus groups as "Magnets" and "Relays".

2.27 The figure number heading shall be used even though there is but one figure on the drawing. In the case where the drawing contains a main figure, not numbered, and several supplementary lettered figures the heading "Main Fig." shall not be used above the associated apparatus on the circuit requirements table. If the drawing contains but one unnumbered figure, no figure heading is required.

2.28 All apparatus, regardless of type, shall be alphabetically and numerically arranged according to designation under the proper major heading of "Magnets", "Relays", or "Miscellaneous". The following general rules govern this arrangement:

(a) Number designations precede letter designations; for example, (0), (1), (2), (A), (B), (B1), (B2), (BA).

(b) Straight number designations precede prime number designations; for example, (0), (1), (2), (0'), (1'), (2').

(c) Letter designations are arranged alphabetically, primarily according to their first letters, secondly according to their second letters, etc; for example, (A), (ACR), (AE), (HA), (HFL), (HN).

(d) Where two or more pieces of apparatus, which would ordinarily follow each other in the table, have the same code and requirements, their designations shall all be shown opposite only one set of requirements. "Relay Under Test" shall be substituted in the testing procedure wherever the designation would ordinarily be shown.

2.29 In general, reserve one blank line after the requirements for each piece of apparatus, three blank lines after the complete requirements for a figure or option, and three blank lines at the end of each page if no three line blank has been left at another point on the page. Where test notes are not required on a page a space of approximately seven lines shall be left at the bottom for their possible future addition. If the strict observance of these spacings would make it necessary to use an additional page for three or four lines of requirements, it will usually be desirable to omit several of the blank lines and save this additional page. On very lengthy circuit requirements tables, it is sometimes desirable to insert a blank line between relays at only three or four points on each page and omit all others. This will involve a saving of several pages on the very large tables. The supervisor should be consulted before lettering a table in this manner.

2.30 The "Remarks" column is used for any test information that cannot be covered in the other columns. "Test Notes" also serve for this purpose and are an overflow point for this information where it is too lengthy for the "Remarks" column. Accordingly, test notes as shown by the engineer, shall be converted to remarks or vice versa with a view to conserving time and space. For example, if the engineer shows an identical remark under three or more relays, it will usually be desirable to convert this information to a test note and refer to that note at each relay. In the reverse case, where the engineer shows a test note that is short enough to be included in the remarks and is referred to at but one or two relays, it will usually be desirable to convert this information to a remark and omit the test note reference at the relay. In all cases, test notes shall be shown on the same page as the apparatus with which they are associated. A detailed explanation of the information shown in circuit requirements tables is contained in BSP A804.001 and BSP A804.007.

Cross-Connections

2.31 Cross-connection and cabling diagram figures are included on drawings to show the method of wiring between units of equipment or pieces of apparatus when terminal punchings are involved or when some peculiar wiring or cabling arrangement is desired. Only enough information is shown to insure proper identification of apparatus, punching assignments, and wiring. These figures shall be placed to the left of the circuit information.

FIG. 51
(FOR FIGS. 1, A, & B)

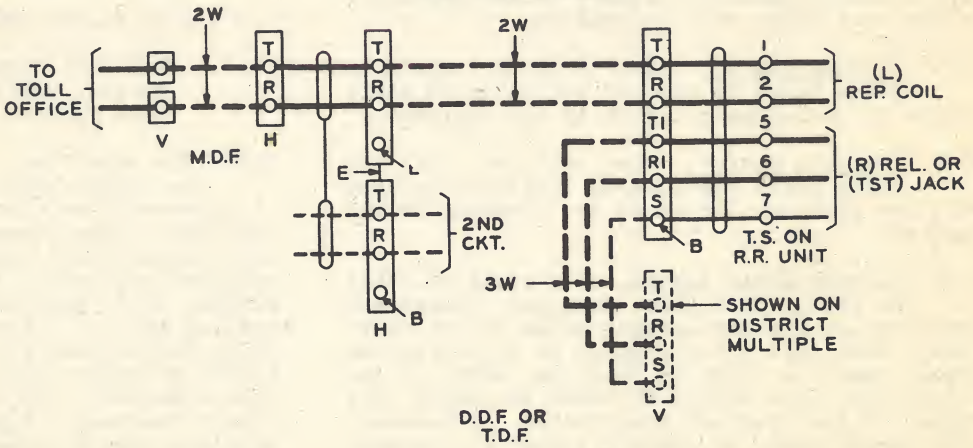


Fig. 4

2.32 Cross-connection figures may be placed on separate sheets when their size and number justifies this procedure.

2.33 Cross-connection figures are numbered 51, 52, 53, etc. The association of circuit figure numbers and cross-connection figure numbers is not required, as small subtitles in parenthesis below the cross-connection figure number will be used for this purpose.

2.34 Standard conventions for talking and signaling leads, cables, jumper wires, punchings, terminal strips, etc., are used. See Fig. 4. A detailed explanation of cross-connection diagrams is contained in BSP AA610.004.

2.35 All equipment notes shall be placed beneath the cross-connections if possible, but in any case the two must be closely associated.

Changes and Redraws

2.36 When tracings are on change, the draftsman shall retouch all indistinct portions of the drawing. Where tracings are in poor condition they shall be referred to the drafting supervisor who will determine whether a redraw is justified.

2.37 Old tracings employing obsolete standards, which are to be redrawn because of their poor condition, shall be handled as follows:

(a) Where the status of the particular drawing warrants and the engineer is in agreement, the tracing shall be redrawn in accordance with this specification.

(b) Where the status of the drawing does not warrant a rearrangement for conformity to existing standards, the old tracing shall be retraced.

The draftsman shall discuss all such cases with the drafting supervisor.

Erasures

2.38 Erasures shall be made only with the regular approved erasers provided for this purpose. Under no circumstances shall erasures be made with knives, razor blades, or hard erasers.

Inkwork on Tracings

2.39 Inking shall be done with approved moisture resistant ink.

2.40 In general, ink shall be applied on the dull side of the cloth. However, where frequent changes are contemplated the grid forms for tables and charts may be drawn on the reverse or glossy side of the cloth. Exceptions to this rule are drawings which are to be reproduced photographically directly from the tracing in which case all linework is done on the dull side i.e., keysheets, handbook drawings, etc.

Notes

2.41 When placing notes on a drawing, care shall be taken that all letters are of a uniform thickness, that the letters forming a word are fairly close together, and that the space between words is not less than the height of a letter. A 1/4" space shall be left between sentences in the same note. Guide lines shall be used for lining up both the left and right hand edges of the column of notes.

2.42 When a jack and plug are used on step-by-step system drawings to make external connections to the connector and selector units, the code of this jack and plug shall be shown above the circuit notes. No convention for this jack and plug shall be shown on the drawing.

2.43 Circuit notes number from 101 up and shall begin at the top of the sheet approximately 3/4" in from the left hand border line. When cross-connection information is shown on the same sheet the notes shall be shown to the right of the cross-connection information.

2.44 Whenever an option table (or similar table) appears on a circuit drawing, either as a note or as a separate table, it is essential that space be left at the end of the table for additions. For large tables, the amount of space to be left shall be approximately equal to one-half of the space utilized. For small tables, the space for additions may be several times that of the space utilized.

2.45 When the standard option table (see Fig. 5) is shown on a drawing, ten lines shall be provided for additional information.

RECORD OF FIGURES, WIRING, AND APPARATUS CHANGES								
CHANGED ON ISS.	IF JOB RECORDS DO NOT SPECIFY	THIS OPTION WAS FURN.	SEE NOTE	USE IN CIRCUIT				
				STD.	A & M	M. D.		
2-D	FIG. A OR B	FIG. A	105	FIG. B		FIG. A		
	X OR Y	Y	105	X		Y		
	Z	NONE		Z				
3-D	8C, 12C, OR 13C LAMP	8C		13C	12C	8C		

Fig. 5

2.46 This table is to be shown as a circuit note on Department 331 and 332 drawings and as a separate table closely associated with the circuit notes on Department 333 drawings. Reference at the figure or option to the note containing the table shall be made only when specifically requested by the engineer.

2.47 Manufacturing and equipment notes number from 201 up and shall be placed below or closely associated with the cross-connections

under the heading "Equipment Notes". When a circuit has an equipment designation but no circuit requirements table in which to show it, the equipment designation shall be shown in an equipment note. The standard wording of this note shall be as follows: The equipment designation of this circuit is "----". If the equipment designation already appears in a circuit note, this note shall not be replaced by an equipment note except on redraws where latest standards are desired, or where the change is requested by the engineer.

2.48 On toll drawings "Transmission Notes" are occasionally required. These notes shall number from 301 up and shall be placed wherever suitable on the drawing.

2.49 On power schematics "Calculation Notes" are occasionally required. These notes shall number from 401 up and shall be placed wherever suitable on the drawing.

2.50 When a drawing requires more than one sheet for the circuit proper, all the circuit notes for the entire circuit shall be shown on the first sheet.

2.51 When a series of more than two words or phrases is shown in a note or on any other part of a drawing and the word "and" or "or" is used before the last word or phrase of the series, commas shall be placed after each word or phrase in the series as in the following examples:

(a) Replaced by SD-12910-01, SD-12875-02, and ES-239875.

(b) Use the L4E, L4F, or L4R cords as required.

Protection of Tracings

2.52 All tracings held by the draftsman and not in actual use shall be kept rolled on the regular cardboard tubes provided for this purpose.

Ratings

2.53 Drawing ratings shall be as shown on Page 18. When a supplementary rating is necessary to show another relation of the drawing to one or more particular pieces of equipment, this supplementary rating shall be as shown on Page 18 below the regular drawing rating. It should be noted that once a drawing has been rated "AT&TCo Standard" the only change that can be made in this rating is to "Mfr. Disc." or "A&M Only". The rating "AT&TCo Standard" can never be changed to "Prov. Std." or "Provisional".

2.54 When a circuit figure receives a rating it shall be enclosed in parenthesis below the figure number as shown in Fig. 6. 140V guide, No. 2 pen shall be used.

FIG. 2
(MFR. DISC.)
Alarm Relay
One Per Frame
See Note 105

Fig. 6

2.55 When one cross-connection diagram has several figure numbers, all of which have the same rating, the same practice shall apply. See Fig. 7.

New arrangement

FIG. 51 (MFR. DISC.)
(For Figs. 1, 2 and 3)

Old arrangement

FIGS. 1K, 2K, & 3K
(MFR. DISC.)

Fig. 7

2.56 When one cross-connection diagram has several figure numbers, only one of which is rated, the rating shall be placed directly after that figure number as shown in Fig. 8.

New arrangement

FIG. 51
(For Figs. 1, 2 (MFR. DISC.), and 3)

Old arrangement

FIGS. 1K, 2K (MFR. DISC.), & 3K

Fig. 8

2.57 When more than one but not all the figures of a cross-connection diagram are rated, the ratings shall be as shown in Fig. 9.

New arrangement

FIG. 51
(For Figs. 1 (MFR. DISC.), 2 (MFR. DISC.), and 3)

FIG. 51
(For Figs. 1, 2 (MFR. DISC.), and 3 (MFR. DISC.))

Old arrangement

FIGS. 1K (MFR. DISC.), 2K (MFR. DISC.), & 3K
FIGS. 1K, 2K (MFR. DISC.), & 3K (MFR. DISC.)

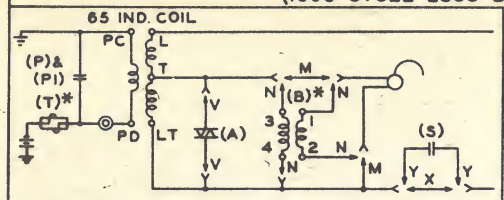
Fig. 9

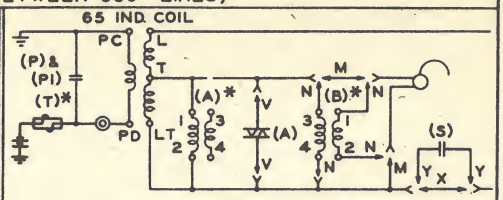
2.58 When a note is given a rating, the rating shall be lettered with the 140V guide, No. 2 pen and enclosed in parenthesis to the left of or under the note number.

Transmission Test Requirements Tables

2.59 These tables are included on regular and handbook schematics which contain talking circuits involving transmission losses. They contain a condensed version of the talking circuit together with the associated losses of the individual parts. Typical forms and arrangements are covered in BSP A804.003. ES-392667 shall be

TRANSMISSION TEST REQUIREMENTS
(1000 CYCLE LOSS BETWEEN 600Ω LINES)





MAX. ALLOWABLE CIRCUIT LOSS

WIRING	SEE NOTE	BRIDG.	TRANS.
M,X		3.6	10.6
M,Y		3.7	10.4
N,V,X	2	2.9	10.8
N,V,Y	2	3.0	10.6

MAX. ALLOWABLE CIRCUIT LOSS

WIRING	SEE NOTE	BRIDG.	TRANS.
M,X		3.7	10.4
M,Y		3.6	10.6
N,V,X	2	3.0	10.8
N,V,Y	2	3.1	10.6

ALLOWABLE INDIVIDUAL APPARATUS LOSSES

APPARATUS	DESIG.	CODE	MAX. LOSS	MIN. LOSS	REMARKS
CONDENSER	P & PI	4M.F.	20.9	17.3	
CONDENSER	S	2M.F.	14.5	11.5	
IND. COIL		65	11.1	8.5	
VARISTOR	A	3A OR 4A			SEE NOTE 1

NOTES:
1. FOR METHOD OF MAKING INDIVIDUAL APPARATUS LOSS TEST, SEE BSP IN "K" SERIES. REQUIREMENTS USING 12 db PAD.

ROOM TEMPERATURE	70°	80°	90°	100°	105°
INDIVIDUAL LOSS	2.1	2.7	3.4	4.1	4.5

LOSSES FOR TEMPERATURES OTHER THAN THOSE LISTED ABOVE MAY BE DETERMINED BY INTERPOLATION.

2. ROOM TEMPERATURE 85°. FOR EACH INCREASE OR DECREASE OF 10° IN TEMPERATURE, ADD OR SUBTRACT 0.2 db RESPECTIVELY FOR BRIDGING LOSS.

3. * INDICATES APPARATUS FOR WHICH INDIVIDUAL LOSSES ARE NOT REQUIRED.

FIG. 10

used as a guide for tracing blank table forms in light lines on the front side of the tracing.

2.60 The circuits in the table shall be drawn with conventions of reduced size and with light line work. Lettering on the circuit shall be done with Leroy pens and Wrico guides, either 100V or 90V depending on the room available. The remainder of the lettering in the table shall be 100V. See Fig. 10 for a typical table.

2.61 On new transmission requirements tables to be drawn up the engineer may refer to standard notes 1, 2, etc. These notes are as follows and shall be shown in the space under "notes" in Fig. 10.

1. For method of making individual apparatus loss test, see BSP in "K" series.

   Requirements using 12 db pad:

Room Temperature	70°	80°	90°	100°	105°
Individual Loss	2.1	2.7	3.4	4.1	4.5

   Losses for temperatures other than those listed above may be determined by interpolation.

2. Room temperature 85°. For each increase or decrease of 10° in temperature, add or subtract 0.2 db respectively for bridging loss.

3. Room temperature 85°. For each increase or decrease of 10° in temperature, add or subtract 0.1 db respectively for bridging loss.

4. Room temperature 85°. For each increase or decrease of 10° in temperature, add or subtract 0.2 db respectively for receiving loss.

5. Room temperature 85°. For each increase or decrease of 10° in temperature, add or subtract 0.1 db respectively for receiving loss.

6. *Indicates apparatus for which individual losses are not required.

3. APPARATUS STANDARDS

Cords

3.01 When a cord is used on a circuit and the actual wiring terminations of both ends of the cord are shown, the word "cord" shall not be used after the code. An arrow shall be used as shown in Fig. 11 to indicate the conductors composing the cord.

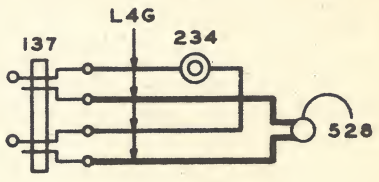


Fig. 11

3.02 When the actual wiring terminations, such as cord fasteners, of a cord are omitted from a circuit, the word "cord" shall be used with the code and no arrows shown. See Fig. 12.

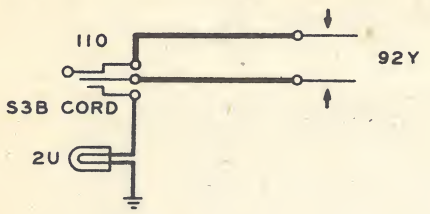


Fig. 12

Interrupters

3.03 Interrupters shall be shown in a vertical position. When the interrupter circuit is covered by a separate drawing but is shown in brief on the individual circuits to which it supplies interruptions, it is shown dotted on these circuits and enclosed in a box of light dash-dot lines. See Fig. 13. A circuit note giving the interrupter intervals is usually shown and referred to at the interrupter. A typical "interrupter interval" convention is shown in the circuit convention book. In drawing these conventions, the outside border shall always be of the same dimensions and the spacing of the intervals shall always use most of the box and be in a rough proportion to the time intervals. The arrangement of these intervals shall agree with the arrangement shown in the relay data book.

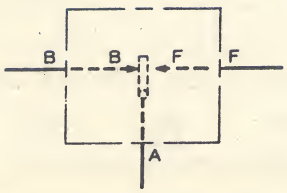


Fig. 13

Jacks

3.04 Jacks with single plungers may be shown to operate either up or down. Jacks with double plungers, that is, tip and ring, shall be shown with the tip on the top side in all cases. Code 410 jacks should be placed on the drawing in a vertical position.

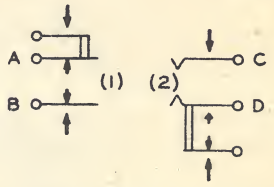
3.05 Jacks used for operator's headset connection shall be shown facing to the right and shall be placed on the right hand side of the schematic.

3.06 On Department 333 drawings only, where the numerical portion alone of the code is shown, the word "type" shall be omitted.

Keys

3.07 Coin collect and coin return keys shall be shown in a vertical position at the top of the circuit layout. All other keys may be shown in any position on a circuit layout.

3.08 The spring pile-ups of all keys shall be checked with the apparatus card file. In placing a key on the drawing the preferred arrangement is that shown on the apparatus card. In all cases the spring pile-up operating from any one plunger shall be shown exactly as indicated by the apparatus card. However, to improve the circuit layout, the key may be rotated as a unit into any of its various positions. For example, referring to Fig. 14, the relation between sections A and C and between sections B and D shall not be changed. (The arrangement A D shall not be used.) B C



TYPICAL SINGLE KEY UNIT

Fig. 14

3.09 Whenever it is found necessary to separate the two halves of a unit, as (1) from (2), they shall both be shown either horizontally or vertically and again the relation between A and C and between B and D shall not be changed.

3.10 In considering multiunit keys, each unit shall be treated as outlined above.

3.11 If one half of a key unit is unused it need not be shown on the drawing. If a whole unit of a multiunit key is unused it need not be shown.

Key Top Figures

3.12 Key top figures, indicating the functions of the key when the key lever is operated to its various positions, shall be shown for all lever type keys.

3.13 Key top figures shall be shown for push button and rotating lever type keys only when requested by the engineer.

3.14 For Department 331 and 332 drawings, the "front" designation indicating the end of the key toward which the patent stamping is located, shall be shown only when the front end is at the top or left of the key top diagram as it appears on the drawing.

3.15 Colors of lever handles shall be shown on key tops when specified by the engineer to be other than that called for by the key code.

3.16 The method of showing key top figures is illustrated in the circuit convention book.

Lamps

3.17 When a lamp is associated with a plug or jack, it shall face in the same direction and shall be either directly above or below this plug or jack.

Magnets

3.18 The term magnets is used to describe electrical magnets whose primary purpose is to operate sequence switches, selectors, crossbar switches, etc., and which may have one or more spring combinations associated with them and operated at the same time. The magnet convention differs from the relay convention in that the

winding is not shown and that the function of the magnet is lettered on the core. See Fig. 15. Conventions for the various magnets used are shown in the convention book.

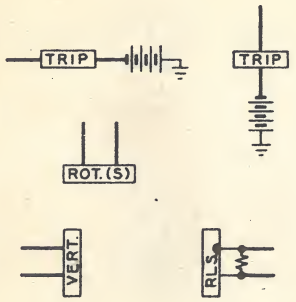


Fig. 15

Plugs

3.19 Plugs are usually shown at the extremities of the circuit. On central office cord circuits, the answering or rear plug shall be shown at the left and the calling or front plug shall be shown at the right hand side of the circuit. On PBX cord circuits, the reverse procedure shall be followed.

3.20 Operator's headset plugs shall line up with their associated jacks in all cases. Where two pairs of parallel wired jacks designated (A), (B), (C), and (D) are shown, the operator's headset plug may line up with either the (A) and (B) or the (C) and (D) pair. However, wherever space permits, it should line up with the (A) and (B) pair in preference to the (C) and (D) pair of jacks.

Relays

3.21 A relay card file is maintained which contains information as to the winding arrangements and spring combinations of practically all relays. The references on these cards are to figures which are shown in the relay data book and the Bell System Practices. All relays should be checked by these means. The designation of the winding terminals is covered in the relay data book, and shall be shown on all circuit schematic and handbook drawings. The circuit convention book shall be referred to for general information on relay conventions.

3.22 All relays may be shown in either a vertical or horizontal position on the drawing. Relays having top and bottom springs shall have the top springs of the relay designated when it is shown horizontally and shall have the top springs on the top side of the relay core when it is shown vertically. Relays of a type having top and bottom springs but of a code calling only for top springs need not have the top designated when shown horizontally. When shown vertically such relays must have the one top set of springs shown above the core. Relays having top, middle, and bottom springs shall be shown similar to relays with top and bottom springs except that the "middle" springs shall be shown with the bottom springs. In this case the spring

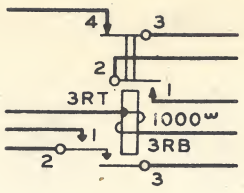
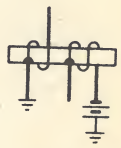


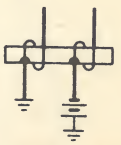
Fig. 16

numbers for the "middle" springs shall include the letter "M" such as "1M", "2M". In all other cases no letters are used with the spring numbers. Relays of a type having only one set of springs; for example, B, G, J, 221 and 222 type, may have their set of springs shown either above or below the relay core when shown vertically. When a relay has two or more armatures in combination on one side of the relay core, these armatures may be reversed with relation to each other and if necessary wiring to the relay springs may be run through the part of the convention representing insulation between armatures. See Fig. 16. Wiring may be run in the space between the core and the nearest armature only when the lead connects to a terminal of the relay.

3.23 Each relay winding shall be shown with one or 1-1/2 turns only and in the direction indicated in the circuit convention book. Winding terminal designations shall be placed on the wire near the relay core. Resistance values shall be placed at the winding. See Fig. 16. All relays shall have the inner end of each winding indicated by a solid half circle. This is the actual inside end of the winding and the ground side of the circuit is usually connected to this end. Any variations encountered will be on polarized relays or relays with the winding connected in inductive opposition. It should be borne in mind that on multiwinding relays, all windings, tracing from inner to outer end, are in the same direction. An opposing relay is obtained by reversing the ground side of the circuit to one or more windings. See Fig. 17.



RELAY WITH WINDINGS AIDING EACH OTHER



RELAY WITH WINDINGS OPPOSING EACH OTHER

Fig. 17

3.24 When a relay has more than one code, each of which is an option, the differences between the options shall be covered by one of the methods shown in Figs. 18 and 19.

(a) Examples of differences which should be covered in the circuit.

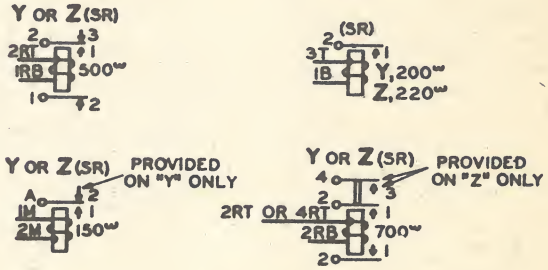


Fig. 18

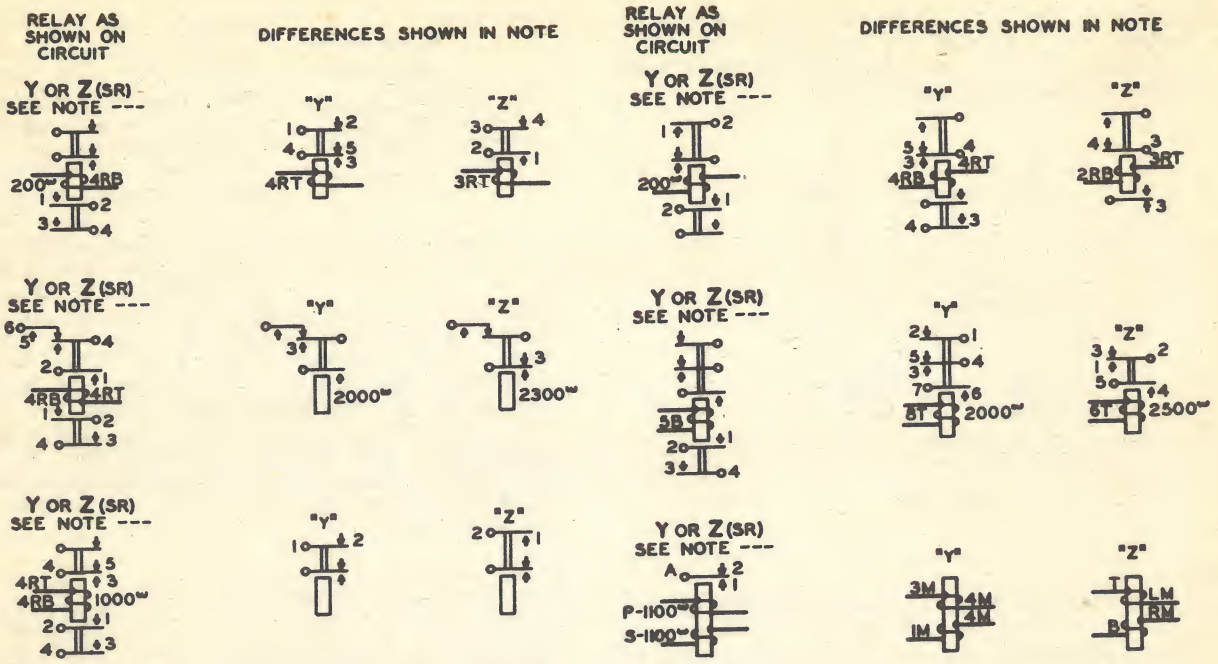


Fig. 19

(b) Examples of differences which should be covered in a circuit note are shown in Fig. 19. The standard wording of this note shall be: "The difference between the (SR) relays is as follows:"

(c) Where relays have different symbols such as a different number of windings or where the connections to the relays cannot be clearly indicated by the use of one symbol in the circuit, separate figures or optional wiring and apparatus shall be shown to cover each option. The use of this method shall be left entirely to the engineer.

3.25 In case of doubt as to the use of any of these methods, the draftsman shall consult his supervisor. No change shall be made without the engineer's approval.

Resistances

3.26 Fixed resistances with two terminals such as 18 type shall be shown as indicated in Fig. 20. The form shown for a three terminal resistance such as 19 type shall be followed for any resistance having a common point. 40 type resistances shall have their terminals designated in accordance with the information in the relay data book. For a typical 40 type resistance see Fig. 20. The plus or minus limits associated with resistance values shall be shown only when specified by the engineer. The standard ± 5% variation shall not be shown.

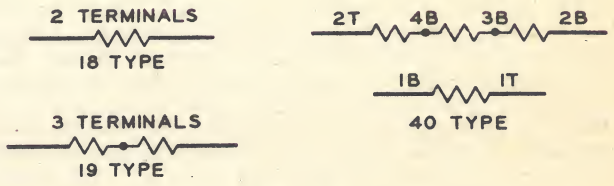


Fig. 20

Sequence Switch Cams

3.27 Sequence switch cams shall be drawn in a vertical position on all new circuit schematics and the relative position of the four brushes shall be as indicated in Fig. 21. This figure also explains the method of designating the cam cuttings. In those cases where it is necessary to add or change cams on old circuits

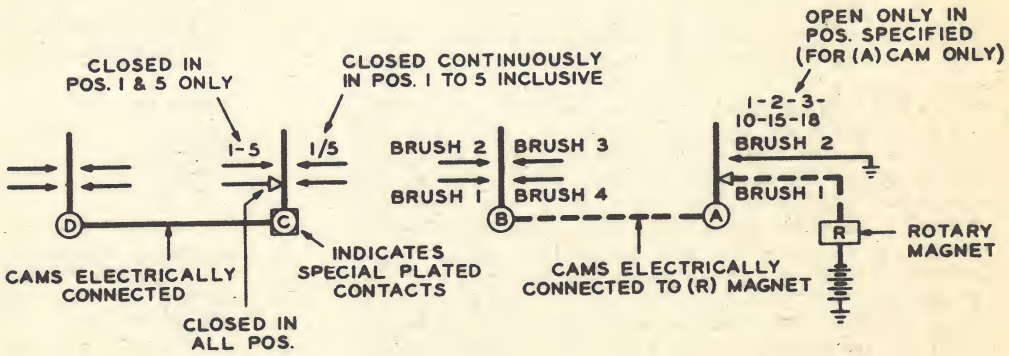


Fig. 21

using a horizontal convention, it is satisfactory to continue the use of this convention, keeping in mind that the brush numbering shall be as indicated in Fig. 22.

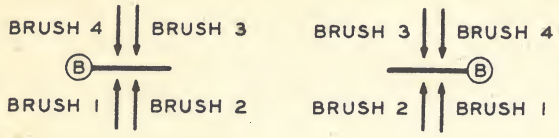


Fig. 22

Varistors

3.28 On local and toll systems drawings the method of wiring and pairing leads to a varistor in the telephone circuit is covered in a note furnished by the engineer. In this case the varistor shall be so placed in the circuit as to facilitate visualizing the run of the pairs as explained by the note.

3.29 On telegraph systems drawings the actual wiring of the varistor in the telephone circuit is shown in the circuit rather than being explained in a note. In this case the varistor should be wired in accordance with the engineer's sketch. It will be noted that no solder points are used since the leads run directly to the varistor terminals and then loop to other points in the circuit.

4. CIRCUIT SCHEMATICS

4.01 These drawings are the most common of those prepared by the drafting department. They shall be drawn upon standard tracing forms, which are obtainable with the borders already printed. The dimensions and various standards applicable to these tracing forms are shown on Pages 17, 18, and 19. The circuit requirements tables shall be prepared in accordance with Pages 26 and 27.

Arrangement of Information

4.02 The arrangement covered below shall be adhered to as closely as possible when laying out a drawing. If the drawing layout is such that using the space remaining above the circuit layout will permit the use of a smaller drawing unit, this arrangement should be discussed with the immediate supervisor.

4.03 The main figure of the circuit together with the divisions of the circuit covered by the numbered figures shall occupy the right hand portion of the drawing. One figure covering an optional or variable feature shall be shown at each of the places on the drawing where a connection to an optional or variable figure is indicated. The figure having the greatest number of leads running to the main figure shall be shown adjacent to the main figure unless a request for a different arrangement is made by the engineer. The remaining figures shall be shown to the left outside the circuit proper and arranged from the top of the drawing toward the bottom alphabetically or/and numerically.

4.04 Circuit notes shall be shown to the left of the lettered figures and when no cross-connection figures or circuit requirements table are required on the same sheet they shall be placed at the extreme left of the drawing approximately 3/4" in from the left hand border line.

4.05 Cross-connections, when shown on the same sheet with the main circuit shall occupy the left hand portion of the drawing. Equipment notes shall be placed beneath the cross-connections or as closely associated with them as possible. The circuit notes shall be placed to the right of the cross-connections.

4.06 Transmission test requirements shall be shown in any convenient space in the lower part of the drawing to the left of the main figure.

4.07 Battery variations, current drain data, tripping ranges, and working limits shall be shown as covered in paragraphs 2.19 to 2.22 inclusive.

4.08 Circuit requirements tables, when on the same tracing with other information shall be placed at the left or top of the drawing with a separating 1/4" margin of heavy lines. It is essential that this arrangement be followed since in actual use provision is thereby made for cutting off these tables and leaving a uniform rectangular print of the remainder of the information.

4.09 When two sheets are required to include the complete information associated with one schematic, there are several possible arrangements of the layout. One arrangement is to place the circuit and associated figures and the cross-connection diagram on sheet 1 and the circuit requirements tables on sheet 2. However, when it is felt that a more practical and economical arrangement would be obtained by placing the circuit and associated figures and the circuit requirements tables on sheet 1 and the cross-connection diagram on sheet 2 or by placing the circuit and associated figures on sheet 1 and the circuit requirements tables and cross-connection diagram on sheet 2, either of these arrangements may be followed.

4.10 When separate sheets are required for the circuit, circuit requirements, and cross-connections, it is a standard practice to show the circuit on sheet 1, the circuit requirements tables on sheet 2, and the cross-connection diagram on sheet 3. Multisheet circuits are usually an expansion of this scheme using the first sheets in successive order for the circuit and associated figures, the next ones in order for the circuit requirements tables, and the last ones in order for the cross-connection diagram.

4.11 When more than one sheet is required for the circuit, the right-hand side of the circuit shall be made sheet 1 and coordinate numbers and letters shall be shown on each sheet suitably spaced so that approximately any point on the drawing may be located by referring to a letter and number. Letters shall be placed at the left and right edges beginning with "A" at the top. Numbers shall be placed at the top and bottom edges beginning with "1" at the left. Note that the coordinate number "1" will appear on each sheet using coordinates.

Lettering

4.12 All lettering shall be done with the Wood-Regan Co's. "Wrico" lettering guides using the Leroy pens. The circuit shall be done with the 100V ("V" for vertical letters) guide, No. 1B pen. Figure numbers shall be lettered with the 175V guide, No. 2 pen, and circuit note and figure number ratings shall be done with the 140V guide, No. 2 pen. In the circuit, option notations for wiring and apparatus shall be lettered with the 140V guide, No. 2 pen. The option letter shall precede the code or designation in all cases. A table showing the optional features shall be shown in the "circuit notes" column.

5. HANDBOOK DRAWINGS

5.01 Handbook drawings are prepared for the use of the maintenance forces in the field and are made up on a form which is arranged for reduction to 3-1/2" x 5-1/2" for insertion into small field handbooks. There are two types of handbook drawings prepared in the schematic drafting group.

Telephone Handbook Drawings

5.02 In general, these drawings are similar in arrangement to the regular circuit schematics described in paragraph 4.01 except that all information is shown within a standard form arranged for a 2, 2-1/4, 2-1/2, 2-3/4 and 3 to 1 reduction. The dimensions and the lettering standards for the various multiples are shown on Page 20.

5.03 When possible, the circuit and associated figures and the cross-connection diagram shall be shown within the same form. However, if an exceptionally large form is thereby required, it is advisable to consult the group supervisor and the engineer. The largest form permissable in any case is a 3 to 1 multiple with two folds.

5.04 The circuit requirements tables shall be shown in the standard manner outside the reduction form. These tables are of such dimensions that they may be reduced to handbook size without any alterations.

Teletypewriter Handbook Drawings

5.05 These drawings cover teletypewriter station equipment and are all very similar in arrangement. They differ slightly from the telephone handbook drawings in form and standards.

5.06 The dimensions and lettering standards shown on Page 21 are for a 3 to 1 multiple which is the size used in practically all cases. Any drawing requiring a larger multiple shall be discussed with the group supervisor.

6. KEY SHEETS

6.01 A key sheet consists of a number of pages each placed on a separate tracing and all arranged for printing and binding in pamphlet form with dimensions of 8-3/8" x 10-7/8". It is used to indicate all possible interconnections of the circuits used with a particular type of equipment. The title page shall be prepared in accordance with information shown on Page 22 and all other pages shall be prepared as shown on Page 23. ES-534459 shall be used as a guide for the title page and ES-436870 for the other pages.

6.02 All line work within the page shall be of a uniform weight, similar to that on the blank form as shown on ES-436870 and shall be shown on the dull side of the tracing cloth. Border lines and dot-dash division lines shall be the same weight as a signaling lead.

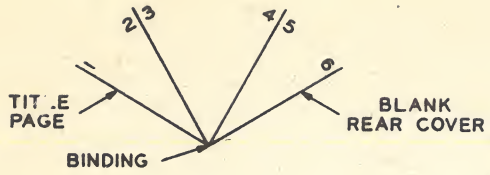
6.03 Use particular care in forming all letters and numbers so that they will be legible when reduced. Lettering outside the boxes shall be at least 1/32" from any other lettering or from any line work. Lines of lettering within the boxes shall be separated by a 1/32" space wherever possible and shall be centered within the box. The number of the circuit described in each box is shown in the lower left hand corner of that box or a reference is made at that point to another box containing this number. When one box covers two or more circuit numbers separated by descriptive information, these numbers shall be centered horizontally in the box.

6.04 Page numbers shall be placed on all pages of a key sheet and shall be on either the right or left hand side of the page according to the requirements of the particular job. As the key sheet is printed in multiples of 4 pages, the numbering of the pages requires consideration. The front cover shall always be the title page and the outside rear cover shall always be blank.

6.05 Accordingly, if the key sheet (excluding the title page) consists of 2 pages of information, the 2 inside pages of the 4 page pamphlet should be used. Similarly, any key sheet containing more than 2 pages of information (in multiples of 4 pages) i.e., 2,6,10,14,18, etc., would also use the complete pamphlet and leave no blank pages other than the outside rear cover. On such key sheets the page number shall be located in the upper left hand corner for odd numbered pages and in the upper right hand corner for even numbered pages.

6.06 In all other cases where the key sheet information is of a number of pages that does not require the complete use of the whole pamphlet, the location of the page numbering shall be reversed from that given above and the back of the title page shall be blank. This is the only blank page ever left at the front of the pamphlet.

6.07 An exception to the above conditions may be encountered on key sheets containing range charts or/and current drain tables. The prime consideration in numbering key sheet pages in this case is to have pages of like information face each other in the finished pamphlet. For such a condition making a plan of the key sheet pamphlet as shown in Fig. 23 will be helpful in determining the correct page numbering.



SCHEME FOR
KEY SHEET PAGE NUMBERING

Fig. 23

6.08 Notes shall be placed below the location of block space "J" unless otherwise required by the engineer. The engineer's sketch shall be followed exactly with reference to the side of the box to which connecting lines are brought in. However, the relative location of a number of connecting lines on any one side of the box may be varied to eliminate unnecessary crosses or bends. It is desirable to center these lines with respect to the box.

7. UNIT TYPE DRAWINGS

7.01 Unit type drawings are made up principally for the maintenance man's convenience. These drawings are usually large routine test circuits, decoders, etc., which are printed on reduced forms 10-7/8" high and assembled in 8-1/2" x 11" ring book binders. Such circuits usually require ten or more sheets to show the necessary apparatus and wiring, circuit requirements, and cross-connections. The drafting standards to be followed in making up a circuit on the unit basis are shown on Page 24. In addition the following information will be of assistance to the draftsman.

(a) Should a unit type circuit consist of less than ten sheets, the first sheet, which is always a key sheet, shall be numbered -011. Should the circuit consist of ten or more sheets the first sheet shall be numbered -0101.

(b) The following sheets shall then be arranged as specified by the engineer so that each circuit unit shall be numbered in consecutive order in the finished assembled book. For example, suppose the key sheet to be -0101, the schematic of the first unit shall be -0102, its circuit requirements and cross-connections shall be -0103, or -0103 and -0104 if necessary. The schematic of the second unit shall follow next in order, i.e., -0104 or -0105 its circuit requirements and cross-connections next, etc.

(c) Where space will permit the circuit requirements table and cross-connection information for a particular unit shall be shown together on one sheet of that unit. However, the circuit requirements table for one unit shall not be shown on the same sheet with the circuit requirements table of any other unit.

(d) Each circuit unit shall have its own circuit notes numbered from 101 up.

(e) The standard abbreviation of the main title shall be shown on the second and each succeeding sheet of the circuit. This abbreviated title is supplemented by a short descriptive title for each particular unit and shall be furnished by the engineer. This title shall be shown both within the reduction form and on the enclosing standard drawing form.

(f) Coordinate numbers and letters as covered in paragraph 4.11 shall be shown on the key sheet and each circuit sheet of a unit type drawing.

8. RELAY DATA SHEETS

8.01 Relay data sheets are arranged for printing on 8-3/8" x 10-7/8" pages in order that they may be inserted into the loose leaf relay data book for engineering reference. This type of drawing is prepared in accordance with Page 25.

9. MISCELLANEOUS

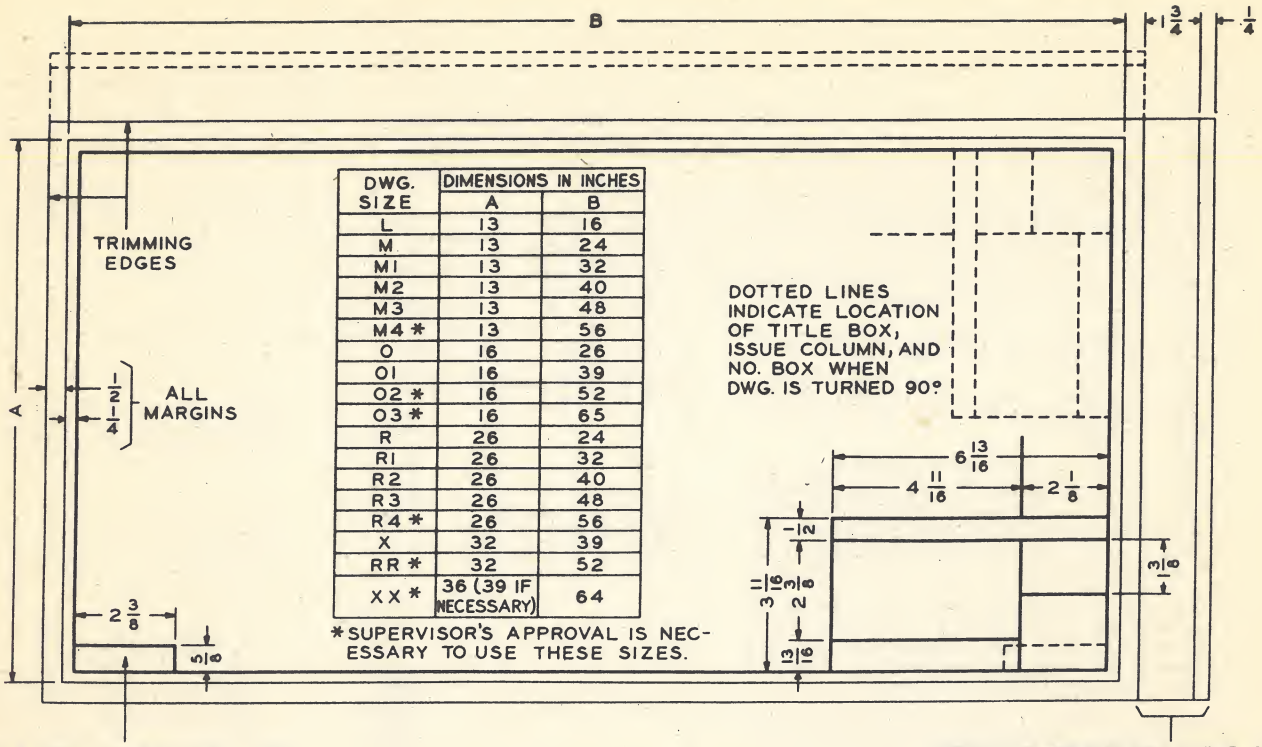
Sequence Switch Cam Charts

9.01 Cam charts are prepared using a printed form on which the draftsman inks in the necessary cuttings indicated on the engineer's marked print. In most cases however, it is desirable to reproduce photographically an existing chart and modify it to meet the requirements for the new sequence switch.

REMARKS

REMARKS

REMARKS



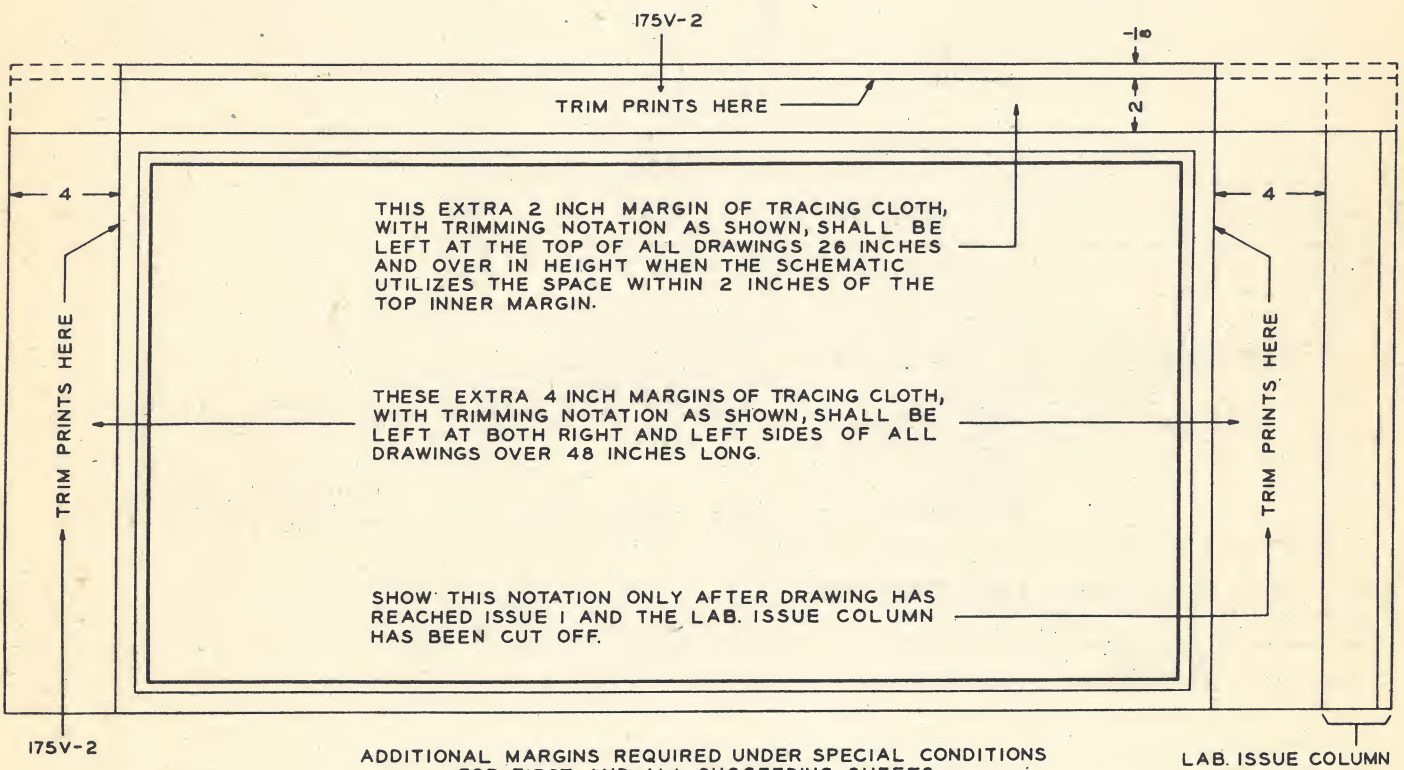
DWG. SIZE	DIMENSIONS IN INCHES A	B
L	13	16
M	13	24
M1	13	32
M2	13	40
M3	13	48
M4 *	13	56
O	16	26
O1	16	39
O2 *	16	52
O3 *	16	65
R	26	24
R1	26	32
R2	26	40
R3	26	48
R4 *	26	56
X	32	39
RR *	32	52
XX *	36 (39 IF NECESSARY)	64

*SUPERVISOR'S APPROVAL IS NECESSARY TO USE THESE SIZES.

THIS DWG. NO. BOX WILL BE LOCATED AS SHOWN ON DWGS. MADE IN EITHER VERTICAL OR HORIZONTAL POSITIONS

FORM FOR FIRST SHEET

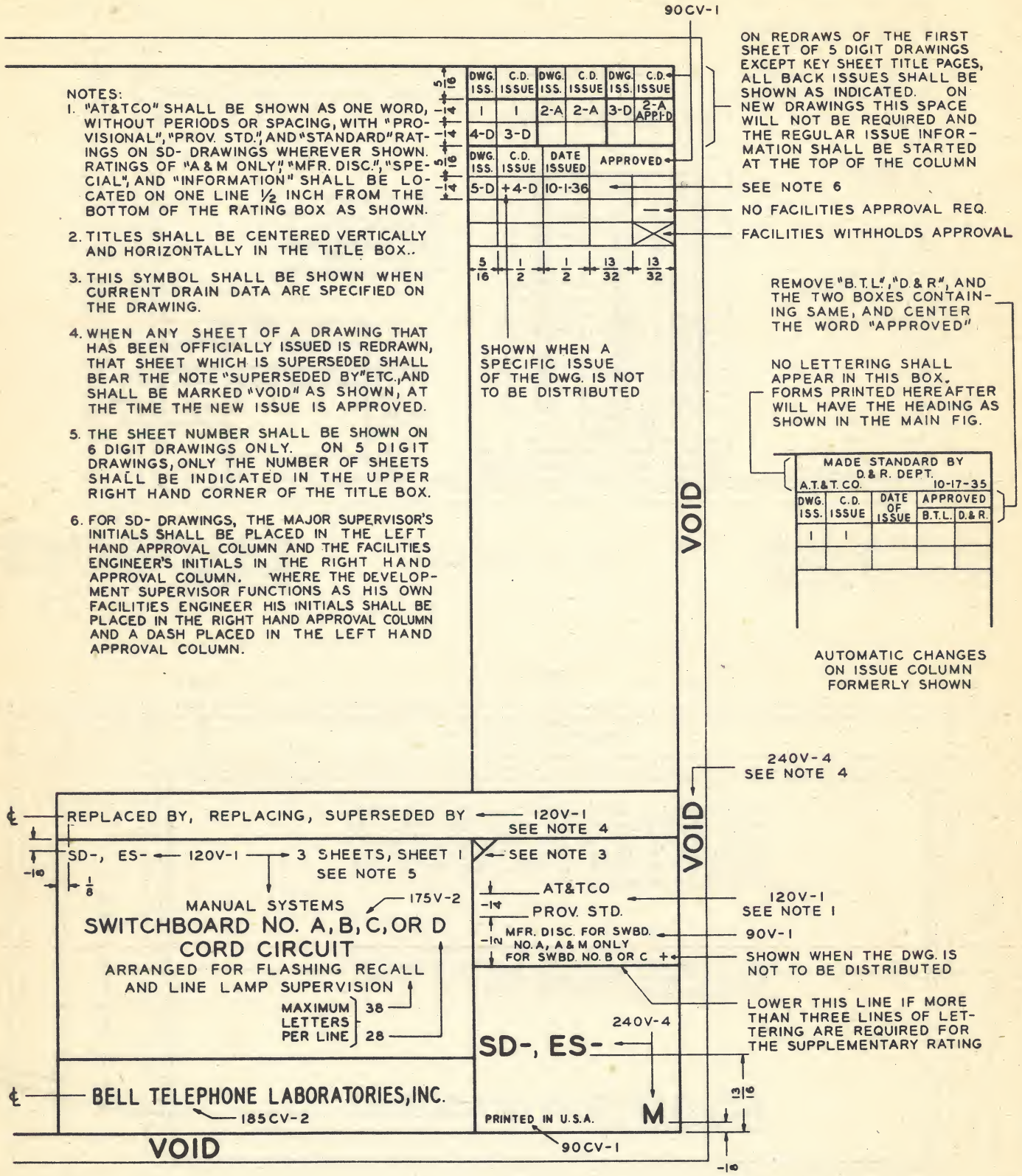
PROVIDE LABORATORY ISSUE COLUMN ON ALL NEW DRAWINGS WHEN THE DRAWING ORDER SPECIFIES LABORATORY ANALYZATION.



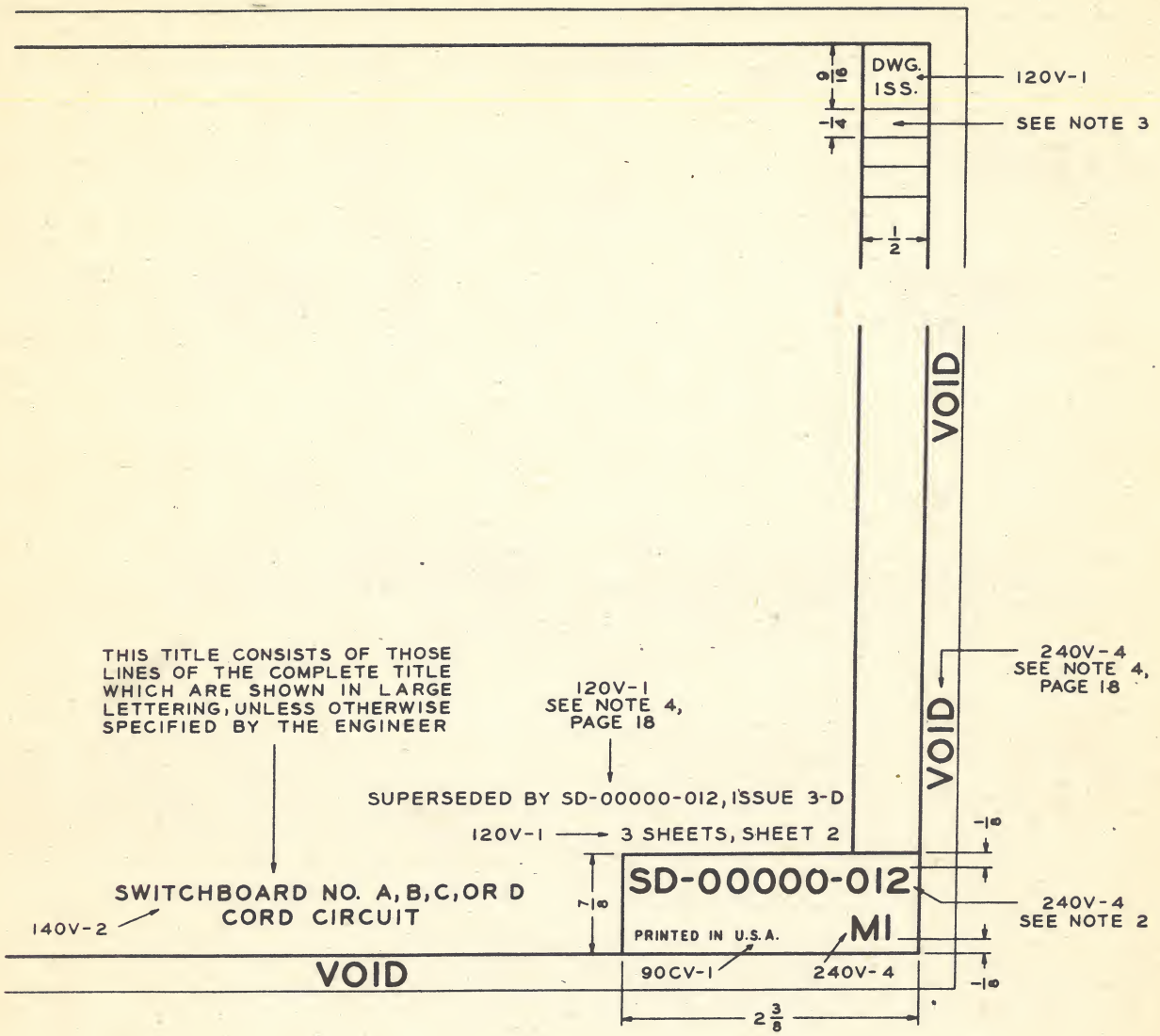
ADDITIONAL MARGINS REQUIRED UNDER SPECIAL CONDITIONS FOR FIRST AND ALL SUCCEEDING SHEETS

LAB. ISSUE COLUMN SEE NOTE 3, PAGE 19

SIZES AND FORMS FOR DRAWINGS



FIRST SHEET
ARRANGEMENT OF TITLE BOX
AND ISSUE COLUMN



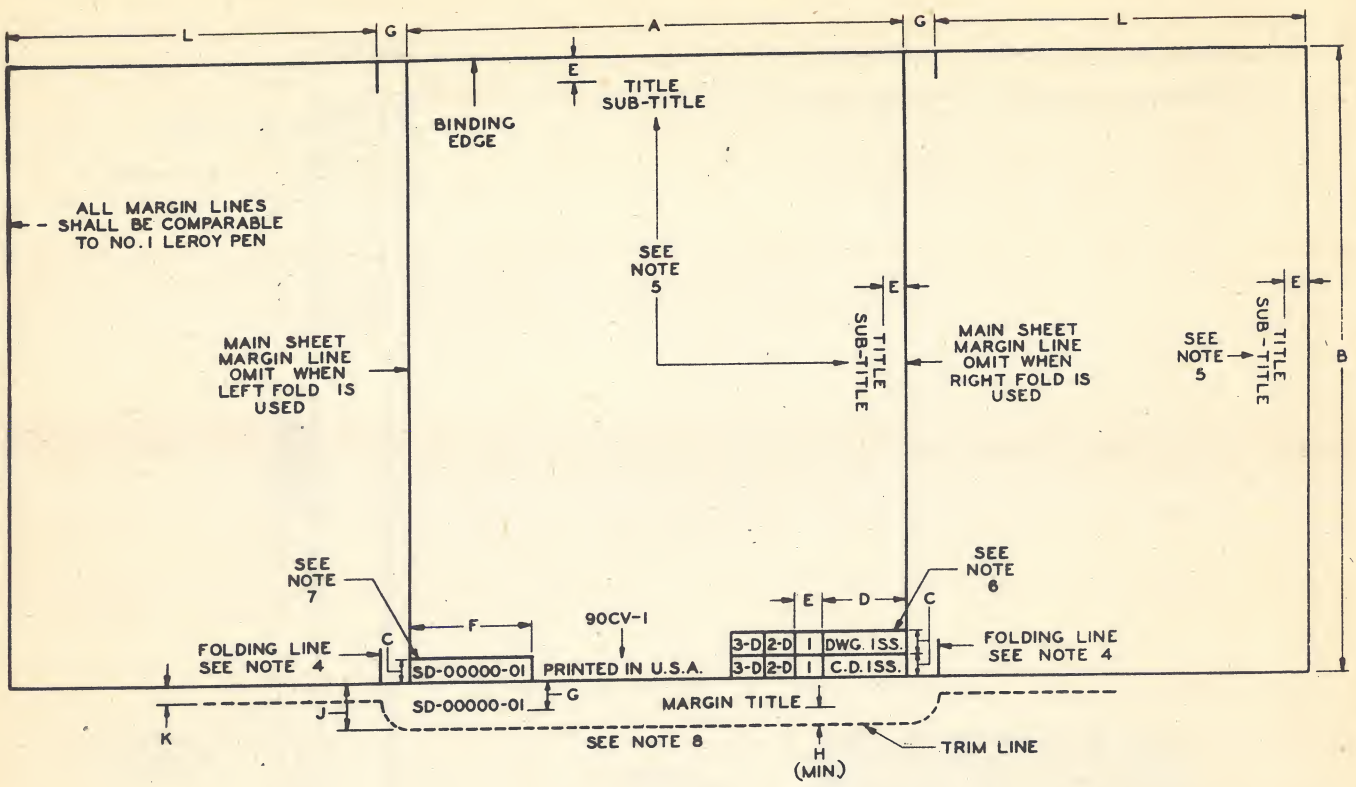
NOTES:

1. GENERAL REQUIREMENTS FOR SIZE OF DRAWING AND FOR SIZE AND LOCATION OF DRAWING NUMBER BOXES ARE THE SAME AS FOR THE FIRST SHEET. THE ISSUE COLUMN, TITLE, AND ENLARGED DRAWING NUMBER BOX MAY ALSO BE SHOWN ON THE SECOND SHEET IN THE SAME RELATIVE POSITION AS THE DOTTED TITLE BOX AND ISSUE COLUMN FOR THE FIRST SHEET AS SHOWN ON PAGE 17.

2. FOR DRAWINGS CONSISTING OF 2 TO 9 SHEETS, DASH NUMBERS ARE -012 TO -019. FOR MORE THAN 9 SHEETS, DASH NUMBERS ARE -0101, -0102, ETC.

3. THE "L" ISSUE COLUMN SHALL BE SHOWN ONLY ON THE FIRST OR TITLE SHEET OF A MULTI-SHEET SCHEMATIC. THE "L" ISSUE SHALL BE SHOWN IN PENCIL IN THE DRAWING ISSUE COLUMN ON THE SECOND AND ALL SUCCEEDING SHEETS. WHEN THE CIRCUIT IS OFFICIALLY ISSUED, THE "L" PENCIL ISSUES SHALL BE ERASED AND THE OFFICIAL ISSUE SHALL BE SHOWN IN ITS PROPER PLACE.

SECOND SHEET ARRANGEMENT OF TITLE, DWG. NO. BOX, AND ISSUE COLUMN

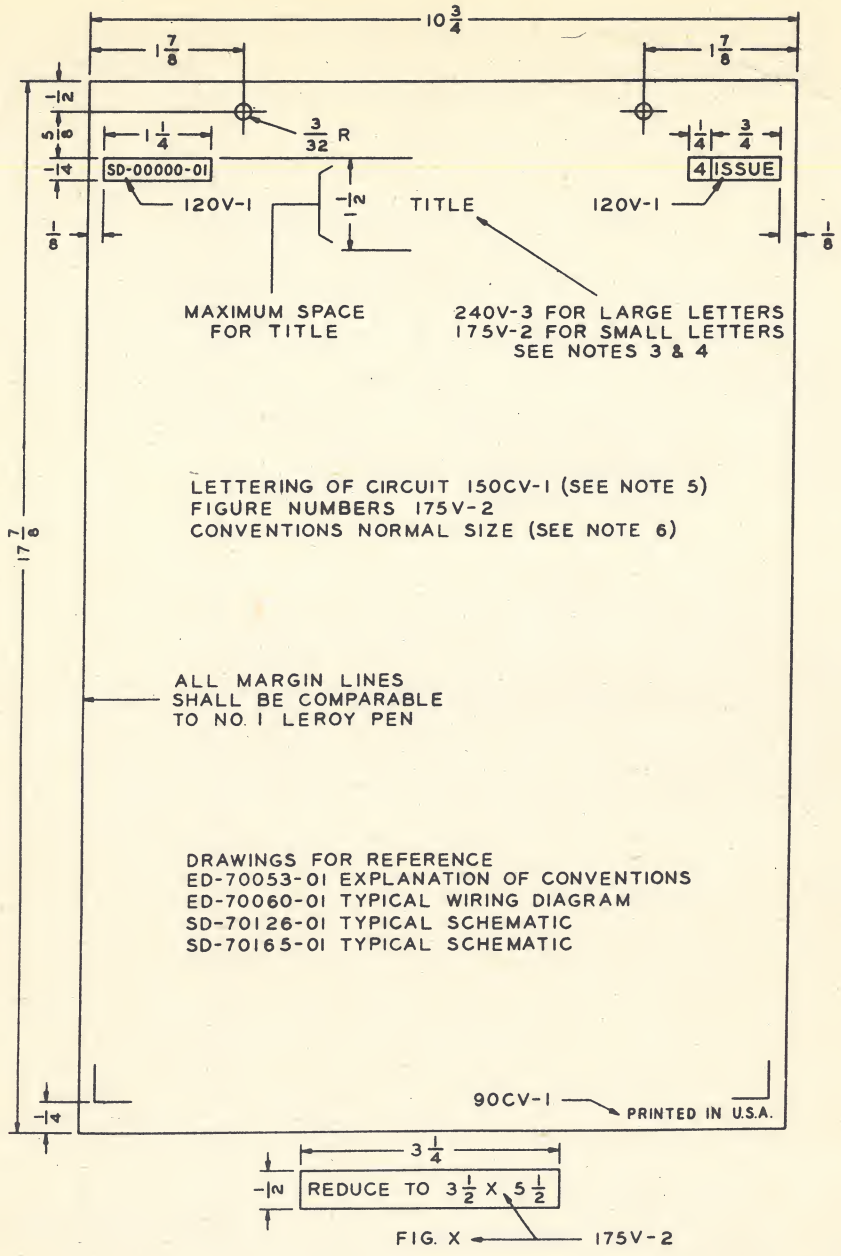


MULTIPLE	DIMENSIONS IN INCHES											LETTERING SIZES			
	A	B	C	D	E	F	G	H	J	K	L	BODY	SHEET TITLE	SD-NO., FIG. NO., SUB-TITLE, & MARGIN TITLE	DWG. AND C.D. ISSUE
2	7	11	3/16	13/16	3/8	1 3/8	1/2	1/8	3/4	1/4	7 3/8	105V-1	140V-1	120V-1	105V-1
2 1/4	7 7/8	12 3/8	3/16	13/16	3/8	1 3/8	9/16	1/8	7/8	5/16	8 5/16				
2 1/2	8 3/4	13 3/4	5/16	1 1/8	9/16	1 3/4	5/8	3/16	15/16	5/16	9 1/4	120V-1	200V-3	175V-2	140V-2
2 3/4	9 5/8	15 1/8	5/16	1 1/8	9/16	1 3/4	11/16	3/16	1	3/8	10 1/8				
3	10 1/2	16 1/2	5/16	1 1/8	9/16	1 3/4	3/4	3/16	1 1/8	3/8	11				

NOTES:

1. CONVENTIONS SHALL BE SHOWN NORMAL SIZE (USING THE OLD RELAY GUIDE NO. CC-1) ON ALL MULTIPLES, BUT THE SIZE OF LETTERING SHALL VARY FOR THE DIFFERENT MULTIPLES AS COVERED IN THE TABLE.
2. TO INSURE CLARITY ON THE REDUCED DRAWING, CARE MUST BE EXERCISED WHEN LETTERING TO KEEP THE LETTERS FROM TOUCHING ASSOCIATED LEADS, APPARATUS, OR OTHER LETTERING.
3. LETTERING WITHIN THE HANDBOOK FORM SHALL FOLLOW THE STANDARD DRAFTING PRACTICE OF READING FROM THE BOTTOM AND RIGHT, CONSIDERING ONLY THE POSITION OF THE CIRCUIT AS VIEWED IN THE HANDBOOK FORM, AND DISREGARDING THE ENCLOSING STANDARD DRAWING SIZE.
4. ON SHEETS WITH AN ADDED FOLD, NO APPARATUS, VERTICAL LEADS, OR LETTERING SHALL BE SHOWN WITHIN $\frac{3}{16}$" OF THE FOLDING LINE.
5. THE SHEET TITLE SHALL BE FURNISHED BY THE ENGINEER AND SHALL BE PLACED IN ONE OF THE POSITIONS INDICATED, SO THAT IT WILL BE ABOVE THE CIRCUIT WHICH MAY FACE IN EITHER DIRECTION. THIS TITLE SHALL BE SHOWN ONLY ON THE SCHEMATIC PAGE.
6. ON REISSUES ERASE THE OLD ISSUE NUMBERS AND ASSOCIATED CHANGE CLASSIFICATIONS ONLY AFTER THREE CONSECUTIVE ISSUES APPEAR ON THE HANDBOOK FORM. THE C.D. SHOULD BE REISSUED (NOT APPENDED) FOR EACH REISSUE OF THE CIRCUIT. IF NOT SO INDICATED BY THE DRAWING ORDER, THE DRAFTING SUPERVISOR SHALL BE CONSULTED.
7. THE SHEET NUMBER OF THE TRACING, AS INDICATED BY THE THIRD DIGIT OF THE DRAWING NUMBER SUFFIX, SHALL NOT BE SHOWN.
8. THE MARGIN TITLE SHALL CONSIST OF THE LARGE LETTERING OF THE SHEET TITLE REARRANGED IF POSSIBLE INTO A SINGLE LINE CENTRALLY LOCATED IN THE SPACE TO THE RIGHT OF THE MARGIN SD-NO. AND ON LINE WITH IT. IF NECESSARY, TWO LINES MAY BE USED AND THE "H" DIMENSION SHALL THEN APPLY. THE MARGIN TITLE, SD-NO., AND TRIM LINE SHALL BE SHOWN ONLY ON THE FIRST PAGE OF A MULTI-PAGE DRAWING.

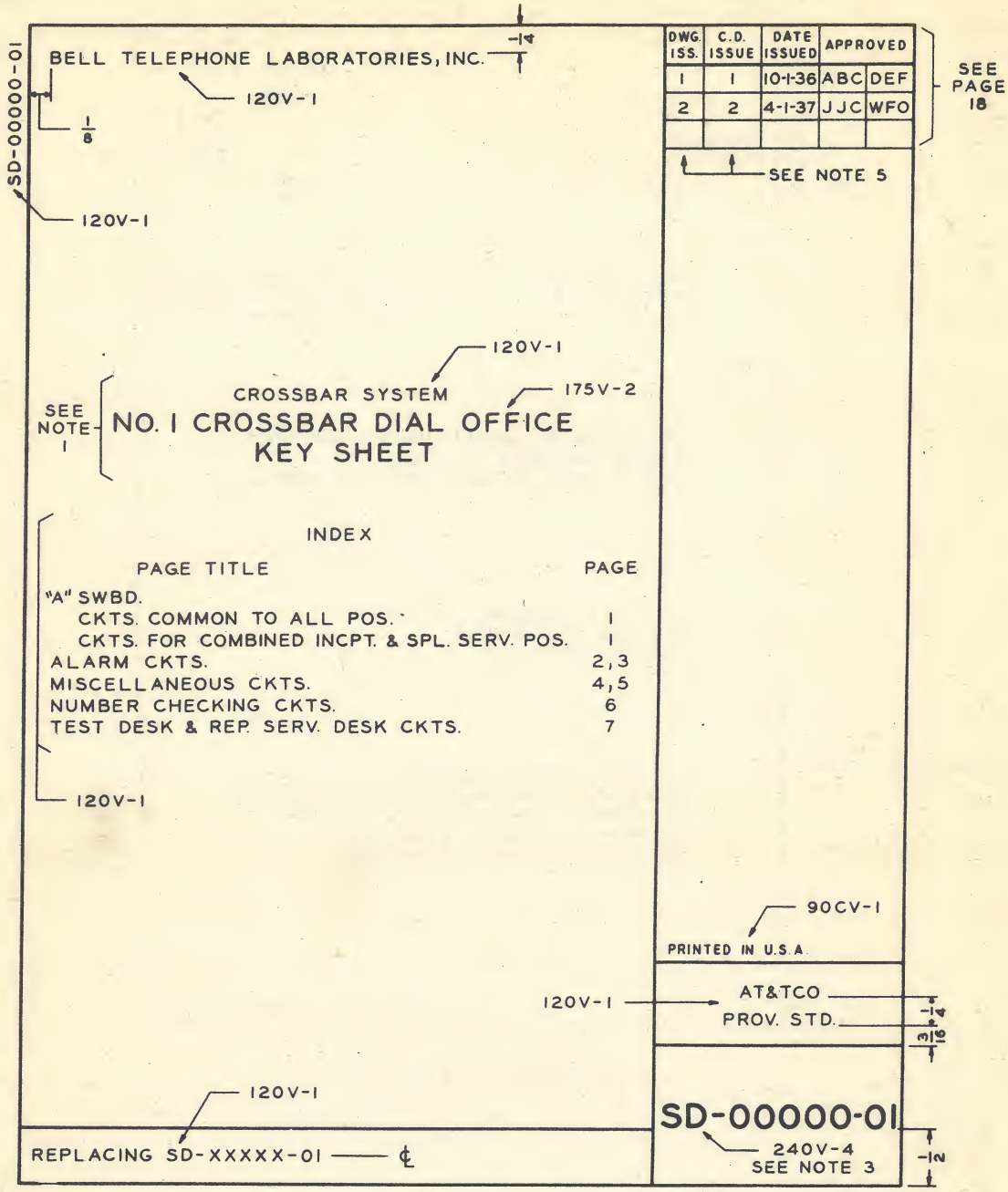
TELEPHONE HANDBOOK DRAWINGS SIZES AND LETTERING



NOTES:

1. DOTTED WIRING OR APPARATUS SHALL BE USED TO INDICATE WIRING OR APPARATUS SHOWN ON ANOTHER DRAWING.
2. TERMINALS SHALL NOT BE SHOWN DOTTED. WHERE IT IS DESIRED TO INDICATE THAT TERMINALS ARE SHOWN ON ANOTHER DRAWING, A DOTTED CONVENTION OF THE APPARATUS SHALL BE DRAWN AROUND THE TERMINALS.
3. TITLES SHALL BE FURNISHED BY THE ENGINEER AND SHALL BE AS BRIEF AS POSSIBLE. STANDARD ABBREVIATIONS AND DASHES SHALL BE USED IN PLACE OF CONJUNCTIONS AND PREPOSITIONS WHERE POSSIBLE.
4. PAGE TITLES SHALL ALWAYS BE LOCATED AS SHOWN ABOVE. WHEN IT IS NECESSARY TO SHOW A CIRCUIT SO THAT IT WILL BE READ FROM OTHER THAN NORMAL PAGE POSITION, THE CIRCUIT SHALL BE SHOWN SO THAT IT WILL BE IN THE PROPER POSITION TO BE READ WHEN THE PAGE IS TURNED 90 DEGREES COUNTER CLOCKWISE.
5. ALL LETTERING, WITH THE POSSIBLE EXCEPTION OF THE TITLE, SHALL BE SHOWN SO THAT THE READING POSITION WILL BE THE SAME AS THE POSITION FROM WHICH THE CIRCUIT IS VIEWED.
6. THE OLD RELAY GUIDE (NO. CC-1) SHALL BE USED.

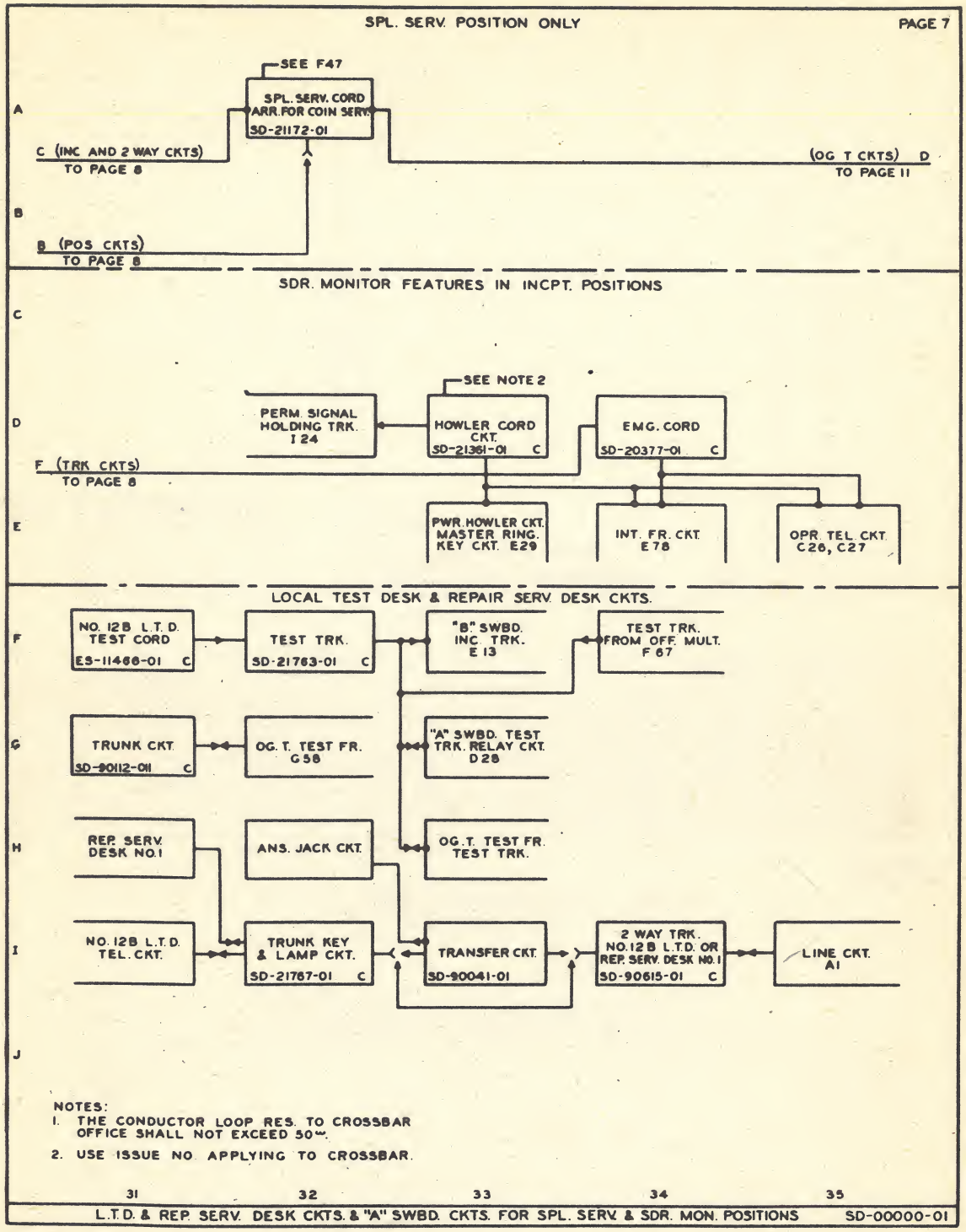
TELETYPEWRITER HANDBOOK DRAWINGS
DIMENSIONS AND LETTERING



NOTES:

1. THE FULL TITLE CALLED FOR ON THE DRAWING ORDER SHALL BE SHOWN ON THE KEY SHEET TITLE PAGE.
2. THE TITLE AND INDEX SHALL BE ARRANGED SO AS TO APPROXIMATELY CENTER IN THE TITLE PAGE.
3. THE SHEET NUMBER OF THE TRACING, AS INDICATED BY THE THIRD DIGIT OF THE DRAWING NUMBER SUFFIX SHALL NOT BE SHOWN WITHIN THE KEYSHEET FORM.
4. THE TITLE, RATING, ISSUE COLUMN, AND REPLACEMENT NOTES SHALL BE SHOWN ONLY ON THE KEY SHEET TITLE PAGE AND OMITTED ON THE ENCLOSING DRAWING FORM. ONLY THE NUMBER OF SHEETS SHALL BE SHOWN IN THE DRAWING FORM TITLE BOX.
5. WHEN A TITLE PAGE IS REDRAWN, BACK ISSUES SHALL NOT BE RECORDED.
6. ES-534459 SHALL BE USED FOR TRACING TITLE PAGE FORM.

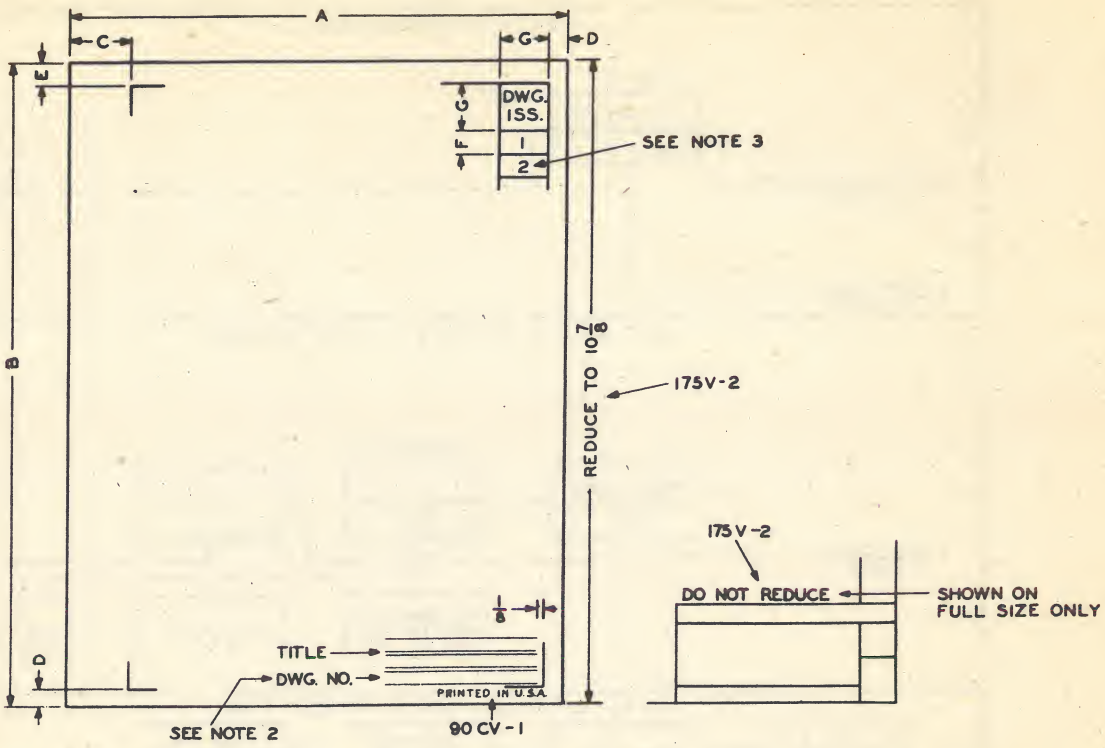
KEY SHEET - TYPICAL TITLE PAGE



NOTES:

1. NOTES, COORDINATES, AND ALL LETTERING INSIDE THE BOXES SHALL BE 100V-1. ALL OTHER LETTERING SHALL BE 120V-1. THE INVERTED FORM SECOND SHEET TRACING SHALL BE USED.
2. WHERE THE LETTERING RUNS FROM BOTTOM TO TOP OF THE PAGE AS ON SOME RANGE CHARTS, THIS LETTERING SHALL READ FROM THE RIGHT HAND EDGE OF THE PAGE.
3. THE SPACE PROVIDED FOR THE PAGE TITLE AND SD- NUMBER SHALL ALWAYS BE SHOWN AT THE BOTTOM OF THE INVERTED FORM TRACING. AN ABBREVIATED TITLE SHALL NOT BE SHOWN ON THE ENCLOSING DRAWING FORM.
4. FOR EXPLANATION OF CONVENTIONS. SEE SD-90250-01.
5. ES-436870 SHALL BE USED FOR TRACING KEY SHEET FORM.

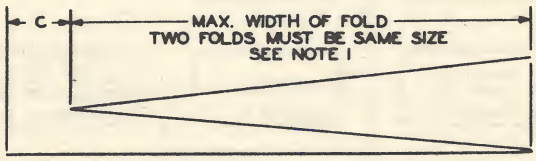
KEY SHEET - TYPICAL SECOND AND SUCCEEDING PAGES



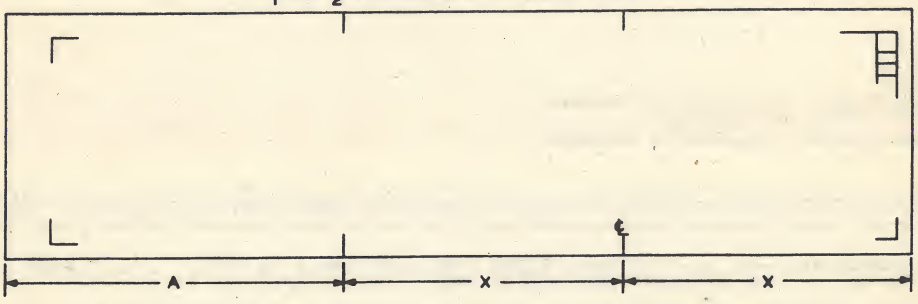
MULTIPLE	DIMENSIONS IN INCHES							CONV.	LETTERING SIZES						MAX. WIDTH OF FOLD
	A		C	D	E	F	G		CIRCUIT	FIG. NO.	TITLE	DWG. NO.	COORDINATE NUMBERS	DWG. ISS.	
FULL SIZE	$8\frac{3}{8}$	$10\frac{7}{8}$	1	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{16}$	$\frac{3}{8}$	NORMAL	100V-1	175V-2	140V-1	120V-1	120V-1	100V-1	$7\frac{3}{8}$
$1\frac{1}{2}$	$12\frac{9}{16}$	$16\frac{5}{16}$	$1\frac{1}{2}$	$\frac{3}{8}$	$\frac{9}{16}$	$\frac{1}{4}$	$\frac{1}{2}$	NORMAL	100V-1	175V-2	175V-2	140V-2	140V-2	120V-1	$11\frac{1}{16}$
2	$16\frac{3}{4}$	$21\frac{3}{4}$	2	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{5}{16}$	$\frac{5}{8}$	NORMAL*	105V-1	175V-2	240V-3	175V-2	175V-2	140V-1	$14\frac{3}{4}$
$2\frac{1}{4}$	$18\frac{7}{8}$	$24\frac{1}{2}$	$2\frac{1}{4}$	$\frac{9}{16}$	$\frac{7}{8}$	$\frac{5}{16}$	$\frac{5}{8}$	NORMAL*	105V-1	175V-2	240V-3	175V-2	175V-2	140V-1	$16\frac{5}{8}$

USE ON APPROVAL OF SUPERVISOR

* THE OLD RELAY GUIDE (NO. CC-1) SHALL BE USED.



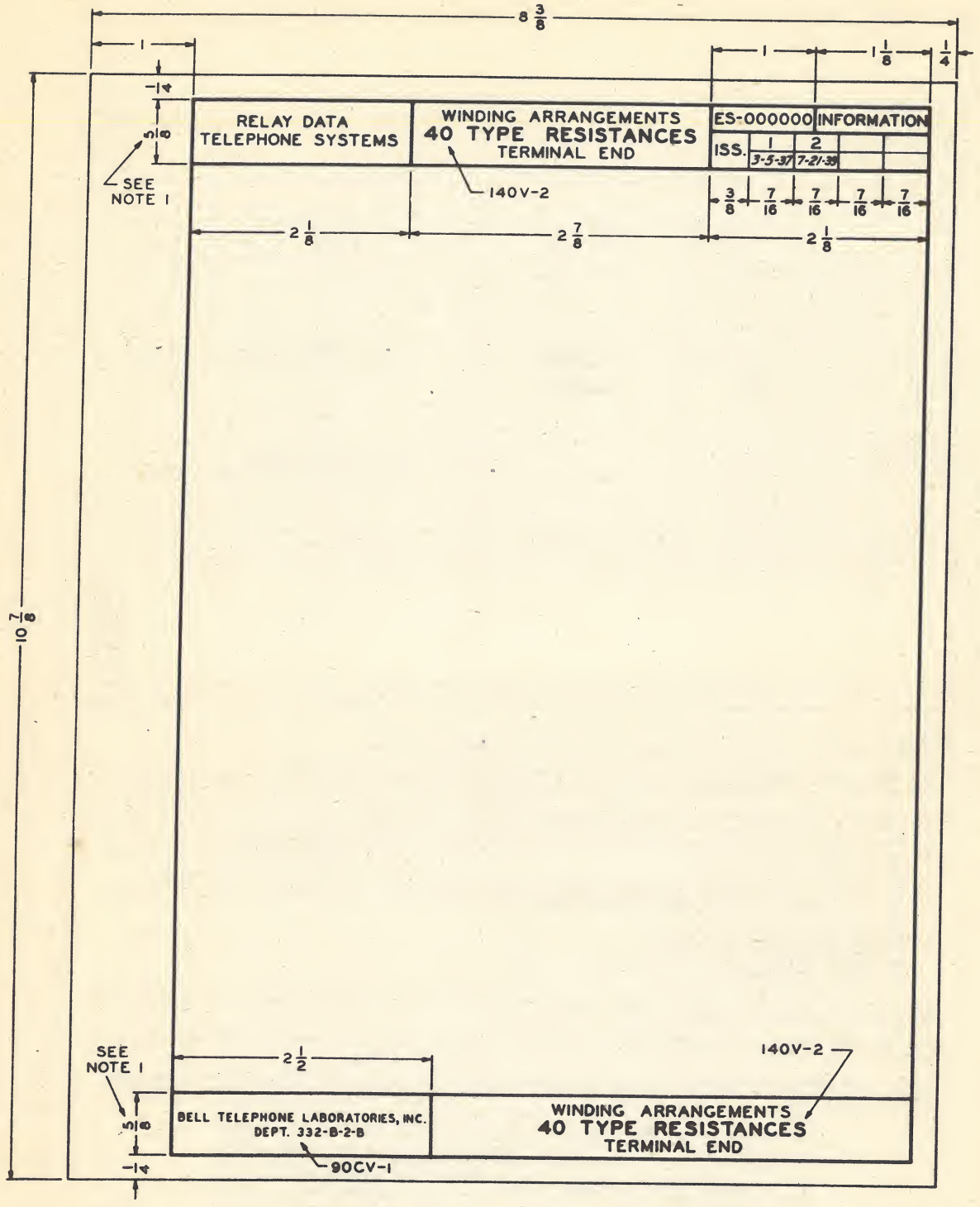
$\frac{2}{1}$ OR $\frac{3}{2}$ PREFERABLE TO USING FOLDS



NOTES:

1. ON SHEETS WITH AN ADDED FOLD, NO APPARATUS, VERTICAL LEADS, OR LETTERING SHALL BE SHOWN WITHIN $\frac{3}{8}$" OF THE FOLDING LINE.
2. THE FULL SUFFIX DASH NUMBER, AS -0102 SHALL BE SHOWN.
3. THE CLASS OF ISSUE SHALL NOT BE SHOWN INSIDE THE REDUCTION FORM.

UNIT TYPE DRAWINGS — SIZES AND LETTERING



NOTES:
1. THIS DIMENSION MAY BE INCREASED TO ACCOMODATE TITLES OF MORE THAN 3 LINES.

2. UNLESS OTHERWISE SPECIFIED, ALL LETTERING SHOWN ABOVE SHALL BE 120V-1.

3. INFORMATION TO BE SHOWN ON THIS FORM SHALL BE ARRANGED TO MEET THE INDIVIDUAL CONDITIONS OF EACH JOB. LETTERING SHALL BE 100V-1.

RELAY DATA SHEET
DIMENSIONS AND LETTERING

SEE NOTE 3

SD-00000-01

CIRCUIT REQUIREMENTS

TRUNK LINK AND CONNECTOR CIRCUIT (T)

DWG. ISS. 1

APPARATUS DESIG.	APPARATUS CODE	MECH. REQ. BSP FIG.	MECH. REQ. CONT. PRESS	MECH. REQ. ARM. TRVL.	LOC.	CIRCUIT PREPARATION BLOCK OR INSULATE	CIRCUIT PREPARATION TEST CLIP DATA CONN. BAT	CIRCUIT PREPARATION TEST CLIP DATA CONN. GRD	TEST SET PREP.	SEE TEST NOTE NO.	DIRECT CURRENT FLOW REQ. TEST WDG.	DIRECT CURRENT FLOW REQ. TEST FOR	DIRECT CURRENT FLOW REQ. AFTER SOAK MA	DIRECT CURRENT FLOW REQ. TEST MA	DIRECT CURRENT FLOW REQ. READJ. MA	REMARKS
																2
MAGNETS FIG. 1																
P HOLD	301A SW.	1			C3	O CROSS POINT		T(HOLD)	GRD.			O		17.5	16.5	WDG. ALONE
								T(HOLD)	GRD.			O		17.5	16.5	CKT. COMB.-MULTIPLY BY NUMBER OF MAGNETS IN PARALLEL
SEL		101			B2			D(SEL)	GRD.			O		29	27.5	
FIG. 2 S HOLD	301A SW.	1			C6	O CROSS POINT		T(HOLD)	GRD.			O		17.5	16.5	WDG. ALONE
								T(HOLD)	GRD.			O		17.5	16.5	CKT. COMB.-MULTIPLY BY NUMBER OF MAGNETS IN PARALLEL
SEL		101			B5			D(SEL)	GRD.			O		29	27.5	
RELAYS FIG. 3 LC	245D				D2							O		80	72	WDG. ALONE
								T(LC)	GRD.			O		26.5	25	CKT. COMB. OF BOTH WDGS.
FIG. 5 JC	245D				F2		B(JC)		BAT.			O		80	72	

SD-00000-01

NOTES:

1. ES-392686 SHALL BE USED FOR TRACING THE CIRCUIT REQUIREMENTS FORM.

2. FOR SINGLE PAGE REQUIREMENTS, THE TYPICAL PAGE SHOWN ABOVE SHALL BE FOLLOWED.
   FOR MULTIPLE PAGE REQUIREMENTS, THE TYPICAL ARRANGEMENT SHOWN ON PAGE 27 SHALL BE FOLLOWED.

3. AS INDICATED, THIS COLUMN IS USED WITH VARIOUS HEADINGS AS FOLLOWS:
   (A). WHEN NO INFORMATION IS TO BE SHOWN THIS COLUMN SHALL BE LEFT BLANK, AND LIKE THE "LOC." COLUMN SHOWN ABOVE, SHALL NOT BE HEADED BY EITHER "MECH. REQ." OR "CIRCUIT PREPARATION".
   (B). ON DRAWINGS USING COORDINATES, THE HEADING SHALL BE "LOC." AND THE COORDINATE LOCATION OF THE APPARATUS SHALL BE INDICATED.
   (C). ON DRAWINGS USING STEP BY STEP TYPE RELAYS THE HEADING SHALL BE "RESID." UNDER "MECH. REQ."
   (D). ON PANEL SYSTEM DRAWINGS REQUIRING SEQUENCE SWITCH ADJUSTMENT DURING RELAY TESTS THE HEADING SHALL BE "SEQ. SW. POS." UNDER "CIRCUIT PREPARATION".

4. LETTERING SIZES SHALL BE AS FOLLOWS:

"CIRCUIT REQUIREMENTS" HEADING	140V-2
SD- OR ES- NUMBERS AND PAGE INFORMATION	120V-1
ALL OTHER LETTERING	100V-1

5. THAT PART OF THE SUFFIX OF THE DRAWING NUMBER INDICATING THE CIRCUIT SHEET NUMBER SHALL NOT BE SHOWN ON THE TABLE EXCEPT ON TABLES OF UNIT TYPE DRAWINGS.

6. SEE BSP SECT. A804.001 FOR THE METHOD OF INDICATING "PULSING REQ." AND "TIMING REQ." AND FOR AN EXPLANATION OF ABBREVIATIONS AND TERMS USED ON CIRCUIT REQUIREMENT PAGES.

7. RELAYS AND MESSAGE REGISTERS WITH WINDING ARRANGEMENTS AS LISTED BELOW ARE TESTED FROM THE REAR, THEREFORE THEIR WINDING TERMINAL NUMBERS MUST BE SHOWN AS PART OF THEIR WINDING TERMINAL DESIGNATIONS IN THE CIRCUIT REQUIREMENTS TABLE.

APPARATUS	WINDING ARRANGEMENTS
"A" AND "AB" TYPE RELAYS	7
"E", "F", "R", AND "T" TYPE RELAYS	23, 27, 29, 31, 32, 34, 35, 36, 38, 39, 41, 44, 46, 49, 66, 58, 60, 63, 64
"L", "N", AND "S" TYPE RELAYS	ALL
"H" TYPE RELAYS	ALL
RELAYS WITH INDIVIDUAL COVERS	ALL
MESSAGE REGISTERS	ALL

TYPICAL CIRCUIT REQUIREMENTS SINGLE PAGE

SEE NOTE 3, PAGE 26

SD-00000-01 2 PAGES

CIRCUIT REQUIREMENTS

INCOMING TRUNK CIRCUIT (INC TRK)

APPARATUS DESIG	APPARATUS CODE	MECH. REQ BSP FIG	MECH. REQ CONT PRESS	MECH. REQ ARM TRVL	CIRCUIT PREPARATION SEQ SW POS	CIRCUIT PREPARATION BLOCK OR INSULATE	CIRCUIT PREPARATION TEST CLIP DATA CONN BAT	CIRCUIT PREPARATION TEST CLIP DATA CONN GRD	TEST SET PREP	SEE TEST NOTE NO	DIRECT CURRENT FLOW REQ TEST WDG	DIRECT CURRENT FLOW REQ TEST FOR	DIRECT CURRENT FLOW REQ AFTER SOAK MA	DIRECT CURRENT FLOW REQ TEST MA	DIRECT CURRENT FLOW REQ READ MA	REMARKS	DWG ISS 1	DWG ISS 2
FIG 1																		
MAGNETS																		
RS	206L SEL	BSP				1B(SC)		1(RS)	G/V					BSP	BSP	STEPPING		
						1B(SC)		2(RS)	G/V					BSP	BSP	RUNNING		
RELAYS																		
0-9	208G							2 (ASSOC PRIME REL)	GRD	1		0		16	15			
									GRD			NO		14	13			
1'-9'	208B							1 (ASSOC CTC REL)	GRD	1		0		16	15			
									GRD			NO		14	13			
CR1, CR2, HW	E734	3/1	H	20			(REL UNDER LT TEST)	RT (REL UNDER TEST)	GRD			0		13	12			
									BAT			H		31	29			
SC	R PER D-79090	24/9	H	30	13							0		25.5	24	WDG. ALONE		
								RT(SC)	GRD	2		0		54	51	CKT. COMB. OF (SC) AND (SCI)		
SCI	R PER D-80325	23/8	H	30	13							0		24.5	23	WDG. ALONE		
								RT(SCI)	GRD	2		0		52	49	CKT. COMB. OF (SCI) AND (SC)		
FIG. A																		
PC	149AS	A						3B(SCI)	GRD	3								

TEST NOTES

1. ARMATURE GAP 15 ± 2
   CONTACT SEPARATION MIN 4 MAX. 7.
2. THE BOTTOM SPRINGS SHALL BE TENSIONED TO MIN 30 GRS
3. AFTER A SOAK OF 80 MA, RELAY MUST RELEASE WITHIN 3 SEC ON 0.4 MA THEN OPERATE ON 23.5 MA AND HOLD FOR 5 SEC WHEN THE CURRENT IS REDUCED TO 2.4 MA.

SD-00000-01 PAGE 1

SEE NOTE 3, PAGE 26

APPARATUS DESIG	APPARATUS CODE	MECH. REQ BSP FIG.	MECH. REQ CONT PRESS	MECH. REQ ARM TRVL	MECH. REQ RESID	CIRCUIT PREPARATION BLOCK OR INSULATE	CIRCUIT PREPARATION TEST CLIP DATA CONN BAT	CIRCUIT PREPARATION TEST CLIP DATA CONN GRD	TEST SET PREP	SEE TEST NOTE NO	DIRECT CURRENT FLOW REQ TEST WDG	DIRECT CURRENT FLOW REQ TEST FOR	DIRECT CURRENT FLOW REQ AFTER SOAK MA	DIRECT CURRENT FLOW REQ TEST MA	DIRECT CURRENT FLOW REQ READ MA	REMARKS	DWG ISS 1	DWG ISS 2
FIG 2																		
A	221A	11		8	7-11	(B) NO	TST JK 2	TST JK 1	M	1/2	F/R	0	100	15.1	14.8			
						(B) NO	TST JK 2	TST JK 1	M	2	F/R	NO	100	13.9	14.4			
C	224A	201		17	5-4		2 (ROT.)	5(B)	B/G	3		0	30	24.5	22			
							2 (ROT.)	5(B)	B/G	3		NO	30	18	20			
"Y" APPARATUS																		
E	221FAE	356		8	7-11	(B) NO	TST JK 2	TST JK 1	M	1/4	S/T	0	130	15.1	14.8			
							TST JK 2	TST JK 1	M		S/T	NO	130	13.6	13.9			
							TST JK 2	TST JK 1	M	1/4/5	S/T	0	130	16		FOR MTCE. APPLY PULS. REP. REQ "B2". LIMITS 56-71% BREAK		
							TST JK 2	TST JK 1	M	5	S/T	NO	130	12.5				
"Z" APPARATUS																		
E	221FAF	307		8	7-11	2(D) 5(D) (B) NO	5(D)	2(D)	M	1/6	P/S	0	22	12.5	11.6			
							5(D)	2(D)	M		P/S	NO	22	10.1	10.7			
							5(D)	2(D)	M	1/5/6	P/S	0	22	13.5		FOR MTCE. APPLY PULS. REP REQ "B3". LIMITS 56-71% BREAK		
							5(D)	2(D)	M	5	P/S	NO	22	9				
"AA" APPARATUS																		
D	248A	500		27	1.5-4	1 & 2 (A)		3(A)	GRD			0	50	10.5	10			
						1 & 2 (A)		3(A)	GRD			NO	50	8.5	9			

TEST NOTES

1. ARMATURE NEED NOT TOUCH CORE.
2. TEST: CONTACT SEPARATION MIN. 3.
   CONTACT FOLLOW MIN. 8.
3. TEST: CONTACT PRESSURE 6T-7T MIN. 15 GRS.
   AS PERMITTED BY SEQUENCE ANY 2 BREAK CONTACTS MAY BREAK.
4. TEST: CONTACT FOLLOW 2-3, 4-5, AND 6-7 MIN. 8.
   CONTACT SEPARATION MIN. 3
   CONTACTS 2-3 AND 4-5 SHALL MAKE BEFORE 6-7.
5. WHEN APPLYING PULSE REPEATING REQ DO NOT USE CIRCUIT PREPARATION SPECIFIED FOR CURRENT FLOW REQ.
6. TEST: CONTACT FOLLOW 2-3 AND 4-5 MIN. 8.
   CONTACT SEPARATION MIN. 3.
   CONTACTS 2-3 SHALL MAKE BEFORE 4-5.

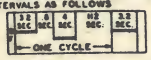
SD-00000-01 (2 PAGES) PAGE 2

TYPICAL CIRCUIT REQUIREMENTS
MULTIPLE PAGE

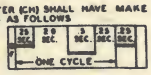
CIRCUIT NOTES.

101. (A) FURNISH ONE 1½ AMP FUSE FROM 48V. TALK BAT PER FIGS. I, A, C, E, F, AND G.
(B) FURNISH ONE 1½ AMP FUSE FROM 48V. TALK BAT. FOR 2 FIGS. 3 AND ONE FIG. 2 ASSOCIATED WITH THE SAME 20 JUNCTORS.
(C) PROVIDE ONE 1½ AMP FUSE PER 20 FIGS. I FOR EACH RINGING LEAD.

102 CONTACTS (RB) AND (RF) SHALL BE PART OF THE SAME INTERRUPTER AND SHALL HAVE MAKE AND BREAK INTERVALS AS FOLLOWS



103 INTERRUPTER (CH) SHALL HAVE MAKE AND BREAK INTERVALS AS FOLLOWS



104. PROVIDE FEATURES AS FOLLOWS

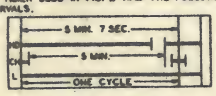
FEATURE	PROVIDE
2 PARTY LINES EQUIPPED WITH M.R.	FIG. A
OTHER THAN 2 PARTY LINES WITH M.R.	FIG. B
TO OMIT REGISTRATION OF NON-ZONE MESSAGES	FIG. C
REGISTRATION OF NON-ZONE MESSAGES WITHOUT TIMING FOR INDIVIDUAL OR 2 PARTY LINES.	FIG. D
OVERTIME REGISTRATION OF NON-ZONE MESSAGES	FIG. E
4 PARTY SELECTIVE RINGING	FIG. F
4 PARTY SEMI-SELECTIVE RINGING	PR, C & L ONE PR. B PER 20 FIGS. I
INDIVIDUAL AND 2 PARTY SELECTIVE RINGING	FIG. H
ZONE REGISTRATION	X
ZONE REGISTRATION NOT REQUIRED	Y

106. THERE SHALL BE 5 PAIRS OF (OB) AND (OF) RELAYS PER (CH) INTERRUPTER CONTACTS "F" AND "B" AND 3 PAIRS OF (EB) AND (EF) RELAYS PER SECOND (CH) INTERRUPTER CONTACTS "F" AND "B" PER JUNCTOR FRAME.

108. LEADS "OB" AND "B" AND LEADS "OF" AND "F" SHALL EACH BE WIRED IN SERIES THRU ALL RELAYS ON THE JUNCTOR FRAME WITH THE SAME RELAY DESIGNATION.

107. RELAYS (B) AND (SC) SHALL BE EQUIPPED WITH CROSS TALK PROOF COVERS.

109. THE TIMER USED IN FIG. E HAS THE FOLLOWING TIME INTERVALS.



109. FURNISH ONE 1½ AMP FUSE FROM 22 V. A-C SUPPLY PER MOTOR WHICH SERVES THE NON-ZONE TIMERS FOR 20 FIGS. E.

110. PROVIDE TWO FIGS. 3 PER GROUP OF 20 JUNCTORS THE RELAYS IN THE FIRST FIG. 3 SHALL BE DESIGNATED (OB) AND (OF) AND SHALL BE ASSOCIATED WITH ODD NUMBERED PRIMARY DISTRICT SWITCHES THE RELAYS IN THE SECOND FIG. 3 SHALL BE DESIGNATED (EB) AND (EF) AND SHALL BE ASSOCIATED WITH THE EVEN NUMBERED PRIMARY DISTRICT SWITCHES.

FIG. B
FOR OMITTING PARTY IDENTIFICATION SEE NOTE 104

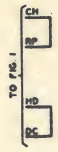


FIG. C
FOR OMITTING REGISTRATION OF NON-ZONE MESSAGES SEE NOTE 104

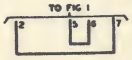


FIG. D
FOR REGISTRATION OF NON-ZONE MESSAGES WITHOUT TIMING SEE NOTE 104

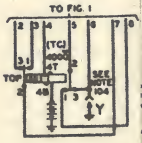


FIG. F
FOR 4 PARTY SELECTIVE RINGING SEE NOTE 104

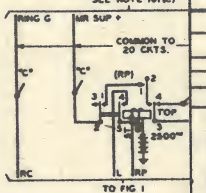
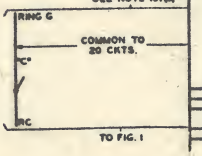


FIG. H
FOR INDIVIDUAL OR 2 PARTY SELECTIVE RINGING SEE NOTE 104



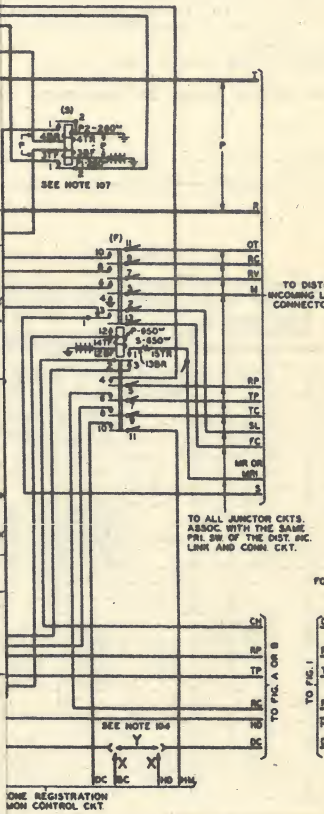
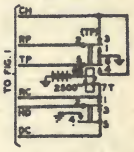


FIG. A
FOR PARTY IDENTIFICATION OF 2 PARTY LINES SEE NOTE 104

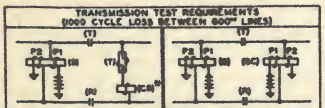


	TRUNK SUPV.		
	20-28 V.	21-28 V.	40-56
MAX. EXT. CKT LOOP	3415~	3575~	7110~
MIN. INS. RES. EARTH POTENTIAL	30,000~	30,000~	30,000~

TRIPPING RANGES

SUB LINE	RELAY	RINGING 20~ A-C VOLTAGE	RINGING 20~ D-C VOLTAGE	SILENT INTERVAL VOLTAGE	RINGING INTERVAL	SIL. INTE
4 PTY	114KA	64-88	37-40	46-52	1000~	10
	114KA	64-88	37-40	46-52	1500~	15
1 OR 2 PTY	114KA	64-88	37-40	46-52	1000~	10
	114KA	64-88	37-40	46-52	1500~	15

TRANSMISSION TEST REQUIREMENTS (1000 CYCLE LOSS BETWEEN 600~ LINES)



MAX. ALLOWABLE CIRCUIT LOSS 0.4	MAX. ALLOWABLE CIRCUIT LOSS

ALLOWABLE INDIVIDUAL APPARATUS LOSSES

APPARATUS	DESIG.	COIL	MAX. LOSS	MIN. LOSS	REMARKS
CONDENSER	T, R	2 MF	14.5	11.5	
RELAY	S,SC	U	0.2		
KEY CONT.		Y	207C	0.1	

* INDICATES APPARATUS FOR WHICH MIN. LOSSES ARE NOT REQ.

ES-392665

2		9-24-58	MLH

ES-392665

SAMPLE DRAWING
PREFERRED LAYOUT OF MAIN. FIG. OPTIONAL FIGS. AND NOTES

INFORMATION

ES-392665

BELL TELEPHONE LABORATORIES, INC.

R3

INDEX

Subject	Page
A	
Abbreviations	2
Apparatus	
Codes	2
Designations	2
Names	2
Apparatus Standards	7
Arrangement of Information	11
B	
Battery Variations	3
Bracket Designations	2
C	
Calculation Notes	6
Cams, Sequence Switch	10
Changes and Redraws	5
Circuit Arrangement	11
Circuit Notes	5 and 11
Circuit Requirements Tables	3, 11, 26, and 27
Circuit Schematics	11
Arrangement of Information	11
Code Numbers	2
Cords	7
Cross-Connections	4 and 11
Current Drain Data	3
D	
Data Books	1
Designations	
On Apparatus	2
On Brackets	2
On Leads	2
Draftsman's Responsibility	1
Drawing	
Arrangement	1, 11, and 28
Form	1
Layouts	1
Ratings	6 and 18
Sizes	17
Standard Form	17
Titles	2
Drawings	
For Reference	1
Handbook	12
Telephone	12 and 20
Teletypewriter	12 and 21
Key Sheet	12, 22, and 23
Relay Data Sheet	13 and 25
Unit Type	13 and 24
E	
Engineer's Responsibility	1
Equipment Notes	5
Erasures	5
F	
Figure Rating	6 and 18
Form of Drawing	1
G	
General Requirements	1
H	
Handbook Drawings	12
Telephone	12 and 20
Teletypewriter	12 and 21
I	
Inkwork on Tracings	5
Interrupters	8
J	
Jacks	8
K	
Keys	8
Key Sheets	12, 22, and 23
Key Top Figures	8
L	
Lamps	8
Lettering	2 and 12
Line Characteristics	2
M	
Magnets	8
Magnets in Circuit Requirements Table	3 and 26
Manufacturing Notes	5
N	
Notes	5
Calculation	6
Circuit	5 and 11
Equipment	5
Manufacturing	5
Rating	6
Replacement and Superseding	18
Test	4
Transmission	6

Subject	Page
O	
Optional Relay Codes	9
Order of Leads	2
P	
Page Numbers on Key Sheets	12
Plugs	9
Protection of Tracings	6
R	
Ratings	6 and 18
Redraws	5
Relay Data Sheets	13 and 25
Relays	9
In Circuit Requirements Table	3 and 26
Optional Codes	9
Position of Springs	9
Winding	9
Resistances	10
Responsibility for Drawings	1
S	
Sequence Switch Cams	10
Sequence Switch Cam Charts	13
Sources of Reference	1
Specifications for Reference	1
Supplementary Information	1
T	
Test Notes	4
Titles and Lettering	2
Tracing Forms	17
Transmission Notes	6
Transmission Test Requirements	11
Transmission Test Requirements Tables	6
Tripping Ranges	3
U	
Unit Type Drawings	13 and 24
V	
Varistors	11
W	
Weight of Lines	2
Working Limits	3

Bell Telephone Laboratories, Inc.