PANEL DIAL SWITCHING SYSTEM
(BATTERY CUT-OFF — WITHOUT ZONE REGISTRATION)

TRAINING MANUAL

SEQUENCE CHARTS AND OPERATIONAL SKETCHES

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY

OPERATION AND ENGINEERING DEPARTMENT

PLANT OPERATION DIVISION

FOR TRAINING PURPOSES ONLY

FEBRUARY 1955
PREFACE

This provisional training material covers the Panel System, Battery Cut-Off type, without Zone Registration.

This manual contains a series of typical circuit diagrams. These are drawn in the simplified style which is used in teaching the complex 'Common Control' switching systems now in current use. This method makes use of sequence charts and operational sketches. This volume contains a chart and sketch for each of the typical circuits.

Since the drawings are intended to be used in the study of the Panel System, Battery Cut-Off type, without zone registration, and do not necessarily conform to any particular office, it may be necessary to consider the regular Schematic Drawings (SD's) and Circuit Descriptions (CD's) when preparing learners to work in a specific office.

Students should be cautioned that the particular circuits contained in this manual are intended to be used as training aids, and are not necessarily applicable for maintenance.
THE SYMBOLS AND CONVENTIONS FOR THE OPERATIONAL SKETCHES ARE THE SAME AS THOSE USED ON SCHEMATICAL DRAWINGS ISD-1 WITH THE FOLLOWING EXCEPTIONS.

DETACHED CONTACT SYMBOLS ARE USED WHENEVER THEIR EMPLOYMENT AIDS IN SIMPLIFYING THE SKETCHES. THEY ARE SHOWN THUS:

(A) MAKE CONTACTS:

ATTACHED CONTACTS

\[ \begin{align*}
1 & \quad O2 \\
\hline
A & \\
\hline
\end{align*} \]

EQUIVALENT DETACHED CONTACTS

\[ \begin{align*}
X & \quad \bar{A} \\
\hline
\bar{X} & \quad \bar{A} \\
\hline
\end{align*} \]

ATTACHED CONTACTS

\[ \begin{align*}
2 & \quad O2 \\
\hline
HA & \\
\hline
\end{align*} \]

EQUIVALENT DETACHED CONTACTS

\[ \begin{align*}
X & \quad 2\bar{X} \\
\hline
\bar{X} & \quad 2\bar{X} \\
\hline
\end{align*} \]

2. INNER ENDS OF WINDINGS ARE OMITTED.

3. BATTERY SYMBOL WITH THE NOMINAL VOLTAGE IS SHOWN THUS:

\[ \begin{align*}
48V & \\
\hline
\bar{X} & \\
\hline
\end{align*} \]

4. CONTACT PROTECTIONS IN GENERAL ARE OMITTED.

5. SEQUENCE CHARTS ARE IN GENERAL PROVIDED ON EACH SKETCH. THE DESIGNATIONS FOR ALL RELAYS OF WHICH THE OPERATING PATHS ARE SHOWN ON THE SKETCH ARE IN HEAVY CHARACTERS. ALL OTHERS ARE IN LIGHT CHARACTERS.

6. IN GENERAL STRAPPING OR MULTIPLE CONVENTIONS ARE OMITTED.

7. TGO-TBP INDICATES THAT THE MAKE CONTACTS (ONE EACH) ON RELAYS TGO TO TBP ARE WIRE IN PARALLEL.

8. CB INDICATES A MAKE CONTACT ON ONE OF A SERIES OF CB RELAYS.

9. GN/GB INDICATES THAT EITHER GA OR GB DESIGNATION APPLIES.

10. TR JACK INDICATES A BREAK CONTACT ON THE TR JACK.

11. XMB JACK INDICATES A MAKE CONTACT ON THE MB JACK.

12. ∪ INDICATES OFF-NORMAL GROUND

∪ INDICATES OFF-NORMAL BATTERY

LEGEND FOR OPERATIONAL SKETCHES

PLANT SCHOOL FOR TRAINING PURPOSES ONLY

Sheet 2007"
GA/GB LOAD SIMILAR
EXCEPT P & N CAMS USED

"GA LOOPS THER
Any Switches, Unless
One is Found in Pos 1

1 & 4 OP
Made Always
2 & 3 OP
Made w/ or 1/2

STA/STB

Star Load Loops
Tied Any SS w/
in Pos 1 & 3. a
Link For in Pos 3
is Found.
NOTE: CL0 - NO CHECK RELAY OPER. OTHER CLASS RELAYS IDENTIFIED BY PATH OF CLA - CLB - CLC RELAYS. ASSOCIATE CLH WITH CLASSES 6, 7, 8.
No TST Call

Ground over tip of AC circuit under control of LED or Operator
Final in POS 6/7 of OPA's (5) in Final
(TK) Closes & Does Not Hop to OPR (5)
Switch Rolls to 12 in Final & NO
TST is made by (6) in POS 10/14, allowing Final
to rise until busy final = step 26

× POS 6/7

-- TK

× 9 (6) Pulls to Oper, in POS 7 AIC TK releasing Therefore no test

× 12

-- C

-- TK

× 13

Disconnect P.35

-- TK

No test equip puts bath to SSV

× 14

With 50 as Switch passes POS 15/1 (6) will not Oper. P.35
NOTE:

1. WHEN ADVANCE'S INC TO DS 6 OPERATIONS IN SRD, INC. DISTRICT ARE THE SAME AS OS-350 (INC. OVF1) EXCEPT X ADV SW 12/15. # 48

2. INC GOES TO IT DUE TO NO COUNT DOWN W/ (LR) IN 8828 ORR.

SEE OS-353 FOR (LR) OPER ON ABANDONED CALL OS-350

SEE OS-356 FOR (LR) OPER ON CROSSING RELAY PATH

5.0.2077-011 LINE FIND & DIST CIRCT
5.0.2115-011 INCOMING CIRCT

PLANT SCHOOL
FOR TRAINING PURPOSES ONLY

DISTRICT TELL-TALE 44
INCOMING TELL-TALE
BATTERY CUT-OFF OS-316
**Disconnection - 2 Party**

- **S (Subs Disc)**
  - **S1**
  - **A D**
  - **A R D**
  - **T2 in POS 14 3/4**
  - **T1 (2nd Line Test)**

**NOTE:**

- **F1 (2nd Line Test)**
  - **T2**
  - IF **R D**
  - LF
  - OP
  - BAT TO OPK MK
  - SL OPK IP 'T PARTY

**DISC E1**

**DISC E2**

**NOTE:**

- **SAME AS 05-317**

**WALL CAUSE DIST LINE ALARM**

- **WHEN MAKING SECOND LINE TEST, GROUND DETECTION ON TIP OR* BOTTOM OF LINE INDICATES LINE TROUBLE. T RELAY OPERATES IN Switch DIST IN POS 16.**

**RESTORE SELECTOR MANUALLY, REFER LINE TROUBLE.**

---

**Panel System:**

- **Battery Cut-Off 05-318**

**PLANT SCHOOL FOR TRAINING PURPOSES ONLY**

**38 2-Party District**

**Return to Normal**
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>260</td>
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<td>269</td>
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<td>220</td>
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</tr>
<tr>
<td>Bank 1</td>
<td>Bank 1</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Bank 0</td>
<td>Bank 0</td>
</tr>
</tbody>
</table>
SENDER

NOTE 1: THE COMM. LOCKS THE C RELAY UNTIL THE SELECTOR ROD CENTERS ON THE TERMINAL.

NOTE 2: WHEN THE UNIT ADVANCES TO POSITION X8, LEADS T, R, E, F, B, 21 V. ARE CLOSED UNTIL THE SELECTOR.MAY BE OPEN OR CLOSED DEPENDING UPON THE SUBSCRIBER'S CLASS OF SERVICE.

NOTE 3: WITH THE X2 RELAY NORMAL BATTERY IS SUPPLIED TO THE T RELAY OVER THE F2 LEAD WITH THE X2 RELAY OPENED THE LEAD IS CLOSED THE T RELAY ENGAGED.

NOTES:
1. SDR COMPLETES WHATEVER IS LEFT OF OFFICE TEST OFF GP AND TCK TEST.
2. INC OR FINAL TO TELL-TALE BECAUSE LR OPENS COUNTING RLY CIRCUIT.

Aborting call
NOTES
1. #2 & 3 Springs make 1/4 before & after Pos. indicated.
2. #3 Spring makes 1/2 before & after Pos. indicated.
3. #2 Spring makes 1/4 before & after Pos. indicated.
4. FBR (Firing) releases when #3 leaves Pos. 10 on 2nd rev.
5. SP operates from CI relay.
6. LRB, LRI operates abandoned calls.
7. + = sent over No. 1 line, & = sent over No. 2 line.
10. * Pulses are never sent in 1st, 2nd, 3rd, or 4th periods.
11. ** Pulses are sent in both 2nd & 4th period regardless of reg. relays.

PULSE CHART

<table>
<thead>
<tr>
<th>Pulse Code Chart for 3 digit senders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sta</td>
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<tr>
<td>-----</td>
</tr>
<tr>
<td>0</td>
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<tr>
<td>1</td>
</tr>
<tr>
<td>W</td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>J</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>5</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>

1st CYCLE STA
2nd TH1
3rd TH2
4th TH3
5th TH4
Final HL + pulse 1/4 + 1/4 (1/2 period)

PLANT SCHOOL
FOR TRAINING PURPOSES ONLY
PC1 IMPULSE

DRAFT SYSTEM BATTERY CUT-OFF 05-331

Sheet 2 of 4
S: 2/273-01/09 Decoder.Cct
PLANT SCHOOL
FOR TRAINING PURPOSES ONLY
DECODER TRANSMITTING OFFICE, BRUSH INTEGATION
PANEL SYSTEM BATTERY CUT-OFF OS-342

O8O-O8B
PRI. WINDING 380 SEC. WINDING 380

Note 1: Winding resistance, by relay OB, O8B, O8C, O8D,
R=124 R=1000 S=5000
R=2007 P=1000 S=5000
064 For Secondary Info.
(50) & (50-1) 4 combinations

Note 2: Winding resistance, by relay OB2 and SDI
R=122 R=1000 S=5000
R=166 R=1000 S=5000
Note 1: Winding resistance at relays TS & TSI
EG451 P1000 S1500
R1866 P1000 S2500
COMM STRAPPING

4 CONDITIONS OF CALLED LINE:
1. IDLE IND OR PARTY S(O) C-
2. IDLE PBX LINE S(O) C-
3. BUSY IND OR PARTY S(O) CX (DD)
4. BUSY PBX LINE S(NO) CX (UP)

S: RELAY VALUES
OPERATE: 01/134
NON-OPERATE: 01/12

NOTES:
1. (C still operated POS is busy back)
2. "S" OPER. ON AN IDLE IND OR IDLE LAST LINE OF PBX, ONLY
3. IF an IDLE LINE IS FOUND C RELEASES.
ATTACH ONE SIDE OF DOUBLE CONNECTION LAMP TO DIST (6) CAM (depending on DIST)

G & D start side of lamp

LIST (1) 3 SPARK AWAY FROM THE CAM

1. 48
   NORMAL - ON LAMP

2. 48
   OFF

3. 48
   OFF

2 DISTANCE TO ONE DOT (6) NO LAMP

IN B 4 (6) CAM

Pry 3 (6) CAM

REC 1N OFF

TEST LAMP

WHEN TESTING GO TO 2ND WHEN REC TO SPRING ATTACH TO 56U W/ PROBE LIFT SPRING

CLICK ON CAM = NO DEL

NO CLICK ON CAM = DEL
OFFICE (3 WIRE)

SEQUENCE CHART

OFFICE TEST &
OFFICE BRUSH SRC.

FOI

OFF

OFT

FOI

FOI

CFS

CFS

MT2

MT2

FOI

FOI

FOI

FOI

FOI

FOI

FOI

FOI

STP

STP

COUNT

COUNT

FOI

FOI

FOI

FOI

FOI

FOI

COUNT

COUNT

FOI

FOI

FOI

OFFICE SWITCH
1-A. NORMAL
2-H. BRUSH SRC.
3-A. CENTER SPADE
4-13. GROUP SRC.
5-A. CENTER "O" RELAY
6-5. TEST, HUMIDITY
7-A. GROUP "O" RELAY
8-2. CHECKOUT & RETURN

SLIDER "F1" SWITCH

S. BUT GROUP
4. OFFICE TEST
5. OFFICE BRUSH
6. OFFICE GROUP
7. TRUNK TEST

NOTES:
1. ON POI AFTER STATION DELAY R1 SWITCH ADVANCES
   TO MARK "A" AND SIGNALS POI
2. ON KM. AFTER TROUBLE, DIST IS RECORDED THT
   OPERATES & RELEASES POI
3. ON KM, SKIP OFFICE CALL 30 HOLES POI COCKED
   UP 3 PLUNGE R2 SWITCH TO BT FOR TRUNK TEST.

Sheet 2 of 2

Panel System
BATTERY CUT-OFF OS-352
NOTE
1. *2, *3 Springs make 1/4 before & after Pos. indicated. (X)
2. *3 Spring makes 1/2 before & after Pos. indicated. (X)
3. *2 Spring makes 1/2 after Pos. indicated. (X)
4. P&FAI releases when R2 leaves Pos. 10 on 2nd rev.
5. 5P operates from C1 relay.
6. LR3L3R operates abandoned calls.
7. +4 sent over 1p, -5 & 8 sent over ring.
8. Furnish = 1st period.
10. Furnish 3rd period = 1st period.
11. 1st period.
12. 2nd period.
13. 3rd period.
14. 4th period.
15. Superimposed in 2nd & 4th period.

Pulse Code Chart for 3 digit senders

<table>
<thead>
<tr>
<th>Sta</th>
<th>Thou</th>
<th>Other</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
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<td>2</td>
<td>1</td>
<td>9</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Final Heavy pulse: 177/884 (2nd&4th)
APPENDIX A

BASIC CIRCUITS
1. A contact spring is designated the same whether the apparatus is view from the contact side, or the terminal side.

2. The upper and lower relay contacts and winding terminals of all relays are designated "T" (top) and "B" (bottom) except as noted:

   a. All armature terminals that are not in alignment with other terminals are designated as "A".

   b. The letters "L" and "R" indicate the left and right side, facing the front or contact side of the relay facing the rear or terminal side of the relay. An "L" terminal will be on the left, and an "R" terminal will be on the right.

3. E Type Relays:

   a. The contact springs are numbered left to right facing the contact side of the relay and from right to left facing the terminal side of the relay.

   b. Where a winding terminal is designated by two letters as RT, RB, LT, or LB, it is an indication that connection is to be made from the primary to the contact as shown in the figure below:

   ![Diagram of E Type Relay](image)

   (Secondary)  (Primary)  RT LB
   CONTACT SIDE
   LT A
   LT A
   LB LT
   (Primary)

   c. Where a winding terminal is designated by a numeral and two letters as shown in the figure below, it is an indication that the connection is to be made from the rear or terminal side of the relay. The numeral is the same as that of the contact terminal side of the relay and indicates the position of the winding terminal with respect to the contact terminal:

   ![Diagram of E Type Relay](image)

   5. L Type Relays:

   The winding and contact terminals are numbered following the scheme for E type relays. See figure below:

   ![Diagram of L Type Relay](image)

   (Primary)  (Secondary)  SRT RB
   TERMINAL SIDE
   SRT
   RB
   SRT
   RB

   (Primary)  (Secondary)  SRT RB
   TERMINAL SIDE
   SRT
   RB
   SRT
   RB

WINDING AND SPRING DESIGNATIONS
FUNDAMENTAL CIRCUITS

RM 000-002  2 SHEETS, SHEET 1  FUNDAMENTALS
6. 201 TYPE RELAYS
   The armature (frame terminals) is indicated by 'A' and the front contact or 'Make contact by Y'. See figure below.

7. 109 AND 118 TYPE RELAYS
   The contact terminals are numbered consecutively from right to left facing the terminal side of the relay. The relative location of the winding terminals as viewed from the terminal side is as shown below.

8. 208 TYPE RELAYS
   The 'Front contact or 'Make contact' is indicated by 'Y', the armature by 'A', and the back contact or 'break contact' by 'Z'. See figure below.

9. SEQUENCE SWITCH SPRINGS
   (A) The 8 springs of a seq sw cam are known as left outer, left inner, right outer, right inner according to their position as viewed from the cam side. The left side of the cam is the side nearest the drive on 'R' magnet and the springs on that side of the cam are the left springs, the 2 springs nearest the cam spindle are the inner springs.

   (B) The springs for cams other than the 'A' cam are numbered as follows:
   1. Left inner
   2. Left outer
   3. Right outer
   4. Right inner

   (C) The 'A' cam has no springs on the left side.
   1. Right inner
   2. Right outer

   (D) The seq sw spring terminal numbering from rear of switch for other than 'A' cam:

   (E) The seq sw spring terminal numbering from rear for 'A' cam:

10. CLUTCH AND TRIP MAGNET
    TERMINAL DESIGNATIONS

    TRIP MAGNET
    UP DRIVE
    DOWN DRIVE
    COMMON CONNECTION
    1 TYPE CLUTCH

11. 200 TYPE SELECTORS
    (A) Facing the front or adjusting end, the interrupter contact springs are numbered from 1 up from front to rear.
    (B) Facing the front end, the winding connections are named. 'Inner end' the terminal at the front and 'outer end' the terminal at the rear.

WINDING & SPRING DESIGNATIONS
FUNDAMENTAL CIRCUITS

FUNDAMENTALS
THE SYMBOLS AND DESIGNATIONS USED IN THE SEQUENCE CHARTS FOR THE FUNDAMENTAL CIRCUITS ARE TAKEN FROM BELL SYSTEM PRACTICES SECTION A 129.801 AM.

SECTION 500 T01 D1 AND APPEAR BELOW.

SEQUENCE CHARTS (SC)

1. RELAY OR OTHER APPARATUS OPERATIONS AND RELEASES ONLY ARE SHOWN.

2. VERTICAL PROGRESSION DOWNWARD SHOWS RELATIVE TIME PHASE OF RELAY OR OTHER APPARATUS MOVEMENT (OPERATION OR RELEASE).


4. THE FOLLOWING TABLE SHOWS, ON A LINE BASIS, THE OPERATE AND RELEASE TIMES WHICH ARE USED FOR THE APPARATUS.

(A) ALL RELAYS EXCEPT SLOW RELEASE

LINE 101 L
LINE 102 L
LINE 103 L

(B) SLOW RELEASE RELAYS

LINE 101 L
LINE 102 L
LINE 103 L

(C) TIMED APPARATUS

LINE 101 L
LINE 102 L
LINE 103 L

5. OPERATE SYMBOLS

EXPLANATION: RA RELAY OR OTHER APPARATUS COMES TO FULLY OPERATED CONDITION.

6. RELEASE SYMBOLS

EXPLANATION: RA RELAY OR OTHER APPARATUS COMES TO FULLY RELEASED CONDITION.

7. SEQUENCE CHART ON OPERATIONAL SKETCHES

THE DESIGNATION OF ALL APPARATUS FOR WHICH THE OPERATING PATHS ARE SHOWN ON THE OS ARE INDICATED LARGER AND HEAVIER THAN DESIGNATIONS IDENTIFYING OTHER APPARATUS. SEE 9 FOR EXAMPLE.

8. CONNECTING LINES

(A) VERTICAL LINES ARE USED TO LINK CAUSES WITH EFFECTS ON SUCCESSING LINES AS

EXAMPLE: "TS" RELAY HAS OPERATED ON LINE 102 AS A RESULT OF RELAY 7 RELAYING ON LINE 101.

(B) HORIZONTAL AND VERTICAL LINE COMBINATIONS ARE USED AS FOLLOWS:

EXAMPLE: EXPLANATION CONNECTION BETWEEN LINES.

(C) HORIZONTAL LINES ARE USED TO CONNECT MULTIPLE CAUSES PRODUCING A COMMON EFFECT OR TO CONNECT MULTIPLE EFFECTS PRODUCED BY THE SAME CAUSE AS


(D) APPARATUS FUNCTIONAL OPTIONS ARE SHOWN BY A BREAK IN THE HORIZONTAL AND VERTICAL CONNECTING LINES.

EXAMPLE: EXPLANATION: THE "S" AND "SP" RELAY ON LINE 102 HAVE OPERATED AS A RESULT OF EITHER THE 7 RELAY RELAYING ON LINE 101 OR THE SEQ SW ADVANCING TO POSITION 7 ON LINE 101.

9. THE CIRCUIT MOST FREQUENTLY USED IN A PARTICULAR SEQUENCE CHART IS IDENTIFIED BY AN ASTERISK OPPOSITE ITS NAME IN THE LIST OF CIRCUITS ABOVE THE TITLE BLOCK. NO CIRCUITS ARE MENTIONED IN SEQUENCE CHARTS NEXT TO RELAYS ASSOCIATED WITH THIS CIRCUIT. THE CIRCUITS IN WHICH ALL OTHER APPARATUS ARE INDICATED LARGER AND HEAVIER THAN DESIGNATIONS IDENTIFYING OTHER APPARATUS SEE 9 FOR EXAMPLE.

SEQUENCE CHARTS FOR FUNDAMENTAL CIRCUITS
The symbols and designations used in the operational sketches for the fundamental circuits are taken from Bell System practices section A 128 801, section 950 70/01 and section A 804 002 and appear below.

Operational Sketches (OS)
The symbols and conventions used are the same as those used on standard circuit schematic drawings (SD) with the following exceptions:

1. A symbol may be turned in any direction without affecting its meaning.

2. Battery (SD) Symbol (OS) Symbol

3. Make Contacts (SD) Symbol (OS) Symbol

4. Break Contacts (SD) Symbol (OS) Symbol

5. Transfer Contacts (SD) Symbol (OS) Symbol

6. Other Contacts (SD) Symbol (OS) Symbol

7. Rotary Type Switch or Selector (Simple Symbol)

8. Sequence Switch (SD) Symbol (OS) Symbol

9. Relay Windings (SD) Symbol (OS) Symbol

Meaning:
- Contacts are closed when relay is operated.
- Contacts are open when relay is operated.
- Relay has top and bottom spring pile-ups.

The arrow is the rotary brush. 'N' is the rotary selector. '2' is the arc of the rotary selector. The circle is the terminal, and '1' indicates the terminal number.

The X (cam brush) 2 is shown in the SD symbol when it makes with the cam to advance the seq sw out of a pass by position.

This indicates complete or portion of other circuit in order to make circuit path complete and to give a general understanding of the circuits.

Relay windings are not shown.
**SEQUENCE CHART FOR SENDER CCT.**

**SC. 000.001 4 SHEETS SHEET 1**

**NOTES:**
1. The RLS is a slow release relay and stays operated during dialing when the L relay is released.
2. The RA is a slow release relay and stays operated when the L relay is operated during the dialing of a digit but releases in between the dialing of digits.
3. The 5 relay operates if the 'tens' digit is not dialed.
4. The No. 3 trip hinger engages the No. 3 multiple brushes trip lever.

**CONTINUED AT B 203 SENDERS SEQ IN**

1. Normal
2. BRUSH SELECTION
3. PASS BY
4. TENS SELECTION

1. AWAITING SEND
2. BRUSH SELECTION
3. AWAITING SEND
4. TENS SELECTION
1. The "RA" is a slow release relay and stays operated by its slow release feature when the "C" relay is operated during the dialing of a digit, but releases in between the dialing of digits and after the last digit is dialed.

2. The "T" and "RC" magnets when energized will not cause the "T" and "RC" switches to step to the next set of terminals.

3. The "T" and "RC" magnets when de-energized will cause the "T" and "RC" switches to step to the next set of terminals.

4. The "B" relay releases because the "Tens" digit is dialed.

5. The "S" relay releases because the "Units" digit is dialed.

CONTINUOUS ABOVE UPPER LEFT
NOTES
IF THE 'UNITS' DIGIT IS DIALED THE STP AND L OPERATE WITH THE SELECTOR SEQ SW IN POS 5 AND THE SENDER SEQ SW IN POS 6.
1. Relay or other apparatus operations and releases only are shown.

2. Vertical progression downward shows the time phase of relay movements (operations or releases).

3. Operate symbols:

   (A) \[ \times \times \] indicates a relay comes to fully operated condition at this point; for polarized relays, the armature has moved to front or left contact.

   (B) \[ \times \times \] indicates interrupter CHG has closed its back contact.

   (C) \[ \times \times \] indicates link sequence switch has advanced to position 2.

   (D) \[ \times \times \] indicates link sender selector up-drive magnet is operated.

4. Release symbols:

   (A) \[ \times \times \] indicates B relay comes to fully released condition at this point; for polarized relays, the armature has moved to back or right contact.

   (B) \[ \times \times \] indicates interrupter disc has opened its front contact.

   (C) \[ \times \times \] indicates link circuit district selector up-drive magnet is released.

5. Symbol notation:

   (A) \[ \times \times \] indicates one or more of the relays designated SS to SS have operated.

   (B) \[ \times \times \] indicates all of the relays designated A1 to A5 have operated.

   (C) \[ \times \times \] indicates both GA and SW relays have operated from the same cause.

   (D) \[ \times \times \] indicates that either one of the relays has operated.

6. Connecting lines:

   (A) Vertical lines are used to link causes with effects on succeeding lines as:

   LINE1 \[ \times \times \times \] indicates that the LI relay on LINE2 has operated as a result of L relay operating on LINE1.

   LINE2 \[ \times \times \times \] indicates that the D relay has operated on LINE2 as a result of either A, B, or C relay operation on LINE1.

   (B) Horizontal or oblique lines are used to connect multiple causes so as to indicate their common effect or to connect multiple effects to indicate their common cause as:

   [Diagram]

   7. Arrowheads:

   Arrowheads are used to show the precise meaning to be attached to the connecting line. (A) If arrowhead is on a horizontal line and is located between two vertical lines, it gives the horizontal line direction insofar as cause to effect is concerned. For example:

   [Diagram]

   X CLA LF \[ \times \times \times \] indicates Z and SW will not operate until both the LF and CLA have operated but the FLA will operate independently of the LF.

   (B) If arrowhead is on a horizontal adjoining a vertical line, the effect of the arrowhead is limited to the operation shown directly below; for example:

   [Diagram]

   X CLA LF \[ \times \times \times \] indicates SW is operating from LF only; the Z from the LF and CLA; and the FLA from the CLA only.

   [Diagram] indicates time interval.
NOTES
1. WHEN 'C3' OPERATES 'X', 'Y', 'Z', 'A', 'B', 'C' RELAYS DECREASE EXCEPT THOSE HELD BY SENDER RELAYS.

2. 'X', 'Y', 'Z', 'A', 'B', 'C' RELAYS HELD OPERATED AFTER 'C3' OPERATES OPERATE 'X', 'Y', 'Z', 'A', 'B', 'C' RELAYS OPERATE 'SA', 'SB'.

3. WHEN 'X', 'Y', 'Z', 'A', 'B', 'C' RELAYS OPERATE RELAYS RELEASE OPERATING ALL LEADS TO DECREASE.
<table>
<thead>
<tr>
<th>CIRCUIT</th>
<th>DRAWING</th>
<th>ISSUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINE - TRIP - START &amp; LINK CIRCUIT</td>
<td>SD-20294-01</td>
<td>31D</td>
</tr>
<tr>
<td>LINE FINDER &amp; DISTRICT CIRCUIT</td>
<td>SD-21077-01</td>
<td>20D</td>
</tr>
<tr>
<td>DECODER CONNECTOR CIRCUIT</td>
<td>SD-21187-01</td>
<td>10D</td>
</tr>
<tr>
<td>DECODER CIRCUIT</td>
<td>SD-21277-01</td>
<td>20D</td>
</tr>
<tr>
<td>INCOMING SELECTOR CIRCUIT FROM PANEL-LOCAL OR TANDEM</td>
<td>SD-21115-01</td>
<td>20D</td>
</tr>
<tr>
<td>3-WIRE OFFICE SELECTOR CIRCUIT</td>
<td>ES-240252</td>
<td>9D</td>
</tr>
<tr>
<td>FINAL SELECTOR CIRCUIT</td>
<td>SD-21200-01</td>
<td>10D</td>
</tr>
<tr>
<td>LINE FINDER-DISTRICT SELECTOR CIRCUIT 2-PARTY</td>
<td>SD-21079-01</td>
<td>10D</td>
</tr>
<tr>
<td>LINE FINDER-DISTRICT &amp; COIN CONTROL CIRCUIT</td>
<td>SD-21350-01</td>
<td>10D</td>
</tr>
<tr>
<td>SUBSCRIBERS SENDER CIRCUIT</td>
<td>SD-21193-01</td>
<td>5D</td>
</tr>
</tbody>
</table>

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S.D. DRAWINGS AND ISSUES

**PLANT DRAWING LISTING**