CROSSBAR SYSTEMS
NO. 1
FULL SELECTOR
TERMINATING SENDER CIRCUIT

CHANGES

D. Description of Changes

D.1 Note 110 revised to show AE option as Standard at Issue 36D and Note 111 and Fig. 1 and N corrected to remove AP option reference at various contact protect networks in order to bring circuit schematic into agreement with manufacturing drawings.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5143-ABVL

Neco DEPT 367-PAM-JBK-GW
CIRCUIT DESCRIPTION

GROSSBAR SYSTEMS
NO. 1
FULL SELECTOR
TERMINATING SENDER CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Removed Replaced By
Relay EF, UI57, Relay EF, UI57, Fig. Q
Fig. N and P Relay EF, UI58, Fig. R

D. Description of Changes

D.1 Relay EF has been removed from Fig. N and P and it is now shown as a separate figure, Fig. Q, rated "Mfr Disc.", and Fig. Q is replaced by Fig. R.

D.2 In Fig. 1 a multiple connection note is added to NS0 and NS1 leads.

D.3 Circuit Note 110 is changed and Circuit Note 118 is added to reflect the changes noted in D.1.

D.4 CAD Fig. IK has been revised and CAD Fig. IR is added to reflect the changes noted in D.2.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5615-JFS-DAJ-RP

Printed in U.S.A.
CIRCUIT DESCRIPTION

CD-25013-01
ISSUE 11D
APPENDIX 2B
Dwg: ISSUE 45D

CROSSBAR SYSTEMS

NO. 1

FULL SELECTOR

TERMINATING SENDER CIRCUIT

CHANGES

A. Changed and Added Functions

A.1 Office brush and office group selections can be used to generate five DID number series for direct-in-dialing type operation to PBX stations using LLP.

A.2 Dedicated trunk group indications OA and OB or FOO and FLO and number series indications NS1 can be used to generate two DID number series for direct-in-dialing type operation to PBX stations using LLP.

B. Changes in Apparatus

B.1 Added Apparatus

OBA Relay J729, Fig. 1, "AU" Option
SC3 Relay U699, NSO Relay U1318, NS1 Relay U694, Fig. 1, "AV", "AW" Options

B.2 Superseded

324C Crossbar Switch - Fig. 1 "AR" Option
324AR Crossbar Switch - Fig. 1 "AX" Option

B.3 In Fig. 1, "AT" option is designated to show the present wiring and its alternate option "AU" is designated to show the wiring required to generate DID number series from office brush and office group selections.

B.4 In Fig. 1, "AV" option is designated to show wiring necessary to generate DID number series from OA and OB indications and its alternate "AW" option is designated to show wiring necessary to generate DID number series from FOO and FLO indications.

B.41 Circuit Note 116 is added to explain the correct use of "AV" and "AW" options.

B.5 Cross-connection Note 400 is added to show DID cross-connections for options "AV", "AW", and "AU".

B.6 New leads "NSO", "NS1", "NS2", and "NS4" from Fig. 1, to the terminating marker connector are added.

B.7 New leads "NSO" and "NS1" from Fig. 1 to the terminating sender link are added.

B.8 CAD Fig. 51, 53, 54, 62, 63, and 64 are modified to include the above changes.

B.9 Option "AP" designations are added to four option "AE" locations to bring the SD and the T drawings into agreement.

F. Changes in CD Sections

F.1 Add the following paragraphs to SECTION III:

3.31 To provide for direct-in-dial type operation to PBX stations using LLP.

3.311 To provide means to receive office brush and office group selections and to translate them to a DID number series which is then transferred to the terminating marker connector on a two-out-of-four leads grounded basis.

Printed in U.S.A. Page 1
3.112 To provide means to translate OA and OB indications or FOO and FIO indications to a DID number series which is transmitted to the terminating marker connector on a two-out-of-four leads grounded basis.

3.113 To operate the TT relay if an improper OB and OG selection is made.

F.2 Change the second sentence of 5.4 to read:

About 38 wires are involved in this connection.

F.3 Change the first sentence of 7.41 to read:

This registers the 5 or 7 selections sent by the originating sender, office brush and office group for DID type operation and incoming brush, incoming group, final brush, final tens and final units for DID and standard type operation.

F.6 Change the first sentence of 11.61 to read:

11.61 Five or seven selections are registered on each call, office brush and office group for DID type operation only and incoming brush, incoming group, final brush, final tens and final units, in that order, for all calls.

F.7 Change paragraph number 11.62 to 11.621.

F.8 Add 11.622.

11.622 When OB and OG selections are used to generate DID number series, the sender must be able to receive both 7 selection DID and 5 selection regular calls. The first selection is always registered on the OB crosspoints and the following action depends on the level of the first selection. If it is a 0-4th level selection the call is a 5-selection call, the OG selection is skipped and the same level cross-points on the IB vertical are closed when the OBA relay operates. A 7-selection call is indicated if the first selection is a 5-9th level selection. When a level from 5-9 is cross-connected for DID operation the selection is stored on the OB vertical only and the call proceeds to the office group selections. If the OG selection is a 4th level selection the call proceeds to the remaining 5 selections. If the first selection is a 5th to 9th level selection indicating a 7-selection call but it is cross-connected as a non-DID call the OG selection is skipped and it is registered on the IB vertical where it is handled as an improper IB selection. If the 5th to 5th level is properly chosen for the first selection and the IB selection is not a 4 the TT relay is operated.

F.9 Add the following sentence to 13.31:

Leads "NSO", "NS1", "NS2", and "NS4" are grounded in a two-out-of-four code to transfer the number series selection used for DID type operation.

F.10 Add 13.37:

13.37 The OB and OG registers ground the leads "NSO", "NS1", "NS2", and "NS4"
as shown below when cross-connected for a particular number series:

<table>
<thead>
<tr>
<th>Number Series</th>
<th>Office Brush Cross-conn.</th>
<th>Office Group</th>
<th>Leads Grounded</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>one of 5</td>
<td>4</td>
<td>&quot;NS0,NS2&quot;</td>
</tr>
<tr>
<td>4</td>
<td>through 9</td>
<td>4</td>
<td>&quot;NS1,NS2&quot;</td>
</tr>
<tr>
<td>5</td>
<td>per number</td>
<td>4</td>
<td>&quot;NS1,NS4&quot;</td>
</tr>
<tr>
<td>6</td>
<td>series</td>
<td>4</td>
<td>&quot;NS2,NS4&quot;</td>
</tr>
</tbody>
</table>

F.11 Add 13.38:

13.38 The OA and OB or F00 and F10 indications when combined with relay NS1

operated can be cross-connected to indicate number series 2-6 and ground leads "NS0", "NS1", "NS2", and "NS4" as shown below:

<table>
<thead>
<tr>
<th>Number Series</th>
<th>Leads to TMC Grounded</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>&quot;NS0,NS2&quot;</td>
</tr>
<tr>
<td>3</td>
<td>&quot;NS1,NS2&quot;</td>
</tr>
<tr>
<td>4</td>
<td>&quot;NS0,NS4&quot;</td>
</tr>
<tr>
<td>5</td>
<td>&quot;NS1,NS4&quot;</td>
</tr>
<tr>
<td>6</td>
<td>&quot;NS2,NS4&quot;</td>
</tr>
</tbody>
</table>

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5615-RFB-TML-WP
CIRCUIT DESCRIPTION

CROSSBAR SYSTEMS
NO. 1
FULL SELECTOR
TERMINATING SENDER CIRCUIT

CHANGES

B. Changes In Apparatus

B.1 Added
R1 Resistor, 18DJ, R2 Resistor, 18DJ-
Fig. P.

D. Description Of Circuit Changes

D.1 Resistors R1 and R2 are added to Fig. P
in series with relay L and resistance
lamp L to enable the L relay to hold over
pulsing thus avoiding the registration of
false numbers.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5615-RFB-TNL-AA
CIRCUIT DESCRIPTION
SWITCHING SYSTEMS DEVELOPMENT DEPARTMENT

CROSSBAR SYSTEMS
NO. 1
FULL SELECTOR
TERMINATING SENDER CIRCUIT

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 Provision is made to indicate to the traffic usage recorder circuit service busy, test busy and maintenance busy conditions.

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 Sheet —015

C.11 On page 3 of the circuit requirements table under relay (L) of Fig. P the N.O. test requirement formerly read 0.6.

C.2 Sheet 016

C.21 On page 8 of the circuit requirements table under relay (SS) of Fig. P the N.O. test requirement formerly read 22.6.

C.22 On page 9 of the circuit requirements table under relay (STP) of Fig. P the N.O. test requirement formerly read 0.6.

C.23 On page 12 of the circuit requirements table test note 1 formerly read:

1. Connect sender (T) jack as described in BSP. Block (ON2), (L1) operated. Block (TM) non-operated. Block (GR) operated to set current flow, unblock (GR) for int. test.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Sheet 011

D.11 In circuit note 104 a break interval of the TS interrupter formerly shown incorrectly as 2.8 seconds is changed to 28 seconds.

D.12 In the contact protection table, circuit note 111, the following changes and additions are made:

The location of contact protection C was formerly shown as Fig. 1.

The information concerning protected contacts for contact protections L1, L1 relay, J and S was formerly shown as 1T-2T(L).

The connect terminal C or D column for contact protection RV1, option AB, formerly showed 8T (RV1).

Information for Fig. P contact protection (RV2) relay is added. The location of contact protection RV4 was formerly shown as Fig. 1.

D.13 Option "AS" is added to the Options Used table.

D.2 Sheet 012

D.21 Leads SB and SBM, option "AS", are added to Fig. 1 and shown connecting Fig. 1 to the traffic usage recorder circuit.

D.22 The lead connecting 6T(FU), 8B(L2) to Figs. G or H, L or M, and N or P was formerly shown as a heavy dashed line.

D.23 Leads grounded by 9-10T (ON1), 3-4T (ON2) and 8-9BB(ON2) were formerly shown as solid lines.

D.3 Sheet 013

D.31 In Fig. N the lead grounded by operated contacts 3-6T (GR) relay was formerly shown as a dashed line.

D.32 In Fig. N the lead which connects 4T (1F1) relay to Fig. C or D and the lead which connects 2T (1F1) relay to Figs. C or D, Figs. J or K and Fig. 1 were formerly shown as solid lines.

D.33 Leads 24 and 25 of Fig. D were formerly shown as solid lines.

D.4 Sheet 014

D.41 Lead 3 of Figs. L and M was formerly shown as a dashed line.

D.42 Option AI in Figs. H and G was formerly incorrectly shown connecting B ground to Fig. 1.

D.43 The wiring at 2T-1T (RV2) relay was formerly shown reversed.

D.44 The wiring at 5B-4B (RV4) relay was formerly shown reversed.

D.45 Capacitor C was formerly incorrectly shown in series with the winding of relay (GR) in Fig. P.

All other headings under Changes, no change.

Page 1
INDEX

1. PURPOSE OF CIRCUIT
2. WORKING LIMITS
3. FUNCTIONS
4. CONNECTING CIRCUITS
5. TRANSIENT CONNECTIONS TO OTHER CIRCUITS
6. GENERAL METHOD OF OPERATION
7. PRINCIPAL PARTS OF SENDER AND OPTIONAL FEATURES
   7.2 General Control Circuit
   7.3 Pulsing Circuit
   7.4 Frame and Selection Register
   7.5 Multi-Office Operation
8. SEIZURE, HOLDING AND RELEASE OF SENDER
   8.2 Sender Seized and Held for a Service Connection
   8.3 Sender Seized and Held for Test
   8.4 Sender Released After Service or Test
   8.5 Sender Made Busy for Maintenance
9. INCOMING FRAME AND DEMAND FOR SPECIAL MARKER REGISTERED IN SENDER
10. REGISTRATION OF OFFICE DESIGNATION
11. PULSING AND REGISTRATION OF SELECTIONS
   11.2 Preparation of Originating Sender for Each Selection
   11.3 Preparation of Incoming Trunk for First Selection
   11.4 Preparation of Terminating Sender for Each Selection
   11.5 Pulse Counting
   11.6 Selections Registered
   11.7 Selections Synchronized
   11.8 Incoming Advance
   11.9 Test Circuit at Incoming Advance
12. TRUNK CLOSURE
13. TERMINATING MARKER ENGAGEMENT
   13.1 General
   13.2 Marker Seized
   13.3 Information from Sender to Marker
   13.4 Connection Established and Marker Released
14. IRREGULARITIES AND TROUBLE CONDITIONS
   14.1 Defective Frame Indication from Link Control Circuit
   14.2 Trouble Release by Link Control Circuit
   14.3 Trouble Release by Marker Connector
   14.4 Premature Disconnect
   14.5 Telltale
   14.6 Stuck Sender Timeout
14.7 Cross Between D & ST Leads in Incoming Trunk
14.8 Bridged (STP) Contacts
14.9 Terminating Sender Overload Control
15. PROVISIONS FOR SPECIAL TESTS
16. FIGURES AND OPTIONS
17. INTERDIGITAL TIMEOUT
18. TAKING EQUIPMENT OUT OF SERVICE
19. ALARM INFORMATION

1. PURPOSE OF CIRCUIT

1.1 The purpose of this circuit is to provide means for satisfying any originating sender circuit which may have to complete a call to a crossbar office on a revertive pulse basis. This circuit receives information from the originating sender and transmits this information with necessary translations to a terminating marker circuit.

2. WORKING LIMITS

2.1 External Circuit Loop
   2.11 The maximum external circuit loop is 3115 ohms, including not more than 32 miles of cable.
   2.12 The minimum external circuit loop is 900 ohms, exclusive of the relays in the originating sender.

2.2 Insulation Resistance
   2.21 The minimum trunk insulation resistance is 30,000 ohms.

2.3 Voltage
   2.31 45-50 volts.

2.4 Panel Multiple Bank Capacity
   2.41 The equivalent of 50 frames in multiple at the originating office (on the basis of .006 mf. mutual capacity per appearance).

3. FUNCTIONS

3.01 To recognize the selection of the sender by the link circuits, and to register the number of the associated incoming trunk frame.

3.02 To provide a circuit path to enable the link circuit to check for continuity of the lead over which the holding ground for the hold magnets is furnished.

3.03 To recognize that the associated link circuit has closed the cross-points.
between the incoming trunk circuit and the sender circuit.

3.04 To furnish ground to the sender busy relay in the link circuit.

3.05 To recognize that the sender busy relay in the link circuit has operated.

3.06 To open the frame indication leads as soon as the frame registration is completed.

3.07 To furnish ground for holding the hold magnets of the primary and secondary switches of the link circuit.

3.08 To furnish ground to the link circuit as a signal that the sender is ready for the link to release, but not to do so in case the link has grounded too few or too many frame indication leads.

3.09 To supply a ground for operating a cut-off relay in the incoming trunk circuit.

3.10 To prevent a false pulse from being recorded by the originating sender circuit at the time that the line and stepping relays are connected to the trunk.

3.11 To provide pulses with which to satisfy the originating sender circuit.

3.12 To record the incoming brush, incoming group, final brush, final tens and final units selection.

3.13 To supply a reverse battery condition to the originating sender circuit after selections have been recorded, first testing with direct battery for the closure of the fundamental in the originating sender.

3.131 To send reverse battery signal on telltale and to prevent premature termination of the reverse battery signal maintaining this signal until the fundamental circuit has been closed for a sufficient period.

3.14 To inform the incoming trunk circuit that the reverse battery condition has been terminated.

3.15 To release the cut-off relay in the incoming trunk circuit and to prevent its reoperation under certain conditions.

3.16 To recognize that the trunk has been closed through to the incoming trunk circuit.

3.17 To furnish battery for starting the associated marker connector circuit.

3.18 To establish connection with a marker through the marker connector after registrations have been completed.

3.19 To transmit to the marker the information recorded on the sender register switch. This information is transmitted by grounding a selection of leads, and this is done in such a way as to check all of the leads for absence of opens or grounds, any trouble encountered preventing the marker from returning information to the sender.

3.20 To release under control of the link circuit in case the link encounters certain trouble conditions.

3.21 To release under control of an automatic priming feature in case of trouble after the sender off-normal relay has operated.

3.22 To release under control of the marker circuit on a normal call.

3.23 To differentiate between a "regular" incoming and a "special" incoming.

3.24 To prevent the circuit from restoring to normal when held for maintenance.

3.25 To prevent the circuit from restoring to normal if ground fails to be removed from the sleeve lead.

3.26 To send current through the contact of the stepping relay in one direction when connected to an incoming trunk mounted on an odd-numbered frame, and to reverse the current when connected to an incoming trunk on an even-numbered frame.

3.27 To indicate the engaged or made busy condition of the sender to an automatic test circuit attempting to seize it.

3.28 When the test circuit is making a non-operate test of the (L) relay to time for reversed battery and at the end of a specific time it furnishes reversed battery.

3.29 To provide for multioffice operation.

3.291 To receive a signal from the sender link and control circuit over leads OA and OB.

3.292 To receive a signal from the originating sender, recognized by incoming group selection under or over 5.

3.293 To signal the terminating marker for selection of number series, normally over the OAB lead, but in some cases over the FlO lead.

3.294 To signal the terminating marker over the OAB lead when the sender is used to discriminate between physical trunk groups and theoretical trunk groups.

3.295 To time cut in 3 to 6 seconds if the Terminating Sender Timing Control Circuit indicates a probable sender overload.
3.296 To recognize an all terminating sender busy condition, as indicated by the Terminating Sender Timing Circuit, and then to send reverse battery to the originating sender, after incoming brush selection, as an indication of the terminating sender overload condition.

3.30 To provide over two leads plugged busy, test busy and service busy information for the use of the traffic usage recorder circuit.

4. CONNECTING CIRCUITS

This circuit will function with the following crossbar system circuits:

4.01 Terminating Sender Link and Controller - SD-25459-01.

4.02 Terminating Marker Connector - SD-25036-01.

4.03 Terminating Trouble Indicator Frame - SD-25064-01.

4.04 Interrupter Frame - SD-25062-01.

4.05 Terminating Sender Frame - SD-25053-01.

4.06 Terminating Sender Test - SD-25159-01.

4.07 Terminating Sender Timing Control - SD-25471-01.

4.08 Terminating Sender and B Sender Selection - SD-25437-01.

4.09 Holding Time Recorder - SD-90246-01.

4.10 Traffic Usage Recorder - SD-95738-01.

DESCRIPTION OF OPERATION

5. TRANSIENT CONNECTION TO OTHER CIRCUITS

5.1 The senders mounted on 2 frames constitute a group of 10 senders, and all the senders in a number of such groups are used in common as a large group to function with a number of incoming trunks and associated terminating sender links. The total number of senders which can be used in one large group is limited by the fact that they are arranged to function with a maximum of 20 incoming frames. Only one such large group can be used with one group of terminating markers. The 10 senders in a small group may consist partly of these terminating senders, and party of "B" position senders.

5.2 Each group of 10 senders is connected to the sender link and control circuit by 19 wires, which are connected into any one individual sender for a short time when it is first seized for service. These are the "GS", "SL", "RL" and "TR" leads which assist the link control circuit in its functions; 12 numbered "F" leads for registering in the sender the number of the incoming frame, and the "EP" lead which indicates when the frame number is even, and the "OA" and "OB" leads which indicate which office is required on multi-office operation.

5.3 Each sender is individually connected to the sender link and control circuit by 9 leads, "TM", "MR", "CM", "DM", "FC", "SM", "SC", "SB" and "BS".

5.31 Leads "TM" and "MR" are connected straight through the link switch contacts to the incoming trunk, and serve to transmit revertive pulses over the trunk line to the originating sender.

5.32 Leads "CM", "DM" and "FC" are also connected straight through the link switch contacts to the incoming trunk, and serve for mutual control while the sender is engaged.

5.33 Lead "SM" is connected through the link switch contacts to hold the switches operated while the sender is engaged.

5.34 Lead "SC" operates relays in the sender while the link control circuit is engaged in seizing the sender, principally for the purpose of connecting the common leads into the sender.

5.35 While the sender is either engaged or plugged busy, it operates a relay individual to itself in the link control circuit over lead "SB", and that relay returns an indication of its own operation to the sender over lead "BS".

5.4 The sender is connected through the terminating marker connector to a terminating marker for a fraction of a second on each call. About 34 wires are involved in this connection, but mutual control and for transmitting information from the sender to the marker.

6. GENERAL METHOD OF OPERATION

6.1 When a sender is seized by a sender link and control circuit to serve on a call, it immediately registers the number of the incoming frame involved, and whether that number is odd or even, by indication from the link control circuit over one of the numbered "F" leads and the "EP" lead. If the kind of incoming trunk requires the services of a special marker, that fact is registered by indication from the trunk over the "FC" lead.

6.2 The sender then prepares the incoming trunk circuit not to interfere with the transmission of revertive pulses to the
originating sender; and proceeds to send such pulses under the control of the origi- 
inating sender, for the five incoming and final selections, counting the pulses of 
each selection and registering the selection. It then sends a pulse in the reverse di- 
rection. In sending directing pulse for 
the five selections, and then a reverse or 
incoming advance pulse, the terminating 
sender acts toward the originating sender 
just as would an incoming and a final se- 
lector of the panel type.

6.3 The sender then restores the incoming 
trunk circuit to a condition where 
it is in control of supervision over the 
trunk, and awaits trunk closure at the ori- 
ginating end. When the incoming trunk notes 
this trunk closure, it sends a signal to the 
sender.

6.4 Notified of trunk closure, the sender 
connects to a marker and sends it the 
number of the incoming frame and the called 
number, which the sender translates from 
the incoming and final selections it has 
registered. The marker then connects the 
incoming trunk to the called line, obtain- 
ing connection with the particular incoming 
trunk by way of the sender. The marker 
then causes the sender to release its con- 
nection with both marker and incoming trunk, 
and to return to normal.

6.5 In case of abandoned call, partial 
dialed, or trouble condition, the 
condition either becomes apparent at once 
or else the sender is stuck and times out 
by its timing circuit. It generally sends 
a reverse pulse to the originating sender 
to establish an overflow indication, and is 
released. If so desired, a jack may be 
plugged up which will cause the sender in 
case of trouble to be released from its 
external connections, but held busy with 
operated relays locked up until it can be 
examined.

7. PRINCIPAL PARTS OF SENDER AND OPTIONAL 
FEATURES

7.1 The elements of this sender may be 
divided, in respect to their func- 
tions, into three principal parts. Each of 
the following subsections is a brief general 
statement of the function of one of these 
principal parts and a list of the relays 
comprising it, and also describes any of 
its features which may be optional.

7.2 General Control Circuit

7.21 This controls the connections between 
the sender and the sender link and control 
circuits and the incoming trunk on the 
one hand, and the connections between 
the sender and the marker connector and 
marker, on the other hand. It consists of 
the following relays when fully equipped: 
Sender control (SC1) and (SC2), off-normal 
(ON1) and (ON2), make busy (KB), trunk 
closure (TC1), (TC2) and (TC3) special 
marker (SPL), release (RL), trouble release 
(TRL), timing (TM1), (TM2) and (TM3).

7.22 Relay (WB) is required only when a 
terminating sender test circuit is 
provided.

7.3 Pulsing Circuit

7.31 This generates and counts the pulses 
which are sent for each selection to 
satisfy the counting relays in the origi- 
inating sender, and generates a reverse 
pulse to advance the originating sender 
when the selections have been completed. 
It consists of the following relays: Line 
(L1), (L2), (L3), (L4) and (L5), 
stepper (STP); grounding (GR); pulse (P1), 
(P2), (P3), (P4), (P5) and (P6); telltales 
(TT), and reversing (RV1), (RV2), (RV3), 
(RV4) and (RV5). When Fig. P is equipped 
an additional relay (SS) is required.

7.4 Frame and Selection Register

7.41 This registers the five selections 
sent by the originating sender, in-
coming brush, incoming group, final brush, 
final tens and final units. It also regis-
ters the number of the incoming frame in-
volved and whether it is odd or even. 
Besides a crossbar switch which registers 
the selections and the units digits of the 
incoming frame number, there are relays to 
register the tens digit of the frame number 
and whether it is odd or even, and relays 
to control the action of the switch. The 
switch has six verticals designated (F) for 
the frame, and (IB), (IG), (FB), (FT) and 
(FU) for the selections. The full compo-
nent of relays is as follows: Incoming frame 
(FOO), (F10) and (EF), select magnet 
(SM), crossed select magnet (XSM), hold 
magnet (HM) and register advance (RA1) and 
(RA2).

7.42 The (F00) and (F10) relays are shown 
as A apparatus, associated with A 
wiring. This equipment is provided accord- 
ing to circuit note 107.

7.5 Multi-Office Operation

7.51 Number Series Indication

The OA and OB relays are designated 
"X" apparatus and are required when the 
sender receives information from the sender 
link and controller circuit over leads OA 
and OB. These leads, together with incom- 
ing group register, are used to signal the 
terminating marker over the OAB lead to 
distinguish between two 10000 number 
series.

When it is desired to use the OAB 
lead to discriminate between physical trunk 
groups and theoretical trunk groups, the
number series identification is passed over the F10 lead.

7.52 "Y" wiring is used in connection with the signal via incoming group selection to distinguish between two number series, or between physical and theoretical offices.

7.53 "Z" wiring is used where the OAB lead is used for signaling in combination with X or Y wiring, but the OA and OB relays are not required.

7.54 "W" wiring is used for operation of the (ON2) relay when the (OA) and (OB) relays or "Z" wiring are omitted.

8. SEIZURE, HOLDING AND RELEASE OF SENDER

8.1 The sender may be seized by a sender link for service, or by a sender test circuit for test. It is held busy when in service or under test, and is made busy when in trouble.

8.2 Sender Seized and Held for a Service Connection

8.21 The ten senders on two frames are associated together in a group and are connected to the associated sender link and control circuit by two sets of leads, one set individual to each sender, and one set common to all ten senders.

8.22 When an incoming trunk calls for a sender, the sender link control circuit chooses an idle sender and grounds its individual "SC" lead. Relay (SCI) operates from ground on the (SC) lead to battery through the resistance lamp, this being of great importance at a later stage in the connection. When operated, (SCI) connects common leads "SL", "GS", "RL" and "TR" into this sender.

8.23 After grounding the "SC" lead, the link control circuit proceeds to operate the link switches which close six individual leads to the sender. Five of these leads, "T", "R", "FC", "CO" and "D" are connected straight through from sender to incoming trunk. The sixth lead "S" is connected to the hold magnets of the link switches.

8.24 The operating ground for the link switch hold magnets gets a circuit into the sender over the individual "S" lead and back to the link control circuit over the common "SL" lead. Satisfied by this that the sender is ready for the next step and that the "S" lead is good, and first making a test to guard against a double connection, the link circuit then grounds common lead "GS" and so operates relay (ON1) after (RV3) has operated as described in a later paragraph.

8.25 (ON1) operated grounds the individual lead "SB", and that causes the link control circuit to ground individual lead "BS" and so operate relay (ON2) after (RA1) has operated as described in paragraph 9.4.

8.26 (ON2) operated connects ground to the individual "S" lead to hold the link switch hold magnets after the link control circuit has released, and it also grounds the common "RL" lead to release the link control circuit.

8.27 The release of the link control circuit breaks ground from the "SC" lead, and relay (SCI) releases to break the connection of the common leads into the sender, but the sender remains connected to the incoming trunk by the individual leads through the link switches until it has completed its work. Relays (ON1) and (ON2) lock each other up, ground off-normal ground leads to hold other relays and the crossbar register hold magnets in the sender, hold the link switches by grounding the "S" lead, and guard against the intrusion of other links and the test circuit by grounding the "SB" lead.

8.28 (RV3) operates over the "FOO" or the "F10" lead from the link control circuit after (SCI) and either (FOO) or (F10) operates, and is held by an off-normal ground after (ON1) operates, until it is released after the completion of selections. The operation of (RV3) causes the operation of (RV4) and (RV5) in turn which operates (ON1) previously described.

8.3 Sender Seized and Held for Test

8.31 All the individual and common leads from the sender and the group of ten senders which run to the sender link and control circuit run also to the sender test circuit, except the individual leads "SB", "BS" and "SC".

8.32 The test circuit seizes a sender for test in the same way that the sender link and control circuit seizes it for service, except that it demands connection with a particular sender instead of choosing an idle sender more or less at random. Before it can seize the desired sender, the latter must be idle, and to determine this condition it makes a test on the "S" lead, which is not made in the case of a service connection.

8.33 If the sender is engaged on a call the "S" lead is grounded by the (ON2) relay. If the sender is made busy, the "S" lead is connected to resistance battery.

8.34 The test circuit first tests the "S" lead for battery and then for ground. Finding neither, it connects to the sender;
otherwise it waits until the battery or ground disappears.

8.35 When the test circuit seizes the sender, the relays operate as on a service call.

8.4 Sender Released After Service or Test

8.41 When a connection has been established or a test completed, or when the attempt has definitely failed, either relay (RL) or (TRL) is operated and locked to an off-normal ground.

8.42 (RL) operating breaks battery from the "ST" lead to release the marker connector. (RL) also breaks the local ground connection which locks (ON1) and holds the link switches over lead "S", but these do not release at once because they are also held by ground over lead "HLD" from the marker connector. When that releases (ON1) and the link switches also release, and the sender is freed from its external connections. The reasons for holding over the "HLD" lead is to prevent the breaking of current on the crosspoint of the register. When (ON1) releases, it is followed by (ON2). The register and all locked up relays release, and the sender is normal and ready for reuse.

8.43 (TRL) operating breaks battery from the "ST" lead to release the marker connector and breaks the local ground connection which locks (ON1) and holds the link switches over lead "S", but they are held over the "HLD" lead to the marker connector. The marker connector is released, and in doing so breaks its ground from the "HLD" lead, so there is no longer any ground on the "S" lead or the primary winding of (ON1). The link switches release and the sender is freed from its external connections. If there is no plug in the "HLD" jack (ON1) also releases and the sender restores to normal just as if (RL) had operated instead of (TRL). But if there is a make-busy plug in the "HLD" jack, (ON1) will hold on its secondary winding, the register and all locked up relays will hold, and the sender will test busy with ground on the "SB" lead, until it is restored by withdrawing the plug. The "HLD" jack is plugged up when it is desired to hold the sender for examination after any timeout.

8.44 While it is operated (RL) grounds the "SB" lead. The purpose of this is in connection with a special test which the sender test circuit makes over the common "TR" lead from the link control circuit. Grounding the "TR" lead, it checks for ground on the "SB" lead to make sure that (RL) operates.

8.5 Sender Make Busy for Maintenance

8.51 The sender is made busy when it is in trouble or for other purposes of maintenance by inserting a make busy plug in the make busy jack. This operates relay (MB) if that is provided, otherwise it simply grounds the "SB" lead to indicate that the sender is busy, just as relay (ON1) would do. The (MB) relay if provided grounds the "SB" lead and also connects resistance battery to the "S" lead to serve as a busy signal to the sender test circuit.

8.52 If a marker connector serving five senders times out for trouble, each of the five senders is made busy by grounding the "MB" lead from the marker connector. This has the same effect on each sender as plugging up the make busy jack.

8.53 The grounding of the "SB" lead when the sender is made busy not only prevents link circuits from seizing it, but it also causes the "BS" lead to be grounded in the link control circuit.

8.54 The "BS" lead is carried thru a make contact of the (ON1) relay. This is to prevent the (ON2) relay from operating and putting a ground on the "S" lead. This would interfere with the link false ground test if the sender should be made busy just after being seized by a link.

8.55 In case there is a false ground on the "S" lead, holding the link switches engaged after relay (RL) has operated to release the sender from a connection, this ground will hold (ON1) from releasing, and that in turn will hold (ON2). The register and all operated relays will hold, and the timing circuit will time out and eventually give an alarm.

9. INCOMING FRAME AND DEMAND FOR SPECIAL MARKER REGISTER IN SENDER

9.1 The frame information comes from the sender link and control circuit in the form of grounds on two or three of the thirteen leads common to ten senders and designated "EF", "FOO", "FIO" and "FO" to "F9", and is registered on relays (EF) and (FOO) or (FIO) and on the "F" vertical of the crossbar register. The special marker indication comes from the incoming trunk over the individual lead "FC" through the link, and is registered on relay (SPL). When the sender is under test, the test circuit sends to the sender a frame indication, and if desired a special marker indication, by means of keys set up in the test circuit.

9.2 When the sender is seized for service by the link control circuit, the first act is to operate relay (SC) as previously described. This connects the common leads "FOO" and FIO to the windings of relays (FOO) and (FIO), and one of them operates from a ground in the link control circuit, according to whether the number of the incoming frame is under or over 10. The relay operated will lock to an off-normal ground when relay (ON1) operates.
9.3 When relay (SC1) has operated, (SC2) also operates to the "SC" lead, and it connects the common leads "EF" and "FO" to "FP" to the windings of relay (EF) and of the crossbar register select magnets. Relay (EF) operates from a ground in the link control circuit and locks to an off-normal ground when (ON1) operates. The (EF) relay is used to extend the life of the (STF) relay contacts, and is operated on approximately one half of the calls which engage the sender. One of the select magnets operates from a ground in the link control circuit, according to the units digit of the incoming frame number, and it passes the operating ground on to operate relay (SM).

9.4 (SM) closes a circuit to operate (RA1) and to shunt the (RA2) so that it cannot operate. (RA1) locks up. The ground which operates and locks (RA1) is furnished from the link control circuit over lead "F00" or "F10" at first, and later through the front contact of (ON1) which locks "F00" or "F10".

9.5 (RA1) operated connects the winding of the (F) hold magnet to both windings of relay (HM). These windings are differentially connected and so proportioned that the relay will not operate or hold with the same current in both windings, before a hold magnet is connected to them, nor will it operate with the combined current through the hold magnet and the secondary winding passing through the primary winding. The hold magnet operates under the latter condition as soon as the (ON2) operates to ground the primary winding of (HM).

9.6 The hold magnet closes the contacts of the crosspoints at the level of the operated select magnet. The locking contact of the hold magnet not only locks up the hold magnet, but also causes relay (HM) to operate with full current through its secondary winding and none through its primary.

9.7 When (ON2) operated, which it had to do prior to the operation of the hold magnet, it released (SC2), and that broke the operating path to the select magnet. But the select magnet and relay (SM) remain locked up through parallel front contacts of (SM) until (HM) operates, and further, until the closure of the "HH" and "HR" leads through the stepper relay of the originating sender causes (L), (L1) and (L2) to operate.

9.8 When (SM) releases, after the (L) has operated, the shunt is removed from the (RA2) which operates and holds along with (RA1), disconnecting the winding of the (F) hold magnet from the winding of (HM), (HM) thereupon releases.

9.9 An incoming trunk which requires the service of a special marker connects ground to the "FC" lead while in its normal condition. When such a trunk is first connected to the sender through the link switches, and (ON1) operates, relay (SPL) operates to this ground. The front contact of (ON1) is to make the final circuit closure and so prevent wear on the link switch contacts. When (ON2) operates (SPL) locks to an off-normal ground. Later on, when lead "FC" is required for its principal function as a path between incoming trunk and marker, it is disconnected from ground by a relay in the incoming trunk, and from the winding of (SPL) by the operation of relay (RV1).

10. REGISTERING DESIGNATION FOR NUMBER SERIES

10.1 Fig. B and the (OA) and (OB) relays will be furnished when the sender is arranged to complete calls over common trunks to two 10,000 number series. While the (SC1) relay is operated as described above, the (OA) or (OB) relay will be operated from ground in the associated link circuit. These relays lock to off-normal ground and they close the circuit for operating the (ON2) relay. The arrangement provided is such that one of these relays must be operated and the other one normal in order to close the path for operating the (ON2) relay and this arrangement is to make sure that one of these relays is operated but not both of them. If the (OB) relay is operated, it also connects ground to the "OAB" lead to the terminating marker. The (OA) relay however connects the "OAB" lead to the incoming group vertical of the register switch.

10.2 Originating senders which are arranged to complete calls over common trunk groups to two number series are arranged to send over or under five incoming group pulses, that is, transmit the normally required number of pulses for incoming group when one of the number series is wanted while for the other, they will transmit five additional pulses to the normally required number of pulses for incoming group selection. If the originating sender transmits the normal number of pulses and the (OA) relay is operated, the "OAB" lead will be connected to the "CK3" lead which will cause the terminating marker to set up the connection up to one of the number series. If the originating sender transmitted five additional pulses for incoming group selection, the "OAB" lead will have ground connected to it and the terminating marker will accordingly set the connection up to the other number series. Originating senders that are not arranged to complete calls over common trunk groups will always transmit the normal number of incoming group pulses and therefore the "OAB" lead
10.3 The (F00) and (F10) relays and "F10" lead may also be used to transmit to the marker the number series designation. In this case these relays cannot also be used for incoming frame number transmission.

11. PULSING AND REGISTRATION OF SELECTIONS

11.1 The five selections registered in the originating sender are transferred to the terminating sender by battery pulses generated in the latter and transmitted over the trunk conductors. They are registered on the crossbar register of the terminating sender. The latter sends a reverse battery pulse to notify the originating sender that all selections have been received. The actions of the originating and terminating senders are synchronized and the pulsing kept in step with the registration.

11.2 Preparation of Originating Sender for Each Selection

11.21 The originating sender is ready for selections or for the receipt of the reverse battery pulse, when its stepping relay and its polarized overflow relay are connected in series across the tip and ring of the trunk.

11.22 The originating sender is ready for the first selection before the terminating sender is seized. It causes the incoming trunk to notify the link control circuit to seize a terminating sender and attach it to the trunk.

11.23 As soon as the originating sender receives the correct number of pulses, on each selection, it opens the fundamental circuit, which is held open for a measured interval and then recloses for the next selection.

11.3 Preparation of Incoming Trunk for First Selection

11.31 At the time the terminating sender is seized and attached to the incoming trunk, the latter is holding ground on the ring conductor, and battery through the winding of its trunk relay on the tip. The trunk relay and the distant stepping relay are operated. This ground and battery must be disconnected before pulsing begins, but before they are disconnected another ground and battery in the terminating sender must be connected to the same conductors otherwise, the distant stepping relay would release and record a false pulse.

11.32 Relays (RV3), (RV4) and (RV5) operate over the "FOO" or "F10" lead when the terminating sender is first seized, and hold up throughout pulsing. When the link control releases (SC1), a ground through its back contact, a front contact of (RV4), back contact (TC2), Fig. D, and a front contact of (ON1), is applied to the "CO" lead. By this time it is certain that the link control circuit has made all its checks and definitely decided to use this particular sender, that the link switches have had time to close through the "T" and "R" leads to the windings of relays (L) and (STP), which are respectively connected to battery and to ground in Fig. N, and are connected through windings of relays (STP) and (L) in series with lamp (L) to battery and ground in Fig. P. Grounding the "CO" lead operates a relay in the incoming trunk which disconnects the battery and ground connections existing there from the tip and ring conductors throughout pulsing.

11.4 Preparation of Terminating Sender for Each Selection

11.41 Unbalanced Revertive Pulsing - Fig. N

11.411 The terminating sender is ready for a selection when the operating winding of relay (L) is connected to the "TM" lead, without being shunted by its noninductive winding, and the winding of relay (STP) is connected to the "RN" lead, without being shunted by ground through back contacts of (L1) or (L2). Although ready when in that condition, it will not begin pulsing on the first selection IB until the incoming trunk has removed ground from the ring conductor, because this shunts the (STP), or on any subsequent selection until the originating sender is ready with the circuit closed through its stepping and overflow relays.

11.412 To get ready for the first selection (ON1) must first operate to cut the leads through to the (L) and (STP) relays. The reason for this is to insure against interference with another terminating sender in case of a double connection at the sender links. (ON1) will not operate until the link control circuit has satisfied itself that a double connection does not exist.

11.413 Because of the variable resistance of the trunk loop the (L) may or may not operate on the first selection as soon as it is cut through to the trunk, or it may wait until the incoming is ready with its trunk relay cut off. On later selections (L) operates as soon as the originating sender is ready. It operates with its noninductive winding shunting its active winding. This is unimportant on the first selection, but on later selections the noninductive winding smooths out the descending side of a cable capacity surge which has a tendency to cause the distant stepper to momentarily release, and then reoperate which would generate a false pulse. When
(L1) operates it cuts off the noninductive winding in order to speed the subsequent operations of the distant stepper.

The (L) is permanently shunted by 4250 ohm resistance (J) and 0.5 mf condenser (B) in series with 2000 ohm resistance (F) to insure that the (L) will hold on all lengths of cable at the end of each ground pulse.

11.4.14 (L) operates (L1) through a back contact of (L2) and a front contact of (SM), and then (L1) locks directly to the contact of (L). (L1) operates (L2) and then (L2) locks to a front contact of (SM). The purpose of these connections is to prevent a selection from starting before the preceding one has progressed far enough in its registration to avoid possible interference, and yet to allow the two selections to overlap one another as much as possible and so save time. This is explained in detail under SELECTIONS SYNCHRONIZED.

11.4.15 When (L1) and (L2) have both operated the terminating sender is ready for selection, a back contact on (L1) disconnected the noninductive winding of (L) from the "T" lead and a back contact on relay disconnected separate ground connections which shorted relay (STP) on the "R" lead. The reason for having parallel ground connections through back contacts of (L1) and (L2) is as follows: On their operation, ground must be finally removed by (L2), because if it were removed by (L1) at the same time (L1) breaks off the noninductive winding of (L), the stepping relay of the originating sender might make a false release from having too much inductance thrown into its circuit at one time. On the other hand, on the release of the relays (L2) may be delayed some time, and it is necessary to short (STP) at once when (L) and (L1) release, to prevent a chance of starting the next selection prematurely.

11.4.2 Pulses Generated - Fig. N

11.4.21 When all three circuits, trunk, originating and terminating sender, are ready to start a selection, relay (L) and the stepping relay of the originating sender will be operated in series, (L1) and (L2) will operate following (L) then (STP).

11.4.22 When (STP) operates, it causes (GR) to operate. (GR) grounds the "T" lead, thus short-circuiting and releasing (STP) and the distant stepping relay while still holding (L1) operated and therefore (L1) and (L2). This operation and release of the stepping relays constitute the first pulse. When (STP) releases so does (GR), removing the ground from the "T" lead and allowing (STP) and the distant stepper to reoperate. (GR) then grounds the "T" lead, again grounds the "T" lead, releasing (STP) and the distant stepping relay. This pulsing, or alternate operation and release of the two stepping relays, continues as long as the circuit is kept closed in the originating sender, or until 11 pulses have been counted.

In order to extend the life of the contact of (STP), the direction of current flow through the contact is reversed on the approximately half of the calls, (EF) being operated by alternate incoming frames.

11.4.3 Balanced Revertive Pulsing - Fig. P

11.4.31 As explained previously, the L relay may operate when the (NV3) connects the two primary windings of the (L) to the tip and ring leads to the trunk, or it may wait until the line relay of the trunk is disconnected from the tip by the operation of the (T) relay. The (SS) operates when the (GR) operated closing auxiliary shunt paths on the stepper line windings.

11.4.32 The (L) relay consists of three windings, two primary windings in series, and a biased secondary winding. (L) operates over the tip and ring leads on its two primary windings in series. The biased secondary winding is energized when (ON1) operates. It is used for providing a non-operative requirement for the (L) to prevent its false operation on cable surges and to prevent non-operative on certain trunk test circuit conditions. Since the (L) relay has no biasing spring the armature may make contact with either front or back contact or may float between them when the circuit is normal and no current is flowing in any of the windings. For this reason the ground is connected to the armature spring only after (ON1) operates.

11.4.33 With both (L) and (ON2) operated, (L1) operates through a back contact of (L2) and a front contact of (SM) which operates during registration of the trunk line link frame number. (L1) locks directly to the front contact of (L). (L1) also operates (L2) which opens one locking path of (SM) and the operated select magnet. The (SM) relay and the select magnet release when an additional locking path is removed by operation of the (HM) relay following closure of the (P) hold magnet and when their operating circuit is removed by release of relays in the link when the (ON1) relay operates. The (SM) relay released, permits operation of the (RA2) relay which releases the (HM) relay. The circuit is now ready for registration of incoming brush selection although pulsing may start before completion of all of the foregoing operations without any adverse circuit reaction. The purpose of the remaining contacts of the (L1), (L2) and (SM) relays is to control registration and to prevent a selection from starting before the preceding one has progressed far enough in its registration to avoid possible interference, and yet to allow the two selections to overlap one another as much as possible so as to save time.

Page 10
11.43 When (L2) has operated indicating that the loop is closed satisfac- 
torily, (SS) releases. When (L1) and (SS) have removed their shunts from the (STP) 
relay, STP operates over the loop. (STP) like the (L) relay has three windings: two 
primary and a secondary. (STP) operates on its two primary windings in series. The 
secondary is used as a bias winding to pre-
vent its false action on cable surges 
and to insure its release on lead currents. 
This winding is energized when (CN1) oper-
ates. The (C) capacitor is connected be-
tween the junction of the bias resistor and 
the secondary winding and the winding of 
the (GR) relay. This (C) capacitor provi-
des a pulse help action to insure that once 
(STP) operates, it remains operated for a 
minimum interval and once it releases, re-
mains unoperated for a minimum interval.

11.44 Pulses Generated - Fig. P

11.441 When the (STP) relay operates, it 
operates the (GR) relay through con-
tacts of relay (EF). In order to extend the 
life of the (STP) contacts, the direction 
of current flow through the contacts is re-
versed on approximately half the calls by 
reversing the connections to the (STP) con-
tacts depending on whether the incoming 
frame number registered is odd or even.

11.442 (GR) in operating, shorts the tip 
and ring leads between the (L) and 
(STP) relays. This short across the tip 
and ring holds (L) operated and therefore 
(L1) and (L2). (GR) also operates (SS) 
which shunts and releases the (STP) and 
the distant stepping relay. This operation and 
release of the stepping relays constitutes 
the first pulse. When (STP) releases so 
does (GR) removing the short from the tip 
and ring leads allowing (STP) and the dis-
tant stepper to reoperate. (GR) then reop-
erates and again operates (SS) which shunts 
and release (STP) and the distant stepping 
relay. This pulsing, or alternate operation and 
release of the two stepping relays, 
continues as long as the circuit is kept 
closed in the originating sender or until 
eleven pulses have been counted to initiate 
a telltale condition.

11.443 (SS) is under control of GR when 
shorting and when operated applies 
shunts to both line windings of the STP re-
lay. This action disables the line windings 
of (STP) momentarily after each release of 
(GR) and prevents a false operation of (STP) 
to the cable capacity at the end of a train 
of pulses when the loop is opened by the 
sender at the distant end.

11.5 Pulse Counting - Fig. N or P

11.51 The originating sender counts the 
pulses on its counting relay and 
breaks the circuit, stopping the generation 
of pulses when a predetermined number from 
1 to 10 has been generated and counted. In 
case of an abandoned call or a trouble con-
tion the originating sender may fail to 
count the pulses and to break the circuit 
after the predetermined number has been 
generated. In that case, the terminating 
sender will generate eleven pulses before 
stopping of itself.

11.52 The terminating sender counts the 
pulses on relays (P1) to (P6), actu-
ating them by relays (L3), (L4) and (L5). 
The periodical operation and release 
(GR) causes (L3), (L4) and (L5) to operate 
and release in a recurrent cycle of half 
the frequency, as follows: The operation 
(GR) on the first or any odd-numbered 
pulse operates (L3); its release permits 
(L5) to operate in series with (L3); the 
operation of (GR) on the second or any even 
numbered pulse operates (L4) in series with 
the secondary winding of (L5), whereupon 
(L3) releases but (L5) holds; (GR)'s release 
causes (L4) and (L5) to release. Thus (L5) 
operates at the end of each odd pulse, and 
releases at the end of each even pulse. 
The ground connection for holding (L3) and 
(L5) in series and (L4) is furnished by 
front contacts of (L1) and (L2) in parallel. 
The reason for having parallel ground con-
nections through front contacts of both 
(L1) and (L2) is as follows: On their op-
eration (L1) operates first, and by having 
it supply a locking ground there is better 
assurance that it will be ready in time than 
if reliance were placed on a possibly vi-
brating contact of (L2) alone. On the 
other hand, on the release of the relays 
(L2) may be delayed some time and it is 
necessary to hold the locking ground until 
it releases, or else an addition (P) relay 
might be operated from the back contact of 
(L5) when it releases.

11.53 The operation of (L5) on the first 
pulse causes (P1) to operate and 
lock. The release of (L5) on the second 
pulse causes (P2) to operate, lock, and un-
lock (P1), which releases. Similarly the 
operation or release of (L5) on subsequent 
pulses operates other (P) relays, and on the 
11th pulse operates relay (TT). The 
relays left locked up after each pulse, any 
one of which may be the last pulse of a 
selection are as follows:

<table>
<thead>
<tr>
<th>Pulse</th>
<th>Relays</th>
<th>Pulse</th>
<th>Relays</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P1</td>
<td>6</td>
<td>P5-P6</td>
</tr>
<tr>
<td>2</td>
<td>P2</td>
<td>7</td>
<td>P1-P6</td>
</tr>
<tr>
<td>3</td>
<td>P3</td>
<td>8</td>
<td>P2-P6</td>
</tr>
<tr>
<td>4</td>
<td>P4</td>
<td>9</td>
<td>P3-P6</td>
</tr>
<tr>
<td>5</td>
<td>P5</td>
<td>10</td>
<td>P4-P6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11</td>
<td>P4-P6-TT</td>
</tr>
</tbody>
</table>

11.54 The operating ground for the (P) re-
lays is controlled through a front 
contact of (L2) to allow sufficient time to 
operate the last (P) relay on the last 
pulse of a selection. For this reason (L2)
11.55 The locking ground for the (P) relays is supplied through a front contact of (L2) and back contact of (SM) in parallel. The contact of (SM) holds the locking circuit until the select magnet is operated and locked. The contact of (L2) holds the locking circuit through the interval during which (SM) has not yet released from the previous selection, and (L2) is held operated until (SM) shall release.

11.56 If (TT) is operated by an eleventh pulse, it locks to off-normal ground, and represents telltale.

11.6 Selections Registered

11.61 Five selections are registered on each call, incoming brush, incoming group, final brush, final tens and final units, registered in that order. Each selection is registered by operating one of the ten select magnets and then operating the hold magnet appropriate to that selection, after which the select magnet is released and the hold magnet is held. This closes the cross-points which are connected, one level of the operated select magnet.

11.62 When the originating sender has counted the proper number of pulses it breaks the fundamental circuit. Relays (L1), (L1) and (L2) release, and (L2) closes a circuit from back contacts of (SM), (TT) and (RV1) in series through a front or back contact of (P6) and one of the front contacts of one of the other (P) relays to operate a select magnet, that one whose number is one less than the number of pulses which had been counted. The front contact of that select magnet passes the operating ground on to operate relay (SM), which locks itself and the select magnet. The operating circuit from a front or back contact of (P6) for the select magnets is taken through two different back contacts of (L2) instead of a single back contact, so that if (L2) operates to start the next selection while a select magnet and relay (SM) are still locked up, and two adjacent (P) relays are for a moment both operated, the locking ground for the operated select magnet cannot find a path to operate another select magnet. The operating circuit for the select magnets is taken through a back contact of (SM) so that if (P6) releases faster than the other operated (P) relay, momentarily closing an operating path to another select magnet, there will be no ground on that path. The operating circuit for the select magnet is taken through a back contact of (TT) so that when eleven pulses are counted for a telltale condition, no select magnet will operate.

11.63 When (SM) operated the first time to register the incoming frame number, it operated (RA1), and when it released (RA2) operated. When (SM) operates the second time to register the first (incoming brush) selection, it shunts down (RA1), and then when (SM) releases, (RA2) released. That completes one cycle of relays (RA1) and (RA2), and on the four subsequent selections they go through the same cycle twice more.

11.64 Each time (SM) operates, it either operates (RA1) and leaves (RA2) normal, or it releases (RA1) and leaves (RA2) operated. In either case, the effect is to connect the windings of (HM) to the winding of the first nonoperated hold magnet, causing the same to operate. The hold magnet closes the contacts of the cross-point at the level of the operated select magnet, locks up to a front contact of (GM), and by connecting the locking ground to the windings of (SM), causes that to operate. When (HM) has operated on one selection and (L2) on the next selection, (SM) and the operated select magnet releases.

11.65 Each time (SM) releases it either operates (RA2) and leaves (RA1) operated, or it releases (RA2) and leaves (RA1) normal. In either case the effect is to disconnect the windings of (HM) from any hold magnet, and (HM) releases.

11.7 Selections Synchronized

11.71 The control of the selections is primarily in the originating sender. It holds the fundamental circuit closed until it has counted the correct number of pulses, then it holds it open while preparing for the next selection, then recloses it. But in order to prevent selections from succeeding one another too rapidly to be registered properly in the terminating sender, the latter must exercise some check on the operations.

11.72 The operations necessary to transmit and record each selection consists of two parts. The first part is the pulsing, which consumes widely varying times depending upon the number of pulses and the speed of pulsing, which in turn depends upon the length of trunk. The second part is the registration of the crossbar register, which consumes a fairly constant time.

11.73 There are two requirements to be met. The first is that selections shall not follow each other too rapidly to be properly registered. The second is to keep down the average total time needed to transmit and record all five selections.

11.74 If control were left solely in the originating sender, with no check by the terminating sender, the second requirement would be met to the greatest possible extent. If all selections were of maximum length, this might work satisfactorily on
the assumption that pulsing would take more time than registration. Then each selection would be registered while the succeeding one was being pulsed, and the total time required would be the sum of the times required for pulsing, plus the times taken out between selections by the originating sender. But a series of successive selections of minimum length would run through too rapidly for registration on the crossbar register and in such case, the first requirement would be violated.

11.75 In order to meet the first requirement the terminating sender could be arranged so as not to permit any selection to start pulsing until the preceding selection had been completely registered. With a fair proportion of long selections this would make the total time required longer than if pulsing and registration were allowed to proceed simultaneously. This circuit is arranged to allow a certain amount of overlapping, but with sufficient control by the terminating sender to prevent the loss of any registration.

11.76 In case of a series of short selections, the originating sender counts the first set of pulses, breaks the circuit, then closes it again for the second set of pulses. The pulses were also counted on the (P) relays, and when the circuit is broken (L), (L1) and (L2) release, a select magnet and (SM) operate, (RAl) either operates or releases, a hold magnet and (HM) operate. Before this can occur the circuit is closed again and (L) operates. The next set of pulses must not start until the (P) relays are released, and they must not release before the select magnet and (SM) are safely operated. Therefore the release of the (P) relays and the operation of (L1) are both delayed until (SM) operates, by locking the (P) relays through a back contact of (SM), and operating (L1) through a front contact of (SM).

11.77 When (SM) operates for the first selection, (L1) and (L2) operate and pulsing starts for the second selection. The originating sender counts the pulses, breaks the circuit, then closes it again for the third set of pulses. The pulses were also counted on the (P) relays and when the circuit is broken (L) and (L1) release. The second registration cannot be permitted to proceed to the point of operating a select magnet until a hold magnet has been operated on the first registration. Therefore, the release of (L2) is delayed until (SM) releases by locking it to a front contact of (SM), and the release of (SM) is delayed until (HM) operates, by locking it to a back contact of (HM).

11.78 (L1) can operate only when (SM) is operated. When a selection is completely registered before the originating sender closes the circuit for the next selection, (HM) will have operated and broken its circuit for locking (SM), but if (SM) should be permitted to release at that time, there would be no circuit to operate (L1) later when (L) operates for the next selection. To prevent that, (SM) is also locked through a back contact of (L2), so that (SM) cannot release from one selection before (L), (L1) and (L2) have operated for the next.

11.79 (L2) can release only when (SM) is normal. This might lead to a situation where the originating sender breaks the circuit and releases (L) and (L1), but (L2) cannot immediately release because (SM) is operated. Before this situation changes, the originating sender closes the circuit and operates (L) and (L1), without (L2) having had any opportunity to release and start a registration. The registration would then be lost. To prevent this possibility, the operating path for (L1) is taken through a back contact of (L2).

11.80 Slow Operate relay (RV2) operates from a front contact of (RV1) and breaks ground from the "R" lead, which was also connected to the winding of (L). Reverse current which starts with a surge due to the previous soak of the (L), is applied toward the originating sender to operate
the distant stepper and overflow relay. The purpose of the procedure described in this
and the preceding paragraph is to compensate for a tendency under certain conditions for
the overflow relay to operate faster than its associated stepper.

11.815 Slow release relay (RV3) starts to
deenergize when its circuit is broken by
back contacts of both (RV2) and (L)
(Fig. D). The release of (RV3) relay breaks
the connections to the "T" and "R" leads, terminating the reverse battery pulse and
allowing the distant stepper to release.

11.82 Balanced Pulsing Circuit - Fig. P

11.821 When the (L), (L1), and (L2) relays
release upon completion of pulsing
of the final units selection, registration
of this selection is completed by operation of
the (FU) hold magnet. (FU) operated,
operates the stepper shunt relay (SS) which
puts a shunt on both line winding of the
(STP) preventing any further operation.

(FU) also closes ground to operate the
(RV1) relay through a front contact of (L2), (L),
(L1) and (L2) operate when the originating
sender closes the loop to receive a reverse
battery pulse. The (L2) also causes release of
(SM), (RA2), (BM) and the operated select
magnet.

11.822 (RV1) locks to a front contact of
(ONZ), and shorts out the tip and
ring leads between the (L) and STP relays.
(RV1) also closes ground to operate the slow
operate (RV2) relay. (RV1) opens the operat­
ing ground of the select magnets to pre­
vent a false operation of the zero magnet
during incoming advance with option AI.

11.823 During the operate time of (RV2)
the tip and ring leads are shorted, re­
leasing the distant stepper and discharging
the cable. When (RV2) operates, it reverses
the connection of the tip and ring leads to
the (L) relay. Thus reverse current is ap­
piled toward the originating sender to oper­
ate the distant stepper and overflow relay.
(RV2) also opens the operating path of the
slow release relay (RV3) and that relay re­
leases if its locking path through a back
contact of (L) is also open. (RV3) is
locked through an (L) back contact to insure
that reverse battery will continue until the
originating sender, by operating the (L) re­
lay, has indicated that it has received it.
This locking path provides for cases where
the terminating sender registers a telltale
condition operating the (TT) and (RV1) re­
ylas and at the same time the originating
sender is satisfied either by the final
pulse or the ground pulse supplied by the
(RV1). Under this condition the originating
sender would be between selections and thus
unable to receive the reverse battery pulse.
The (RV3) locking path is wired through the
(IBL) circuit so that it is effective only after the incoming brush selection has
been registered. If the originating sender
receives reverse battery during incoming
brush selection it will open the fundamental
during the reverse battery period without
waiting for termination of the reverse bat­
tery. An (RV3) locking path during this
selection might stick the terminating
sender.

11.9 Test Circuit at Incoming Advance

11.91 When the test circuit checks for non­
operate of the (L) relays the (L) re­
lay remains normal and consequently the
(RV1) and (RV2) do not operate to send
reversed battery to the test circuit and the
test is blocked. When (FU) hold magnet
operated, ground through the B contact of
the interrupter (IF) operates (IF) relay
and when the (F) contact makes one second
later (IF1) operates, which operates (RV1)
relay starting reversed battery functioning.
On a regular call the operation of the (RV1)
opens the operating path of the (IFI) relay.

12. TRUNK CLOSURE

12.1 This section describes how the termin­
at ing sender, after registering all
selections and sending a reverse battery
incoming advance pulse to the originating
sender, returns supervision to the incoming
trunk, and receives notice from the incom­
ing trunk that trunk closure has been ef­
fected at the originating end.

12.2 When (RV3) releases to break the "T"
and "R" leads and thereby terminate
the reverse battery pulse, it starts (RV4)
to releasing, and the release time of (RV4),
which is slow release, affords a short open
period to allow the originating sender to
function and open the trunk at that end.

12.3 When (RV4) has released, it connects
the "T" lead to battery through a
resistance lamp, and the "R" lead to the
resistance battery feed to (RV5). This
discharges the cable from the preceding re­
verse battery pulse and recharges the tip
side of the trunk to a negative polarity,
which reduces the trunk capacity surge on
the trunk relay when its battery winding
is connected prior to trunk closure, thereby
preventing its false operation.

12.4 (RV4) releasing also breaks ground
from the "CO" lead through the link to
the incoming trunk. This releases the
relay in the incoming trunk which previ­
ously cut off the incoming trunk relay,
which is reconnected to the trunk for super­
visory purposes, but with its winding con­
nected to the "H" lead shorted out by
direct ground in the trunk. This ground
also shunts down and releases relay (RV5).

12.5 (RV5) releasing breaks its own wind­
ing from the "H" lead, and the lamp
battery from the "TT" lead, leaving both
those leads open in the sender. (RV5) re­
leasing also connects the lamp battery to
13.32 The (F) register grounds leads "F1", "F2", "F4", and "F5" according to the incoming frame as follows:

<table>
<thead>
<tr>
<th>Frame</th>
<th>Leads</th>
<th>Leads</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 or 10</td>
<td>None</td>
<td>5 or 15</td>
</tr>
<tr>
<td>1 or 11</td>
<td>F1</td>
<td>6 or 16</td>
</tr>
<tr>
<td>2 or 12</td>
<td>F2</td>
<td>7 or 17</td>
</tr>
<tr>
<td>3 or 13</td>
<td>F1-F2</td>
<td>8 or 18</td>
</tr>
<tr>
<td>4 or 14</td>
<td>F4</td>
<td>9 or 19</td>
</tr>
</tbody>
</table>

If the frame number is 0 to 9 relay (F00) connects lead "CK1", or if it is 10 to 19 relay (F10) grounds lead "F10", with "A" option.

13.33 The (IB) and (IG) registers ground leads "TH1", "TH2", "TH4" and "TH8" according to the thousands digit of the called number as translated from the incoming brush and group selections, as follows:

<table>
<thead>
<tr>
<th>Thousands</th>
<th>IB</th>
<th>IG</th>
<th>Leads</th>
</tr>
</thead>
<tbody>
<tr>
<td>000 or 1</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>102 or 3</td>
<td>TH1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>201 or 1</td>
<td>TH2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>302 or 3</td>
<td>TH1-TH2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>401 or 2</td>
<td>TH4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>512 or 3</td>
<td>TH1-TH4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>613 or 2</td>
<td>TH2-TH4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>714 or 3</td>
<td>TH1-TH2-TH4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>815 or 3</td>
<td>TH1-TH8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>916 or 3</td>
<td>TH1-TH8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13.34 The (IG) and (FB) registers ground leads "H1", "H2", "H4", and "H5" according to the hundreds digit of the called number as translated from the incoming group and final brush selections, as follows:

<table>
<thead>
<tr>
<th>Hundreds</th>
<th>IG</th>
<th>FB</th>
<th>Leads</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 or 2</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>102 or 3</td>
<td>H1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>203 or 2</td>
<td>H2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>302 or 3</td>
<td>H1-H2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>404 or 2</td>
<td>H4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>510 or 3</td>
<td>H5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>613 or 2</td>
<td>H1-H5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>714 or 3</td>
<td>H2-H5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>815 or 3</td>
<td>H1-H2-H5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>916 or 3</td>
<td>H4-H5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

13.35 The (FT) register grounds leads "T1", "T2", "T4", and "T5", and the (FU) register grounds leads "U1", "U2", "U4" and "U5", according to the tens and units digits, respectively, of the called number, which are the same as the final tens and units selection, as follows:
13.36 When the sender and marker are first connected together, leads "CK1", "CK2", "CK3" and "CK4" are grounded in the marker, so the marker relays connected to all the "F", "TH", "H", "T", "U", "OAB" and "RO" leads operate. That closes chain circuits in the marker, with the effect of breaking ground from leads "CK1", "CK2", "CK3" and "CK4". This releases all the marker relays except those which are operated by ground originating in the sender. The reason for first operating all the relays in the marker and then releasing such as are not wanted, is to check all the connecting leads for continuity and for freedom from grounds and crosses.

13.4 Connection Established and Marker Released

13.41 When the marker has received information from the sender, it establishes a connection between the incoming trunk and the called line, or if the latter is busy it puts the incoming trunk in position to send a busy back signal. In performing these functions the marker has direct connection with the particular incoming trunk involved over lead "FC", through the connector to the sender and thence through the link to the incoming trunk.

13.42 Its work completed, the marker grounds lead "RL" to operate relay (RL). (RL) breaks battery from the "ST" lead, dropping the marker connector and marker, and it also causes the complete release of the sender.

14. IRREGULARITIES AND TROUBLE CONDITIONS

14.1 Defective Frame Indication From Link Control Circuits

14.11 If the link control fails to ground either lead "FOO" or lead "PIO", (RV3) cannot operate, therefore (ON1) cannot operate to ground the "SB" lead, so ground will not return over the "BS" lead to operate (ON2).

14.12 If the link control fails to ground one of leads "FO" to "F9" to operate a select magnet, (SM) will not operate nor (RA1), so no circuit will be closed from the "BS" lead to operate (ON2).

14.13 If the link control operates both (FOO) and (PIO), or both (OA) and (OB), when furnished, they will break the connection from the "BS" lead to operate (ON2).

14.14 If the link control operates two or more select magnets, marginal relay (XSM) will operate and break the connection from the "BS" lead to operate (ON2).

14.15 In any of the above cases (ON2) will fail to operate, the "RL" lead to the link control will not be grounded, the link control will time out and release all connection with the sender. The sender will at once restore to normal without having grounded the "CO" lead to disturb the incoming trunk.

14.16 If some trouble condition should cause the closure of one of the unused crosspoints on the register switch for Incoming Brush, Incoming Group or Final Brush, ground thru the crosspoint will operate the (TT) relay. This will cause reverse current to be sent to the originating sender and set up an overflow condition. (TT) and (L2) operated, the (RV1) operates. See Telltale section for operation following (RV1).

14.2 Trouble Release by Link Control Circuit

14.21 If the link control circuit, while in the act of connecting the sender to an incoming trunk, detects a trouble such as a double connection or a failure to receive a release signal from the sender, it grounds the "TR" lead and so operates relay (RL). If (ON1) and (ON2) have operated to hold the link switches and relays in the sender, (RL) will lock to a front contact of (ON2), but will break the ground for locking the link switches and (ON1). When the link control circuit disconnecting relays (SC1), the sender will completely release.

14.3 Trouble Release by Marker Connector

14.31 If two markers called in by the marker connector both fail to complete the call, the connector grounds lead "TRL". Relay (TRL) operates and causes the release of the sender.

14.4 Premature Disconnect

14.41 If a call is abandoned after trunk closure but before the marker has given a release signal, the sender must be disconnected at once from the trunk, which is liable to be seized for another call.

14.42 The abandoning of the call breaks the trunk closure, with the result of
removing ground from the "D" lead, and leaving attached to it in the trunk only a relay with battery on its winding. This causes (TC1) to release and closes a circuit through front contact of (TC2) to operate (TC3). (TC3) is slow to operate to prevent its operating on a momentary accidental-break in the trunk closure.

14.413 (TC3) operating operates (RL), and causes the release of the sender.

14.42 If a call is abandoned after the fundamental circuit has been closed long enough to operate the (L), (L1) and (L2) relays and release the (SM) but before one or more pulses have been sent, the opening of the fundamental at the originating end will release the (L), (L1) and (L2) relays. Since no pulse has been sent the reclosure of the fundamental upon reselection of the trunk causes the (L) to reoperate on trunk test rather than the trunk relay in the incoming. The (L1) cannot operate since the (SM) is released. The operation of the (L) with the (SM) released will operate the (IF) when the (IF) interrupter closes its "P" contact. When the "P" contact closes, 1 second later, the (IF1) operates and operates (RV1) to send reverse battery to the originating sender.

14.5 Telltale

14.51 If a call is abandoned while pulsing in progress or if a trouble condition in the originating sender prevents its breaking the circuit when ten pulses have been generated in any selection, or if a trunk with crossed conductors seizes the sender without having been called into service at its originating end, a telltale condition ensues. This condition is one where the pulses of a selection are allowed to run to 11, and is so called because of a similar condition when a panel incoming or final selector is involved, drives the selector elevator to the telltale position.

14.52 The first effect is for the eleventh pulse to operate relay (TT). (TT) locks up and grounds the R lead of the trunk through the back contact of (RV2), which in a completed call, is grounded by the operation of the (FU) hold magnet. This shunts the (STP) and stops pulsing. (RV1) is operated and the succeeding operations are the same as in incoming advance and trunk closure on a completed call, except that the sender is released without calling in a marker.

14.53 The operation of (RV1) and (RV2) switches the "P" to the "R" lead, thus connecting reverse battery to the trunk. The operation of (RV3) terminates the reverse battery pulse (RV1) and (RV5) then releases in the usual manner.

14.54 (RV4) and (RV5) releasing substitute battery for ground on the "CO" lead, restoring the incoming trunk relay to its normal connection with the trunk, and (RV5) releasing grounds the "D" lead through the winding of (TC1). Shortly after the termination of the reverse battery pulse, or immediately in case of a crossed trunk, the incoming trunk recieves trunk closure and grounds the "D" lead, operating (TC1), and (TC1) operates (TC2).

14.55 The operation of (TC2) cannot call in a marker as it does after completed selections, because a back contact of (TT) breaks the "ST" lead. But the operation of (TC2) closes a circuit from ground (TM2) normal through a front contact of (TT) to operate (RL), and that causes the complete release of the sender.

14.6 Stuck Sender Timed Out

14.61 Various conditions may cause the sender to stick and time out, among them the following: The sender is seized by a trunk having the tip or both conductors grounded; the calling subscriber does not finish dialing or else is so slow that he is still dialing after the sender times out; a trouble in the originating sender prevents the closure of the fundamental for one of the selections; a trouble in the terminating sender prevents its sending pulses.

14.62 The timing interrupter (TS) is always in operation on a 30 second cycle, both contacts open 28 seconds, then the back contact closes one second, then the front contact closes one second, and repeats. If the front contact closes while the sender is engaged, with relay (ON2) grounding the "A" lead, relay (TM1) operates over the "F" lead and locks. If the sender still remains engaged on the same connection when the back contact closes, relay (TM2) operates over the "B" lead and locks. It thus required from 28 to 58 seconds to time out and operate (TM2). If the sender still remains engaged on the same connection when the front contact again closes, one second after the operation of (TM2), relay (TRL) operates over the "F" lead and locks, causing the complete or partial release of the sender.

14.621 If (TT) was not previously operated, the operation of (TM2) will operate it, and then if the reverse battery has not been sent, (TT) will operate (RV1) which in turn operates (RV2) to connect reverse battery to the trunk. (RV3), (RV4) and (RV5) then release, terminating the reverse battery, substituting battery for ground on the "CO" lead, and grounding the "D" lead through the winding of (TC1), causing the complete or partial release of the sender.
14.622 If the (RV3) is locked up to the back contact of (L) through the crosspoints IB Fig. D if the reverse battery is not removed. One second later the (TRL) operates to release the circuit.

14.63 If the nature of the trouble is such that the sender cannot be released as described above, or if a plug in the (HLD) jack prevents the operation of (TRL) from causing a complete release, it will remain stuck, testing busy to links and test circuits, and with (TM2) grounded lead "TL" to light an individual lamp at the trouble indicator frame, and it grounds lead "AL" to a timing circuit which is common to a number of senders. The timing circuit will give an audible alarm.

14.7 Cross Between D and ST Leads Incoming Trunk

An added back contact on the TC2 relay Fig. D opens the CO lead to prevent reaction in case of a cross at the "transmission cut through relay" in the incoming trunk on trunk closure. This cross would ground the ST lead as well as the D lead and cause a 2d link and sender to be attached to this same trunk. The TC1 and TC2 relays of the 2d sender would also operate in multiple with the 1st sender trunk closure, but the operated 2d sender TC2 relay prevents the operation of the "trunk reversing relay" by opening the CO lead and thereby prevents a possible false charge.

14.8 Bridged (STP) Contacts

If the (STP) contacts become bridged during pulsing the (GR) will remain operated and no more pulses will be sent to the originating sender. The terminating sender will time out and the (TT) Fig. H operates which will transfer the retroactive pulse ground, supplied by the operated (GR), from the winding of the (L) to the "S" winding of the (ON1) and will in effect be the same as if the hold plug was in the (HLD) jack, but only for as long as the bridge remains on the (STP) contacts.

14.9 Terminating Sender Overload Control

When Fig. K is used, and when an all term sender busy condition is recognized by the term, sender timing circuit, the "G" and "OL" leads and the "G2" and "Q3" leads to the term, senders are closed. If the sender is in the process of handling a call, this closure will be ineffective. However on the next call, when the sender is seized and on the operation of the sender relays (SC1) and (ON2), relay (OF) operates and locks. When the fundamental circuit is closed for incoming brush selection, the sender (L) and (LI) relays operate as before, and the (LI) relay operates relay (IF) which locks. When the (L) relay releases at the completion of inc. brush selection, relay (IF1) operates, locks and operates relay (RV1) which operates the tip and ring. When the originating sender recloses the fundamental for incoming group selection, it recognizes the reversal as an overflow signal. Circuit action from this point is similar as described for incoming advance. This feature is intended to relieve originating sender delay caused by an overload in the terminating office.

15. PROVISIONS FOR SPECIAL TESTS

15.1 The (T) jack provides ready connection for a special test set to test the characteristics of the pulses generated.

15.2 Terminal "SB" is provided for connection to a holding time recorder.

15.3 Two leads are grounded to the traffic usage recorder circuit under the following conditions:

Sender Busy (SB) Grounded whenever sender is busy for any reason.

Sender Busy Maintenance (SBM) Grounded whenever sender is plugged busy.

16. FIGURES AND OPTIONS

16.01 Fig. A shows the (SC1) relay where "OA" and "OB" leads are not required.

16.02 Fig. B shows the (SC1) relay having contacts for the "OA" and "OB" leads.

16.03 Fig. C shows the circuit arrangement prior to the change per Fig. D.

16.040 Fig. D

16.041 Shows the (TC2) with a break contact in the "CC" lead to prevent reaction in the case of a cross of the "D" and "ST" leads at the "transmission cut through relay" in the incoming trunk circuit, on trunk closure.

16.042 Another break contact on the (TC2) relay removes ground from the "TH2" lead used to operate the (TT) relay at IB crosspoints which likewise are rearranged in Fig. D to facilitate the next item.

16.043 Changes the locking path of the (RV3) to prevent terminating reverse battery closure before the originating sender has the fundamental circuit closed.

16.044 Changes the (IF1) relay locking circuit to prevent a stuck sender in case of a short single pulse received after the sender is off normal.
16.045 Show connections to timing control circuit for Interdigital Timeout.

16.05 Fig. F replaces Fig. E to provide a (RV3) relay which is faster in release time to accommodate the automatic test circuit.

16.06 Fig. H replaces Fig. G to arrange a trap for bridged (STP) contacts and removes direct ground from the winding of the (STP) relay to facilitate its readjustment.

16.07 "A" or "G" wiring and apparatus provides for frame indicators above 10 or for two 10,000 number series.

16.08 "E" wiring less than 10 frames.

16.09 "E" wiring and apparatus provides for terminating sender test circuit.

16.10 "F" wiring when terminating sender test circuit is not furnished.

16.11 "H" wiring and apparatus provides Interdigital Timeout.

16.12 "J" wiring when Interdigital Timeout is not provided.

16.13 "M" wiring produces Telftale on certain incoming group selection oversteps.

16.14 "M" wiring provides a path for the operation of the (ON2) relay when the (OA) and (OB) relays are omitted.

16.15 "X" wiring and apparatus provides for a signal from the sender link for selection of number series when two 10000 number series are used, or may also be used to distinguish between physical and theoretical offices.

16.16 "Y" wiring permits the use of incoming group selection above five as a means of distinguishing between number series or between physical and theoretical offices, and is used in combination with "X" or "Z"). "Y" and "N" wiring are never used together.

16.17 "Z" wiring is provided to permit omission of the (OA) and (OB) relays in those cases where no signal from the sender link is required.

16.18 "AI" wiring and apparatus supersedes "AH" and introduces a break contact in the select magnets operate path at the (RV1) relay to prevent a possible false operation of the select magnet at the end of a call following "Incoming Advance".

17. INTERDIGITAL TIMEOUT

17.1 "H" option and Fig. D provides an interdigital timeout of 3 to 6 seconds under control of the Terminating Sender Timing Control Circuit which functions when all terminating senders are busy for a measured interval. The purpose of this feature is to reduce sender holding time in an emergency when all senders are busy and partial dials are encountered.

17.2 The (L) and (LL) will not operate if the originating sender holds the fundamental open awaiting the subscriber to dial.

17.21 The (LL) failing to operate whenever the "G" and "G1" leads are closed in the timing control, or timed to a measured interval of 3 to 6 second, any time after the sender is seized, and before the (TG2) operates for trunk closure the (IDT) interrupter B contact will operate the (TM3) and the F contact operates the (TRL) to effect a release.

17.22 The operation of the (L1) relay shunts the (TM3) and will cause its release if operated or prevents its operation, and accordingly starts a new cycle count between each digit.

17.3 Subsequent closure of the fundamental at the originating end may cause the reseizure of another terminating sender which will again time out in the same manner if the Timing Control Circuit is still effective. In spite of this possibility, however, the holding time is less than that which would be required, if the (T5) interrupter and relays (TM1) and (TM2) were controlling.

18. TAKING EQUIPMENT OUT OF SERVICE

18.1 This circuit is taken out of service by the insertion of a (J32A) make busy plug into the associated MB jack at the terminating trouble indicator frame.

19. ALARM INFORMATION

19.1 Alarms and Indications

19.11 If this sender is delayed in the progress of a call for an interval greater than 30 to 60 seconds for the measured interval of 3 to 6 second, any time after the sender is seized, the trouble release feature will function and the individual sender TL (trouble) lamp at the terminating trouble indicator frame will light momentarily.

19.12 Should the trouble release feature fail to restore the sender to normal, or if a make busy plug in the HLD (hold) jack prevents the operation of the sender trouble release relay from causing a completed release, the sender will remain stuck, testing busy to links and test circuits. Under this condition the TL and AL leads are grounded and the individual sender TL lamp at the terminating trouble indicator frame lights and after 5 to 12 seconds the minor alarm operates.
19.13 If a TL lamp on the trouble indicator frame is observed to flash occasionally without bringing in an audible alarm it may be an indication that the sender is requiring too long a time to handle the call, in which case a make busy plug should be inserted into the HLD jack of the sender in order to hold the trouble. If the lamps appear generally over a large number of senders it may be desirable to insert make busy plugs in the HLD jacks associated with those senders.

19.2 Responding To Alarms

19.21 If, in response to the intermittent audible alarm, a lighted sender TL lamp on the terminating trouble indicator frame is found, the lamp indicates the particular frame and sender which is being held.

19.22 The audible alarm may be retired by operating the ACO key before leaving the trouble indicator frame.

Note: This key should be operated as short a time as possible. The ACO key when operated cuts off the minor audible alarm for the terminating trouble indicator frame. This cancels the minor audible alarm for any trouble which may occur in the sender, marker or trouble indicator circuits.

19.23 If a full selector terminating sender is causing the alarm, determine from its setting in what portion of the sender or what general direction the trouble may be located. The following examples give an indication of the location of trouble outside of the sender.

(a) If the sender is seized and no selections recorded this may be an indication of trouble in the sender link or incoming trunk circuit.

(b) If the sender had partially completed selections this may indicate a failure in the originating sender.

(c) If the sender reverse battery condition has not been satisfied, this may indicate a failure in the terminating sender itself.

(d) If the trunk closure feature in the sender is not satisfied this may indicate a failure in either the incoming trunk or originating circuits.

(e) If it is found in the sender that trunk closure had been completed it may indicate a failure in either the associated marker connector or marker.

19.24 If trouble is located in the sender and cannot be cleared immediately make the sender busy in accordance with par. 18.1 and manually restore the sender to normal and restore the ACO key.

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