TERM SONDER TST

241 - 1101 441A

3840 SD 25159

CD25159

T.S.T. INDEX

SEE BSP 216-301-501

DRAWINGS

BSP A 271.311

SEE
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T.S.T. FRAME KEYS

Sheet 0103.

ST - Start Key

The operation of this key controls the advance of the connector circuit from normal and when restored causes the test set to complete the test in progress but not to start a new test. The crossbar switch does not restore when the "ST" key is restored.

PCR & PCS - Particular Circuit Keys.

These keys are used to advance the crossbar switch to a particular terminal for testing a particular sender.

CA - Control Advance Key.

The operation and release of this key causes a test to be started on the next sender if the repeat key is normal, or causes a new test to be started on the sender upon which the test circuit is resting if the repeat key is operated.

Rep. - Repeat Key.

This key causes the test circuit to test the same sender repeatedly. It is also used to extend the control advance feature to the remote control jack at the sender frames.

Rep. 2 - Repeat 2 Key.

This key causes two tests to be made on each sender.

TA - Time Alarm Key.

When this key is operated the time alarm circuit is restored to normal. The key must be restored to normal before the test circuit will advance to the next sender. If this key is left operated while the test frame is unattended, the alarms cannot operate, and, if a trouble is detected by the test frame, either one sender or a subgroup of senders may be held out of service.

PBS - Pass B Senders -

This key operated causes all "B" senders to be passed without testing.

PTS - Pass T Senders.

This key operated causes all "T" senders to be passed without testing.

APB - Automatic Pass Busy Key.

This key operated causes the test circuit to pass a busy sender after a period of 29 second minimum, 59 seconds maximum.

RN - Restore to Normal Key.

This key is used to restore the connector mechanism to normal.

ACO - Alarm Cut Off Key.

This key is used to silence the minor alarm without interfering with aisle pilot and floor alarm frame lamp indications.

0 to 7 - Class of Call Keys.

The operated class key controls the type of test to be made on the sender.

Sheet 0106

LT - Light Traffic Key.

This key is operated in light load periods to make effective certain tests which cannot be made during heavy loads (Pages 5 & 7.)

MGB - Make Group Busy Key.

This key is operated to make busy the group circuit to which the test circuit is connected, thereby giving preference to the test circuit for this group of senders.

OA or OB - Office A or Office B Keys.

One of these keys is operated when it is desired to transmit an office indication to the sender as from the link circuit.

FAO or FA1 - Frame Group Indication Keys.

FAO key operated indicates an Inc frame in the first ten.
FA1 " " " " " " " " second "

FO to F9 - Frame Indicating Keys.

The operated F key indicates which Inc. frame in the group of ten is to be registered.

Sheet 0108

L - Sender L Relay Test Key.

This key when operated adds the maximum loop resistance in the fundamental circuit and when normal the minimum loop resistance is in the fundamental (Page 10.)

LST - Selection Transfer Timing Key.

This key when operated tests the sender to insure that it will advance, following the completion on one fundamental selection, and reclose the fundamental in a definite maximum time. When the key is normal a test is made that the sender advances in a minimum time (Page 11.)

SS - Step By Step Key.

This key when operated, arranges the circuit for step by step operation.

AV - Advance Key.

With the (SS) key operated the (AV) key is used to send one selection into a terminating sender or one digit into a B Sender and to cause the test circuit to advance to the next sender on - "Time Out Test"

STP - OPR - Stepper and L Relay Operate Test Key.

When this key is operated the sender L and STP. relays are tested for operate. (Page 12)

LRB - Reverse Battery Key.

This key when operated tests the sender that it does not maintain too long a closure of reverse battery and when normal tests that the sender does not give too short a closure of reverse battery. (Page 13)

IG5 - Incoming Group High Five Indication Key.

This key when operated causes five additional pulses to be transmitted for incoming group selection indicating Unit B.

TTSC - Tell Tale Short Circuit Key.

This key when operated tests for short circuits on front contacts of the IB register which lock the RV3 relay.

<u>Sheet 0110</u>

TT - Tone Test Key.

This key when operated arranges the circuit for tone test. In this test the sender selects a position and the order tone is passed thru the sender to the test circuit. The testman may also talk thru this circuit to the operator. The testman may then judge the quality of the transmission (Page 28.)

PP - Particular Position Key.

This key, when operated, permits the position selector switch to be advanced to any position by means of the dial. (Page 29)

PT - Position Test Key.

This key, when operated, arranges the circuit for testing position circuits. (Page 29).

SKP - Slow KP Relay Test Key.

With this key operated the KP relays generate slow pulses for detecting certain troubles in the sender steering relays and for making non-operate tests of the sender register marginal relays. (Page 24)

KP2-KP3-KP4 - Pulsing Relay Time Check Jacks.

These jacks are used when testing the operation of the KP2-KP3-KP4 relays.

TP - Transfer Position Key.

Before a position is tested, the sender to be used for this test is routined. The operation of the TP key stops the routine of the sender at the end of the test then in progress, and causes the position test to start (Page 29)

PD - Cancel Position Disconnect Test Key.

This key is operated to eliminate the test of the position disconnect feature. (Page 30)

PR - Position Release Key (Page 32)

This key is operated at the end of a position test to release the position cct. and the test cct.

OA-OB - Office A & Office B Key.

This key when operated to the OB position causes the ground to be connected to the T & R to the B sender and in the OA position battery will be connected to the T & R. (Page 32)

Sheet 0112

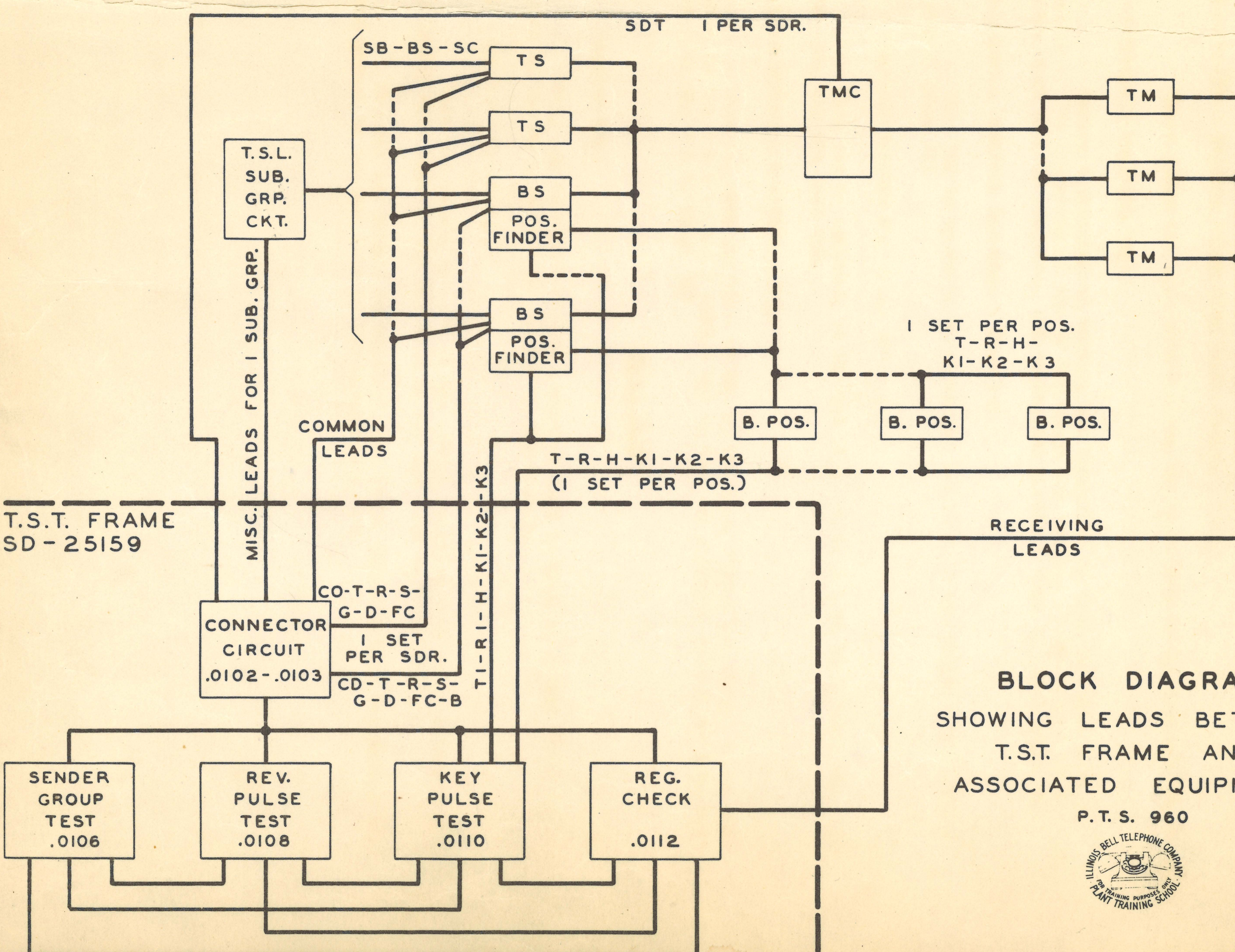
RO - Reorder Key.

This key is operated when a reorder test is made to permit check of the signal on the RO lead from the sender to the marker.

OAB - OAB Lead Check Key.

This key should be left in its normal position when it is expected that the sender will connect the CK3 lead to the OAB lead to the marker.

The OAB key should be operated when it is expected that the sender connects ground to the OAB lead to the marker (Page 17)



BLOCK DIAGRAM

SHOWING LEADS BETWEEN
T.S.T. FRAME AND
ASSOCIATED EQUIPMENT

P. T. S. 960

TERMINATING SENDER TEST FRAME

This circuit provides means for routine testing of Call Distributing "B" Senders and Full Sel. Senders of the Crossbar System on an automatic basis. Registration in the senders is made directly from the test circuit and the proper functioning of the senders is checked by the test circuit. When the test has been completed satisfactorily, the next circuit is seized and tested. The test circuit continues to function automatically until a trouble is encountered or until the end of cycle is reached. Repeat tests can be made in two ways, first, repeat tests can be made continuously on a particular sender or, second, two tests can be made on a sender and then the test circuit is automatically advanced to the next sender and the two tests are made and the test circuit is advanced until all senders under test have been tested twice. The test circuit is connected to the senders by means of crossbar switches, one crossbar switch is necessary for each group of 100 or less senders. Each switch can connect to ten sender subgroups, each one having a maximum of ten senders, which may be all Full Sel., all "B", or some of each. Each subgroup has a separate horizontal row on the crossbar switch. Connection to the circuit common to a subgroup of senders is obtained by means of a multi-contact relay and a pair of U type relays. Each multi-contact relay and a pair of U type relay is associated with a horizontal row of the crossbar switch to which row are connected the senders of the subgroup. A particular circuit test can be made. An automatic pass busy feature is provided. The sender being tested can be located by means of lamps, which indicate the position of the sender on the test circuit crossbar switch. There are two alarms, major and minor. The major alarm is used when the test is stuck on a time out while testing common equipment for ten senders; the minor alarm is used when the test circuit is stuck while testing individual senders.

The circuit provides means for testing CDB position circuits in a crossbar office on a manual basis. Two testmen are required for this test, one at the position and one at the test frame. One of the "B" senders is selected for use in this test and the position to be tested is selected by means of a 206 type selector under control of a dial. The man at the position writes an agreed upon number, or otherwise manipulates the position keys, causing signals to be passed thru the test circuit into the sender. The test circuit checks the registration in the sender and makes certain tests directly on the position circuit.

In the following code a regular call test will be made and the following keys operated:

CL-0, F-0, FA-0, LOA, TH-0, H-0, T-0, and U-9.

The test of a term. sender will be considered first.

CONNECTION OF TEST FRAME TO <u>TS</u>

+ ST key	+ ST
+ ST	Locks + W (Awtg TA Int) + WH + BT2
+ WH	Locks + AS
+ BT2	+ S1
+ AS	Locks + AS1
+ AS1	+ CO
+ CO	+ WS
+ WS	Locks + S-0 (Sel)
+ S-0 (Sel)	+ AH
+ AH	Locks - AS S-0 (Sel) Locks
- AS	+ ZS - AS1
+ ZS	¢ add.lock path to S-0 (Sel) - % GRD to S-0 (Sel)
- AS1	- CO + HO & HOA (HLD)

- CO + O

+ HO (HLD) + T, R, S, & CO XPTS
¢ % path H1 & H1A

+ HOA (HLD) + G, B, D, & FC XPTS
+ U-O
+ AV

CONNECTING COMMON LEADS TO SEN. SUBGRP.

+ O	Locks + O Lamp (horiz.ind.) + AO + BO + SMO
+ U-O	+ O Lamp (vert.ind.)
+ AV	Locks HO & HOA Locks (HLD) + C (0106) + ZH
+ AO	¢ F leads to sen. subgrp.
+ BO	¢ PF leads to P leads

NOTE: Assuming five TS - cross connect the PF00 to the P4, PF01 to P0, PF02 to P1, PF03 to P2, and PF04 to P3.

+SMO	¢ common leads to sen. subgrp.
+ C	Locks + BY lamp ¢ grd. to ON leads + XC + SID3
+ ZH	¢ add. lock grd. to HO & HOA (HLD) + EV

NOTE: If an odd numbered hold magnet is operated, the ZH and WH relays will be normal causing the operation of relay OD.

+ SID3	+ SID2
+ EV	Locks + TS (See note)

NOTE: The TS lead is connected to the G term.of all XPts. connecting to TSs.
The BS lead is connected to the G term.of all XPts.connecting to BSs.
The SPT lead is connected to the S term.of all spare XPts.

SENDER GROUP BUSY TEST

Group Busy

+ TS	+ CH (See Note 1) + GB (See Note 2)

NOTE 1: The operation of the CH indicates that no TLS is attempting to connect to any TS within this subgroup.

NOTE 2: If all the TSs or BSs of the subgroup are busy, or if the subgroup is made busy, battery is connected to the TMBO lead for the TSs or to the BMBO lead for the BSs by the sen.subgrp.cct.

+ GB	+ T (Awtg.int.) - SID % path
+ T	Locks + GB lamp + T-1 (Awtg.int.) - SID1 % path
+ T1	Locks + PB

The T1 relay operates 5 to 12 seconds after the GB. If the APB key is normal the circuit blocks with the GB lamp lit.

AUTOMATIC PASS BUSY

If the APB key is operated circuit action is as follows:

+ PB	Locks + PB (REG)
+ PB (REG)	+ CA

The operation of the CA relay will cause the test frame to release the sender and advance to the next sender as on completion of an OK test. This will be covered later.

BUSY TEST TS MADE BUSY

+ CH	+ BT1 - BT2 (slow release)
+ BT1	Holds BT2 + BT4
+ BT4	Holds BT2 + BT3
+ BT3	Locks - BT1 - BT4 (slow release)

The BT4 is slow release and keeps the wdg. of the BT1 and the sleeve lead open momentarily so that, if the bat. which operated the BT1 was not the make busy bat. in the TS but was some relay or hold mag.wdg., this false operating circuit will remove itself before the second test is made by the BT1.

- BT4	+ BT1

The operated BT1 now holds the BT2 and blocks the test.

BUSY TEST TS BUSY IN SERVICE

- BT2	+ S - S1 (slow release)
+ S	Holds S1

The operated S now holds the S1 and blocks the test.

SEIZURE OF SENDER SUBGROUP
Subgrp.& Sen.Idle

- BT2	- S1
- S1	+ SID - BY lamp
+ SID	+ SID1 + MGB + GB lamp + REG + RES
+ SID1	Locks - SID3 + T (Awtg.int. starts maj.alm.timing) - minor alm.timing (BKL lead)
+ MGB	+ TMB & BMB on all TSLs assoc.with this sen.subgrp.
- SID3	- SID2
- SID2	+ GE

The LT key is operated during light load periods to make effective the check of the regular testing leads TT or TB.

With the LT key normal the GE will operate thru the RES relay and only the RTO lead will be checked.

With the LT key operated the GE must operate thru both the RES and REG and both the RTO and TTO leads will be checked.

+ GE	Locks - GB lamp + SEL lamp + EF lamp + CI CH locks

SENDER SEIZURE

+ CI	+ CI1
+ CI1	+ CH1
+ CH1	Locks + S-O TSL
+ S-O TSL	Locks + SGE TSL + SC1 TS
+ SGE TSL	- REG - RES
+ SC1 TS	Locks + SC2 TS
+ SC2 TS	+ EF & EF TS

FRAME INDICATION

+ EF	+ SEL - EF lamp
+ SEL	Locks - SEL lamp + FOO TS + OA TS + SEL-O TS - CH - CH1
+ FOO TS	+ RV3 TS
+ OA TS	EF locks TS - EF (Shunted if not released by SPF4 in tst.frame)
+ SEL-O TS	+ SM TS
+ RV3 TS	+ RV4 TS
+ SM TS	+ RA1 (locks & RA2 shunted) TS
+ RV4 TS	+ RV5 (locks) TS

PREFERENCE LEAD CHECK

- CH	- % path S-O TSL
- CH1	+ SPF + RL lamp
+ SPF	+ SPF4 + SPFA
+ SPF4	+ SPF5 - EF (shunted)
+ SPFA	Locks - S lead to S wdg.

PREFERENCE LEAD CROSS CHECK

If the preference lead of the sender being tested is crossed with the preference lead of the next sender in the preference chain, the SPF3 will operate at this time - thru the operated S-O to grd. on the LK lead. If the LT key is operated the test will be blocked as follows:

+ SPF3	+ SPF1
+ SPF1	+ XA (SPF5 will be operated)

The operated XA will lock, light the X lamp, and cause the test to block, altho circuit action will progress up to the operation of the XB as on an OK test. The SPF4 is slow release to allow time for this test to be made.

With the LT key normal the operating path of the XA is open and the test is cancelled.

SENDER ADVANCE

If the preference leads are not crossed the SPF3 will not operate at this time and the test proceeds as follows:

+ SPF5	+ ON1 TS
+ ON1 TS	+ SB TSL ¢ add. lock grd. to RA1, RV5 TS Locks FOO, OA, EF TS ø add. hold grd. to RV3 TS
+ SB TSL	+ ON2 TS - SPF

+ ON2	Locks ¢ grd.to ON leads TS - SC2 TS Locks SEL-O & SM TS Locks ON1 TS + F (HLD) TS ¢ grd. to (TS) int. TS
- SC2 TS	- F leads from (SEL) TS
+ F (HLD) TS	Locks ¢ F-O XPTS. TS + HM TS

ADVANCE OF PREFERENCE LEAD

- SPF	- SPF4 (slow release)
- SPF4	- SPF5
- SPF5	+ RL
+ RL	Locks + SPF2 - RL lamp + SPF lamp
+ SPF2	- S-O TSL + SPF3

The operation of the SPF3 indicates that the preference lead has been advanced to the next sender.

SENDER "S" LEAD CHECK AND CHECK FOR CROSSES ON SC RELAY CONTACTS

- S-O TSL	- SGE TSL - SC1 TS
+ SPF3	+ SPF1
+ SPF1	+ XB (slow operate) - SPF lamp

The XB is slow operate to insure the release of the SC1 TS before applying the cross test.

+ XB	+ X1, X2, X3, X4 + S lamp

If there is no grd.on the S lead from the TS at this time the X1-4 relays will not operate and the test circuit will block with the "S" lamp lit.

+ X1, X2, X3, X4	∉ X wdg.to transmitting & control leads

One side of the X relay wdg.is connected to a potential of approximately 24 volts and the other side is connected thru the operated X1-4 relays to the leads to be tested for crosses. If any of these leads are connected to either grd.or 48-V battery, the X relay will operate, operating the XA. The XA operated locks, lights the X lamp and blocks the test circuit, bringing in the major alarm.

+ X1	- XC (slow release)

The XC is slow release to permit the X and XA to operate in case of a grd.or bat. cross as described above.

- XC	+ C (0103) - S lamp

SENDER GROUP TEST CIRCUIT RELEASE

+ C (0103)	Locks - C (0106) + C (0108)
- C (0106)	- SID - grd.to maj.alm.timing - SPFA - RL - X1, X2, X3, X4
- SID	- SID1 - GE
- SPFA	- SPF3 - SPF2
- RL	- XB
- GE	- CI - SEL
- SPF3	- SPF1
- CI	- CI1
- CI1	- MGB + BT2
- MGB	- TMB <u>TSL</u> - BMB <u>TSL</u>
+ BT2	+ S1

CHECK OF SENDER "CO" LEAD

+ C (0108)	+ IB + C1 - OF1 - BST + CO lamp + C (0112)
+ IB	Locks (IB' shunted)
+ C1	Locks (S shunted) + CO1 SEE NOTE 1 + BS + RC Energizes P' wdg. OF1 SEE NOTE 2

STICKY TC

NOTE 1: If there is no grd. on the CO lead from the TS at this time the CO1 will not operate and the test circuit will block with the CO lamp lit.

NOTE 2: The OF1 does not operat at this time due to the S wdg. being energized to oppose the P wdg.

REGISTRATION

+ CO1	Locks + IB' - CO lamp
+ BS	+ G
+ IB'	+ FO1 + IB lamp ¢ % path IG
+ G	Locks
+ FO1	Locks + STP + L <u>TS</u>

The L key normal places a minimum loop resistance in the fundamental. Operated, it places a maximum loop resistance, together with a line leak condition in the fundamental. This checks the ability of the <u>TS</u> L3 and L4 relays to respond to short closures and the ability of the L to release against a line leak current flow.

+ STP	+ O (FO & BO shunted)

The operation of the L in the <u>TS</u> prepares the pulsing circuit of the <u>TS</u> causing it to send grd. pulses over the T lead at a speed of about 16 to 28 pulses per sec. The first grd.pulse short circuits the STP relay of the test circuit and the STP of the <u>TS</u> which are in series.

- STP	+ BO & FO
+ BO	Opens fund. (stops pulsing)
+ FO	- RC - BS + IG
- BS	+ BST

The release of the BS relay connects the BS condenser to the S wdg. of the BST relay which operates, opening the operating circuit to the BS. The current that is operating the BST will start to decrease as the BS condenser is charged and finally the current will be reduced to a point where the BST will release, reoperating the BS provided the FO in the meantime has released which it usually will. The BST relay due to the close requirements of the associated resistances and BS condenser is operated for a very definite and uniform time and, therefore, the BS remains released, keeping the fundamental open for a definite time. This action takes place between each selection.

With the LST key normal this timing interval is such as to test the sender to make sure it will advance on a minimum open of the fundamental while with the LST key operated the sender is tested with a long between selections interval.

+ IG	Locks (IG' shunted) + IG1

To indicate office "B" the IG5 key would be operated. In this case the IG will operate the IG5 which will cause five additional pulses to be recorded in the <u>TS</u> for Incoming Group.

+ IG1	- FO1
- FO1	- O, BO, & FO Holds fund. open
- BO	~~c~~ Fund in part
- FO	+ IG' + RC
+ IG'	- IB & IB' + IG lamp ~~c~~ % path FB
- IB'	- IB lamp + FO1
+ FO1	Locks ~~c~~ Fund. in part

After the time interval controlled by the LST key the BST relay will be driven on its back contact. A failure in the <u>TS</u> on this test would result in an incomplete or wrong registration.

- BST	+ BS
+ BS	+ STP + L TS

L AND STP RELAY TEST

With STP OPR key normal, IG, FB, FT and FU selections are registered in the TS in the same manner as IB selection.

When the STP OPR key is operated an operate test is made on the TS L and STP relays during FB and FT selections. Circuit action on FB selections is as follows:

+ FB	+ TF
+ TF	Locks + FTP + L TS
+ FTP	+ FRP
+ FRP	+ STP TS + Ctg.rel.(depending on H key operated)

The TS functions and shunts down the FTP.

- FTP	- FRP
- FRP	+ Prime ctg. rel. - STP TS

FT selections will be made in a similar manner. However, the operation of the FU relay on FU selections will release the TF relay, and FU selections will be made in the regular manner.

FU selections having been registered, circuit action proceeds as follows when the STP releases on the last pulse:

- STP	+ BO & FO
+ BO	Opens fund.
+ FO	+ RB - RC - BS
+ RB	Locks (RB' shunted) - FO1 + RB lamp
- BS	+ BST
- FO1	- O, BO, & FO

- FO	+ RB'
	+ RC
+ RB'	- FU & FU'
	- Tert.shunt on OF
- FU'	- FU lamp
	+ FO1
+ FO1	ø fund. in part
- BST	+ BS
+ BS	+ L TS

REVERSE BAT. AND GRD. TIMING

The TS will now advance to return bat. over the R lead and grd. over the T lead which will cause the OF relay in the TST to operate. The STP will also operate but performs no function.

LRB KEY NORMAL

With the LRB key normal the TS is tested for minimum reverse bat. interval. The OF1 relay is a condenser timed, slow operating relay. If the reverse bat. and grd. is removed by the TS before the OF1 relay operates the TST will block with the RB lamp lit.

+ OF	+ OF1 (cond.timed)
+ OF1	+ OF3
+ OF3	Locks
	ø % path OF2

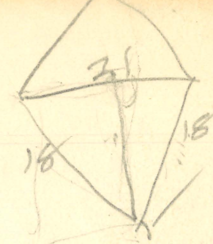
When the TS opens the fund. the OF releases.

- OF	+ OF2

LRB KEY OPERATED

With the LRB key operated the TS is tested for an excessive interval of reverse bat. and grd., the operating time of the OF1 being increased. In this case, if the reverse bat. interval is too long the OF1 will operate before the OF releases and the path to operate the OF2 will be open, causing the TST to block with the RB lamp lit.

+ OF	+ OF3
	+ OF1 (cond.timed)
+ OF3	Locks
- OF (by TS)	+ OF2 (provided OF1 has not yet operated)



+ OF2	Locks - RB lamp + D lamp X T lead to T wdg. X R lead to R cont.

TRUNK CLOSURE

The advance of the TS will now connect bat. to the T lead, operating the T relay, and open the CO lead, releasing the CO1 relay.

+ T	¢ T1 % path
- CO1	- FO1 + T1
+ T1	Locks X D lead from TD3 to D (SEE NOTE) X CO lead to CO2 + R

NOTE: Had the D lead been prematurely grded. the TD3 would have operated and blocked the TST with the D lamp lit.

+ R	- RV5 TS (shunted down)
- RV5 TS	- T + CO2 + D
+ CO2	- R

False bat. on the R lead would hold the R operated and block the TST.

+ D	Locks (R normal) - D lamp + TC lamp + TC1 TS

The operation of the TC1 TS causes a TM to be selected which in turn will operate relays in the register check cct. Meanwhile the register check cct. has been prepared as follows:

+ C (C112)	+ SRL + CKG + G ¢ Grd. to SDT lead to TMC (GC lead)
+ CKG	+ CK1 + CK2 + CK3

CONNECTION TO TM AND TST REGISTRATION

When the S and TM relays in the TMC have been operated the SDT lead will be closed thru to operate the SDT1 TM.

+ SDT1 TM	Locks + U4, U5 (grd. at TS XPTS) + TH1, TH2, U1, U2 (CK1 lead) + TH4, TH8, T1, T2, T4, T5 (CK2 lead) + H1,H2,H4,H5,F1,F2,F4,F5,F10,RO,OAB (CK3 lead) + SDT TM
+ All reg.rel.	+ CK4
+ F1	+ W
+ SDT TM	+ FC - ST bat. to ILC SEE NOTE - % grd.to FH + FH' rel. TM SEE NOTE

NOTE: This is removed to prevent the TM functioning to set up incoming and line choice switches.

+ CK4	Locks - CKG
+ W	Locks + TC
+ FC	+ FC1
- CKG	- CK1 - CK2 - CK3 - All operated reg.relays except U4 and U5
+ TC	Locks - TC lamp + TH lamp ¢ ADV lead to AV lead
+ FC1	Locks
- CK1,CK2,CK3	+ Z + LU (slow operate)

The LU is slow operate to allow time for all reg.relays which are going to release to do so.

+ LU	+ LUA, LUB, LUC, LUD
+ LUA,LUB, LUC,LUD	¢ lock grd.to reg.rels.locks U4 & U5 LUC locks LUA, LUB, LUD hold + RL (slow operating)

The RL is slow operate to allow all operated register relays to lock before releasing the TS.

+ RL	+ RL TS - SRL (slow release)

The operation of the RL TS will cause the release of the TMC which in turn releases the CK4 TST. The SRL is slow release to time the release of the TMC. If the SRL releases before the RL TST is released the BK TST will operate and block the TST.

CHECKING REGISTRATION

- CK4	+ THA - LU
+ THA	- RL + O lamp + THB
- RL	+ SRL (SRL has not mechanically released)
+ THB	Locks - TH lamp + H lamp + HA
+ HA	- & + O lamp + HB
+ HB	Locks - H lamp + T lamp + TA
+ TA	- & + O lamp + TB
+ TB	Locks - T lamp + U lamp + UA
+ UA	- O lamp + 9 lamp + UB
+ UB	Locks - U lamp + F lamp + FA
+ FA	- 9 lamp + O lamp + FB

+ FB	Locks - F lamp + F10 lamp + FAA
+ FAA	- & + 0 lamp + FAB
+ FAB	Locks - F10 lamp + RO lamp + ROA

In case of wrong registration on TH, H, T, U, or F registers the TST will block with a register checking progress lamp lit indicating the register where the failure occurred, together with a check lamp indicating the number actually registered.

+ ROA	- 0 lamp + ROB
+ ROB	Locks - RO lamp + CT (REG)

Proper Office Indication in the TS is checked by means of the OAB relay, lamp, and key and the LUD relay. The OAB key should be normal when the TS should connect the OAB lead to the CK3 lead (Off "A") and the OAB key should be operated when the TS should connect grd. to the OAB lead (Off "B"). In case of wrong registration the operate path of the ROB relay will be open and the TST will block with the OAB lamp lit.

COMPLETION OF TEST

+ CT	+ CA
+ CA	Locks + CA1 - AV
+ CA1	- C (0103) - EV - All % timing relays
- AV	- One grd. to HO & HOA (HLD)
- C (0103)	- C (0108) - CO2 (if not released by TS)
- EV	- TS
- C(0108)	- OF2 - RB & RB' - BS - T1 - C1 - OF3 - G - C (0112)

- CO2	- D
- OF2	- TC
- C1	- OF1
- C (0112)	- LUA, LUB, LUC, LUD - THA - SRL - FC1 (FC was released by <u>TM</u>) - G - W & Z
- LUB	- U4 & U5
- LUC	- THB, HA, HB, TA - TB, UA, UB, FA - FB, FAA, FAB, ROA, ROB

<u>ADVANCE TO NEXT SENDER</u>

- TC	- CT
- CT	- CA
- CA	- CA1
- CA1	- WH
- WH	- AH + H1 & H1A (HLD)
+ H1 (HLD)	+ T, R, S, & CO X PTS ∅ % path H2 & H2A
+ H1A (HLD)	+ G, B, D, & FC X PTS + U1 + AV
+ U1	+ 1 lamp (vert. ind.) X P, SDT, S, & PF leads
+ AV	Locks - ZH + C (0106)
- ZH	Locks H1 & H1A (HLD) - HO & HOA (HLD)
- HOA	- U-O (- O lamp vert. ind.)

The test of the second sender proceeds in the same manner as the test of the first sender and the ADV lead is grded. at its completion, again causing the operation of the CT register and CA and CA1 relays. These relays cause the release of all relays as before and when the CA and CA1 release the circuit to the

WH and ZH is again closed causing the WH to operate. This supplies grd. to the EHO lead to operate the H2 and H2A hold magnets thru the operated H1 hold magnet. The advance from one hold magnet to the next is accomplished in this manner until all senders connected to the first horizontal row of the crossbar switch have been tested.

ADVANCE TO NEXT SENDER SUBGROUP

When the last sender connected to the first horizontal row of the crossbar switch has been tested, lead ADV is grded. in the usual manner and eventually causes the operation of the WH relay. The operation of the WH with the H9 hold magnet operated causes circuit action as follows:

+ WH	Locks + RLN
+ RLN	Locks - H9 & H9A (HLD)
- H9	+ AS
- H9A	- U9 (- 9 lamp)
+ AS	Locks + AS1
+ AS1	+ CO
+ CO	- WS
- WS	+ S-1 (SEL)
+ S-1 (SEL)	+ AH
+ AH	Locks - AS
- AS	- ZS - AS1 (slow release)

The AS1 is slow release to permit the select magnet of the lower sender subgrp. to release before the hold magnets operate when advancing from one subgrp. to the next.

- ZS	S-1 locks (SEL) - S-0 (SEL) - 0
- AS1	- CO + HO & HOA (HLD)
- 0	- AO, BO, SMO - 0 lamp (horiz.ind.)
- CO	+ 1

+ HO (HLD)	+ X PTS
+ HOA (HLD)	+ X PTS + U-O + AV
+ 1	Locks + 1 lamp + A1, B1, SM1
+ U-O	+ O lamp
+ AV	Locks HO & HOA lock (HLD) + C (0106) + ZH
+ ZH	- RLN

END OF CYCLE

The TST is now connected to the first sender of the second subgrp. The TST will continue to test and advance from sender to sender and subgrp. to subgrp. until the last sender in the last subgrp. has been tested. When the Hold Mag. #9 releases on the last sender the EC relay is operated which halts the TST with the EC lamp lit. Releasing the ST key and momentarily operating the RN key will restore the test circuit.

"B" SENDER TEST

(SPL key)

For the following test call consider the OA^{B} key operated, together with numerical keys 1379.

When the connector circuit of the TST connects to a BS, circuit action through the sender group test circuit is essentially the same as on connection to a TS. However, since the G terminal of the connector crossbar switch is connected to the BS lead, the BS relay (0106) will operate instead of the TS relay. Since there is no EF relay in the BS the operated BS closes a shunt around the contacts of the EF TST cancelling the test of the EF lead. The cross check of the CO lead, made on TS when the GE operates, is also cancelled since the CO lead of a BS normally has bat. on it. Also, the operation of the CI TST (0106) operates the TS relay in the BS which opens the leads to the "B" positions. Bat. on the H lead from the TST will then operate the DT BS preventing Pos. Hunt and advancing the BS to await trunk closure. As the BS advances bat. on the K1 lead from the BS will operate the CT TST which will be locked to ON Grd (when the C (0110) operates), at the same time making a non-operate test of the RO BS. If the RO BS operates falsely the TST will block when checking registration.

When the sender group test circuit has completed its functions it operates the C(0103) as before, causing the Sen Grp Tst cct. to release; and operating the C relay in the Key Pulsing Test cct. (0110).

+ C (0110)	¢ Grd to ON lead
	+ D Lamp
	+ C1 (0110)
	+ G (0110)
	+ C (0112)
+ C1 (0110)	Locks
	+ D (0110) (TC1 BS does not operate)

+ D (0110)	Locks
	+ CO
	- D Lamp
	+ CO Lamp (If CO lead is open)
	+ TC1 BS
+ CO	+ TC lamp

The operation of the TC1 in the BS causes the BS to advance and close through the T1, R1, K2, and K3 leads to the TST. The CT TST has been operated so bat. on the T1 lead and grd on the R1 lead from the BS will now operate the CT1 relay.

CHECK OF REGISTRATION LEADS

+ CT1	+ CT2
	+ RC Lamp
+ CT2	Locks
	+ CT3

False grd on the K2 lead would have operated the X relay, preventing the operation of the CT3 and blocking the TST.

+ CT3	Locks
	- CT Lamp
	+ K Lamp
	- DT BS
	¢ bat. to K1 and K2 leads

The release of the DT BS and the connection of bat. to the K1 and K2 leads causes the BS to function to prepare for registration and return bat. over the K3 lead operating the K relay.

+ K	Locks
	+ AB
	+ AB1

+ AB	Locks
	+ TRA and TR1
+ AB1	+ OAB Lamp
+ TRA	Locks
	+ TRB and TR2
+ TRB	Locks
	+ TRC and TR3
+ TRC	Locks
	+ TRD and TR4
+ TRD	Locks
+ TR4	+ K1
+ K1	Locks
	+ K2
+ K2	- Bat to K1 and K2 leads
	+ KP1, KP2, KP3, KP4 (Note later)

The release of bat. to the K1 and K2 leads causes the BS to function and remove bat. from the K3 lead releasing the K relay TST.

- K	+ K3
+ K3	- K Lamp
	+ RR Lamp
	∅ K1, K2, K3 leads from BS to numerical keys
	+ KP5 (when KP4 operates)

If the check of the K leads fails to function properly the TST will block with the K lamp lit.

REGISTRATION AND REGISTER RESET

+ KP5	Locks (KP6 shunted)
+ KP1	- KP2, KP3, KP4, KP1 (shunted)

The KP1 is a condenser timed relay controlling the interrupter circuit, consisting of the KP1 to KP6 relays, so as to provide a definite closed period for operating the register relays in the BS. Pulses of approximately .050 sec. closed and .040 sec. open are furnished when the SKP key is normal, and approximately .250 sec. closed and .250 sec. open when the SKP key is operated. The slower key pulses are used to detect certain troubles in the sender steering relays and in making non-operate tests of the sender register marginal relays.

- KP4	+ KP6
+ KP6	Prepares shunt path for AB
	Prepares operate path for Off Registration
- KP1	+ KP2, KP3, KP4, KP1
+ KP2	¢ bat to T1 and R1 leads through CT1 wdg (Registers Off "A" in BS)
+ KP4	AB1 locks
	- AB (shunted)
+ KP1	- KP2, KP3, KP4, KP1
- KP2	- bat to T1 and R1 leads
- KP4	- AB1
- AB1	- OAB Lamp
	+ TH Lamp
	¢ TH and TH1 leads from numerical keys to pulsing cct.
- KP1	+ KP2, KP3, KP4, KP1
+ KP2	¢ 105^W resist bat to K3 lead to BS (+ TH3 BS)
+ KP3	¢ 115^W resist bat to K1 lead to BS (+ TH1 and TH4 BS)
+ KP4	TR1 locks
	- TRA

+ KP1	- KP2, KP3, KP4, KP1
- KP2, KP3	Allows BS to advance to next registration
- KP4	- TR1
- TR1	- TH Lamp
	+ H Lamp
	¢ H and H1 leads to pulsing cct.
- KP1	+ KP2, KP3, KP4, KP1
+ KP2	¢ 108^{W} resist bat. to K3 lead (+ H3 BS)
+ KP3	¢ 115^{W} resist bat. to K2 lead (+ H1, H2, H4 BS)
+ KP4	TR2 Locks
	- TRB
+ KP1	- KP2, KP3, KP4, KP1
- KP2, KP3	Advances BS
- KP4	- TR2
- TR2	- H Lamp
	+ T Lamp
	¢ T and T1 leads to pulsing cct.
- KP1	+ KP2, KP3, KP4, KP1
+ KP3	¢ 615^{W} resist bat. to K1 lead (+ T1 BS)

The K3 lead is left open to permit an operate test of the K3 relay BS on its secondary wdg.

+ KP4	TR3 locks
	- TRC
+ KP1	- KP2, KP3, KP4, KP1
- KP3	Advances BS
- KP4	- TR3
- TR3	- T Lamp
	+ U Lamp
	¢ RR wdg to pulsing cct.
- KP1	+ KP2, KP3, KP4, KP1
+ KP3	+ RR

+ KP4	TR4 locks
	- TRD
+ KP1	- KP2, KP3, KP4, KP1
- KP4	- TR4
- TR4	- U Lamp
	- KP5, KP6
	Stops pulsing
+ RR	Locks
	- K1
	- K2
- K1	- one hold path to K3
- K2	¢ bat to K1 and K2 leads (See note)
	- K3

NOTE: Bat. on the K1 and K2 leads will cause the BS to function and release the register relays that were operated during the registration just described. When the BS relays have released and the sender is again ready for registration, battery through a resistance is again connected to the K3 lead from the BS.

- K3	+ RR1
	+ K Lamp
	- RR Lamp
+ RR1	Locks
	- RR
	¢ U and U1 leads to transfer cct.
- RR	+ K

REGISTRATION

The test cct. is now in the same condition as it was on the previous operation of the K relay, except that the RR1 is now operated. Circuit action will be the same through the completion of tens registration to the release of the TR3.

- TR3	- T Lamp
	+ U Lamp
	¢ U and U1 leads to pulsing cct.
- KP1	+ KP2, KP3, KP4, KP1
+ KP2	¢ 495^W resist bat to K3 lead
+ KP3	¢ 476^W resist bat to K2 lead (+U1, U2 BS)
+ KP4	TR4 locks
	- TRD
+ KP1	- KP2, KP3, KP4, KP1
- KP2, KP3	Advances BS
- KP4	- TR4
- TR4	- U Lamp
	- KP5
	- KP6
	Halts pulsing

SENDER REGISTER RELAY MARGINAL TESTS

The sender register relays are tested to insure meeting their operate and non-operate conditions imposed in service. The operation of the numerical keys 0 to 4 inclusive, and keys 6 and 8, imposes operate test conditions on the sender register relays. The #9 keys when operated impose non-operate test conditions on the sender marginal relays. These non-operate tests should be made with slow key pulses (SKP key operated). The #7 key imposes an operate test on the BS K3 relay on its secondary wdg. and the #5 key imposes an operate test on its pri. wdg.

REGISTRATION COMPLETED

Registration having been completed the BS function to open up the T and R leads releasing the CT1 relay which extinguishes the RC lamp. The BS will also connect to a TM, which in turn will be connected to the TST Register Check Cct. Circuit action, including check of the registration and release of the TST or advance to the next sender, will be the same as on a test of a TS.

TEST OF ORDER TONE CIRCUIT

When it is desired to check the order tone circuit and transmission circuit of the BS, the TT key is operated which allows the BS to function and pick an idle occupied position cct.

+ TT Key	- % path TS BS
	¢ T & R leads of TST Tel cct. to T&R of BS
	- % path which sets up Register Transfer cct.
	Make PT key ineffective
	+ TP
+ TP	+ P Lamp

Since the TS BS is normal the H, T1, R1, K1, K2, and K3 leads from the BS to the TST will be open, and the BS will hunt and pick an idle occupied position as on a regular call. When the BS has found a position the T and R leads from the position will be extended through the BS to the TST tel. cct. This enables the test man to check the quality of the order tone and transmission.

With the test cct. in this condition the test man may request the "B" operator to operate keys or perform any function which she normally does on a regular service call. The operation of the position PD key by the operator may be used to test the reorder feature of the BS. The numerical keys in the test circuit should be operated corresponding to the number keyed at the position. If the position PD key is to be operated, the #5 numerical key should be operated on the TST for those digits not transmitted from the position. Also the RO key should be operated to check the reorder feature of the BS. The PTS key should also be operated to pass the TS's if senders are being tested on a routine basis.

"B" POSITION CIRCUIT TEST

When it is desired to test a position circuit the test is made by two testmen, one located at the "B" pos. to be tested and the other at the test frame. The "B" pos. ccts. are tested by the TST in connection with a BS. For this reason a sender should be selected and then, with the REP key operated, routined to assure satisfactory operation. After the BS has been routined, the TP key is operated. This key may be operated as the TST is progressing in its routine test of the BS. If the TP key is operated before the CT2 relay operates, then the next operation of the CT1 relay operates the TP. However, if the TP key is operated after the CT2 relay operates the routine test in progress is completed and a new test started. During this new test the operation of the CT1 operates the TP.

+ TP	+ P Lamp
	X K1, K2, K3 leads to TR contacts
	- % path which sets up Register Transfer Cct.
	+ CT3

The TST is connected to the "B" pos. to be tested through a 206 type selector by the operation of the PP key and a dial, as follows:

+ PP key	¢ Grd to dial
+ Dial contacts	+ DO
+ DO	+ STEP (S)
- Dial contacts	- DO
- DO	- STEP (S)
- STEP (S)	Steps selector one position

The dial is operated so as to transmit the number of pulses necessary to advance the selector to the position desired. When the desired position is reached, the PP key is released and the PT key is operated. The operated PT key operates the PT relay.

+ PT	+ PD1 Lamp
	+ PD2 Lamp
	+ PB Lamp
	¢ PT1 wdgs to H lead

When the testman at the "B" pos. plugs a telephone set into the tel. jacks of the pos., 270^W bat. will be connected to the H lead, operating the PT1 relay. The PT1 will not operate if the H lead resistance to bat. is greater than approx. 350 ohms, or if the 270^W bat. is shunted by a false grd. to approx. 100 ohms or less

+ PT1	- PB Lamp
	+ PT2
+ PT2	Locks
	¢ bat. through PD wdg to K1 lead

Bat. on the K1 lead will cause a relay in the Pos. cct. to operate and the LK lamp at the pos. to flash. The PD is marginal and does not operate at this time.

POSITION DISCONNECT TEST

When the PD key on the TST is normal it will be necessary for the "B" pos. PD key to be operated twice. The first operation causes the following circuit action:

+ PD key (B Pos)	+ PD TST
+ PD	+ PD1
+ PD1	Locks (PD1 shunted by PD)
	- PD1 Lamp
- PD Key (B Pos)	- PD
- PD	+ PD2
+ PD2	¢ Bat and grd. to T and R leads to pos. cct.

Bat. and grd. on the T and R leads to the pos. cct. operates the T relay in the pos. cct. which lights the S lamp at the pos. and also causes the pos. cct. to function and transmit order tone over the T and R leads, after which the circuit for transmitting speech is established between the "B" pos. and the TST. The operation of the T in the pos. cct. also removes bat. from the H lead releasing the PT1 relay. Bat. and grd. through the wdgs. of the PT1 relay remain connected to the H lead and if a false bat. should be connected to this lead the PT1 relay will operate and the TST will block with the PD2 lamp lit.

When the S lamp lights at the "B" pos. the testman again depresses the pos. PD key.

+ PD key (B Pos.)	+ OBP
+ OBP	+ OB
+ OB	Locks (OP shunted)
	+ OB Lamp
- PD key (B Pos.)	- OBP
- OBP	+ OP
+ OP	+ TR

Instead of operating the Pos. PD key the second time the testman may remove the operator's plug momentarily to test the ability of the position to send a PD signal in this manner. The circuit operation in the TST is the same in either case.

CANCELLING PD TEST

The PD key in the TST may be operated to eliminate the operations of the PD key in the Pos. Cct. as follows:

+ PD key TST	+ PD1 and PD2
+ PD2	Pos. Cct. functions - PT1

- PT1	+ OP
+ OP	+ TR

REGISTRATION

+ TR	Locks
	- PD2 Lamp
	∅ K1, K2, K3 leads from "B" pos. to BS

Closing the K1, K2, and K3 leads through causes the "B" pos. cct. and the BS to advance and prepare for registration. When ready the S lamp at the Pos. is extinguished. The testman at the "B" pos. may then operate one of the office keys as requested by the testman at the TST. For office "A" circuit action is as follows:

+ OFF "A" Key (B Pos.)	∅ bat. to T and R leads + OAP
+ OAP	∅ bat. to T1 and R1 leads to BS

The number corresponding to that set up on the TST numerical keys is now set up by the testman at the "B" pos. At any time before the units digit has been pulsed, the "B" pos. RS key may be operated to test this feature. When the last digit has been recorded in the BS, the BS connects to a TM which in turn connects to the register check cct. of the TST. Registration check is made as on a regular test of the BS, and the test circuit and BS then advance to normal. Since the time out cct. on the BS will function and round its minor alarm in 30 to 60 seconds from the time it is seized, all the digits should be keyed in less than this time. The test cct. and BS will then advance and prepare for registration again. However, the "B" pos. cct. must be released by operating the PR key causing cct. action as follows:

+ PR key	- T B Pos (Causes pos. cct. to restore)
	- PD1 and PD2
	- PT2
	- OA or OB - OA or OB Lamp
	- OP
	- TR

With these relays released and bat. again connected to the H lead, the PT1 relay reoperates, and when the PR key is released the TST and Pos. Cct. function as previously described.

T.S.T. LAMPS

TESTS OF FULL SELECTOR TERMINATING SENDERS

A - Regular Call Test

B - Special Call Test

C - Tell-tale Test

D - Trouble Release By Link

E - Trouble Release By Marker

F - Trunk Disconnect

G - Time Out Test

H - Non-operate Test Of L Relay

TESTS OF "B" TERMINATING SENDERS

J - Regular Call Test

K - Special Call Test

L - Trouble Release by Link

M - Trouble Release by Marker

N - Trunk Disconnect

O - Time Out Test

P - Test of Order Tone and Transmission Circuit

Q - Test of Reorder Feature of Sender

TABLE 1

Failure Indications

Lamps lighted in addition to TA lamp

(see note 1)

Tests of full selector terminating senders.

Lamps Lighted	Test	Failure Indicated
BY	A to H	Sender busy
GB	A to H	Sender sub-group busy
SEL	A to H	Failure of link S relay to operate
CH	A to H	Failure of link S relay to open ground chain
CH1	A to H	Failure of link S relay to open battery chain
EF	A to H	EF lead open
RL	A to C, E to H	Failure of sender to ground RL lead
SPF	D	Sender grounds RL lead falsely
SPF	A to C, E to H	Failure to advance preference lead
X	A to C, E to H	Premature advance of preference lead or cross on SC relay contacts
MGB	A to H	Sender sub-group held busy by test circuit
S	A to C, E to H	Sender fails to ground S lead
CO	A to C, E to H	Sender fails to ground CO lead
IB	A, B, E, F, H	Sender fails to register incoming brush
IG	A, B, E, F, H	Sender fails to register incoming group
FB	A, B, E, F, H	Sender fails to register final brush
FT	A, B, E, F, H	Sender fails to register final tens
FU	A, B, E, F, H	Sender fails to register final units
RB	A, B, E, F, H	Sender fails to transmit satisfactory reverse battery closure
TC	A, B, E, H	Sender fails to seize marker
D	A to C, G, H	Sender fails to ground D lead
D	F	Failure of premature disconnect feature of sender
TH	A, B, H	Failure to transmit thousands correctly to marker
H	A, B, H	Failure to transmit hundreds correctly to marker
T	A, B, H	Failure to transmit tens correctly to marker
U	A, B, H	Failure to transmit units correctly to marker
F or F10	A, B, H	Failure to transmit frame correctly to marker

Lamps Lighted	Test	Failure Indicated
TRL	E	Failure to release on trouble release from marker
S	C	Premature removal of ground from S lead
RB	C	Failure to recognize tell-tale condition
RB	G	Failure to time out
RB	H	False operate of L relay on non-operate test

TESTS OF "B" SENDERS

Lamps Lighted	Test	Failure Indicated
BY	J to Q	Sender busy
GB	J to Q	Sender sub-group busy
SEL	J to Q	Failure of link S relay to operate
CH	J to Q	Failure of link S relay to open ground chain
CH1	J to Q	Failure of link S relay to open battery chain
RL	J, K, M to Q	Failure of sender to ground RL lead
SPF	L	Sender grounds RL lead falsely
SPF	J, K, M to Q	Failure to advance preference lead
X	J, K, M to Q	Premature advance of preference lead or cross on SC relay contacts
MGB	J to Q	Sender sub-group held busy by test circuit
S	J, K, M to Q	Sender fails to ground S lead
D	J, K, M, O to Q	Sender fails to ground D lead
CO	J, K, M, O to Q	Sender fails to ground CO lead
CT	J, K, M, O to Q	Sender fails to close talking circuit
K	J, K, M, O to Q	K lead conditions incorrect
RC	J, K, M, P, Q	Failure to complete registration
D	N	Failure of premature disconnect feature of sender
TH	O	Failure of sender to time out
TC	J, K, M, P, Q	Failure to seize marker
P	P	Failure to seize marker
TH	J, K, P, Q	Failure to transmit thousands correctly to marker
H	J, K, P, Q	Failure to transmit hundreds correctly to marker
T	J, K, P, Q	Failure to transmit tens correctly to marker
U	J, K, P, Q	Failure to transmit units correctly to marker
F or F10	J, K, P, Q	Failure to transmit frame correctly to marker
RO	Q	Failure to transmit reorder correctly to marker
TRL	M	Failure to release on trouble release by marker

NOTE 1: The TA lamp does not light when the test circuit blocks on tests G and O.

MF Term Sw

RC-H-O Mill to Relay

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CROSSBAR SYSTEMS
NO. 1
TERMINATING SENDER TEST

CHANGES

D. Description of Changes

D.1 Options TV and TW are added to Fig. 3, sheet -0106A.

D.2 Sheet 0101:

Options TV and TW are added to Options Used Table.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5243-ABVL

WE DEPT 367-DJF-EER-JF

CROSSBAR SYSTEMS
NO. 1
TERMINATING SENDER TEST

CHANGES

D. Description of Changes

D.1 On sheet -0102 Note 106 made Mfr Disc.

D.2 Note 138 added on sheet -0102.

D.3 References to Note 106 on sheet -0102 changed to Note 138.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5144-UKS

WECo DEPT 335-JRF-PKP-JF

CROSSBAR SYSTEMS
NO. 1
TERMINATING SENDER TEST

CHANGES

D. Description of Changes

D.1 Option TT added to Fig. 3, sheet -0106A.

D.2 Lead NSG connected to 11 top CI1 relay through TM option.

D.3 Note 122 modified on sheet -0106B.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5144-UKS

WECo DEPT 335-JRF-PKP-JF

KEY SHEET SECTION -0101
CROSSBAR SYSTEMS
NO. 1
TERMINATING SENDER TEST

CHANGES

D. Description of Changes

D.1 Units on which changes have been made:

KEY SHEET	0101
MF PULSING TEST CIRCUIT	0118

D.2 Sheet 0101:

Options TR and TS are added to the options used table.

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CIRCUIT UNIT - SECTION -0118
MF PULSING TEST CIRCUIT

D. Description of Changes

D.1 A minor wiring change, incorporating options TR and TS, is made in Fig. 8.

D.2 Note 105 is modified and Note 116 is added to reflect the above change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5615-PHS-DAJ-EB

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101

KEY SHEET SECTION -0101
CROSSBAR SYSTEMS
NO. 1
TERMINATING SENDER TEST

CHANGES

D. Description of Changes

D.1 Units on which changes have been made:

Key Sheet	0101
Connector Circuit	0102
Group Test Circuit	0106
Revertive Pulsing Test Circuit	0108

D.2 Sheet 0101:

Option TQ is added to the options used table.

CIRCUIT UNIT - SECTION -0102
CONNECTOR CIRCUIT

D. Description of Changes

D.1 A minor wiring change is made in Fig. 1.

D.2 The NSO and NS1 leads in Fig. 2 are rerouted to the group test circuit instead of the revertive pulsing test circuit reflecting changes in these circuits.

AK
99

CIRCUIT UNIT - SECTION -0106
GROUP TEST CIRCUIT

B. Changes in Apparatus

B.1 Added:

X5 Relay - coded U177 - Option TM - Fig. 3

D. Description of Changes

D.1 The X5 relay is added to Fig. 3 under TM option.

D.2 Circuit Note 109 is modified and Circuit Note 122 is added to reflect the above changes.

CIRCUIT UNIT - SECTION -0108
REVERTIVE PULSING TEST CIRCUIT

D. Description of Changes

D.1 Minor wiring changes are made in Fig. 4, C, D, and E.

D.2 The TQ optional wiring is added to Fig. 4 and made mutually exclusive with option TM.

D.3 Circuit Note 105 and 106 are modified to reflect the above changes.

D.4 CAD Fig. 72, 73, and 74 are modified to reflect the above changes.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5615-PHS-DAJ-EB

AK
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KEY SHEET SECTION -0101
CROSSBAR SYSTEMS
NO. 1
TERMINATING SENDER TEST

CHANGES

D. Description of Changes

D.1 Units on which changes have been made:

Key Sheet	0101
Connector Circuit	0102
Group Test	0106
Revertive Pulsing Test Circuit	0108
Register Check	0114

D.2 Sheet 0101

Options "TK", "TL", "TM", "TN", "TO", and "TP"; and Fig. BM, BN, BO, and BP are added to the options used table.

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AK
96

CIRCUIT UNIT - SECTION - 0102
CONNECTOR CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Added

DO-9 Relays - 5 AK24 - Option "TL" - -SH-0102

D. Description of Changes

D.1 Leads "NSO" and "NS1" are added to sheet -0102 under "TM" option from the revertive pulsing test circuit to the terminating senders. Relays DO-9 are added, parallel to their respective A- relays to provide the contacts needed for the new leads.

D.2 Option "TM" is added to note 116.

D.3 Circuit Note 137 is added to reflect the above changes.

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CIRCUIT UNIT - SECTION -0106
GROUP TEST

CHANGES

D. Description of Changes

D.1 Figure 3, sheet -0106, location G18, is changed so that leads "F" and "FA" connect to Fig. BM or BN in the register check circuit rather than to Fig. 6. This reflects changes made in the register check circuit.

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CIRCUIT UNIT - SECTION -0108
REVERTIVE PULSING TEST CIRCUIT

CHANGES

A. Changed and Added Functions

A.1 A feature is added to allow for testing of DP and MF terminating senders arranged for DID operation and FS terminating senders using either OB and OG selections or dedicated DID trunk group indications to generate DID number series.

B. Changes in Apparatus

B.1 Added

OG Relay - 1/2AK30 - Opt "TL" - Sheet -0108

OG' Relay - 1/2AK30 - Opt "TL" - Sheet -0108

OB1 Relay - 1/2AK30 - Opt "TL" - Sheet -0108

OB1' Relay - 1/2AK30 - Opt "TL" - Sheet -0108

OG Lamp - M1 - Opt "TL" - Sheet -0108

OB1 Lamp - M1 - Opt "TL" - Sheet -0108

OI Keys - E1CL - Opt "TO" - Sheet -0109

DD Key - 592A - Opt "TM" - Sheet -0108

NS Keys - E1CL - Opt "TL" - Sheet -0109 or -0110

MF11 Relay - U333 - Opt "TP" - Sheet -0109 or -0110

D. Description of Changes

D.1 The OG, OG', OB1, and OB1' relays are added to Fig. 4, sheet -0108, under "TL" option.

D.2 The OG and OB1 lamps are added to Fig. 4, sheet -0108, under "TL" option.

D.3 The DD key is added to Fig. 4, sheet -0108, under "TM" option.

D.4 The "TK" optional wiring is added to Fig. 4, sheet -0108, to show wiring when "TL" option is not provided.

D.5 The OI keysaare added to Fig. C, sheet -0109, under "TO" option.

D.6 The NS keys are added to Fig. C and E, sheet -0109, under "TL" option.

D.7 The NS keys are added to Fig. D, sheet -0110, under "TL" option.

D.8 Figures C and E, sheet -0109, locations I4 and I9 respectively are changed to show that leads to the register check circuit go to Fig. BM or BN instead of Fig. 6.

D.9 Figure D, sheet -0110, location I11 is changed to show that leads to the register check circuit go to Fig. BM or BN instead of Fig. 6.

D.10 The MF11 relay is added to Fig. E, sheet -0109, under "TP" option.

D.11 The "TN" optional wiring is added to Fig. E, sheet -0109 to show wiring when "TP" option is not provided.

D.12 The MF11 relay is added to Fig. D, sheet -0110, under "TP" option.

D.13 The "TN" optional wiring is added to Fig. D, sheet -0110, to show wiring when "TP" option is not provided.

D.14 The circuit requirements table, sheet -0111 is modified to show reference to relays OB1, OB1', OG, OG', and MF11.

D.15 Circuit Notes 105 and 106 are modified and Circuit Notes 120 and 121 are added to reflect the above changes.

D.16 CAD Fig. 73 and 74, sheet -0105, and Fig. 72, sheet -0120 are added to reflect the above changes.

F. Changes in Description of Operation or Changes in CD Sections

F.1 Add 2.121 after 2.12.

2.121 To test for DID operation using either OB and OG selections or dedicated DID trunk group indications to generate DID number series.

F.2 Add 3.351 after 3.35.

3.351 The DD key, when operated, grounds the "NS1" lead to the FS terminating sender to test dedicated DID trunk group indications.

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F.3 Change the first sentence of 3.42 to read:

The IB, IG, FB, FT and FU lamps, and the OB1 and OG lamps when provided, indicate which selection is next to be registered in the sender.

F.4 In 5.2, remove the last sentence and add the following:

When "TK" option is provided or on a non-DID test when "TL" option is provided, the operation of relay C operates relay IB. The IB operated operates relay CO1 which opens a shunt ground path and allows IB' to operate in series with IB. Relay IB' operates DP2 through an operated DP1 contact directly with Fig. G, or after RV3 operates with Fig. AX. On a DID test, when "TL" option is provided, the operation of relay C operates the OB1 relay which in turn operates relay CO1. Relay CO1 removes a shunt ground allowing OB1' to operate in series with OB1. Relay OB1 operates the DP2 relay in the same manner as the IB' did above.

F.5 In 6.1, remove the last sentence and add the following:

The C relay also operates the IB relay on a non-DID test or the OB1 on a DID test.

F.6 In 7.1, change the first sentence to read:

The C1 relay operated, closes the "CO" lead to the CO1 relay through relay IB or relay OB1 operated.

F.7 Change the beginning of the third sentence of 8.1 to the following:

With "TK" option or on a non-DID test with "TL" option, when the C relay operates...

F.8 In 8.1 remove the last two sentences and add the following:

On a DID test with option "TL" provided, the registration proceeds in a similar manner except that the C relay first operates the OB1 relay instead of the IB. The CO1 in operating, operates the OB1' instead of the IB'. The counting relay corresponding to the operated OI key is first operated. After proceeding as above, the sender prepares itself for the next registration which is "Office Group". The OG relay operates the OG lamp and releases the OB1' relay extinguishing the OB1 lamp. The registration again proceeds as above except that counting relay 4 is always operated irregardless of any operated keys. After completing the OG registration the test circuit continues with incoming brush, incoming group, final brush, final tens, and final units in the manner described for the non-DID test.

If for any reason any selection does not progress properly due to trouble in the test circuit or sender, the test will block. If the sender recorded the registration incorrectly, the test will block at the time the sender registration is checked by the register check feature of the test circuit.

F.9 In 8.3, remove the third and fourth sentences and add the following in their place:

When the C relay operates, ground through the back contact of relay CO1 operates relay IB, or relay OB1 on a DID test, closing the operating circuit for the CO1 relay. When relay CO1 operates, it permits the operation of relay IB' in series with relay IB on a non-DID test, and it permits the operation of relay OB1' in series with relay OB1 on a DID test. Relay IB or relay OB1' operated operates relay DP2.

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CIRCUIT UNIT - SECTION -0114
REGISTER CHECK CIRCUIT

CHANGES

A. Changed and Added Functions

A.1 A feature is added to allow for checking the registration of office brush and office group selections in senders arranged for DID operation.

B. Changes in Apparatus

B.1 Added

NSO Relay - 1/2AK4 - Option "TL" - Sheet -0114

NS1 Relay - 1/2AK4 - Option "TL" - Sheet -0114

NS2 Relay - AF30 - Option "TL" - Sheet -0114

NS4 Relay - AF30 - Option "TL" - Sheet -0114

NSA Relay - 1/2AK8 - Option "TL" - Sheet -0114

NSB Relay - 1/2AK8 - Option "TL" - Sheet -0114

LUE Relay - U236 - Option "TL" - Sheet -0114

DID Relay - AF134 - Option "TL" - Sheet -0114

NS Lamp - M1 - Option "TL" - Sheet -0114

B.2 Replaced

THA Relay - U113 - Fig. BO - Sheet -0114

G Relay - U223 - Fig. BM - Sheet -0114

Replaced By

THA Relay - AF115 - Fig. BP - Sheet -0114

G Relay - AF83 - Fig. BN - Sheet -0114

D. Description of Changes

D.1 The NSO, NS1, NS2, NS4, NSA, NSB, LUE, and DID relays are added to Fig. 6, sheet -0114, under "TL" option.

D.2 Relay G is broken out of Fig. 6 and its code is changed such that it appears in Fig. BN, sheet -0114, furnished with "TL" option, and Fig. BM, sheet -0114, furnished with "TK" option.

D.3 Relay THA is broken out of Fig. 6 and its code is changed such that it appears in Fig. BP, sheet -0114, furnished with "TL" option, and Fig. BO, sheet -0114, furnished with "TK" option.

D.4 The NS lamp is added to Fig. 6, sheet -0114, under "TL" option.

D.5 The "TK" optional wiring is added to Fig. 6, sheet -0114, to show wiring when "TL" option is not provided.

D.6 The circuit requirements table, sheet -0115, is modified to show reference to relays NSO, NS1, NS2, NS4, NSA, NSB, LUE, DID, and the new codes for relays THA and G.

D.7 Circuit Note 106 is modified and Circuit Notes 108 and 109 are added to reflect the above changes.

F. Changes in Description of Operation or Changes in CD Sections

F.1 Change the first sentence of 3.4 to read:

To check the registration against the setting of the numerical keys, the frame keys, the RO key, and the NS keys when provided.

F.2 Change the seventh sentence of 7 to read:

With the CK4 relay operated and the rest of the CK- relays released, a circuit is closed to operate the LU relay which in turn operates the LUA, LUB, and LUC relays, and the LUD and LUE relays when provided.

F.3 Add to the end of the last sentence in 7 the following:

...on a non-DID test or the NSA relay on a DID test.

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F.4 Add the following to the end of the last sentence of 7:

...on a non-DID test of the NS lamp on a DID test.

F.5 Add at the beginning of 9:

On a DID test, the registration of the number series digit on the NSO, NS1, NS2, and NS4 relays is checked against the setting of the NS keys before the thousands digit is checked. The NSA relay operated, connects ground through the contacts of the NS- relays to one of the circle leads numbered "2-6". The number series check is made as described for the thousands digit in 8 except that the NS- relays and the NS row of keys are involved. If the check is satisfactory, the NSB relay operates and locks to extinguish the NS lamp, light the TH lamp, and operate the THA relay. The thousands digit is then checked as described in 8. On a non-DID call, the NS check is omitted and the registration of the thousands digit is first to be checked.

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KEY SHEET SECTION - 0101
CROSSBAR SYSTEMS
NO.1
TERMINATING SENDER TEST

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Units on which changes have been made:

Key Sheet	0101
Connector Circuit	0102
Group Test	0106
MF Pulsing Test Circuit	0118

D.2 Sheet 0101

Option "TJ" is added to the options used table.

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CIRCUIT UNIT - SECTION - 0102
CONNECTOR CIRCUIT

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Sheet 0102

D.11 "Record of Wiring" table (Note 116) is changed to include option "TJ".

D.12 On issue 55D a change was made on the connector circuit to prevent the test circuit from selecting a busy B or MF sender. This change was shown as option "TD" superseding option "TC". However, in the record note 116, both options "TC" and "TD" were rated "AT&TCo Std". The WECo drawings have been changed to show "TD" as "AT&TCo Std" and "TC" as "Mfr Disc." This change is made to show option "TC" rated "Mfr Disc." to agree with WECo drawings.

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CIRCUIT UNIT - SECTION - 0106
GROUP TEST

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Sheet 0106 - Figure 3

D.11 "Record of Wiring" table (Note 109) is changed to include option "TJ".

D.12 On issue 56D a change was made to permit the test circuit to function with the terminating sender link and control circuit with the reserve test feature removed. This involved removing the REG relay of the control unit. Prior to this change the REG and RES relays were designated as option "YU" and "YV". Option "YU" was previously rated "Mfr Disc." The change as shown could not be applied to the "YU" apparatus since the "YU"(REG) relay could not be removed without removing the "YU"(RES) relay. A change is made to correct this condition by replacing option "YU" on the REG relay with option "TJ" and replacing "TI" option wiring with "TG" option wiring. "TJ" option is rated "Mfr Disc." "TG" option was rated "Mfr Disc." on issue 56D.

D.13 Option "TJ" is added to note 114.

D.2 Sheet 0107

D.21 Option "TJ" is added to note 121.

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CIRCUIT UNIT - SECTION - 0118
MF PULSING TEST CIRCUIT

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Sheet 0118

D.12 Experience in the field has shown that the twist test requirement of 8.25 db specified for the MF receiver, SD-95536-01, imposes a severe requirement on this receiver. Laboratory tests have shown that 6.25 ± 0.25 db twist test requirement is satisfactory. This change establishes a uniform requirement for testing the twist capability of MF receivers in all types of offices.

D.13 On the next reissue of the CD change the paragraph for test #5 (Section 19) to read as follows:

After - - -" frequency 6.25 ± .25 db" - - - delete - - - "V" and "UX" option or 8.25 ± .25 db "UY" option - - - and continue - - -" below that of the 700 cycle frequency".

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KEY SHEET SECTION -0101
CROSSBAR SYSTEMS
NO. 1
TERMINATING SENDER TEST

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Units on which changes have been made

Key Sheet	0101
Connector Circuit	0102
Group Test	0106

D.2 Sheet 0101

Options "TG", "TH" and "TI are added to the Options Used table.

All other headings, no change.

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CIRCUIT UNIT - SECTION -0102
CONNECTOR CIRCUIT

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Sheet 0102

D.11 Option "TG" is added to Figures 2 and K.

D.12 Option "TG" is added to the "Record of Wiring" Table (Note 116).

D.13 Note 136 is added.

All other headings, no change.

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CIRCUIT UNIT - SECTION -0106
GROUP TEST

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Sheet 0106 - Figures 3 and L.

D.11 Options "TG" and "TI" show the circuit prior to this issue.

D.12 Option "TH" is used when the reserve sender test feature is removed from the terminating sender links and controller circuit.

D.2 Sheet 0107

D.21 Notes 120 and 121 are added.

On the next reissue, paragraph 8.1 will be charged as follows. If the sender group is idle and more than one sender is available, the (REG) relay "TG" option, will operate. With the (REG) relay, "TG" option if provided and the (RES) relay operated the (SID2) released, the (GE) relay operates. The (GE) relay operated locks under control of the (SID) relay, extinguishes the (GB) lamp, lights the (SEL) lamp and operates the (CI) and (CI1) relays. When "TG" option is provided, the (LT) key is operated during light load periods to make effective the check of the regular testing leads "TA", "TB", "TD" or "TT". Fig. L includes etc.....

All other headings, no change.

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KEY SHEET SECTION -0101
CROSSBAR SYSTEMS
NO. 1
TERMINATING SENDER TEST

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Units on Which Changes Have Been Made.

Key Sheet	0101
Connector Circuit	0102
Group Test	0106
Revertive Pulsing Test Circuit	0108

D.2 Sheet -0101

Options "TA," "TB," "TC," "TD," "TE" and "TF" are added to the "Options Used" Table.

All other headings under Changes, no change.

1. PURPOSE OF KEY SHEET

The purpose of this key sheet is to show the various units of the test circuit and the manner in which they connect to the circuits under tests.

2. PURPOSE OF CIRCUIT

2.1 This circuit provides means for routine testing of MF pulsing terminating senders, noncentral "B" swbd. senders, central "B" switchboard senders (terminating part) and Full Sel. terminating senders of the Crossbar System on an automatic basis. The Dial Pulse Terminating Sender is tested similar to the above except that the sender is primed manually by means of a dial. Registration in the senders is made directly from the test circuit and the proper functioning of the sender is checked by the test circuit. When the test has been completed satisfactorily, the next circuit is seized and tested. The test circuit continues to function automatically until a trouble is encountered or until the end of cycle is reached. Repeat tests can be made in two ways, first, repeat tests can be made continuously on a particular sender or, second, two tests can be made on a sender and then the test circuit is automatically advanced to the next sender and the two tests are made and the test circuit is advanced until all senders under test have been tested twice. The test circuit is connected to the senders by means of crossbar switches, one crossbar switch is necessary for each group of 100 or less senders. Each switch can connect to 10 sender subgroups, each one having a maximum of 10 senders, which may be all MF pulsing, all non-central "B" swbd., all central "B" switchboard senders (terminating part), all Dial Pulse terminating senders, all F.S. terminating senders or some of any two types of these senders except that non-central "B" swbd. senders and central "B" switchboard senders (terminating part) will not be used in the same office to be tested by one test circuit. Each subgroup has a separate horizontal row on the crossbar switch. Connection to the circuit common to a subgroup of senders is obtained by means of a multicontact relay and two or three U type relays. Each multicontact relay and associated U type relays is associated with a horizontal row of the crossbar switch to which row are connected the senders of the subgroup. A particular circuit test can be made. An automatic pass busy feature is provided. The sender being tested can be located by means of lamps, which indicate the position of the sender on the test circuit crossbar switch. There are two alarms, major and minor. The major alarm is used when the test is stuck on a time out while testing common equipment for 10 senders; the minor alarm is used when the test circuit is stuck while testing individual senders.

2.2 This circuit provides means for testing call Distributing "B" Position Circuits in a crossbar office on a manual basis. This part of the test circuit operates in a manner similar to the circuit for testing panel call distributing "B" position circuits and the two test circuits may be used interchangeably, in this respect. Two test men are required for this test, one at the position and one at the test frame. One of the noncentral "B" swbd., senders is selected for use in this test and the position to be tested is selected by means of 206 type selector under control of a dial. The man at the position writes an agreed upon number, or otherwise manipulates position keys causing signal to be passed through the test circuit into the sender. The test circuit checks the registration in the sender and makes certain tests directly on the position circuits. The noncentral "B" Swbd. sender circuits and "B" position circuits must be in the same building at this test circuit.

2.3 This circuit provides means for talking to the central "B" switchboard operator through the "B" switchboard sender (terminating part). Numbers keyed up at the position will be registered in the sender circuit (term. part) and checked by the test circuit. The sender circuit (term. part) and test circuit may not be in the same building as the central "B" switchboard sender (switchboard part).

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CIRCUIT UNIT - SECTION -0102
CONNECTOR CIRCUIT

CHANGES

B. CHANGES IN APPARATUS

B.1 Added

BSY U1235 Relay TD Option

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Sheet 0102.

D.11 Options WA and WB are changed to Option TA and TB. This change is shown without record of prior circuit, as agreed to with the WECo.

D.12 Option WA and WB are removed from the "Record of Wiring" table (Note 116).

D.13 Options TA, TB, TC and TD are added to the "Record of Wiring" table (Note 116).

D.14 Note 135 is added.

D.2 Sheet 0103

D.21 Option "TD" relay. BSY is added to Fig. 1.

D.22 Option "TC" shows the circuit prior to this change.

D.3 Sheet 0104.

D.31 Option "TD" relay BSY is added to the CR table.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit controls the connection of the various units of the test circuit to the senders.

1.2 The class of test to be made on the sender is controlled by the position of the class keys.

1.3 Connection to the senders is made by means of crossbar switches. The selection of each crossbar switch is controlled by relays designated (G-).

1.4 The connecting switches are automatically advanced to all senders in rotation or may be manually advanced to a particular sender.

1.5 One crossbar switch is necessary for each group of 100 or less senders. Each switch can connect to 10 sender subgroups, each subgroup having MF pulsing terminating senders, non-central "B" Swbd. senders, central "B" switchboard senders (terminating part), dial pulse terminating senders or F. S. terminating senders or combinations of two types of these senders. Noncentral "B" swbd. senders and central "B" switchboard senders (terminating part) will not be used in the same office so will not be tested by one test circuit. Each subgroup has a separate horizontal row on the crossbar switch and has one relay of the 5 following groups of relays (0) to (9), (SM0) to (SM9), (SMA0) to (SMA9), (A0) to (A9) and (B0) to (B9).

1.6 Connection to the circuit common to a subgroup of senders is obtained by means of relays (SM0)-(SM9), (SMA0) to (SMA9), (A0)-(A9) and (B0)-(B9) per subgroup. Each set of (SM-), (SMA-), (A-) and (B-) relays is associated with a horizontal row on the crossbar switch to which are connected the individual leads of each of the senders of the subgroup.

1.7 The connector circuit may be controlled to cause the advance from a busy sender after a predetermined interval.

1.8 The connection to the several individual test units is made by means of a number of leads, the closure of which is controlled by the class keys.

2. WORKING LIMITS

2.1 None.

3. FUNCTIONS

3.01 Preparation for Test

The operation of the (ST) start key causes this circuit to seize a sender after which connection is made to the individual control circuit as determined by the setting of the class keys. Means are provided to prevent interference with any sender while the connections are being established.

3.02 Passing Busy Senders

A pass busy feature is provided under control of the (APB) key. The pass busy feature functions after 29 seconds minimum, 59 seconds maximum.

3.03 Alarm and Blocking

An alarm is given after a period of minimum 60 seconds, maximum 90 seconds from the start of the test. The test circuit is blocked when the alarm is given, by opening of the lead which furnishes progress ground for the several control circuit units and also opening the "ADV" lead.

3.04 Registration

Registers are provided to record the number of circuits tested satisfactorily, the number of repeated single tests (not records on the circuits tested meter), and the number of busy senders which are passed without testing.

3.05 Passing Spare Terminals and End of Cycle.

This circuit is arranged to pass by spare terminals on the crossbar switches and be given an alarm indication when all senders have been tested.

3.06 Blocking Time Alarm Feature

If, after a predetermined interval, the test has not been completed, the test circuit blocks and cannot be advanced except by a manual operation. A time alarm (TA) key is furnished which when operated prevents the functionion of the alarm circuit. The connector circuit is prevented from advancing to the next sender when this key is operated.

KEYS

3.07 Start Key (ST)

The operation of this key controls the advance of the connector circuit from normal and when restored causes the test set to complete the test in progress but not to start a new test. The crossbar switch does not restore when the (ST) key is restored.

3.08 Group Keys (G-)

The operation of a (G-) key causes the selection of the associated crossbar switch for connecting to the desired group of senders.

3.09 Particular Circuit Keys (PCR) and (PCS)

These keys are used to advance the crossbar switch to a particular terminal for testing a particular sender.

3.10 Control Advance Key (C..)

The operation and release of this key causes a test to be started on the next sender if the repeat key is normal, or causes a new test to be started on the sender upon which the test circuit is resting if the repeat key is operated.

3.11 Repeat Key (REP)

This key causes the test circuit to test the same sender repeatedly. It is also used to extend the control advance feature to the remote control jack at the sender frames.

3.12 Repeat 2 Key (REP 2)

This key causes two tests to be made on each sender before advancing to the succeeding sender.

3.13 Time Alarm Key (TA)

When this key is operated the time alarm circuit is restored to normal. The key must be restored to normal before the test circuit will advance to the next sender. If this key is left operated while the test frame is unattended, the alarms cannot operate, and, if a trouble is detected by the test frame, either one sender or a subgroup of senders may be held out of service.

3.14 Pass "B" Senders (PBS) and Pass Term. Senders (PTS) Key - Fig. 1D

This key causes all senders of either type to be passed without testing.

3.15 Pass Undesired Senders (MFS), (BS), (DPS) and (TS) Keys - Fig. 1E

The operation of one of these keys causes the test circuit to test the senders indicated by the key and to pass all other types of senders. The (MFS), (BS), (DPS) and (TS) designations indicate MF terminating senders, "B" senders, dial pulse terminating senders and F. S. terminating senders respectively. With all keys normal the dial pulse terminating senders are passed without testing and are only tested by the operation of the (DPS) key.

3.16 Automatic Pass Busy Key (APB)

This key causes the test circuit to pass a busy sender after a period of 29 seconds minimu, 59 seconds maximum.

3.17 Return to Normal Key (RN)

This key is used to restore the connector mechanism to normal during the progress of a test call or at the end of a test cycle.

3.18 Alarm Cut Off Key (ACO) is used to silence the minor alarm without interfering with aisle pilot and floor alarm frame lamp indications.

3.19 (EG1)-(EG4) keys are used to stop the test and display a lamp at the end of one group of senders when the following

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group has any senders with different operating conditions.

3.20 (PG1)-(PG4) keys are used to pass a group or groups of sender which have different operating conditions from the preceding and succeeding groups of senders.

JACKS

3.21 Remote control jacks (C) are installed in suitable locations on the sender frames and by the use of a make-busy plug the remote control advance feature is operated. The use of a 32A test set which has a cord with two keys equipped to furnish ground over either the tip or the ring, will perform the same function as the make-busy plug when that key is depressed which furnishes the ground on the ring. When the key which furnishes ground on the tip is depressed the step-by-step feature of the test set is operative.

LAMPS

3.22 Time Alarm Lamp (TA)

This lamp lights at the expiration of the time alarm period.

3.23 Group Locating Lamps (G-)

Each crossbar switch is associated with a lamp which identifies the group of senders to which the crossbar switch is connected.

3.24 Sender Locating Lamps - Tens 0 to 9 and Units 0 to 9

These lamps indicate which crosspoint of the crossbar switch is operated.

3.25 End of Cycle Lamp (EC)

This lamp lights when all the senders connected to this test circuit have been tested.

3.26 End of Group Lamp (EG)

4. CONNECTING CIRCUITS

When this circuit is listed on a keysheet the connecting information shown thereon is to be followed.

4.01 Crossbar MF Pulsing Terminating Sender - SD-25455-01.

4.02 Crossbar Full Selector Terminating Sender - SD-25013-01.

4.03 Crossbar Dial Pulse Terminating Sender - SD-25434-01.

4.04 Crossbar "B" Switchboard Sender and Position Finder - SD-25014-01.

4.05 Any Crossbar Central "B" Switchboard Sender (terminating part) - SD-25382-01.

4.06 Crossbar Central "B" Switchboard Senders (switchboard part) - SD-96285-01.

4.07 Crossbar Terminating Sender Link Circuit - SD-25459-01.

4.08 Crossbar Terminating Marker Connector Circuit - SD-25036-01.

4.09 Crossbar Terminating Marker Circuit - SD-25283-01.

4.10 Audible and Visual Alarm Circuit - SD-96188.

4.11 Crossbar Floor Alarm Frame, Fuse and Time Alarm Circuit - SD-25046-01.

4.12 Crossbar Interrupter Frame Circuit - SD-25062-01.

4.13 Crossbar Misc. Circuits for Sender Frame - SD-25053-01.

4.14 Sender Group Test Circuit - SD-25159-0106.

4.15 Revertive Pulsing Test Circuit - SD-25159-0108.

4.16 "B" Switchboard Sender and Position Finder Test Circuit - SD-25159-01-0112.

4.17 "B" Switchboard Sender and Position Finder and Multifrequency Pulsing Test Circuit - SD-25159-0116.

4.18 Multifrequency Pulsing Test Circuit - SD-25159-0118.

4.19 Register Check Circuit - SD-25159-0114.

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DESCRIPTION OF OPERATION

5. START OF TIME ALARM

When one of the class keys and the (ST) key have been operated, the (ST) relay operates supplying ground to the time alarm circuit which consists of the (TA) interrupter and relay (W), (Z), (W1) and (BK). This ground supplied to the time alarm circuit, operates the (W) relay when the (TA) interrupter closes. When the (TA) interrupter opens the (Z) relay operates. When the (TA) interrupter closes again the (W) relay is short-circuited and releases. With the (W) relay released and the (Z) relay operated, the (W1) relay operates. The next opening of the (TA) interrupter permits the (Z) relay to release. When the interrupter closes for the third time, the (W) relay operates. When the interrupter opens, the (Z) relay operates, operating the (BK) relay. The (BK) relay operated, grounds lead "LA" to the floor alarm frame fuse and time alarm circuit to operate the minor alarm etc., lights the (TA) lamp on this test frame and other test frames, and removes ground from the "G" lead to the control circuits and opens the "ADV" lead which prevents further advance of these circuits. While the time alarm circuit is functioning, tests of the sender are being made and if the tests are completed satisfactorily before the (BK) relay operates, the ground supply to the time alarm circuit is opened by the (CA1) relay restoring the time alarm circuit to normal and preventing the operation of the time alarm bell and the time alarm lamps. The time alarm period is 60 to 90 seconds. See "Short Time Alarm", Section -0106, Par. 16.

6. SELECTION OF THE FIRST SWITCH

The operation of the (ST) relay operates the (G-) relay of Figure 1A if this figure is used. This relay locks under control of the (ST) relay and (RN) key, lights a lamp corresponding to the crossbar switch to be selected and connects certain leads to the first crossbar switch so that its magnets may be operated. When Fig. 1A is not used these leads are strapped at the position of the (G-) relay.

7. OPERATION OF SELECT MAGNET

The operation of the (ST) relay as described above connects a ground through the back contacts of the (AV), (CA) and (CA1) relays to the (WH) and (ZH) relays, causing the operation of the (WH) relay. The operation of the (WH) relay connects ground through the back contacts of relays (AH), (ZH) and (PCR) to lead "EHO". This lead is extended by the operated (G-) relay to the first figure 2. Since all hold magnets of this figure are normal, this ground is extended to the armature of relay (9) and through its back contact to lead "AVS" to Figure 1. This causes the operation of relay (AS) which locks under control of the (WH) and (AH) relays, operating the (AS1) relay, which operates the (CO) relay of all figures 2 which connect ground to the (WS) and (ZS) relay windings. This causes the operation of the (WS) relay. The (WS) relay operated, connects ground through (ZS) relay to the "ESO" lead which is extended to the first figure 2 and through the normally closed contacts of the odd numbered relays of the first figure 2 to the select magnet (SO). This magnet operates and extends its ground through its front contact to lead "ESL" operating relay (AH). Relay (AH) operated, locks under control of the (WH) relay, removes the operating and locking circuits of the (AS) relay and supplies a ground to the "ESL" lead for locking the operated select magnet. The release of the (AS) relay permits the (ZS) relay to operate and opens the circuit to the (AS1) relay which releases. The (ZS) relay operated, opens the circuit to the "ESO" lead which operated the select magnet, connects ground to the "ESL" leads for locking the select magnet.

8. OPERATION OF HOLD MAGNET

The (AS1) relay releases as described in the previous paragraph removing ground from the "CO" lead which permits all (CO) relays to restore to normal, which causes the operation of a relay in Figure 2 associated with the operated select magnet. The (AS1) relay released also grounds the "OHM" lead which operates magnets (HO) and (HOA). These two hold magnets operated, close two cross-points on the crossbar switch which corresponds to those two hold magnets and the operated select magnet and operate one of the (U-) relays. These two cross-points close leads (6 leads for F.S. and Dial Pulse terminating and 7 leads for MF pulsing, 3 Wire D-C Pulsing and "B" switchboard terminating part senders) from the sender to be tested to the test circuit. The operation of magnet (HO) extends ground to lead "EHL" which operates relay (AV) through a back contact on relay (ZH). Relay (AV) locks

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through a back contact of the (CA) relay to ground on relay (AH), connects ground to the "C" lead of the sender group test circuit, connects ground to the "EHL" lead to lock the operated hold magnet and opens the circuit to the (WH) and (ZH) relays, permitting the (ZH) relay to operate. The (ZH) relay operated connects ground to the "EHL" lead to lock the operated hold magnet, opens the operating circuit of the (AV) relay and opens the operating circuit of the even hold magnet.

9. SEIZURE OF GROUP TEST CIRCUIT

With the (AV) relay operated, the "C" lead to the sender group test circuit is grounded causing that circuit to start its portion of the test. When the sender group test circuit is ready for testing, it connects battery to the "EV" lead, operating either the (EV) or (OD) relays, depending upon the position of the (WH) and (ZH) relays. If an even numbered hold magnet is operated, the (WH) and (ZH) relays will be operated, causing the operation of relay (EV). If an odd numbered hold magnet is operated, the (ZH) and (WH) relays will be normal causing the operation of relay (OD). Either the (EV) or (OD) relay operated, connects the leads from the sender to be tested into the control circuits to be used for this particular test; and also removes ground from the "BT" lead to start the busy test circuit of the sender group test circuit. At the completion of its test, the sender group test circuit operates relay (C) which locks, opens the "C" leads to the sender group test circuit, causing that circuit to return to normal, transfers the sleeve lead to the control circuits used for the class of test to be made, closes the FC lead, and connects ground to the "CG" lead.

10. COMPLETION OF TEST AND ADVANCE TO NEXT SENDER

When the control circuits have completed the test of a sender, ground is connected to the "ADV" lead, operating the (CT) register. The (CT) register operated, connects ground to the (CA) relay which operates. The (CA) relay operated, operates relay (CA1) which opens the holding circuit for some of the relays of this circuit. The (CA) relay operated also releases relay (AV). When the (C) relay releases, it opens the ground supply to the "CG" lead of the sender group test circuit which causes the circuit units used to restore to normal. The restoration of the circuits opens the lead "ADV" which releases the (CT) register and the (CA) and (CA1) relays. The (CA) and (CA1) relays released connect ground to the (WH) and (ZH) relays, causing the release of the (WH) relay. The (WH) relay released, releases the (AH) relay and connects ground to lead "OHO" which is connected through the back contacts of the even numbered hold magnets and front contact of the operated (HO) hold magnet, causing the operation of hold magnets (H1) and (H1A). The operation of these hold magnets causes the crosspoints corresponding to the operated select magnet to close, connecting the leads of the second sender to be tested into the test circuit. The (H1A) hold magnet also operates the (U1) relay. In addition, the operation of the (H1) hold magnet connects ground to lead "OHL" which operates relay (AV) through a front contact of relay (ZH). Relay (AV) performs the function described before with the exception that its operation permits the release of the (ZH) instead of its operation. The release of relay (ZH) connects ground to the "OHL" lead to lock the operated hold magnet, removes ground from the "EHL" lead to release the previously operated hold magnet. The test of the second sender proceeds in the same manner as the test of the first sender and the "ADV" lead is grounded at its completion, again causing the operation of the (CT) register and (CA) and (CA1) relays. These relays operated, cause the release of all relays of this circuit including the (C) relay and (AV) relay, and restore the control circuit to normal which permits the release of the (CA) and (CA1) relays. With all relays normal, the circuit to the (WH) and (ZH) relays is again closed, causing the operation of the (WH) relay which supplies ground to the "EHO" lead, as described above. Ground on the "EHO" lead operates the (H2) and (H2A) hold magnets through the operated contact of the (H1) hold magnet. The advance from one hold magnet to the next is accomplished in the manner described above until all the senders connected to the first horizontal row of the crossbar switch have been tested.

11. ADVANCE TO NEXT GROUP OF SENDERS

When the last sender connected to the first horizontal row of the crossbar switch has been tested, lead "ADV" is grounded in the usual manner and eventually causes the operation of the (WH) relay. The operation of the (WH) relay with the (H9) hold magnet operated, operates the (RLN) relay. The (RLN) relay operated, locks under control of the back contact of the (ZH) relay and opens the "OHL" lead which permits the release of the (H9) and (H9A) hold magnets. With the (H9) hold magnet released, the ground supply from the front contact of the (WH) relay over the "EHO" lead is extended through the back contacts of all the odd numbered hold magnets through the back contact of relay (9) to the "AVS" lead which operates the (AS) relay. The (AS) relay operated, locks under control of the (WH) and (AH) relays and operates the (AS1) relay which in turn operates all (CO) relays, and connects ground to the (WS) and (ZS) relays which are operated at this time. This causes the release of the (WS) relay which grounds lead "OSO", operating select magnet

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(S1) through a front contact of relay (0). Relay (0) has remained locked up through the locking contact of select magnet (S0) over lead "ESL" to a front contact of relay (ZS). With select magnet (S1) operated, ground is connected to lead "OSL" operating relay (AH) through a front contact of the (AS) relay. Relay (AH) operated performs the functions described above releasing relays (AS) and (AS1). Relay (AS) released, permits the release of relay (ZS). Relay (ZS) released, connects ground to the "OSL" lead to lock the operated select magnet, and removes ground from the "ESL" lead to release the previously operated select magnet and corresponding (0) to (9) relay. The release of the (AS1) relay releases the (CO) relay as previously described and grounds the "OHM" lead which operates hold magnets (HO) and (HOA). These hold magnets operated cause the cross-points corresponding to the select magnet (S1) to close. The select magnets are operated in numerical order until select magnet (S9) is operated.

12. ADVANCE TO NEXT CROSSBAR SWITCH OR END OF CYCLE

At the completion of the test on sender No. 99, the "ADV" lead is grounded as usual and the (WH) relay caused to operate as described in paragraph 11. This connects ground to lead "EHO" which operates relay (RLN) and releases hold magnet (H9) in the usual manner. With hold magnet (H9) released, ground is connected through the front contact of relay (9) to lead "AV" which operates the (G-) relay corresponding to the next crossbar switch, or if there is no subsequent crossbar switch, operates the (EC) relay. The operation of the next (G-) relay causes the release of the operated (G-) relay and connects the controlling leads to the next crossbar switch. The circuit operation for the subsequent crossbar switches is the same as for the first switch. If the (EC) relay operates, it lights the (EC) lamp, opens the locking circuit of relay (ST), and prevents relays of the group test circuit from operating. Releasing the (ST) key and momentarily operating the (RN) key will restore the test circuit.

13. TYPE OF SENDER INDICATOR

13.1 Fig. 1D

The G contact, of all crosspoints of the crossbar switches which are connected to all "B" senders, is connected to the (BS) lead and the "G" contact, of all crosspoints of the crossbar switches which are connected to terminating senders, is connected to the (TS) lead. In case it is desired to test only one type of sender, the test circuit may be made to pass by the other type by means of the (PTS) or (PBS) key. The (PTS) or (PBS) key operated caused the (SPT) relay to operate and automatically advance the connector switch mechanism to the next sender. The (SPT) relay is, therefore, operated for all senders which are not to be tested.

13.2 Fig. 1E

The "G" contact of all crosspoints of the crossbar switches which are connected to MF pulsing Terminating senders is connected to the "MFS" lead. The "G" contact of all crosspoint of the crossbar switches which are connected to 3 Wire DC Pulsing senders or "B" switchboard senders (terminating part) is connected to the "BS" lead. (Only one type of these senders will be in use in an office at a time.) The "G" contact of all crosspoints of the crossbar switches which are connected to Dial Pulse Terminating senders is connected to the "DS" lead and the "G" contact of all crosspoints of the crossbar switches which are connected to F.S. Terminating senders is connected to the "TS" lead. When it is desired to test all the senders of one type only, the test circuit may be made to pass by the senders of all other types by the operation of the key associated with the type of senders desired; (MFS) key for MF Pulsing terminating senders, (BS) key for noncentral "B" switchboard senders or central "B" switchboard senders (terminating part), (DS) key for Dial Pulse Terminating senders and the (TS) key for the F.S. terminating senders. The (MFS), (BS), (DS) or (TS) key operated causes the operation of the (SPT) relay for all senders other than those indicated by the key operated and automatically advances the connector switch mechanism to the next sender. The (SPT) relay is therefore operated for all senders which are not to be tested.

14. CONNECTION TO SUBGROUP OF SENDERS

The operation of the (0) to (9) relays corresponding to the select magnets operates a corresponding multicontact relay and two U type relays which close leads common to the same subgroups of senders. These senders must all be wired to the same horizontal row on the crossbar switch. When MF Pulsing terminating or Dial Pulse terminating senders are to be tested an additional "U" type relay is operated directly by the multicontact relay.

15. LOCATING LAMPS

The operation of one of the (G-) relays operates a corresponding lamp which indicates which crossbar switch and therefore which group of 100 senders is being used for test purposes. The operation of one of the (0) to (9) relays connects ground to one of the ten lamps to indicate on which horizontal row the sender under test is located. The operation of the hold magnets operates a corresponding relay in Figure 1 designated (U0) to (U9) which lights one of the units lamps indicating in which vertical row the sender under test is located.

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16. SELECTION OF ONE OF TEN COMMON LEADS

As described above, the operation of a multicontact relay connects certain common leads to the test circuit. Some of these leads are in groups of ten, one for each of the ten senders in a subgroup. The operation of relays (U0) to (U9) connects "GC", "SEL," "SPF" and "SPF1" leads to the proper one of a group of ten leads.

17. REPEAT TEST

In order to make repeat tests on a particular sender, the (REP) key is operated. With this key operated, the ground on the "ADV" lead at the end of a test operates the (RST) (repeat single test) meter instead of the (CT) (circuits tested) meter. The (RST) meter operated, grounds the (CA) interrupter. Closure of contact B operates relay (T1) which locks under control of the (RST) meter, and grounds lead "MGB1" to cause the group of senders to be made busy. One second later, after any link attempting to pick a sender in this group has done so, the F contact closes operating relay (T2) which also locks under control of the (RST) meter. Relay (T2) operates the (CA1) relay directly and does not operate the (CA) relay. The operation of the (CA1) relay releases the (C) relay which restores the control circuits to normal which then removes ground from the "ADV" lead causing the release of the (RST) meter and the (T1), (T2) and (CA1) relays. Relay (T2) is slow release to permit the (C) relay and other relays under control of the back contact of the (CA1) relay to release before allowing the (CA1) to release. With the (CA1) relay released, a new test is started upon the same sender. With the (C) relay released the sleeve is opened.

18. REPEAT 2 TEST

In order to test the same sender twice before advancing to the next sender, the (REP2) key is operated. When the "ADV" lead is grounded at the conclusion of a test, the (RP) relay is operated, grounding the (CA) interrupter operating the (T1) and (T2) relays, which perform their usual functions, operating the (CA1) relay and restoring the test circuit as usual, causing the removal of ground from the "ADV" lead and the operation of the (RP1) relay in series with the (RP) relay. This releases the (T1), (T2) and (CA1) relays and causes a new test to be started on the same sender. The (RP) relay furnishes ground to lead LS to lock the (S) relay and block the test if the sender does not restore promptly. At the conclusion of the second test, the "ADV" lead is grounded again, locking the (RP1) relay and operating the (CT) register. The (CT) register operated, causes the operation of the (CA) and (CA1) relay which releases the (AV) relay, opening the locking circuit of the (RP) and (RP1) relays, causing the release of the (RP) relay but not the (RP1). When the ground is removed from the "ADV" lead, the (RP1) relay and the (CT) register release, causing the release of the (CA) and (CA1) relays and the advance to a new sender. If a trouble is encountered with the (REP-2) key operated, the (REP) key may also be operated to cause the test to be repeated on the sender.

19. AUTOMATIC PASS BUSY FEATURE

If the sender selected for test is busy and the (APB) key is operated, the test circuit will wait 29 to 59 seconds for the sender to become idle and will then advance to a new sender. This action is controlled by the time alarm circuit which operates relay (W1) after an interval of 29 to 59 seconds. With the (W1) relay operated ground over the "TC" lead operates the (PB) relay. The (PB) relay operates the (PB) register. The (PB) register operated, connects ground to the (CA) relay which advances the test circuit to the next sender in the usual manner. If the (APB) key is normal and the sender is found busy, the time alarm circuit will eventually operate the (BK) relay which will light the (TA) lamp and sound the time alarm bell. The (PB) meter may also be operated from the (PB) relay which operates from the Sender Group Test Circuit, if that circuit encounters a sender group which is busy for 5 to 12 seconds.

20. OPERATION OF REGISTERS

A register is provided to count the number of tests successfully completed. This register is designated (CT) and operates at the conclusion of each successful test, if the repeat key is normal. If the repeat key is operated for a number of tests, the (RST) register operates at the conclusion of each successful test until the repeat key is restored during the last test on that sender which causes the (CT) register to operate at the conclusion of the test. The (CT) register therefore counts the number of circuits tested successfully and the (RST) register counts the number of successful tests made which are not counted on the (CT) register. The (PB) register counts the number of senders passed by automatically. It cannot be operated with the (REP) key or with the (REP 2) key operated except when the sender tests busy on the first test of the (REP 2) test.

21. CONTROL ADVANCE FEATURE

21.1 When it is desired to advance the test circuit from a busy sender the (CA) key is operated, which with the (C) relay of this circuit and the (SID) relay of the Group Test Circuit both normal operates relays (CA) and (CA1) which perform their usual functions to cause the next sender to

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be selected. These relays will be held operated and the next sender will not be selected until the (CA) key is released.

21.2 When it is desired for any reason other than a sender busy condition to advance the test circuit, the (CA) key is operated, which operates the (CA2) relay. The (CA2) relay operated locks under control of the (CA1) relay, and grounds lead "D" to simulate release in the sender. Relay (CA2) also closes ground to operate relay (CA3) Fig. N, which is slow operate, when relay (RL) of Group Test Circuit is operated and has in turn operated relay (CA4). Relay (CA3) permits the ground to be closed to the "D" lead long enough to operate the (TC1) and (TC2) relays, in the sender, and then opens the "D" lead. In most cases this will restore the sender to normal. The (CA2) relay also grounds the (CA) interrupter which causes the (T1) and (T2) relays to operate, as described above, in not less than one second. This interval allows the sender sufficient time to respond to the signals described above. The (T2) relay operates either the (CA) or (CA1) depending upon whether the (REP) key is normal or operated. These relays perform their usual functions except that they remain operated while the (CA) key is operated, and the relays locked to the back contact of the (CA1) remain locked to the (CA2). In addition, the operation of the (T1), with (REP) or (REP 2) key operated, causes the sender group to be made busy, over lead "MGB1". If a repeat 2 test is being made the (CA2) unlocks the (RP) and (RP1) relays, so that both tests will be made on the next sender to be tested.

22. REMOTE CONTROL FEATURE

Jacks are provided at the sender frames to enable the test man to control this test frame from a remote point. Insertion of a make busy plug into a remote control jack causes the same operation as the operation of the (CA) key. The remote control jacks at the sender frames are ineffective, however, unless the repeat key is operated. Instead of using a make busy plug a 32A test set may also be inserted into the remote control jacks, and the operation of a key of this test set will short-circuit the ring and sleeve to perform the same function as a make busy plug. In addition, a 32A test circuit is provided with a key which short-circuits the sleeve and tip causing a ground to be connected to the "RC" lead of the revertive pulsing and key pulsing circuits which will cause circuits to control the step-by-step revertive pulsing and key pulsing features.

23. PARTICULAR CIRCUIT FEATURE

The test may be started on any sender by using the particular circuit feature of this test frame. The crossbar switch to be used is first selected by the operation of its corresponding (G-) key which operates and locks the corresponding (G-) relay. A particular cross-point on this crossbar switch may be selected by means of the (PCS) and (PCR) keys. The (PCR) key causes the crossbar switch to advance automatically as long as the (PCR) key is held operated. When a point near the desired cross-point is reached as indicated by the tens and units lamps, the (PCR) key is restored. The operation and release of the (PCS) key will cause the crossbar switch to advance one step at a time. The circuit operation to perform these functions is described below. If the test circuit is not connected to any sender, the operation of the (PCR) key will operate the (PC) relay which locks through a back contact on the (ST) relay and connects ground through the back contacts of the (AV) and (CA) relays to the (WH) and (ZH) relays, causing the first sender to be selected and the (AV) relay operated in the usual manner. With the (AV) relay operated, ground is connected to the (CA) relay which operates and causes the release of the (AV) relay. The (AV) relay released, releases the (CA) and (CA1) relays which cause the crossbar switch to advance to the next sender. When the "OHO" lead is grounded to operate the first odd hold magnet, the (PCR) relay also operates and short circuits the contacts of the (PCR) key, so that the release of the key will not interfere with subsequent operations. When next the (WH) relay operates the (RLN) relay operates, releasing the odd hold magnet and the (PCR) relay and causing the advance to the next level in the usual manner, the (PCR) relay is slow release so that it will not close the EHO lead until the hold magnet has released. This operation continues as long as the (PCR) key is held operated. When a crosspoint near the desired cross-point is reached, the (PCR) key is restored. The position of the crossbar switch will be indicated by the tens and units lamps. The operation of the (PCS) key at this time operates relay (SPT) through a contact of the (AV) relay. The (SPT) relay operated, locks under control of the (PCS) key and operates relays (CA) and (CA1). When the (PCS) key is restored, the (SPT), (CA) and (CA1) relays release and cause the test circuit to advance to the next sender. This operation is repeated until the desired sender has been selected. If the (PCS) key is operated while no sender is connected to the test circuit, the (AV) relay will be normal and it will, therefore, provide no path for the operation of the (SPT) relay. In this case, however, a path is provided through a back contact of the (PC) relay to operate the (SPT), (CA) and (CA1) relays. With the (CA1) relay operated, ground from the (PCS) key operates the (PC) relay which locks through a back contact of the (ST) relay

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and connects a ground to the back contact of the (CA) relay which is operated at this time. The release of the (PCS) key releases the (SPT), (CA) and (CA1) relays which causes the first sender to be selected. Subsequent operation of the (PCS) key will advance the crossbar switch one step at a time. When the (ST) key and (ST) relay are subsequently operated to start testing, the (AV) relay is already operated, which prevents stepping to the next sender until the sender to which the test circuit is connected has been tested.

24. TIME ALARM

If at any time the time alarm bell operates, it may be silenced and the time alarm circuit restored to normal by the operation of the (TA) key. The (TA) key operated, removes ground from the time alarm interrupter and its associated relays, restoring these relays to normal and opens the circuit to the (CA) relay so that the test circuit cannot be advanced to another sender while the (TA) key is operated, except when making "Time Out Test" where the #6 class key is operated. The operation of the (TA) key will not, however, interfere with repeat tests. Whenever the test circuit times out sounding either the minor or major alarm a plug should be inserted in the Hold Jack of the sender and the (REP-2) key operated for making repeat tests of the sender. This is necessary since the sender, in which a trouble occurs, may time out and restore to normal causing the test circuit to advance. The (ACO) key when operated will cause the audible alarm to be silenced or prevent it from being sounded but the alarm lamps will still light.

25. SPARE TERMINALS

When a cross-point is operated, which is not connected to a sender, the (SPT) relay operates in series with the (S) relay of the Group Test Circuit. This causes relays (CA) and (CA1) to operate, and release the (AV) and either the (EV) or (OD) relays, opening the circuit to the (SPT) relay. The (SPT), (CA) and (CA1) relays release, and the next spare cross-point is passed in the usual manner.

26. TRUNK DISCONNECT TEST

On this class of test the #5 or #9 key grounds lead "MCB" to the Sender Group Test Circuit causing the sender group to be held busy during the entire test. This is to prevent the sender under test from being seized by a service call when it is unguarded during the test as explained in sections 0108, 0112, 0116 and 0118. Since the sender group is held out of service for a long interval, this special test should be made at a time when traffic will not be affected and the test should be supervised. In order to test that the trunk disconnect feature causes the sender to return to normal the (REP 2) key should be operated, and a plug should be inserted into the sender hold jack to prevent a time out from restoring the sender to normal.

27. Certain troubles in the Markers Marker Connectors, and in the sender apparatus closely associated with the connector cannot be readily located by using the sender test frame, because of the short time out in those circuits. These troubles can most easily be located by means of the trouble indicator records.

28. SPECIAL CALL TEST

This does not make a test of the special feature of the sender which if in trouble will be detected by a record in the trouble indicator circuit, but this test will check those sender trouble reactions on a special call that are not registered in the trouble indicator. This test is made as is described for a "Regular Call Test" except that the "FC" to the sender is momentarily grounded.

29. RETURN TO NORMAL (BLOCKED TEST FRAME)

In case the test frame is blocked before operating the (RN) key to return the test frame to normal the (CA) key should be operated momentarily.

30. END. OF GROUP - FIG. AM WITH "ZM" OPTION

In case senders in different groups have operating conditions in which one or more groups may not satisfy the test circuit when set up for given conditions an "end of group" signal may be given after the last sender, of the group or groups for which the test circuit is set, has been tested. When this condition is present Fig. AM shall be furnished and equipped with "ZM" option and when testing senders in which the above condition exists proper (EG-) key is operated to bring in the end of group signal.

31. PASS SENDER GROUP - FIG. AM WITH "ZN" OPTION

When intermediate groups of senders have different operating conditions from the preceding and succeeding group or groups of sender and it is desirable to test all senders of one operating condition before giving an end of cycle indication Fig. AM shall be furnished and equipped with "ZN" option. With the proper (PG-) key operated relay (SPT) will be operated after testing the last sender advancing the circuit to the next group of similar senders.

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CIRCUIT UNIT - SECTION 0106
GROUP TEST CIRCUIT

CHANGES

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Sheet 0106

D.11 Lead BSY is added from connector circuit to ZT of SPF5 relay.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 In conjunction with other units of the sender test circuit, this circuit is designed to test the "Terminating Sender Link Group relays common to Full Sel. termainating, MF pulsing terminating, Dial Pulse Terminating and non-central "B" switchboard or Central "B" switchboard (terminating part) senders. Tests are made of the ability of these relays to operate properly, and continuity and cross tests are made of the contacts and associated wiring.

2. WORKING LIMITS

2.1 None.

3. FUNCTIONS OF THIS CIRCUIT UNIT

3.01 To make a busy test of the sender to be tested.

3.02 To make a busy test of the terminating sender group circuit common to FULL SEL. terminating, MF pulsing terminating, Dial pulsing terminating and non-central "B" switchboard or Central "B" switchboard (terminating part) senders.

3.03 To transmit frame indication to the sender.

3.04 To check the terminating link group relay contacts and associated wiring for opens and crosses.

3.05 To operate the major alarm if the sender group test is not completed in a short interval.

3.06 Under control of the (MGB) key, to make the group circuit busy to all links, giving preference to the test circuit for this group.

3.07 To transmit an office class indication over the "OA", "OB" or "OC" lead to sender.

3.08 To transmit a start-pulsing class indication over the "DT" or "SP" lead to dial-pulse senders.

KEYS

3.09 (LT) Key. This key is operated in light load periods to make effective certain tests which can not be made during heavy load.

3.10 (MGB) Key. This key is operated to make busy the group circuit to which the test circuit is connected, thereby giving preference to the test circuit for this group of senders.

3.11 (LOA), (LOB) or (LOC) Keys. One of these keys is operated when it is desired to transmit an office indication to the sender as from the link circuit.

3.12 (F) Keys. One of these keys is operated to transmit the units digits of the incoming frame indication to the sender as from the link circuit.

3.13 (FA) Keys. One of these keys is operated to transmit the tens digit of the incoming frame indication to the sender as from the link circuit.

3.14 (DT) and (SP) Keys. One of these keys is operated when testing dial-pulse senders, to control the type of start-pulsing signal, - which may be dial-tone, reverse-battery, or both.

LAMPS

3.15 (BY) lamp lights during busy test.

3.16 (GB) lamp lights during group busy test.

3.17 (SEL) lamp lights while waiting for the (S-) relay associated with the sender under test to operate.

3.18 The (CH) lamp lights while waiting for the ground chain on the (S-) relays to open.

3.19 The (CH1) lamp lights while waiting for the battery chain on the (S-) relays to open.

3.20 The (RL) lamp lights while waiting for the sender to close the RL lead.

3.21 The (SPF) lamp indicates that the sender chain circuit has failed to advance the preference lead to the next lower sender in the chain when the sender becomes busy, or that the chain circuit has failed to disconnect the (S-) relay from its associated preference lead when the sender becomes busy.

3.22 The (X) lamp indicates that a cross has been detected at the contacts of the (SC-) relays of the sender under test, or that the chain circuit advances the preference lead prematurely.

3.23 The (MGB) lamp lights when a sender group is being held out of service, waiting for a particular sender to become idle.

3.24 The (EF) lamp lights when the (EF) relay in the F.S. terminating sender or Central "B" switchboard sender (terminating part) fails to operate.

3.25 The (S) lamp remains lighted if the sender fails to ground the "S" lead.

4. CONNECTING CIRCUITS

When this circuit is listed on a key sheet the connecting information shown thereon is to be followed.

4.1 Positions Busy and Night Alarm Circuit SD-21139-01.

4.2 Connector Circuit SD-25159-0102.

4.3 Revertive Pulsing Test Circuit SD-25159-0108.

4.4 "B" Switchboard Sender and Position Finder Test Circuit SD-25159-0112.

4.5 "B" Switchboard Sender and Position Finder and Multi-Frequency Pulsing Test Circuit SD-25159-0116.

4.6 Multi-Frequency Pulsing Test Circuit SD-25159-0118.

4.7 Register Check Circuit SD-25159-0114.

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5. PRELIMINARY OPERATION

5.1 Prior to the seizure of this circuit, a ground is supplied by the connector circuit to the "BT" lead, thru the back contact of the (CI1) relay, operating the (BT2) relay which in turn operates the (S1) relay. The back contact of the (CI1) relay is used to make sure that this and other relays are normal before permitting this circuit to be used. These relays are operated before this circuit is seized so that they may have sufficient soak in order to insure proper releasing time. The (BT2) relay operated also connects the "S" lead to the (BT1) relay for busy test purposes as described in subsequent paragraphs. A battery is also supplied by the connector over the "BS", "MFS", "DS" or "TS" lead, operating the (BS), (MFS), (DPS) or (TS) relay. Either the (BS), (MFS), (DPS) or (TS) relay will open a path for holding relay (BT2), thus assuring that the busy test will not be made until one of these relays has operated.

6. SEIZURE

6.1 When this circuit is seized by the connector circuit ground is supplied over the "C" lead through a contact of the operated (S1) relay to operate the (C) relay. The (C) relay operated locks directly to the "C" lead, connects battery to the "EV" lead as a signal to the connector that this circuit is ready to proceed with its test, supplies ground for locking various relays of this circuit and energizes the (XC) relay for use in a subsequent test and operates the (SID3) and (SID2) relays in sequence.

7. BUSY TEST

7.1 The connector circuit closes the "S" lead and opens the "BT" lead at approximately the same time. Also the (CH) relay operates thru a contact chain in the link circuit when the sender group is idle. The (CH) relay operated, opens the remaining circuit for holding the (BT2) relay, and closes the sleeve to the (BT1) relay. This causes the release of the (BT2) relay, and subsequently the release of the (S1) relay. However, while the (BT2) relay is still operated, the (BT1) relay is connected to the "S" lead and this connection is extended by the connector circuit to the "S" lead of the sender to be tested. If the sender to be tested is "made busy" battery through a resistance will be connected to its "S" lead, and this circuit will operate the (BT1) relay which will hold the (BT2) relay and operate the (BT4). Relay (BT4) operated, holds (BT2) and operates (BT3). (BT3) operated locks under control of (CH), opens the winding of

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the (BT1) relay, and releases the (BT4). The (BT4) is slow release and keeps the winding of (BT1) and the sleeve lead open momentarily so that, if the battery which operated (BT1) was not the "make busy" battery in the sender but was some relay or hold magnet winding, this false operating circuit will remove itself before a second test is made by the (BT1) relay. After the (BT4) has released the (BT1) is again connected to the sleeve and if battery is still on the sleeve it reoperates, holding the (BT2) relay and blocking the test. This circuit remains blocked in this condition until the "make busy" condition is removed from the sender and the (REP) and (CA) keys are operated for repeat test or until the test circuit is advanced to another sender where the test is restarted. If the sender is not "made busy" the release of the (BT1) and (BT2) relays connects the "S" lead to the (S) relay and at the same time, starts the (S1) relay releasing. If the sender to be tested is busy in service the "S" lead will be grounded operating the (S) relay. The (S1) relay is slow enough in releasing to insure that the (S) relay will operate if the "S" lead is grounded. If the (S) relay operated, the circuit remains blocked until the sender becomes idle or until the test circuit is advanced to a new sender. While the (S) or (S1) relay is operated the (BY) lamp is lit. If the sender to be tested is idle, or if it becomes idle a circuit from ground on relay (C) through the back contacts of the (S1) and (GB) relays is closed to the (SID) relay winding. If, during the busy test, the sender group is seized by a service call, the (CH) relay releases restoring the busy test circuit to normal. When the sender group again becomes available, the busy test restarts as described above. On spare terminals, relay (CH) does not operate but connects the (S) relay to the sleeve to permit the connector to pass by the spare terminals. While the busy test is being made the "TC" lead is grounded which makes the automatic pass busy feature effective in the connector circuit.

8. BUSY TEST OF SENDER GROUP CIRCUIT

8.1 If the sender subgroup is busy battery is connected to the "AMBO" leads for the MF terminating senders, to the "BMBO" leads for the "B" switchboard sender and position finder or central "B" switchboard senders, to the "DMBO" leads for the Dial Pulsing terminating senders and to the "TMBO" leads for the F.S. terminating senders. Battery on the "AMBO" "BMBO", "DMBO" or "TMBO" leads operates the (GB) relay. With the (GB) relay operated the path for operating the (SID) relay is opened, and the timing circuit consisting of the (T) and (T1) relays is started. As described in a later paragraph the (T1) relay operates after 5 to 12 seconds closing leads "PB" and "BK1" to the connector. This signals the connector circuit to pass by this sender if the (APB) key is operated. If the (APB) key is normal this circuit blocks with the (GB) lamp lit. If the sender subgroup is or becomes idle the (GB) relay is released releasing relays (T) and (T1) and operating relays (SID), (SID1), and (MGB) and (MGB2) if used. With the(SID), (SID1) and (MGB) relays operated, battery is connected to the "BMB-", or "TMB-" leads to make the subgroup of senders appear busy to all link circuits, the (GB) lamp is lighted and circuits are closed for operating the (RES), (REG) relays and relays (SID3) and (SID2) are released. These relays are slow release to allow any link which has started to seize this group of senders to complete its action and exclude the test circuit and also to allow any sender which is restoring to normal to completely restore before seizing the sender. If the sender group is idle, the (RES) relay will operate. If the sender group is idle and more than one sender is available, the (REG) relay will operate. With the (REG) and (RES) relays operated, the (SID2) released, the (GE) relay operates. The (GE) relay operated locks under control of the (SID) relay, extinguishes the (GB) lamp, lights the (SEL) lamp and operates the (CI) and (CI1) relays. The (LT) key is operated during light load periods to make effective the check of the regular testing leads "TA", "TB", "TD" or "TT". Fig. L includes relay (MFS) ("R" apparatus) for use when testing Dial Pulse terminating senders. Relay (BS) ("B" apparatus) is used for both "B" switchboard sender and position finder sender by connecting per Fig. AD and for Central "B" switchboard sender circuit (Terminating part) by connecting per Fig. AE.

9. FRAME INDICATION

9.1 With the (CI) relay operated, ground from (SEL) relay is connected to the (F) and (FA) keys. One button in each of these two rows of keys is operated causing two frame indication leads to be grounded.

When the even numbered frame keys are operated, that is the 0-2-4- etc. keys, the "EF" lead to the sender is grounded thru the contacts of the (SPF4) relay. When the (SPF4) relay releases this ground is connected through the winding of the (EF) relay to the "EF" lead. The (EF) relay in the test circuit should operate in series with the (EF) relay in the F.S. terminating or central "B" switchboard sender provided the "EF" lead is not open. The test circuit (EF) relay extinguishes the (EF) lamp and closes the operate circuit for the (SEL) relay. When the odd numbered frame keys are operated they close the operating circuit for the (SEL) relay.

9.2 The (FA-0) key shall be depressed a. When testing senders arranged to serve

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more than ten incoming frames and it is desired to indicate incoming frame number nine or below. b. When testing senders arranged to serve ten or less incoming frames when the associated markers and terminating sender test frame are both arranged to work with senders arranged to serve more than ten incoming frames.

The (FA-1) key shall be depressed when testing senders arranged to serve more than ten incoming frames and it is desired to indicate incoming frame number ten or above.

The (FA-2) key shall be depressed when testing senders not equipped with (F00) and (F10) relays, where the associated markers are not equipped with (F10) relays, but the terminating sender test frame is arranged to work with other senders and markers arranged to serve more than ten incoming frames.

In some multi-offices where there are not more than 10 incoming trunk frames the "F00" and "F10" leads from the link and the "F10" lead to the marker are used for indicating the desired office unit. In such cases the (FA-0) or (FA-1) keys are operated in the test circuit to select the desired unit.

10. CLASS INDICATION

10.1 Office Indication

The (LOA), (LOB) and (LOC) keys and associated wiring to the senders are used to provide means for operating relays in the senders as to which office is wanted when testing senders that complete calls to multi-office units. One of these keys should be operated when it is desired to transmit a signal to the sender corresponding to the signal that it might receive from the link circuit. The (OAB) key in section -0114 will be operated or left in its normal position depending upon the position of these keys.

10.2 Start-Pulse Indication, Dial Pulse Senders

10.21 The (DT) key operated connects ground to the "DT" lead of the sender, which will cause the sender to transmit dial-tone as a start-pulsing signal, with or without a reversal of the battery on the tip and ring leads depending on the optional equipment of the sender. When the sender is arranged to combine the reverse-battery with the dial tone the test circuit is provided with "WM" wiring. When the sender does not reverse the battery on "DT" indication, the test circuit is provided with "WN" wiring.

The "DT" ground is connected from ground at front contact of the (DPS) relay, front contact of (DT) key, back contact of (X1) relay and front contact of the (SM-) relay, sheet -0102, associated with the dial-pulse sender.

10.22 The (SP) key operated connects ground to the "SP" lead of the sender, which will cause the sender to transmit a reverse-battery start-pulse signal. The "SP" ground is connected from ground at front contact of (DPS) relay, front contact of (SP) key, back contact of (X4) relay, front of (DPS) and front of (SM-), sh. -0102, associated with the dial pulse sender.

11. SEIZURE OF SENDER

11.1 The (CI1) relay operated connects the "CH1" lead (of the sender selector figure of the link) to the (CH1) relay of this circuit. The (CH1) relay operates through a chain of contacts to battery. The (CH) relay has already operated as described above. If either or both of these relays fail to operate the test circuit will block. The (CH) and (CH1) relays lock under control of the (SEL) relay and supply ground through 1095 ohms to the "SPF" lead. The connector circuit extends the "SPF" lead to the preference lead corresponding to the sender to be tested, and, since the sender to be tested is idle, the corresponding terminating sender link group (S-) relay will be operated. The (S-) relay operated causes the (RES) and (REG) relays to release. The winding of the (SEL) relay is connected through the back contact of the (RES) and (REG) relays thru the connector to the "S" lead of the link corresponding to the sender under test and if the proper (S-) relay operates, it causes the test circuit (SEL) to operate. The (SEL) relay locks under control of the (GE) relay, extinguishes the (SEL) lamp, lights the (CH) lamp, and unlocks the (CH) and (CH1) relays. The link (S-) relays should open both the battery and ground chains, releasing the (CH) and (CH1) relays. If the ground chain fails to open, the (CH) relay will remain operated, blocking the test frame with the (CH) lamp lit. If the battery chain fails to open, the (CH1) relay will remain operated, blocking the test frame with the (CH1) lamp lit. With the (CH) and (CH1) relays released the (RL) lamp lights, the operating circuit of the link (S-) relay is opened, and the (SPF) relay is connected to the "SPF" lead, through the connector, to the winding of the (S-) relay corresponding to the sender under test. The (SPF) relay operates thru the locking circuit ground of the (S-) relay which is closed at the contacts of the (SPF2) relay to the "LK" lead. The (SPF) relay operates the (SPF4) relay which operates (SPF5) relay and closes the operating circuit of the (SPFA) relay, which grounds the "S" lead to the sender to check the continuity of the path between the "S" and

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"SL" leads of the sender. This ground returns to the test circuit over the "SL" lead, and is connected through resistance to the "GS" lead. This furnishes the operating circuit for an off-normal relay in the connected sender circuit. The (SPFA) relay also opens leads "CH" and "CH1" to prevent interference with a later part of the test. If the test circuit tries to make a connection to a sender that is timing out and has a plug in its hold jack, the test circuit will be blocked with the (MGB) relay operated holding a subgroup of senders out of service. The test circuit major alarm will sound in 6 to 12 seconds warning the testman that the group is held busy.

12. CHECK OF RELEASE SIGNAL

12.1 When the (S-) relay of the link circuit operated as described above it operated a relay in the associated sender which connected ground to the "RL" lead. In service this ground on the "RL" lead is used as a release signal to the link control circuit. Under test conditions ground on the "RL" lead operates the (RL) relay of the group test circuit which locks under control of the (C) relay. The (RL) relay operated, extinguishes the (RL) lamp, lights the (SPF) lamp and prepares the operating circuit of the (XB) relay and the (SPF2) relay. If the release feature fails to operate properly, the test circuit blocks with the (RL) lamp lit.

13. CHECK OF ADVANCE OF PREFERENCE LEAD TO NEXT SENDER

When the off-normal relay of the sender operated,as described above, it caused the operation of the (SB-) relay of the link. The (SB-) relay operated, should disconnect the "SPF" lead from the locking circuit of the (S-) relay, thereby releasing the test circuit (SPF) relay, and should connect the "SPF" lead to the preference lead of the next sender. The release of the (SPF) relay releases the (SPF4) and (SPF5) relays. Relay (RL) now operates, which closes ground through the operated (SPFA) relay to operate the (SPF2) relay. The (SPF2) relay operated grounds the "SPF" lead, and opens the "LK" lead, releasing the link (S-) and sender (SC) and (SC1) relays. Ground on the "SPF" lead is returned through the operated contacts of the link (SB-) relay to the preference lead of the next sender which is connected to lead "SPF1". This operates relays (SPF1). If the (SPF3) relay operates in turn operating relay (SPF1) before the (SPF5) releases, indicating that the preference lead has been connected to the next preference lead prematurely, the (XA) relay will operate ((LT) key operated) block the test circuit, and light the (X) lamp. The (SPF4) relay is slow release delaying the release of relay (SPF5) to allow time for this test to be made. With the (LT) key normal during heavy load, the test for premature operation of (SPF3) is cancelled. The operation of the (SPF1) relay extinguishes the (SPF) lamp, and operates relay (XB). In case there is only one sender of a particular kind in a subgroup, ground is supplied from a front contact of (SPF2) to the PX punching of the connector circuit which is cross-connected to operate the (SPF3) relay as if the preference lead was transferred.

14. CHECK FOR CROSSES ON (SC-) RELAY CONTACTS

This paragraph describes the method used for checking the contacts of the (SC1) and (SC2) relays of the sender and their associated leads for crosses. With the (SC1) and (SC2) relays normal all of the frame indication, "GS", "SL", "RL", "TR", "F00", "F10" and "F0" to "F9" leads with leads "OA", "OB" and "OC" (if used) should be open. Under this condition, a relay connected to a potential of approximately 24 volts is connected to all of these leads for the purpose of detecting crosses to either battery or ground. The operation of this feature is as follows: The operation of the (XB) relay as described above, connects ground from the "S1" lead to the windings of the (X1), (X2) and (X3) relays and (X4) relay (if used) which operate, and prepares in part the closure of ground to the "AV" lead. The outer end of the winding of the (X) relay is connected to a potential of approximately 24 volts obtained by means of a potentiometer and the inner end is connected through make contacts on the (X1) to (X4) relays to all the leads to be tested for crosses. If any of these leads is connected to either 48 volt battery or ground, the (X) relay will operate, operating the (XA) relay. The (XA) relay operated locks under control of the (C) relay, prevents closing the advance lead and grounds the circuit to the (X) lamp causing this lamp to light. If no crosses are detected, the (XC) relay releasing on the operation of the (X1) relay, closes a circuit to the "AV" lead of the connector circuit and causes that circuit to proceed with the test. The (XC) relay is slow release so as to permit the (X) and (XA) relays to operate. The (SB) relay is slow operate to permit the sender (SC-) relays to release before applying the cross test.

15. RELEASE

The connector circuit, having received a signal over the "AV" or "ADV" lead releases this circuit by removing ground from the "C" lead. The removal of ground from the "C" lead releases the (C) relay which causes all other relays of this circuit to restore to normal. This

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circuit can not be reseized until the (BT2) and (S1) relays have been operated, and the (CI1) released to close the operating circuit of the (C) relay.

16. SHORT TIME ALARM

When the (SID1) relay operates to seize the group circuit as described above, it closes a circuit from the (T) interrupter to the (T) relay and opens the ground to relays (W), (Z), (W1) and (BK) to restore the regular time alarm. The (T) relay is slow operate to insure that the (SIF1) will lock before its operating circuit is opened. When the (B) contact of the interrupter closes the (T) relay operates and locks under control of the (C) relay. The (T) relay operated supplements the ground supplied by the (SID) relay for locking various relays and closes a path for the (F) contact of the interrupter to the (T1) relay. When the (F) contact of the interrupter closes, the (T1) relay operates. The (T1) relay operated, locks under control of the (C) relay. The (T1) relay operated grounds the "MA"lead to the connector circuit to function the major alarm and also (FIG. R) closes a circuit to light the (TA) lamp. The purpose of this timing circuit and the operation of the major alarm is to insure that a subgroup of senders will not be held out of service too long if the test circuit blocks while testing the group circuit. The interval counted is approximately 5 to 12 seconds. This timing circuit is also caused to operate when the (MGB1) or (GB) relays operate.

17. GROUP MAKE BUSY

In order that the test frame attendant may make a particular subgroup of senders busy from the test frame, the (MGB) key and (MGB), (MGB1) and (MGB2) (if used) relays are provided. The operation of the (MGB) key, with the (ST) key operated operates the (MGB1) relay which locks under control of the (SID) relay and operates relay (MGB) and (MGB2), which connects battery to the group busy leads of the group to which the test circuit is connected. This enables the test man to seize a sender which is busy in service or which has been made busy and give preference to the test circuit over link circuits when this particular sender becomes idle. When the (SID) relay operates, the (MGB1) relay releases, but the (MGB) and (MGB2) relays are held operated. Since the operation of the (MGB) key causes a group of senders to be held out of service, care should be taken to see that the sender to be tested is made available quickly. The (MGB1) relay will cause the major alarm to operate if the sender is not made available within 5 to 12 seconds. To silence the alarm operate the (TA) key. When a repeat test is to be made, the (MGB1) relay operates over the (MGB1) lead to the connector circuit and performs the above functions thereby insuring that the sender under test will not be seized by a service call. The (MGB1) relay is made slow release for two reasons, (a) to hold the (MGB) and (MGB2) relays from the time that the (SID) opens the (MGB1) locking circuit, until the time that the (SID) establishes the (MGB) and (MGB2) holding circuit, and (b) on CA calls with the (SID) operated, to hold the (MGB) and (MGB2) relays from the time that the (CA) key is released, until the time that the (C) and (SID) relays have released.

18. CHECK OF TROUBLE RELEASE FEATURE

Under service conditions there is a trouble release feature between the link and sender of such a nature that if the sender fails to return a ground over the "RL" lead to the link within a specified time, the link registers a trouble condition and grounds the "TR" lead to the sender which functions to restore the sender to normal.

In order to test this feature the corresponding class key of the connector circuit is operated, operating the (TR) relay of the group test circuit. The (TR) relay operated, transfers the "SL" lead from the "GS" lead to the winding of the (TR1) relay, so that when ground is supplied over the "SL" lead, as described in paragraph 11, the (TR1) relay operates. The (TR1) relay operated, transfers a contact of the (SPFA) relay from the (SPF2) relay to the "ADV" lead of the connector circuit and grounds the "TR" lead to the sender circuit operating a relay in the sender which operates the (SB-) relay of the link circuit. The (SB-) relay operated releases the (SPF), (SPF4) and (SPF5) relays. The (SPF5) relay grounds the "ADV" lead to the connector as a signal that the test has been completed. If the "RL" lead is grounded falsely, the (RL) relay opens the "ADV" lead blocking the test. Since on this class of test the sender group is held busy almost all the time, this test should be made during light load periods and should be supervised.

19. TESTING SENDERS THAT ARE PLUGGED BUSY

When testing senders that are plugged busy, it is necessary, in order to test the sender to remove the make busy plug after the test circuit has reached the sender. The make busy plug should not be reinserted until after the (S) lamp has lighted.

20. TESTING SENDERS WITH HOLD PLUGS INSERTED

If the test circuit makes connection to a sender that has encountered a trouble in service and a plug is in the hold jack, the test circuit will block and it will be necessary to operate the (REP) key, remove the hold plug and operate the (CA) key in order to advance the test circuit for testing that sender.

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CIRCUIT UNIT - SECTION -0108
REVERTIVE PULSING TEST CIRCUIT

CHANGES

B. CHANGES IN APPARATUS

B.1 Sheet 0108.

B.11 Superseded	Superseded By
Option "UX", "TE" B condenser .5 mf.	Option "TF" 4.28 - 4.36 mf.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Sheet 0108.

Option "TF" is added to provide an Improved Maximum Loop (AMX) Test Condition for Balanced Revertive Pulse Circuit.

D.2 Sheet 0111.

D.21 Options TE and TF are added to the "Record of Wiring" table (Note 106).

D.22 Note 119 is added.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit in conjunction with other units of the test circuit provides means of making tests on full selector terminating, dial pulse terminating, multi-frequency, and central "B" switchboard (terminating part) senders in a crossbar office.

2. WORKING LIMITS

2.1 None.

3. FUNCTIONS OF THIS CIRCUIT UNIT

3.01 To check the "T", "R", "S", "CO" and "D" leads of the terminating senders.

3.02 To set up registration in the full selector terminating and central "B" switchboard (terminating part) senders in terms of incoming and final selections on a revertive pulse basis.

3.03 To check reverse battery and trunk closure from the sender.

3.04 To test the trunk disconnect feature.

3.05 To make a telltale test.

3.06 To make a time out test.

3.07 To test F.S. Terminating Sender or Central "B" Sender (terminating part) (L) relay for non-operate and time out for Reverse Battery.

3.08 To send "over five" incoming group pulses under control of the (IG5) key.

3.09 To test reorder on Central "B" senders (terminating part).

3.10 To check talking circuit through Central "B" senders (terminating part) to the position at the switchboard part.

3.11 To give a tone to the operator at the Central "B" Switchboard position when the "terminating part" is in condition for keying so that the operator may key up a preassigned number.

3.12 To time the start-pulse signal from dial pulse senders.

Keys

3.13 (L) Key. This key when operated, adds the maximum loop resistance in the fundamental circuit and when normal the mininum loop resistance is in the fundamental.

3.14 (LST) Key. This key when operated tests the sender to insure that it will advance, following the completion of one fundamental selection, and reclose the fundamental in a definite maximum time. When the key is normal a test is made that the sender advances in a minimum time.

3.15 (SS) Key. This key, when operated, arranged the circuit for step-by-step operation.

3.16 (AV) Key. With the (SS) key operated, the (AV) key is used to send one selection into a terminating sender or one digit into a "B" sender and to cause the test circuit to advance to the next sender on "Time Out Test".

3.17 The (STP-OPR) key when operated tests the sender (L) and (STP) relays for operate, and with "WG" option tests the (STP) for release. This test applies only to senders with the unbalanced revertive pulse circuit.

3.18 The (LRB) key when operated tests that a full selector sender does not maintain too long a closure of reverse battery and when normal tests that the sender does not give too short a closure of reverse battery.

3.19 The (IG5) key when operated causes five additional pulses to be transmitted for incoming group selection.

3.20 The (TTSC) key when operated tests for short circuits on front contacts of the IB register which lock the (RV3) relay in a full selector sender.

3.21 The (RBT) key when operated tests that the reverse battery from F.S. terminating sender is not falsely delayed.

3.22 The (CBT) key when operated opens the "T", "R", "FT" and "FR" leads between the "terminating part" and the "Switchboard part" of the Central "B" switchboard sender and connects the leads from both parts to networks to duplicate the trunk resistance conditions.

3.23 The (LLR) key when operated cuts resistance into the leads between the "terminating part" and "switchboard part" of the Central "B" switchboard sender to test the relays on the working limits of the circuits.

3.24 The (TOS) key Fig. H when operated, releases the (TS) relay in the sender and permits the test man to talk through the "terminating part" of the Central "B" switchboard sender to the positions at the "switchboard part" under service conditions.

3.25 The (TO) key Fig. H when operated disconnects the "T" and "R" leads from the tone coil and connects them to the telephone set at the test frame.

3.26 The (DSD) key Fig. G or Fig. AX when operated changes the circuit to test for "Trunk Disconnect" before registration is completed.

3.27 The (DSR) key Fig. G or Fig. AX when operated operates relay (DSR) which locks and opens the "T" and "R" circuit to simulate a "Trunk Disconnect".

3.28 The (LTK) key Fig. G or Fig. AX when operated changes the dialing loop, from the test frame to maximum resistance.

3.29 The (SST) key Fig. G or Fig. AX when operated transfers the "R" lead to the sender frame and closes the "G" lead to (DPD) relay for testing at sender frame.

3.30 The (FTO) key Fig. G or Fig. AX when operated causes the dial pulse sender to release immediately after registration by means of the (FTO) relay.

3.31 The (IDT) key Fig. AZ when operated checks that the interdigital time out interval in the F.S. terminating sender is not too short.

3.32 The (IDT1) key Fig. AZ when operated checks that the interdigital time out interval in the F.S. terminating sender is not too long.

3.33 The (VIO) key, figure BD is used to connect 700 cycles to the (VI) jack for adjusting the network associated with the (TWT) key on sheet -0116 or -0118.

3.34 The (V17) key, figure BD is used to connect 1500 cycles to the (VI) jack for adjusting the network associated with the (TWT) key on sheet -0116 or -0118.

3.35 The (BAL) key when operated provides a maximum loop test condition for senders equipped for balanced revertive pulse circuits.

Lamps

3.36 The (D) lamp lights while waiting for the "D" lead to close.

3.37 The (DG) lamp lights when there is a false ground on the "D" lead.

3.38 The (CO) lamp lights while waiting for the "CO" lead to close.

3.39 The (RB) lamp lights while waiting for reverse battery.

3.40 The (TC) lamp lights while waiting for the terminating sender to recognize trunk closure and seizes a marker, or while waiting for a "B" sender to recognize completion of registration and seize a marker.

3.41 The (0-9) lamps indicate what number was transmitted to the marker for the particular digit being checked by the register check circuit at that time. The digit being checked is indicated by lamps shown on the register check circuit Fig. 6, sheet 0114.

3.42 The (IB), (IG), (FB), (FT) and (FU) lamps indicate which selection is next to be registered in the sender. These lamps are particularly useful on step-by-step operation.

3.43 The (TR) lamp lights while awaiting the closure of the "FT" and "FR" lead to the pulsing circuits.

3.44 The (CB-REG) lamp lights to indicate that the registration in the Central "B" Switchboard sender "terminating part" is from the position at the "switchboard part".

3.45 The (RC) lamp Fig. AM is lit during registration and when extinguished

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indicates the registration has been completed and the sender has advanced.

3.46 The (IDT) lamp lights while relay (IDT) is operated for interdigital time out test in F.S. terminating senders.

3.47 The (SSP) lamp lights when the "start-pulse" signal is too short.

3.48 The (LSP) lamp lights when the "start-pulse" signal is too long.

4. CONNECTING CIRCUITS

When the circuit is listed on a key sheet the connecting information shown thereon is to be followed.

4.01 Central "B" Switchboard Sender (Terminating Part) SD-25382-01.

4.02 Miscellaneous Interrupter Frame Circuit SD-25062-01.

4.03 Multifrequency Current Supply and Distribution Circuit - SD-95391-01.

4.04 Multifrequency Current Supply and Distribution Circuit - SD-95086-01.

4.05 Connector Circuit SD-25159-0102.

4.06 Sender Group Test Circuit - SD-25159-0106.

4.07 "B" Switchboard Sender and Position Finder Test Circuit - SD-25159-0112.

4.08 "B" Switchboard Sender and Position Finder and Multifrequency Pulsing Test Circuit - SD-25159-0116.

4.09 Multifrequency Pulsing Test Circuit SD-25159-0118.

4.10 Terminating Sender Timing Control Circuit - SD-25471-01.

4.11 Register Check Circuit - SD-25159-0114.

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DESCRIPTION OF OPERATION

5. SELECTION

5.1 F.S. Term. or Central "B" Sender

When a Full Selector Terminating or Central "B" switchboard (terminating part) sender has been selected for test by the test circuit, the sender group test unit grounds the "C" lead to this circuit operating the (C) relay. The (C) relay operated, operates the (BS) and (RC) relays upon operation of relay (C1) and then the (G) relay operates through contact on (BS) relay and connects thru the individual leads from the sender. The (C) relay also energizes the secondary winding of the (OF1) relay in the non-operate direction.

5.2 Dial Pulse Terminating Sender

When the Dial Pulse terminating senders are to be tested the (DPS) key and either "DT" or "SP" key should be operated. When Dial Pulse terminating sender has been selected for test by the test circuit, the sender group test unit gronnds the "C" lead to this circuit operating the (C) relay. Relay (DP1) will also be operated. Relay (C) operated closes the "D" lead to the winding of relay (TD3) to test the "D" lead for a false ground. Relay (C) operated also operates relay (IB) thru a back contact of relay (CO1) operates relay (IB') operates in turn operating relay (DP2) thru relay (DP1) operated, directly, with Fig. G. or after (RV3) operates, with Fig. AX.

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5.21 With Fig. AX Timing Test of Reverse-Battery Start-Pulse Signal

With Fig. G the "T" and "R" leads to the sender are closed when relay (DP1) operates, and no test is made of the start-pulse signal. With Fig. AX the "T" and "R" leads to the sender are closed through the polar (A) relay in Fig. 10 when the (DP3) relay is operated by the operation of the (SPF2) relay in the sender group test unit. This synchronizes the operation of the (A) relay in the test circuit with the operation of the (L) relay in the sender, for the timing test of the reversal of the "T" and "R" leads in the sender.

The operation of the (A) relay removes the ground from the secondary winding of the condenser-timed (RVT) relay allowing it to start to operate. If the (A) relay is still operated when (RVT) operates the (RV1) relay will operate and lock, and extinguish the (SSP) lamp, indicating that the start pulse was long enough. When (RV1) operates the slow-release (RV2) relay will start to release. If the sender reverses the battery and ground, as it should, before (RV2) releases, the release of (A) followed by the release of (RVT) will hold the (RV2) and operate the (RV3) relay. The (LSP) lamp will be extinguished indicating that the start pulse was not too long. The operation of (RV3) completes the path for the operation of (DP2), which lights the (RC) lamp, indicating that the sender is in condition for dialing; and short-circuits the winding of the (A) relay to remove this winding from the dialing circuit.

If the dial pulse senders on receiving "DT" class indication return dial tone only, without reversal of the tip and ring battery, when the (DT) key in the test circuit is provided with "WN" wiring. In this case the (A) relay is not released by reversal of the tip and ring leads in the sender. The operation of (A) operates (RVT) which operates (RV1) as before. Relay (RV2) releases, following operation of (RV1), and with "WN" wiring this causes the operation of (RV3). Relay (RV3) operated short-circuits the winding of the (A) relay, in preparation for dialing and operated (DP2) which lights the (RC) lamp.

6. CHECK OF "S" LEAD

6.1 F.S. and D.P. Terminating Senders

The (C) relay operated, lights the (CO) lamp and closes thru the "S" lead to the (C1) relay. There should be ground on the "S" lead from the sender circuit at this time which operates the (C1) relay. The (C1) relay locks under control of the (C) relay. If the check of the "S" lead does not function properly the test circuit will block and the (CO) lamp remain lit. The (C) relay also operates the (IB) relay.

6.2 Central "B" Sender

The Central "B" Sender test is the same as above for the F.S. terminating sender except that the (D) lamp is lit by the (C) relay.

7. CHECK OF "CO" LEAD

7.1 F.S. Terminating and Dial Pulse Senders

The (C1) relay operated, closes the "CO" lead to the (CO1) relay, through relay (IB) operated. Ground on the "CO" lead from the sender circuit operates the (CO1) relay, extinguishing the (CO) lamp. If the check of the "CO" lead does not function properly the test circuit will block and the (CO) lamp will remain lit.

7.2 Central "B" Switchboard Sender - Fig. H

The operation of relay (BS) on the Sender Group test circuit for a Central "B" Switchboard sender (terminating part) operates relays (BS1), (BS2) and (BS3). The (C1) relay operated, closes the "D" lead, from a polarized relay in the sender, thru normal contacts on relays (TD) and (TD1) and resistance (D) to relay (D). Relay (D) operates and (a) locks under control of relay (BS3), (b) extinguishes the (D) lamp and lights the (CO) lamp and (c) closes the "CO" lead to relay (COA) which operates. Relay (COA) operated closes ground to operate relay (CO1) through the (IB) relay operated and also closes the operating circuit for relay (IB2). If the check of the "D" or "CO" lead does not function properly the test circuit will block with the (D) or (CO) lamp lit.

8. REGISTRATION

8.1 Full Selector Terminating Sender

Before operating the (ST) key of the test circuit, the numerical keys corresponding to the number with which it is desired to test the sender should be depressed. This number is transmitted to the sender by means of revertive pulses in terms of incoming and final selections. When the (C) relay operates, ground thru the back contact of the (CO1) relay operates the (IB) relay and when the (CO1) relay operates it causes the (IB') relay to operate in series with the (IB) relay lighting the (IB) lamp. These relays lock under control of the (IG') relay.

The (CO1) relay operated, extinguishes the (CO) lamp, and operates the (FO1) relay. The (FO1) relay operated, bridges the (OF) and (STP) relays across the "T" and "R" leads completing the fundamental circuit. This bridge circuit causes the sender circuit (L) relay to operate and prepare the

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pulsing circuit of the sender. The (OF) relay is a polarized relay and does not operate at this time, but the (STP) relay operates and closes a circuit thru the back contact of the (1') relay, front contact of the (IB') relay, thru the operated (TH) key, back contact of the (IF) relay, to operate the counting relay corresponding to the operated (TH) key. The pulsing circuit of the sender functions and sends ground pulses over the "T" lead at a speed of about 16 to 28 pulses per second. The first ground pulse from the sender short-circuits the (STP) relay of the test circuit and the (STP) relay of the sender which is in series. The (STP) relay of the test circuit releases causing counting relays to operate as in a subscriber sender until the (FO) and (BO) relays operate. The (BO) relay in operating opens the fundamental circuit which stops the pulsing mechanism of the terminating sender circuit. The (FO) relay operated operates the (IG) relay which in turn permits the (IG') relay to operate upon the release of relay (FO). Relay (IG) also operates relay (IG1) in turn releasing relay (FO1). The (FO1) relay in releasing also removes the holding ground from the counting relays causing them to release, the (FO) relay releasing with the other counting relays.

The (FO) relay when it operated also released the (BS) relay. The (BS) relay also opens the fundamental circuit and connects the (BS) condenser to the winding of the (BST) relay which operates opening the operating circuit to the (BS) relay. The current that is operating the (BST) relay will start to decrease as the (BS) condenser is charged and finally the current will be reduced to a point where hte (BST) relay will release reoperating the (BS) relay provided the (FO) relay in the meantime has released which is usually will. The (BST) relay due to the close requirement of the associated resistances and (BS) condenser is operated for a very definite and uniform time and, therefore, the (BS) relay remains released, keeping the fundamental open, for a definite time and this time is such as to test the sender to insure its advance to the next selection within a certain time. This action takes place between each fundamental selection.

With the (LST) key normal this between-selections timing interval is such as to test the sender to make sure that it will advance on a minimum open of the fundamental while with the (LST) key operated the sender is tested with a long between-selections interval. Both of these intervals are necessary to assure that the sender will work in service.

The (FO) relay in releasing removes ground that is shunting the (IG') relay which now operates in series with the (IG) relay and they both lock under control of the (FB') relay. The (IG') relay releases the (IB) and (IB8) relays and when the (IB') has released with the (IG') and (IG1) relays operated a path is closed reoperating the (FO1) relay. The test circuit has now completed its registration for "Incoming Brush" and the sender circuit has functioned to establish a record, on its crossbar register switch, of the number of pulses that it was necessary to transmit to satisfy the condition set up in the test set by the operation of the numerical keys.

The sender proceeds to prepare itself for the next registration which is "Incoming Group". The (IG') relay lights the (IG) lamp and releases the (IB') relay extinguishing the (IB) lamp. When the (FO1) and (BS) relays have reoperated the fundamental circuit is again closed and when the sender has functioned to connect the (L) relay to the "T" tip lead and the (STP) relay to the "R" ring lead, the test circuit proceeds with "Incoming Group" selection. Incoming Group, Final Brush, Final Tens and Final Units selections are made in the same manner as described above for Incoming Brush Selection, the (IG) and (IG;) relays being used for Incoming Group, the (FB) and (FB') relays being used for Final Brush, the (FT) and (FT') relays being used for Final Tens, and the (FU) and (FU') relays being used for Final Units registration. The (FB), (FT) and (FU) lamps will be lighted as the associated (FB'), (FT') or (FU') relays are operated. The (IGA) and (IG) relays are used in connection with Incoming Group registration. The (IGA) relay is operated if an odd thousands key is operated and the (IGB) relay is operated if a hundreds key above 4 is operated. The counting relay arrangement is such that if more than five pulses are necessary for Final Tens or Final Units registration the particular counting relay first operated will be the one whose number when added to 5 will give the number corresponding to the number of pulses required. The (RC) relay is operated for all pulse count conditions except that where the number of pulses required is more than five the (RC) relay releases when the (5) relay operates.

If for any reason any selection does not progress properly due to trouble in the test circuit or sender the test will block. If the sender recorded the registration incorrectly the test will block at the time the sender registration is checked by the register check feature of the test circuit.

8.2 Central "B" Switchboard Sender - Fig. H

The closure of the "B" lead to the sender operates the sender (TS) relay cutting the "T", "R", "FT" and "FR" leads from the "terminating part" of the sender to the test circuit as leads "T", "R", "FT" and "FR" also the "T", "R", "FT" and "FR" leads from the "switchboard part" of the sender to the test circuit as leads "CT", "CR", "CFT" and "CFR". The operation of relay (BS1) transfers the "T" and "R" of the (STP) relay circuit of the test circuit from the connector, so that it is now connected through relays (PM2), (SP) and (CBT) to the sender over the "FT" and "FR" leads. The "T" and "R" leads from the sender, through the connector circuit are connected to the tone coil through the (TO) key. The "T" and "R" leads from the sender through the sender (TS) relay are connected to relay (A) thru contacts on relay (RO) to simulate the "switchboard part" of the sender.

Before operating the (ST) key of the test circuit, the numerical keys corresponding to the number with which it is desired to test the sender should be depressed. This number is transmitted to the sender by means of revertive pulses in terms of incoming and final selections. When the (C) relay operates ground through the back contact of the (CO1) relay operates relay (IB) and when the (CO1) relay operates it causes the operation of relay (IB'). The operation of relay (IB') operates relay (IB2) through contact on relay (BS1) operated. The operation of relay (IB2) lights the (TR) lamp and closes a ground to operate relay (SP) when relay (A) is operated. The closure of the "T" and "R" leads from the sender operates relay (A). Relay (SP) operated (a) locks under control of relay (BS1), (b) closes the "FT" and "FR" leads through toward the (STP) and (OF) relays in the test circuit and (c) extinguishes the (TR) lamp and lights the (IB) lamp. The further operation of the test circuit will be the same as described in paragraph 8.1.

8.3 Dial Pulse Terminating Sender - Fig. G

Before operating the (ST) key of the test circuit, the numerical keys corresponding to the number with which it is desired to test the sender should be depressed. This number is transmitted to the sender by means of the dial. When the (C) relay operates ground through the back contact of relay (CO1) operates relay (IB) closing the operating circuit for the (CO1) relay. When relay (CO1) operates it permits the operation of relay (IB') in series with relay (IB), in turn operating relay (DP2). Relay (DP2) operated (a) locks under control of relay (C) , (b) transfers its operating ground lead to the (RC) lamp through relay (DRC) normal, which lights, (c) opens the "D" lead from the winding of relay (TD3) and closes it in part to relay(D) through resistance (D). The (RC) lamp lighted indicates that the sender is in condition for dialing.

8.31 With Fig. AX

The circuit operation is the same as just described except that the operation of (DP2) waits for the operation of (RV3) as described in Paragraph 5.21.

8.32 Registration Over Long Trunk, (LTK) Key Operated

The operation of the (LTK) key cuts resistance into the trunk to simulate the worst conditions over which the sender receives dial pulses.

9. REVERSE BATTERY - FULL SELECTOR TERMINATING SENDER

At the conclusion of Final Units registration the sender functions to return battery over the "R" lead and ground over the "T" lead. When the (FO) relay of the test circuit operated for Final Units selection it caused the (RB) relay to operate and when the (FO) relay released, the (RB') relay operates in series with the (RB) relay, locks to the (C) relay and opens the locking circuit for the (FU) and (FU') relays. The (RB) relay operated lights the (RB) lamp. When the (FO1) relay has operated, the fundamental circuit is again closed toward the sender circuit. The sender, at this time, is furnished battery and ground in the reversed direction from which it was furnished for registration. This circuit operates the (L) relay in the sender circuit and the (OF) polarized relay in the test circuit.

With the (LRB) key normal, to test the sender for minimum reverse battery interval, the (OF) relay operated, operates the (OF1) relay. The (OF1) relay is slow in operating due to the fact that the current for charging the (BS) condenser flows thru the secondary winding of the (OF1) relay preventing its operation until the (BS) condenser is charged. If the reverse battery is removed by the sender circuit before the (CF1) relay operates, the (OF) relay will release and the non-operate condition for the (OF1) relay will be reestablished. Under this condition the test circuit will block and the (RB) lamp will remain lit. However, if the timing of the reverse battery condition by the sender circut is satisfactory, the (OF) relay will be held operated long enough for the (OF1) relay to operate.

With "Z" wiring and Fig. A the (OF1) relay operated, operates relay (OF2) which locks, extinguishes the (RB) lamp, and lights the (D) lamp.

With "Y" wiring and Fig. B the (OF1) relay operated, operates (OF3) which locks and grounds the armature of (OF). When the sender opens the fundamental, the (OF) relay releases, operating the (OF2) relay. The (OF2) relay locks, extinguishes the (RB) lamp and lights the (D) lamp.

During incoming group selection the (IG) relay opens the condenser circuit which delays the operation of (OF1). This permits the (OF1) to operate on incoming group selection if the fundamental is reversed. The (IG) contact is also used to open the condenser when adjusting the (OF1) relay.

With the (LRB) key operated - to test that the reverse battery interval is not too long, the operation of the (OF) relay starts the (OF1) relay to operating and operates the (OF3). The sender should advance and terminate reverse battery before the (OF1) relay has operated. The (OG) relay then releases and operates the (OF2) relay and the test continues to advance. If the reverse battery interval is too long, causing the (OF) relay to remain operated until after the (OF1) relay has operated, the circuit to the (OF2) relay will be opened and the test circuit will block.

9.1 Check for Delayed Reverse Battery F. S. Terminating Sender - Fig. P

(RBT) key operated, (LRB), (LST) and (TT-SC) keys normal. With the (RBT) key operated, the operation of relay (STR) operates relay (RBT1) which locks to contacts on both the (RB2) and (FO1) relays. Relay (RBT1) operated operates relay (RBT2). Also with the (RBT) key operated and relay (RB') operated, after units registration, relay (RB2) operates. Relay (RB2) operated (a) opens its side of the locking circuit for relay (RBT1), (b) closes in part a circuit to operate relay (RBT), (c) opens the operating circuit for the (OF2) relay and (d) opens the locking circuit of the (STR) relay. The operation of relay (FO1) for closure of the fundamental, for check of reverse battery from the F. S. Terminating Sender, opens the locking circuit of relay (RBT1) which releases in turn releasing relay (RBT2). Relay (RBT2) is slow enough in releasing to permit the sender to function and return the reversed battery operating relay (OF) in turn operating relay (RBT) which locks. Relay (RBT) operated recloses the operating circuit for the (OF2) relay. The test circuit now proceeds as described under "Reverse Battery". If relay (RBT2) releases before relay (RBT) is operated the test circuit will block with the (RB) lamp lighted.

10. TEST OF TRUNK CLOSURE CIRCUIT

10.1 F. S. Terminating Sender

The operation of the (OF2) relay also transfers the tip to the (T) relay and the ring to a contact of the (R) relay. After the reverse battery has been disconnected by the sender, it opens the "CO" lead, connects battery thru a resistance lamp to the tip operating relay (T), and connects the ring to a contact on the sender (RB5) relay. This releases the test circuit (CO1) relay and operates the (R) relay. This operates the (T1) relay, which locks under control of the (C) relay, transfers the "CO" lead to relay (CO2), and transfers the "D" lead to the (D) relay. Previously the "D" lead was connected to the (TD3) relay which would operate and block the test circuit by opening the operating circuit of the (D) relay, if the "D" lead was grounded prematurely. The (T1) relay also operates the (R) relay which when operated grounds the ring lead which short-circuits and releases the sender (RV5) relay. With the sender (RV5) relay released, the "D" lead is grounded thru a relay and resistance, the "T" lead is opened, and battery thru the resistance lamp is connected to the "CO" lead. In the test circuit this causes the (D) relay to operate, the (T) relay to release, and the (CO2) to operate. The (CO2) relay opens the operating path to the (R) relay which will release provided there is not a resistance battery on the "R" lead. With these relays in the condition stated the test circuit locks the (D) relay and supplies ground thru a resistance to the "D" lead which causes a test operate current to be applied to the sender (TC1) relay. The (D) relay operated extinguishes the (D) lamp and lights the (TC) lamp.

The operation of the sender (TC1) relay causes a terminating marker to be selected which in turn operates relays in the register check circuit, which ground lead "TC", operating the (TC) relay. This indicates that the trunk closure signal has been registered properly in the sender. The (TC) relay operated locks under control of the (C) relay, extinguishes the (TC) lamp, and provides a path from the "AV" lead of the register check circuit to the "ADV" lead of the connector circuit, to permit a signal to be passed indicating that the test has been completed.

10.2 Dial Pulse Terminating Sender

At the completion of registration of units digit in the sender, the sender functions to open the "CO" lead and connect low resistance ground to the "D" lead. The opening of the "CO" lead releases relay (CO1) which operates relay (DRC). Relay (DRC) operated (a) closes the "D" lead through to the (D) relay, (b) closes a locking ground for relay (D), (c) extinguishes the (RC) lamp and (d) lights the (D) lamp. The low resistance ground, through the (TC1) relay of the sender, over the "D" lead operates relay (D). Relay (D) operated, (a) closes its locking ground through a resistance over the "D" lead operating the sender relay (TC1),

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(b) extinguishes the (D) lamp and (c) lights the (TC) lamp.

The operation of the sender (TC1) relay causes a terminating marker to be selected which in turn operates relays in the register check circuit, which ground lead "TC", operating the (TC) relay. This indicates that the trunk closure signal has been registered properly in the sender. The (TC) relay operated, locks under control of the (C) relay, extinguishes the (TC) lamp, closes ground to the "TRL" lead and provides a path from the "AV" lead of the register check circuit to the "ADV" lead of the connector circuit, to permit a signal to be passed indicating that the test has been completed and properly checked by the register check circuit.

11. RELEASE

When a test has been completed the connector opens the "C" lead releasing the (C) relay. This in turn releases all other relays in the circuit.

12. STEP-BY-STEP REGISTRATION

12.1 F.S. Terminating and Central "B" Switchboard (Terminating Part) Senders

When the step-by-step (SS) key is operated, the (FO1) relay is prevented from operating until the (AV) key is operated and released. The operation and release of the non-locking (AV) key operates the (SA) and (SA') relay, which permits the (FO1) relay to operate. The function of the (AV) key must be performed at the sender frame by the use of the white button of the 32A test set, which momentarily grounds the "RC" lead.

12.2 Dial Pulse Sender

As the registration in the dial pulse terminating sender is made by dialing each digit manually, step-by-step operation is accomplished by delaying the dialing of each digit as desired.

13. TRUNK DISCONNECT TEST

13.1 F. S. Terminating Sender

There is a feature in the sender circuit which functions to restore the circuit to normal in case a premature disconnect signal is received from the trunk circuit. When this feature is to be tested, the trunk disconnect #5 class key of the connector circuit is operated which supplies ground over the "TD" lead operating the (TD1) relay. When the (C) relay operates the "D" lead is closed from the connector circuit thru the front contacts of the (TD1) relay to the winding of the (TD) relay. The test circuit functions in a normal manner up to where the sender functions to apply ground thru a resistance and the polarized (TC1) relay to the "D" lead at the completion of the reverse battery period, the (TC) relay operates. The (TD) relay operates under this condition but the polarized (TC1) relay in the sender does not operated. The (TD) operates and locks and the locking ground is supplied to the "D" lead causing the sender (TC1) relay to operate. The (TD) relay operated also causes the (TD1) relay to release. The (TD1) relay is slow release in order to allow sufficient time for the sender relays to function. The (TD1) relay released, connects the "D" lead to relay (TD3). The sender polarized (TC1) relay releases and the sender then functions to restore to normal. The sender opens the "S" lead causing the (C1) relay to release. Ground thru the front contacts of the (TD) relay and back contacts of the (C1) relay is supplied over the "ADV" lead to the connector circuit causing the test circuit to advance. If the premature disconnect feature of the sender fails to function properly the "S" lead will not be opened by the time the (TD2) relay has released. The (TD2) relay released furnishes a locking circuit for the (C1) relay. With the (C1) relay locked under this condition the test circuit will block and the (D) lamp will remain lit. If the sender fails to remove ground from the "D" lead, the (TD3) relay will operate, and lock opening the "ADV" lead and blocking the test circuit with the (DG) lamp lit. Precautions outlined in Section 0102 under "Trunk Disconnect Test" should be observed.

13.2 Central "B" Switchboard Sender (Terminating Part)

There is a feature in the sender circuit which functions to restore the circuit to normal in case a premature disconnect signal is received from the trunk circuit. When this feature is to be tested, the trunk disconnect #5 class key of the connector circuit is operated which supplies ground over the "TD" lead operating the (TD1) relay. When the (C1) relay operates the "D" lead is closed from the connector circuit through the front contacts of relay (TD1) to the winding of relay (TD). The (TD) relay operates under this condition but the polarized (TC1) relay in the sender does not operate. The (TD) relay operates and locks to the "TD" lead ground which is now supplied to the "D" lead which causes the sender (TC1) relay to operate. The (TD) relay operated also causes the release of relay (TD1). The (TD1) relay is slow release in order to allow fufficient time for the sender relays to function. The (TD1) relay released connects the "D" lead to relay (TD3). The sender polarized relay (TC1) releases and the sender then functions to restore to normal. The sender opens the

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"S" lead which permits the (C1) relay to release. Ground through back contact on (TD2) relay, front contact on relay (TD), back contact on relay (C1) and back contact on relay (TD3) is supplied over the "ADV" lead to the connector circuit causing the test circuit to advance. If the premature disconnect feature of the sender fails to function properly the "S" lead will not be opened by the time the (TD2) relay has released. Relay (TD2) released, furnishes a locking circuit for the (C1) relay. With the (C1) relay locked under this condition the test circuit will block and the (D) lamp will remain lit. If the sender fails to remove ground from the "D" lead, relay (TD3) will operate and lock opening the "ADV" lead and blocking the test circuit with the (DG) lamp lit. Precautions outlined in section 0102 under "Trunk Disconnect Test" should be observed.

13.3 Dial Pulse Terminating Sender

13.31 Disconnect Before Registration is Completed. Class (0) and (DSD) Keys Operated

There is a feature in the sender circuit which functions to restore the circuit to normal in case the call is abandoned after the sender has been seized but before registration is completed. When this feature is to be tested, the trunk disconnect key (DSD) is operated, supplying ground over the "TD" lead to operate relay (DTR). To simulate the release condition the (DSR) key is momentarily operated at any time before all digits have been dialed. The operation of the (DSR) key operates relay (DSR) which locks under control of relay (DRC) and opens the "T" and "R" leads releasing the (L) relay in the sender. The sender now proceeds to return to normal opening the "S" and "CO" leads. The "CO" lead opened releases relay (CO1) which operates relay (DRC). Relay (DRC) operated, (a) extinguishes the (RC) lamp, (b) lights the (S) lamp, (c) opens the locking circuit of relay (DSR) which releases and (d) closes ground, in part, to the "ADV" lead to the connector circuit. The "S" lead opened releases relay (C1) which closes the circuit to the "ADV" lead to the connector circuit. Should the "CO" open but the "S" lead fail to open the test circuit will block with the "S" lamp lit. The sender should release immediately after the disconnect. However, if the sender fails to release it will be released after the sender time out period of 28 to 58 seconds is completed. Precautions outlined in section 0102 under "Trunk Disconnect Test" should be observed.

13.32 After Registration is Completed (#5 Class Key Operated)

There is a feature in the sender circuit which functions to restore the circuit to normal in case the call is abandoned after the registration has been completed. When this feature is to be tested the trunk disconnect, #5 class, key of the connector circuit is operated supplying ground over the "TD" lead to operate relay (TD1). When the (C) relay operates the "D" lead is closed from the connector circuit thru the front contacts of relay (TD1) to the winding of relay (TD). The test circuit functions in a normal manner up to completion of dialing where the sender functions to apply ground thru a resistance and the polarized relay (TC1) to the "D" lead operating relay (TD). The polarized relay (TC1) does not operate at this time but when relay (TD) locks the locking ground is supplied over the "D" lead causing the operation of the sender (TC1) relay. Relay (TD) operated also causes the release of relay (TD1) which connects the "D" lead to the winding of relay (TD3). Relay (TD1) is slow release in order to allow sufficient time for the sender relays to function. The sender (TC1) relay now releases causing the sender to restore to normal. The sender opens the "S" lead causing the release of relay (C1). Ground thru back contact on relay (TD2), front contact on relay (TD), back contacts on relays (C1) and (TD3) is supplied over the "ADV" lead to the connector circuit causing the test circuit to advance. If the sender fails to function properly and open the "S" lead by the time the (TD2) relay has released relay (C1) will be locked. With the (C1) relay locked under this condition the test circuit will block with the (D) lamp lit. If the sender fails to remove ground from the "D" lead the (TD3) relay will operate, and lock, opening the "ADV" lead and blocking the test circuit with the (D) lamp lit. Precautions outlined in section 0102 under "Trunk Disconnect Test" should be observed.

14. COMPENSATING NETWORK - F. S. TERMINATING AND CENTRAL "B" SWITCHBOARD (TERMINATING PART) SENDERS

The (L) key provides means for changing the cable loop condition for testing the revertive pulsing feature of the sender circuit. With this key normal the sender is tested to insure satisfactory operation on minimum loop resistance and when operated, on maximum loop resistance.

15. TELLTALE TEST

15.1 F. S. Terminating Sender - #2 Class Key and (PBS) Key Operated

When the Telltale class key is operated ground over the "TT" lead operates the (TT) relay. The (TT) relay operated, short circuits the (STP) relay, operates the (TT1) relay, and prepares in part a circuit for lighting the (RB) lamp. The (TT) relay also prepares a path for operating the connector (BK) relay if a marker

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is called in on this test. When the (ST) key of the test circuit is operated, with the (TT) relay operated, the test proceeds in the regular manner until such time as the fundamental circuit is closed for incoming brush selection. Due to the fact that the (STP) relay is short-circuited by the contacts of the (TT) relay the pulsing circuit of the terminating sender proceeds to record eleven pulses and then functions to send reverse battery to the test circuit. This battery reversal operates the (OF) relay. This reverse battery interval is recorded as outlined under "Reverse Battery" and if the sender functions satisfactorily the (OF2) relay is operated. The (OF2) operated extinguishes the (RB) lamp, lights the (D) lamp, and causes the operation previously described under "Test of Trunk Closure Circuit" to be performed, finally operating relay (D) and grounding the "D" lead. This releases the (TT1) relay which grounds the "ADV" lead causing the test circuit to release as usual. The (TT1) is slow release to give the sender time to respond to the signal on the "D" lead.

This test should be made with the (LRB) key operated.

If the sender prematurely removes ground from the "S" lead, the (S) relay will operate and block the test circuit.

15.2 Central "B" Switchboard, (Terminating Part) - #2 Class Key, (BS) and (RO) Keys Operated

The Central "B" sender routes a "Telltale" call to "Reorder" by means of the Marker therefore a check through the Register check circuit is required. When the Telltale Class key #2 is operated ground over the "TT" lead operates the (TT) relay. The (TT) relay operated, short circuits the (STP) relay. The "0" numerical keys should be operated and as this call is routed to "reorder" by the sender the (RO) key should be operated. Relay (BS2) operated opens the "BK" lead from the "Register Check Circuit" to prevent blocking the test circuit when the marker is called in to complete the test.

When the (ST) key of the test circuit is operated, with the (TT) relay operated, the test proceeds in the regular manner until such time as the fundamental circuit is closed for incoming brush selection. Due to the fact that the (STP) relay is short-circuited by the contacts of the (TT) relay the pulsing circuit of the Central "B" sender proceeds to record eleven pulses and then functions to call in the marker and route the call to "reorder." The operation of the sender (MS) relay causes a terminating marker to be selected in turn operating relays in the register check circuit which causes ground to be connected to the "TC" lead operating relay (TC). Relay (TC) operated, (a) locks under control of relay (C), (b) closes in part the "AV" lead from the register check circuit to the "ADV" lead to the connector circuit to permit a signal to be passed to the connector, indicating that the test has been completed and (c) extinguishes the (TC) lamp and connects ground to the "TRL" lead toward the register check circuit. The check will now be completed as previously described for a regular call.

15.3 Test for Shorted Contact on IB Vertical Which Controls Locking Circuit of Sender (RV3) Relay - F. S. Terminating Sender

Telltale class key #2, (PBS) pass "B" sender key, and (TT-SC) key of -0108 operated. Test proceeds as usual on telltale class except that operation of (OF) locks (OF) and operates (OF2) immediately. This opens fundamental and releases sender (L) relay. If locking circuit of sender (RV3) is closed due to short circuit on (IB) register controls, sender and test circuit will block.

16. TEST OF TERMINATING SENDER (L) RELAY FOR NON-OPERATE AND TIME OUT FOR REVERSE BATTERY - NO. 7 CLASS KEY OPERATED, (LRB) AND (L) KEYS NORMAL

This test is made to insure the proper operation of the sender when functioning with an incoming selector test circuit and to test the sender (L) relay for non-operate and also to insure that the sender after final units digit has been recorded will not time out and send reverse battery in less than approximately 1 to 2.5 seconds.

The No. 7 class key operates the (LNO) relay and the sender and the test circuit function in a normal manner as has been described up to the completion of final units selection. When the (BO) and (FO) relays are operated at the completion of final units and the (RB) and (RB') relays have operated as usual, with the (LNO) relay operated and when the (FO1) relay has again operated, the fundamental circuit is closed for receiving reverse battery. However, a high resistance is placed in the fundamental circuit through which the sender (L) relay should not operate. At the same time ground to the secondary winding of the (OF1) relay is opened. This ground was holding the (OF1) relay in its non-operate position even though the relay is energized in the operate direction on its primary winding. The (OF1) relay will not operate immediately however, on removing ground to the secondary since current will continue to flow through the other winding as the associated condenser is charged. This current is reduced, however, as the condenser becomes charged and finally the energy produced by the secondonary

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winding is not as great as that produced by the current in the primary winding and the (OF1) relay operates. There is a time delay then from the closure of the fundamental by the (FO1) relay to where the (OF1) relay operates and this time is to allow the sender time to advance and reverse the tip and ring if the sender (L) relay should operate falsely on its non-operate test current. Should this occur before the (OF1) relay has operated, the (OF) relay would be operated in turn operating the (BK) relay and the test would be blocked. If, however, the (L) relay does not operate, the (OF1) relay will operate the (LN1) relay and the test circuit waits for the sender to time out and send reverse battery which it should do in approximately 1 to 2.5 seconds. The operation of the (OF) relay on this reverse battery will close ground to the armature of the (LNO) interrupter. When the interrupter closes its (B) contact, the (LN2) relay will be operated and locked and then when the interrupter (F) contact closes, the (LN3) operates and locks. There is a delay then after receiving reverse battery until the (LN3) relay operates of approximately 5 to 12 seconds and this time is to allow time for the sender to advance and open reverse battery closure if there is trouble in the sender which might cause it to do this. When the (LN3) relay is operated the high resistance in the fundamental circuit is shunted and the sender (L) relay should operate and the sender should advance and terminate the reverse battery closure. The (OF) relay will then release operating the (OF2) relay and the test circuit and sender continue to function in a normal manner as has been described.

17. TIME OUT TEST

17.1 F. S. Terminating Sender

Class Key No. 6, (PBS), Fig. 1D or (TS) 1E, (LRB) and (TA) key operated, (APB) key normal. Insert a plug in the hold jack of the sender. When making this test the sender minor alarm will be sounded and the other members of the maintenance force should be advised accordingly.

When the (C) relay operates in the beginning the (TM) relay operates from the No. 6 class key and the (TT) relay is operated. The (TT) relay operates the (TT1) relay which lights the (RB) lamp and shorts the winding of the (STP) relay. The (TM) relay opens the "T" lead and connects ground through the winding of the (OF) relay to the "R" lead. The sender should start to time out because the (L) relay will not be operated. The (RB) lamp should stay lit until the sender does time out and this time out period should be measured with a stop watch and should be between 28 and 58 seconds. When the sender has timed out battery thru the (L) relay timing is connected to the "R" lead operating the (OF) relay and finally the (OF2) relay is operated in the usual manner extinguishing the (RB) lamp. One second after closing reverse battery the sender advances and removes ground from the "S" lead releasing the (C1) relay which lights the (S) lamp. The test circuit and sender continue to advance as described under "Test of Trunk Closure Circuit" except that the (TM) relay has opened a path over which the test circuit usually causes an advance signal to be sent so that the test circuit and sender will wait. The sender has connected ground to a miscellaneous alarm circuit which starts to time out and 5 to 12 seconds after the (RB) lamp is extinguished the sender minor alarm should sound, and the (TL) lamp at Trouble Indicator frame lights. The (MGB) key is then operated to make the sender group busy so that when the sender is subsequently released with the test circuit attached service will not be interfered with. The hold plug is now removed from the hold jack of the sender and the minor alarm is silenced and the (TL) lamp is extinguished. The (AV) key should be operated and released which will cause the test circuit to advance and start testing the next sender or the same sender as just tested if the (REP) key is operated. Once the (MGB) key has been operated, the hold plug should be removed and the (AV) key operated without undue delay since the sender sub-group is made busy until the test circuit seizes the next sender to be tested.

17.2 Central "B" Switchboard Sender (Terminating Part)

Class Key No. 6, (BS) and (TA) keys operated, (APB) key normal. Insert a plug in the hold jack of the sender. When making this test the sender minor alarm will be sounded and the other members of the maintenance force should be advised accordingly.

When the (C) relay operates in the beginning the (TM) relay is operated from the No. 6 key and the (TT) relay is also operated. The (TM) relay opens the "T" lead and connects ground through the winding of the (OF) relay to the "R" lead. Relay (BS3) operated prevents the release of the sender (TC1) relay. The sender should start to time out because the (L) relay will not be operated. The (TC) lamp will remain lit until the sender does time out and open the "CO" lead which releases relay (COA). This time out period should be between 28 and 58 seconds and should be measured with a stop watch. The sender has connected ground to a miscellaneous alarm circuit which starts to time out and 5 to 12 seconds after the (TC) lamp is extinguished the sender minor alarm should sound, and the (TL) lamp at Trouble Indicator frame lights. The (MGB) key is then operated to make the sender group busy so that when the sender is subsequently released with the test circuit attached service will not be interfered with. The hold plug is now removed from the hold jack of the sender and the minor alarm is silenced and the (TL) lamp extinguished. The (AV) key should be momentarily operated which will cause the test circuit to advance and start testing the next sender or the same sender, as just tested if the (REP) key is operated. When the (REP) key is operated the (AV) key should be held operated until the test circuit advances for the next test. Once the (MGB) key has been operated, the hold plug should be removed and the (AV) key operated without undue delay since the sender sub-group is made busy until the test circuit has seized the next sender to be tested.

17.3 Dial Pulse Terminating Sender

17.31 Route to Reorder

Keys (DPS), (TA) and (RO) operated. The numerical keys should also be set up for 0,0,0,0. As this sender attempts to route timed-out calls to "reorder" the (RO) key should be operated to check that the sender functions properly. This test is made in the same manner as for a regular call except that no digits, or part of the digits only, are dialed. The (RC) lamp should remain lit until the sender does time out when it is extinguished and the (TC) lamp lighted. This time out period should be measured with a stop watch and should be between 28 and 58 seconds. The sender should now call in the marker and route the call to "reorder" in the regular manner.

17.32 Trouble Release

Keys (DPS), (TA) and class key #6 operated. When making this test the (FTO) relay in the sender under test shall be blocked operated. Insert a plug in the hold jack of the sender. When making this test the sender minor alarm will be sounded and the other members of the maintenance force should be advised accordingly. When the (C) relay operates in the beginning relay (DTM) operates from the #6 class key. Relay (DTM) operated opens the locking circuit for the (D) relay and closes the contact of the (AV) key to the "ADV" lead toward the connector. This test will proceed as for "route to reorder" up to the operation of relay (D) when, due to its locking circuit being open, no ground is provided to operate relay (TC1) of the sender. The failure of the (TC1) relay to operate prevents the calling in of a marker and routing to reorder. The sender remains stuck and continues to time. At the termination of another 30 seconds the sender (TRL) relay is operated but due to the plug in the hold jack the trouble release is not effective. The "S" lead will be opened releasing relay (C1) which lights the (S) lamp. The sender closes ground to the (TL) lamp at the Trouble Indicator Frame. The sender has also connected ground to a miscellaneous alarm circuit which starts to time out and 5 to 12 seconds after the (S) lamp is lighted the minor alarm should sound.

The (MGB) key is then operated to make the sender group busy so that when the sender is subsequently released with the test circuit attached service will not be interfered with. The hold plug is now removed from the hold jack of the sender and the minor alarm is silenced and the (TL) lamp extinguished. The (AV) key should be operated and released which will cause the test circuit to advance and start testing the next sender, or the same sender as just tested if the (REP) key is operated. Once the (MGB) key has been operated, the hold plug should be removed and the (AV) key operated without undue delay since the sender subgroup is made busy until the test circuit seizes the next sender to be tested.

17.33 Fast Release of Sender - (FTO) Relay

Keys (FTO) and Class "0" operated. This test is made to check that the (FTO) relay releases and releases the sender should the trunk have been abandoned at a time that no ground is available to lock relay (D) in the trunk after having been operated. All digits should be dialed but as the (FTO) key opens the locking circuit for the test circuit relay (D), relays (TC1) and (TC2) in the sender will not be operated. The call cannot be completed through the marker as the "ST" lead will not be closed. Relay (FTO) releases operating sender relays (TC3) and (RL) which opens the "S" lead permitting the release of relay (C1). The (FTO) key operated opens the locking circuit of the (C1) relay.

At the completion of dialing the (RC) lamp will be extinguished and the (D) lamp lighted. The operation of relay (D) extinguishes the (D) lamp awaiting the release of relay (C1) which will close the (ADV) lead to the connector. The opening of the "D" lead by the sender releases the (D) relay which again lights the (D) lamp. If the sender (FTO) relay fails to release the (S) lamp remains lighted.

18. FUNDAMENTAL SELECTION TEST CONDITION

The following is a list of the test conditions that should be made on the F.S. terminating and central "B" switchboard terminating senders. These tests, will not of course, check every cross-point on the register switch in the sender and if any

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particular crosspoint is thought to be in trouble a test should be made that causes that crosspoint to be used. To speed up such tests, the (L) and (LST) key should be normal.

Test Call No. 1

(LST) key normal to obtain minimum between-selection interval and (L) key normal. Test No. 0000 to give 0 selection for incoming brush to final unit selections. This test combination will check the F. S. terminating and Central "B" switchboard senders for the following:

(a) That the (L2) relay is held operated until the (SM) relay releases.

(b) That the (SM) relay is held operated through the back contact of the (RM) relay after the (L2) relay has reoperated for the next selection.

(c) The 6B contact of the (L2) relay and the 8B contact of the (L2) relay.

(d) That the (L2) relay has the required slow operate time and that the (RA1) relay has the required operate and release time.

Test Call No. 2

(L) and (LST) keys normal. Test No. 9999. This test combination will check the F. S. terminating and central "B" switchboard senders for the following:

(a) That the 3B contact on the (L2) relay is not open.

(b) That the 6B contact of the (L2) relay does not open too soon due to this relay releasing abnormally fast.

(c) The ability of the (L3), (L4) and (L5) relays to respond to the opening of the (GR) relay contacts.

(d) The ability of the (P) relays to follow fast pulses.

Test Call No. 3

F. S. terminating and Central "B" Switchboard senders. This test checks the circuit for holding the (SM) relay operated under conditions where it depends entirely upon the 5B contact of the (L2) relay. (LST) key operated to obtain maximum between selections interval. (L) key normal. Any test number may be used, however, to save time - 0000 may be used.

Test Call No. 4 (Unbalanced Revertive Pulse Circuit)

(LST) key normal, (L) key operated, Test No. 9999. This test combination checks the ability of the F. S. terminating and central "B" Switchboard senders L3 and L4 relays to respond to short closures and the ability of the (L) relay to release against a line leak current flow.

Test Call No. 4 (Balanced Revertive Pulse Circuit)

(LST) key normal, (L) key operated, (BAL) key operated test No. 9999. This test combination provides a maximum loop test condition of the send (L) and (STP) relays. It also checks the ability of the sender L3 and L4 relays to respond to short closures.

Test Call No. 5 (Unbalanced Revertive Pulse Circuits Only)

(LST) key normal, (STP-OPR) key operated, Test No. 0490. This test combination makes an automatic current flow operate check of the F. S. terminating and Central "B" Switchboard sender (L) and (STP) relays.

The test circuit and sender advance in a normal manner in making incoming brush and incoming group selections using minimum fundamental loop resistance. When the (FB) relay operates for advancing to make final brush selection, however, the (TF) relay is operated and it locks under control of the (FO) relay. The (TF) relay transfers the fundamental tip lead from the regular (STP) and (OF) relay circuit and connects it thru the winding of the (FTP) relay to resistance ground. The fundamental ring lead is connected thru the contacts of the (FRP) relay to resistance battery. The (FTP) relay will operate to battery through the sender (D) relay and then the (FRP) relay will be operated closing the resistance battery to the fundamental ring lead and the sender (STP) relay will be operated. The sender advances then in a normal manner and connects the shunt ground on the fundamental tip lead which causes the (FTP) relay to release and the fundamental ring lead is open and the sender (STP) relay releases removing the shunt ground on the fundamental tip lead and the (FTP) relay is again operated. The (FRP) relay operates and releases, under control of the (FTP) relay, and counts down the counting relays in the test circuit and this cycle of events is repeated until the (BO) relay operates opening the fundamental tip lead to terminate the selection. The resistance in the fundamental tip and ring leads is such as to test the sender (L) and (STP) relays for operate. However, the pulsing speed will be slow on account of the high resistance in the fundamental tip and ring. The test circuit and sender at the completion of final brush selection will advance to final tens selection position in a normal manner and this selection is made as has just been described for final brush selection. When the (FU)

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relay operates on advancing to final unit selection the (TF) relay is released and final unit selections and reverse battery is made in a normal manner as has been described.

Test Call No. 6

(L) and (LST) keys normal. This test is made to check the ability of the select bar, its unengaged select fingers and its off-normal contact to release and become stabilized in the minimum time between selections. The test number to be used should be such as to cause the operation of the select bar or finger in question and then follow this after the minimum time between selections by a second selection involving the least number of pulses which can be used and yet not operate the select bar under question. This second selection will be zero in every case except when the 0-1 select bar is being tested when the second selection should be 2.

19. OVER OR UNDER 5 INCOMING GROUP SELECTION

Full selector terminating or Central "B" Switchboard (terminating part) senders may be arranged to record over or under 5 incoming group selections as an indication as to which office is wanted when they are arranged to complete calls to multi-office terminating units. The originating or Central "B" Switchboard (switchboard part) sender will transmit the regular number of pulses for incoming group selection when one of the offices is wanted and will add 5 pulses to the normally required number of incoming group selection pulses when the other office of the multi-office unit is wanted.

19.1 Full Selector Terminating Sender

The (IG5) relay and the key provide means for testing the senders that they will properly record the added 5 incoming group selection pulses. With the (IG5) key in its normal position the regular number of pulses will be received from the full selector sender for incoming group selection. With the (IG5) key operated, when the test circuit advances for incoming group selection the (IG5) relay operates in parallel with the (IG1) relay when the (IG) relay has operated. The (IG5) relay transfers the path from the No. 1 contact of the (1') counting relay, which is the path that would normally operate the (0) counting relay and thereby terminate the selection, to the winding of the (6) counting relay. The incoming group selection pulses will therefore be continued until the (6), (5), (4), (3) and (2) counting relays are operated before the (0) counting relay is operated to terminate the selection. This arrangement then adds 5 additional pulses to whatever number of incoming group selection pulses are required when the (IG5) key is operated. When the (IG5) key is operated to "Add five" to the incoming group selection the (OAS) key should also be operated to check that the (OAB) lead is grounded.

19.2 Central "B" Switchboard Sender Fig. H - (LOC) and (IG5) Keys Operated

The Central "B" senders may be arranged to record over five incoming group selection as an indication for the second office when they are arranged to complete calls to multi-office terminating units. The (LOC) key operated operates the (OC) relay in the Central "B" sender which reverses the battery over the "FT" and "FR" leads operating relay (PM) in turn operating relay (PM2) which locks. This is to simulate the indication from the terminating part of the switchboard part of the Central "B" sender that an office indication key must be depressed by the operator. Relay (PM2) operates restores the battery over the "FT" and "FR" to its proper polarity for revertive pulsing. The call will be completed as described above.

20. REVERSAL OF BATTERY THROUGH (STP) RELAY CONTACT - FIG. P

When relay (FT) operates in preparation for final tens selection relay (STR) is operated and locks to off-normal ground reversing the battery circuit through the contacts of the (STP) for subsequent selections to increase the life of the (STP) relay contacts.

21. "B" SWITCHBOARD SENDER - (SWITCHBOARD PART)

21.1 With the (CBT), (TO) and (TOS) keys operated the test circuit is arranged to permit the test man to talk to the operator at the "Switchboard Part" of the "B" switchboard sender and request that any number be keyed up. The number to be keyed up by the operator should have been previously keyed up on the test frame. The operation of the (TOS) key releases the (TS) relay in the "B" switchboard sender (terminating part) to restore the leads between the "terminating" and "switchboard" parts of the sender to their normal condition. The operation of the (TO) key connects the telephone circuit of the test set to the "T" and "R" leads to the sender. The number now passed to and keyed up by the operator will be checked in the regular manner.

21.2 With the (CBT) and (TOS) keys operated the test circuit is arranged to pass a tone to the operator when relay (F01) operates. A pre-assigned number should have been keyed up on the test circuit. The operator now keys up the preassigned

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number which is checked by the test circuit in the regular manner.

21.3 To test the relays on the working limits of the circuits the above procedure should be followed except the (TOS) key should be left normal (to operate the sender (TS) relay) and the (LLR) key operated (to cut in the necessary resistance) to build up the trunks to their working limits.

22. DIAL PULSE TERMINATING SENDER

Dialing from Sender Frame (SST) Key Operated

A feature is provided in the test circuit for dialing from the sender frame by means of a hand set in place of the test frame, to permit observation of the operation of the sender as each digit is dialed. Provision is made for dialing over a minimum or maximum loop by means of (MN-D) and (MX-D) jacks located at the sender frame. Where it is desired to do the dialing from the sender frame the (SST) key should be operated but the (ST) key should be left normal. The (SST) key transfers the "R" lead thru to the sender frame and closes in part the operating circuit for the (DPD) relay.

When the hand set is connected to either the (MN-D) or (MX-D) jack relay (DPD) is operated. The operation of relay (DPD) closes the circuit to operate the (ST) relay, in place of the (ST) key, and closes the "T" lead for maximum loop to the sender frame. The test circuit will now function as previously described. The disconnection of the hand set from the jack will function the same as restoring the (ST) key. The remote control of the "Control advance feature" applies to these sender frames as described in paragraph 22 of Section 0102.

23. F. S. TERMINATING SENDER

Interdigital Timing Test. Fig. AZ

There is a feature in the sender to time the interval of 3 to 6 seconds between the registration of any two digits. If the succeeding registration is not started before the expiration of this time the sender is released. The test circuit is arranged to test that the sender is not released too quickly and that the sender is released within a given time. For these tests the test frame shall be set up for testing a regular call.

23.1 Not Released Within a Minimum Interval of Approximately 2 to 2-1/2 Seconds

For this test the (IDT) key shall be operated. The test will proceed as for a regular call until relay (FB) is operated. The operation of relay (FB) operates relay (IDT). The operation of relay (BS) will now operate relay (IDS). The operation of relay (FB') with relay (IDT) operated lights the (IDT) lamp. The operation of relay (IDS); (a) closes ground to the terminating sender timing control circuit to start the timing in the sender, (b) closes the circuit from the (ID) interrupter to the armature and back contact of the (6') relay, (c) closes ground to the armatures of relays (0), and (1), (d) closes ground to the armatures of relays (2) to (6) and (e) closes a circuit from the front contact on relay (FO) to the winding of relay (IDR). The (IDT) relay transfers the leads from the back and front contact of relay (1') to give a count of four pulses from the interrupter when the operation of relay (FO) operates relay (IDR) which locks.

The operation of relay (IDR) opens the locking circuit for relays (1) to (6) and the operating circuits of relays (IDT) and (IDS) which release but relay (IDT) cannot release until relay (IDS) has released. The release of relay (IDT) recloses the leads to the counting relays as set up for (FB) selection and closes the circuit from relay (FB') to the (FB) lamp indicating the next selection. Relay (IDS) released; (a) opens the circuit through the interrupter for pulsing, (b) opens the ground from the timing control circuit and (c) recloses the circuit from the front contact of relay (FO) for operating relay (FT) at the completion of (FB) registration. The sender now proceeds to make (FT) registration and subsequent functions as for a regular call.

Should the sender time out falsely and open the "S" lead, the (Cl) relay will lock in series with the (S) relay, which operates. The (S) relay operated, with "VI" option, operates the (BK) relay which causes the test circuit to block with the (IDT) lamp lighted if timing in the test circuit is in progress or to block with the (FB) lamp lighted when timing is completed.

23.2 Released Within a Maximum Interval of Approximately 7 Seconds

For this test the (IDT1) key shall be operated in place of the (IDT) key.

The operation of the (IDT1) key changes the pulsing circuit from the (ID) interrupter to the (ID1) interrupter and the connections to the counting relays to give a count of eight pulses of 1 second each. The operation of relay (IDT) with the (IDT) key normal; (a) locks relay (IDT), (b) closes a circuit to operate relay (TD2) and (c) closes a circuit in part to ground the (ADV) to the connector circuits upon the release of relay (Cl). The release of relay (Cl), due to opening the "S" lead by the sender,

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closes the "ADV" lead to the connector circuit causing the test circuit to advance. The release of relay (C1) also causes the release of relay (IDS) stopping further pulsing.

Should the sender fail to open the "S" lead before the operating circuit for relay (IDR) is closed by relay (FO) operated, (IDR) will, (a) operate and lock, opening the ground circuit to the "ADV" lead to the connector; (b) place ground on the sender "S" lead to hold the sender circuit out of service. Relay (IDS) will now release to prevent further pulsing but the test circuit will block with relay (IDT) operated and the (IDT) lamp lit.

On a repeat test, with the (IDT1) key operated, the (IDT1) relay operates, and when the (IDT) relay operates the (IDT2) relay is operated. The sender is guarded by the premature operation of relay (MGB) on the operation of the (RST) register with the (IDT1) and (IDT2) relays and the repeat key operated.

23.3 Terminating Sender Timing Control Circuit Transfer. Fig. 9, 11 & 12

When the full selector senders are in two groups associated with two terminating Sender Timing Control Circuits the (MCD) relay, Fig. 9, provides means for connecting the proper control circuit to Fig. AZ.

23.31 The winding of relay (MCD) is connected to the contacts of those (SM0) to (SM9) relays "WH" Option, or (0) to (9) relays "WK" Option (Fig. 2, sheet 0102, in the connector unit) which are associated with senders which use the second Timing Control Circuit. The operative ground is obtained from front contacts of the (IDT) or (IDT1) keys, Fig. AZ, when either of these keys is operated for interdigital timing tests.

When senders using the first timing control circuit are being tested, this control circuit is connected to Fig. AZ thru back contacts of the (MCD) relay, which is not operated.

When senders using the second timing control circuit are being tested, relay (MCD) is operated by the (SM0) to (SM9) relays "WH" option, or (0) to (9) relays "WK" option, and the second timing circuit is connected to Fig. AZ through front contacts of (MCD).

23.32 When the full selector senders are in three groups associated with three Terminating Sender Timing Control circuits the (MCD-1) relay of Fig. 11 Sheet -0108 provides means for connecting the proper control circuit to Fig. AZ.

The winding of the (MCD-1) relay is connected to the contacts of the (0) to (9) relays of Fig. 2 Sheet -0102 which are associated with the third timing control circuit. The operative ground is obtained from front contacts of the (IDT) or (IDT-1) keys Fig. AZ when either of these keys are operated for interdigital timing tests.

23.33 When the full selector senders are in four groups associated with four terminating sender timing control circuits the (MCD-2) relay of Fig. 12 sheet -0108 provides means for connecting the control circuit to Fig. AZ.

The winding of the (MCD-2) relay is connected to the contacts of the (0) to (9) relays of Fig. 2 sheet -0102 which are associated with the fourth timing control circuit. The operative ground is obtained from front contacts of the (IDT) or (IDT-1) keys Fig. AZ when either of these keys are operated for interdigital timing tests.

24. REORDER - CENTRAL "B" SWITCHBOARD SENDER. FIG. H - CLASS KEY (8) OPERATED

With the class key (8) operated on a test of a Central "B" Switchboard sender the call will progress as for a regular call until relay (FT) is operated. The operation of relay (FT) causes the operation of relay (RO). Relay (RO) operated reverses the battery over the "T" and "R" leads to the Central "B" Sender (terminating part) operating relay (PD) in turn operating relay (TT) which locks. This will route the call to "Reorder". Relay (RO) also operates relay (RO1) Fig. AG to skip the check of the numerical digits. The call will now be completed in the regular manner.

25. F. S. TERMINATING SENDER OVERLOAD CONTROL FEATURE

There is a feature in the sender to send back reverse battery and grounder to the originating sender in Incoming Group selection, when an all busy F. S. Terminating Sender condition exists for an extended interval of time. This reversal will release the originating sender and it is intended to relieve term. sender overload conditions by reducing the term. sender holding time. The test circuit can be used to test whether this reversal is sent out during Incoming Group Selection when an overload condition is experienced or it can be used to test whether the reversal is given falsely.

25.1 Term. Sender Test for Reverse Battery and Ground During Incoming Group Selection, When an Overload Condition is Indicated by the Term. Sender Timing Control Circuit

Strict observance of the test frame indicating lamps is necessary in order to make this test satisfactory.

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This test should be performed during periods of very light traffic, to eliminate the danger of sending false overflow signals to the originating senders.

Remove the senders, to be tested, from service by making the group busy with an M. B. plug, in approved methods.

Block operated the associated contacts of the term. sender timing control circuit (OF-) and (IT-) relays, for the group of senders made busy.

Operate the proper test frame keys for Trunk Disconnect test, (TD) #5 key operated and place the test circuit on the first sender to be tested. Release the MB plug while the (MGB) key is momentarily operated, so the test circuit gains access to the sender to be tested. During the test, the test frame will hold the sender group busy to service.

By observing the test circuit progress lamps, during the test, it will be noted that the term. sender will send back reverse battery and ground during incoming group selection and trunk disconnect will take place during that selection. Test frame circuit action then is similar as described under Trunk Disconnect.

Should selections continue after incoming group, such as Final Brush, Final Tens, Final Units and the disconnect given after Final Brush, it is an indication that the overload control feature is not functioning properly. The test circuit will not block as an indication of this failure, therefore observance of the test circuit progress lamps is necessary. When testing the last sender of the group, make the group busy with the M. B. plug and release the operated contacts on the timing control circuit (OF-) and (IT-) relays. Release the sender group made busy.

25.2 F. S. Term. Sdr. Test for False Overflow Conditions

Should the Term. Sender Timing Control Circuit cause its (OF-) and (IT-) relays to be operated falsely, false overflow indications will be relayed to the originating senders by the term. senders. This trouble can be detected by the term. sender test circuit on a regular test call. The test circuit will block in Incoming Group selection after receiving the battery and ground reversal from the term. sender. With this failure, the term. sender will have its (OF), (IF) and (IF1) relays operated.

CIRCUIT UNIT - SECTION -0112
"B" SWBD. SENDER AND POSITION FINDER TEST CIRCUIT

1. PURPOSE OF CIRCUIT

1.1 This circuit in conjunction with other units of the test frame provides means of making tests on call distributing "B" switchboard sender and position circuits.

2. WORKING LIMITS

2.1 None.

3. FUNCTIONS OF THIS CIRCUIT UNIT

3.01 To check the H. S, CO, D, T and R leads and their associated apparatus.

3.02 To set up registration in the sender on a 3 wire d-c key pulsing basis.

3.03 To check the reset of the register relays.

3.04 To provide means of testing the talking circuit of the B senders for continuity.

3.05 A means is provided to connect to any position circuit for test.

3.06 To check the ability of the position circuit to register a number in the sender by means of key pulses.

3.07 To test the position disconnect feature of the position circuit.

3.08 To test "B" senders for registering office designation from the "B" position.

3.09 To test the ability of the "B" position circuit to transmit over the T and R leads the office indication.

3.10 To make a non-operate test of the (K3) relay in the "B" switchboard Sender and Position Finder.

Keys

3.11 (TT) key. This key when operated arranges the circuit for the tone test. In this test the sender selects a position and the order tone is passed thru the sender to the test circuit. The test man may also talk thru this circuit to the operator.

3.12 (PP) Key. This key, when operated, permits the position selector switch to be advanced to any position by means of the dial.

3.13 (PT) key. This key arranges the circuit for testing position circuits.

3.14 (SKP) key. With this key operated the (KP-) relays generate slow pulses for detecting certain troubles in the sender steering relays and for making non-operate tests of the sender register marginal relay.

3.15 (TP) key. Before a position is tested the sender to be used for this test is routined. The operation of the (TP) key stops the routing test then in progress, and causes the position test to start.

3.16 (PD) key. This key is operated to eliminate the test of the position disconnect feature.

3.17 (PR) key. This key is operated at the end of a position test to release the position circuit and the test circuit.

3.18 The (OA-OB) key. This key when operated to the (OB) position causes ground to be connected to T & R to "B" sender and in the (OA) position battery will be connected to T & R.

Lamps

3.19 The (CT) lamp lights while waiting for the sender to close its talking circuit towards the position.

3.20 The (RC) lamp lights while waiting for the sender to recognize that registration has been completed.

3.21 The (L) lamp lights while waiting for the removal of battery from the K3 lead in preparation for registration.

3.22 The (RR) lamp lights during the transmission of the first three digits for the first time. After the reset signal is sent to the sender and during the transmission of the number the second time the (RR) lamp is not lit.

3.23 The (P) lamp, on test set or position test, lights while waiting for the position circuit to register a number in the sender and for the sender to find a marker. The (P) lamp also lights if the connector start key is restored without restoring the position test apparatus to normal.

3.24 The (PB) lamp lights while making the busy test of the position.

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3.25 The (PC1) lamp lights while waiting for the position disconnect signal from the position over the K1 lead.

3.26 The (PD2) lamp lights while waiting for the position disconnect signal from the position over the tip and ring leads.

3.27 The (TH), (H), (T) and (U) key pulsing progress lamps indicate which digit the circuit is ready to send. Also (OAB) lamp when furnished. These lamps are particularly useful in step-by-step operation.

3.28 The (OB) lamp lights when ground is connected to the T & R leads from the "B" position under test and the (OA) lamp lights when battery is connected.

4. CONNECTING CIRCUITS

When this circuit is listed on a key sheet the connecting information shown thereon is to be followed.

4.1 Crossbar "B" Swbd. Sender and Position Finder Circuit - SD-25014-01.

4.2 "B" Position Circuit - SD-21104-01.

4.3 Connector Circuit - SD-25159-0102.

4.4 Sender Group Test Circuit - SD-25159-0106.

4.5 Revertive Pulsing Test Circuit - SD-25159-0108.

4.6 Register Check Circuit - SD-25159-0114.

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DESCRIPTION OF OPERATION

5. SELECTION

When a non-central "B" sender has been selected for test by the test circuit, the sender group test unit grounds the "C" lead to this circuit, operating the (C) relay. The (C) relay operated, operates the (G) relay and connects thru the individual leads from the sender. Ground is supplied over the "B" lead to operate a relay in the sender circuit which transfers the six leads, which in service are connected to the position circuit to the key pulsing test circuit for the test purposes.

6. CHECK OF "S" LEAD

The "S" lead is tested for ground in the sender group test circuit and this lead is extended into this unit operating the (C1) relay. The (C1) relay locks, under control of the (C) relay. If the check of the "S" lead does not function properly the test circuit will block.

7. CHECK OF "D" and "CO" LEADS

The "D" lead is connected to a polarized (TC) relay in the sender circuit and when the (C1) relay has operated, this polarized relay is connected to the (D) relay thru the (D) resistance. The (D) relay operates, extinguishes the (D) lamp, lights the (CO) lamp, connects the (CO) relay to the "CO" lead, and locks under control of the (C) relay. This locking ground over the "D" lead operates the sender polarized relay causing the sender to progress with the call. When the (CO) relay operates the (CO) lamp is extinguished, and the (CT) lamp is lit. If the check of the "D" lead or "CO" lead does not function properly the test circuit will block and the (D) lamp or (CO) lamp will remain lit.

8. CHECK OF REGISTRATION LEADS (SENDER PREPARED FOR REGISTRATION)

The operation of the (CO) and (D) relays lights the (CT) lamp if the (CT3) relay has not been operated. The relay in the sender circuit which operates over the "B" lead causes the sender "T1", "R1", "K1", "K2", "K3" and "H" leads to be connected to the test circuit. The resistance battery on the "H" lead causes the double test feature of the sender to function and close battery to the "T1" lead, ground to the "R1" lead, and battery thru a marginal relay to the "K1" lead. The (CT) relay operates over the "K1" lead but the marginal relay in the sender does not operate since the

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test circuit imposes a non-operate test condition. However, if the sender marginal relay operates falsely on this non-operate test condition, a reorder signal will be transmitted to the marker and the test circuit will block when checking the registration. With the (CT) relay operated a circuit is closed to operate the (CT1) relay over the "T1" and "R1" leads. The (CT1) relay operated, lights the (RC) lamp and operates the (CT2) relay. The (K2) lead should be open at this time, but if it is closed, the (X) relay will operate, and prevent (CT3) from operating. The (CT2) relay operated, operates the (CT3) relay and connects battery thru the (A) resistance to the "K2" lead and thru the (B) resistance to the "K1" lead. The (CT3) relay locks, extinguishes the (CT) lamp, lights the (K) lamp and removes the battery from the "H" lead.

Battery over the "K1" and "K2" leads causes the sender to function to prepare for registration and return battery over the "K3" lead operating the (K) relay. The (K) relay operated, locks and with "K" wiring operates the (TRA) and (TR1) relays in series. When Fig. AP is furnished, relays (AB) and (AB1) will be operated first in turn operating (TRA) and (TR1) relays. The operation of relay (AB1) lights the (OAB) lamp. The (TR1) relay operated, lights the (TH) pulse progress lamp, if the (AB1) relay is not furnished. The (TRA) relay locks under control of the (C) relay and operates the (TRB) and (TR2) relays in series. The (TRB) locks and operates the (TRC) and (TR3) relays in series. The (TRC) relay locks and operates the (TRD) and (TR4) relays in series. The (K1) relay then operates, in turn operating the (K2) relay.

The (K2) relay connects ground to the armature of the (KP1) relay. If the (SKP) key is normal, this causes the relay interrupter circuit, which is composed of the (KP1) to (KP6) relays, to start pulsing. If the (SKP) key is operated, the secondary winding of the (SKP1) relay has previously been connected to ground by the operation of the (G) relay, so that pulsing cannot begin at this time since the (KP1) relay is operated to hold its #4 contact closed until this ground is removed. The (K2) relay also removes battery from the "K1" and "K2" leads causing the sender to function to remove battery from the "K3" lead. The removal of battery from the "K3" lead releases the (K) relay. With the (K) relay released and the (K1) relay operated the (K3) relay operates and closes thru the "K1", "K2" and "K3" leads to the numerical register keys. The (K3) relay operated, extinguishes the (K) lamp and lights the (RR) lamp. If the check of the "K" leads fails to function properly the test circuit will block and the (K) lamp will be lighted. If the (SKP) key is operated, the (K3) relay also removes the ground from the secondary winding of the (KP1) causing the relay interrupter circuit to start pulsing.

9. REGISTER RELAYS RESET

The register relays in the sender circuit are under control of the relay interrupter circuit, the (TR1) to (TR4) relays, and the numerical register keys in the test circuit. Before operating the (ST) key of the test circuit, the numerical keys corresponding to the number with which it is desired to test the sender shall be depressed. The (TR1) to (TR4) relays, releasing one-by-one after each digit, switch the transmitting leads from one set of numerical keys to the next. The purpose of the relay interrupter circuit (KP1) to (KP6) relays is to provide a definite closed period for operating the register relays in the sender.

Ground is supplied thru the front contacts of the (G) relay to the (L) resistance and to the windings of the (KP1) relay. This causes the operation of the (KP1) relay. When the (KP1) front contact closes, the (KP1) relay releases, and the opening of the front contact starts the (KP1) to operate again. The operation of this relay is delayed due to the fact that the condenser (KP) must be charged by a current flowing thru the (KP1) secondary winding before the relay can operate. This condenser charging current in the secondary winding is in the direction to prevent the relay operation, and therefore the relay will not operate until the charging current has been sufficiently reduced, so that the primary ampere turns are greater than the secondary. The release of the (KP1) relay is delayed in a similar manner due to the (KP) condenser discharging thru the secondary winding. The characteristics of the (KP1) relay and associated condenser and resistances are such that the relay contact furnished pulses of approximately .050 sec. closed and .040 sec. open, when the (SKP) key is normal and approx. .250 sec. closed and .250 sec. open with the (SKP) key operated. The slower key pulses are used to detect certain troubles in the sender steering relays and making non-operate tests of the sender register marginal relays. The (KP2), (KP3) and (KP4) relays repeat the pulses supplied by the (KP1) contact for the purpose described below.

When the (KP4) relay closes its contact, ground is supplied to operate the (KP5) relay under control of the (TR4) and (K3) relays ann when the (KP4) relay releases the (KP6) relay is operated. The (KP5) and (KP6) relays lock up under control of the (TR4) relay and their purpose is to absorb the first pulse of the relay interrupter so that the first pulse supplied to the sender register relays will be of full duration. The (KP6) relay operated closes battery to the contacts of the (KP2) and (KP3) relays and also extends the circuit from the (KP4) relay contact to the inner end of the winding of the (TR1) relay or relay (AB1) if Fig. AP is furnished. The contacts of the (KP2), (KP3), and (KP4) relays make and break simultaneously. When (KP2) and (KP3) relay contacts closed, battery is connected thru the front contacts of the (TR4), (TR3), (TR2) and (TR1) relays and thru the operated thousands numerical key to leads K1, K2 or K3 to the sender circuit for operating the sender register relays for thousands registration. Fig. AO; The (KP4) relay contact closing, connects ground to the inner end of the winding of the (TR1) relay which holds this relay operated but shunts the (TRA) relay and it releases. When the (KP4) relay contact opens the (TR1) relay also releases. Fig. AP; The (KP4) relay contact closing, connects ground to the inner end of the winding of the (AB1) relay which holds this relay operated but shunts the (AB) relay and it releases. When the (KP4) relay contact opens the (AB1) relay also releases. The release of relay (AB1) (a) recloses the "TH" and "TH1" leads to the (TR1) relay, (b) transfers the pulse lead to the inner winding terminal of relay (TR1), (c) extinguishes the (OAB) lamp and lights the (TH) lamp. Unless the (OA) or (LB) key, if furnished, is operated as described in paragraph 18 the (AB) and (AB1) relays perform no useful function at this time. The next operation of relay (KP4) will connect ground to the inner end of the winding of the (TR1) relay and the call will progress as above for Fig. AO. The (TR1) relay released transfers the register leads for hundreds registration, extinguishes the (TH) lamp, and lights the (H) lamp. Hundreds registration is accomplished in the same manner as thousands registration just described except that battery is connected thru the hundreds key to the "K1", "K2" and "K3" leads. The (KP4) relay contacts closing for hundreds registration shunt and release the (TRB) relay and when the contact opens it releases the (TR2) relay. The (TR2) relay transfers the register leads for tens registration extinguishes the (H) lamp, and lights the (T) lamp. Tens registration is accomplished in the same manner as thousands and hundreds registration except that battery is placed on the "K-" leads thru the tens key and the (TRC) and (TR3) relays are released as were the (TRB) and (TR2) relays. On the next closure of the (KP4) relay contacts the (TRD) relay is shunted and released, and when the (KP4) relay contacts open the (TR4) relay is released. When the (KP3) relay contacts close with the (TR3) relay released, the (RR) relay is operated. This closure of the (KP2) and (KP3) relays does not, therefore, make unit registration and thereby complete the registration in the sender, but instead is used to prepare the test circuit to release the sender register relays which have been operated. The (RR) relay operated, releases the (K1), (K2) and (K3) relays and operates the (RR1) relay which locks and opens the operating circuit of the (RR) relay causing it to release. The (RR1) relay operated, extinguishes the (RR) lamp and closes a circuit for the (TC) lamp under control of the (K3) relay. The (K2) relay released closes a circuit from battery thru resistance to the "K1" and "K2" leads. This causes the sender to function and release the register relays that were operated during the registration just described. When the sender relays have released and the sender is again ready for registration battery thru a resistance is again connected to the "K3" lead from the sender. This operates the (K) relay. With the (K) relay operated, a circuit is again closed for operating the (AB) and (AB1), if furnished, (TRA), (TR1), (TRB)and (TR2) etc. relays and the (K1) and (K2) relays then operate as previously described. The (K2) relay operated removes the battery from the "K1" and "K2" leads causing the sender to function and remove battery from the "K3" lead releasing the (K) relay. With the (K) relay released and the (K1) relay operated the (K3) relay is again operated which closes thru the "K1", "K2" and "K3" lead to the numerical register keys. The test circuit is now in the same condition as it was at the start of the "Register Relays Reset" test except that the (RR1) relay is locked operated. The test circuit and sender are now ready for registration.

10. REGISTRATION

10.1 Fig. AO

Registration takes place as described in the previous paragraph. All four digits are registered this time, (TR4) relay releasing as the transmission of the units digit is completed. The release of the (TR4) relay stops the interrupter relays.

10.2 Fig. AP. Non-operate Test (K3) Relay

Registration takes place as described in the previous paragraph except that when relay (KP3) is operated with relays (AB1) and (RR1) operated, ((OB) key if furnished is non-operated) battery will be connected through resistances (AE) and (AF) to the "K3" lead giving a non-operate current to the (K3) relay in the sender. The call should proceed in the usual manner but if the (K3) relay should operate falsely on this current the sender would record a "5" on the thousands register and advance for hundreds registration prematurely. The test circuit will now proceed with the registration of the four digits releasing relay (TR4) as the transmission of the units digit is completed. The release of the (TR4) relay stops the interrupter

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relays. With any button other than a "5" operated on the thousands key the register check circuit would block with the No. 5 lamp lit for check of the thousands digit. When the (OB) key is operated this test is ineffective as the test circuit will apply ground in place of battery to the "K3" lead.

11. SENDER REGISTER RELAYS - MARGINAL TESTS ((SKP) KEY OPERATED)

The sender register relays are tested to insure meeting their operate and non-operate conditions imposed in service. The operation of the numerical keys (0) to (4) inclusive, and keys (6) and (8), imposes operate test conditions on the sender register relays. The number (9) numerical keys when operated impose non-operate test conditions on the sender marginal relays. These non-operate tests should be made with slow key pulses (SKP) key operated. The number (7) key imposes an operate test condition of the (K3) relay on its secondary winding, and the number (5) key imposes an operate test of the (K3) relay on its primary winding.

12. REGISTRATION COMPLETED

When registration has been completed the sender functions to open the "T" and "R" leads releasing the (CT1) relay, which extinguishes the (RC) lamp.

13. STEP-BY-STEP REGISTRATION

In order to aid in locating troubles the pulses may be transmitted to the sender one at a time under control of a key. The (SS) key in the revertive pulsing circuit is operated which grounds the "SS" lead and operates the (KS) relay. This opens the circuit of the (KP2) and (KP3) relay contacts, prevents the (KP-) relays from pulsing, and closes the path of the (KA) relay to the revertive pulsing circuit. Each operation of the (AV) key in the revertive pulsing circuit grounds the "AV" lead, operating the (KA) relay which closes the circuit ordinarily closed by the interrupter relays. In this manner a pulse is transmitted and the (TRA) and (TR1) relays function as on regular interrupter pulsing. The (TRB), (TR2), (TRC), etc. relays are operated in this manner as they are on regular pulsing. Remote control jacks located at the sender frames may be used instead of the test frame key for operating the (KA) relay. A 32A test set is used for this purpose, using the key which shorts the sleeve to the tip.

14. TRUNK DISCONNECT TEST

This is a feature in the sender circuit which functions to restore the circuit to normal in case a premature disconnect signal is received from the trunk circuit. When this feature is to be tested the #5 class key of the connector circuit is operated which supplies ground over the "TD" lead operating the (TD1) relay. When the (C1) relay operates the "D" lead is closed from the connector circuit thru the front contacts of the (TD1) relay to the winding of the (TD) relay. The (TD) relay operates under this condition but the differential relay in the sender does not operate. The (TD) operates and locks and the locking ground is supplied to the "D" lead which causes the sender differential relay to operate. The (TD) relay operated also causes the (TD1) relay to release. The (TD1) relay is slow release in order to allow sufficient time for the sender relays to function. The (TD1) relay released, connects the "D" lead to relay (TD3), the sender differential relay releases and the sender then functions to restore to normal. The sender opens the "S" lead which causes the (C1) relay to release. Ground thru the front contacts of the (TD) relay and back contacts of the (C1) relay is supplied over the "ADV" lead to the connector circuit causing the test circuit to advance. If the premature disconnect feature of the sender fails to function properly the "S" lead will not be opened by the time the (TD2) relay has released. The (TD2) relay released, furnishes a locking circuit for the (C1) relay. With the (C1) relay locked under this condition the test circuit will block and the (D) lamp will remain lit. If the sender fails to remove ground from the "D" lead, the (TD3) relay will operate and lock opening the "ADV" lead and blocking the test circuit with the (D) lamp lit. Precautions outlined in section 0102 under "Trunk Disconnect Test" should be observed.

15. TEST OF ORDER TONE CIRCUIT

When it is desired to check the order tone circuit and transmission circuit of the sender, the (TT) key is operated which allows the sender circuit to function and pick an idle occupied position circuit. The (TT) key also operates the (TP) relay lighting the (P) lamp. The "T" and "R" leads which in service are extended to the trunk circuit are connected to the telephone circuit of the test circuit. This enables the test man to check the quality of the order tone and transmission.

With the test circuit in this condition the test man may request the "B" operator to operate keys or perform any function which she normally does on a regular service call. The operation of the (PD) key of the position may be used to test the reorder feature of the sender. The numerical keys in the test circuit should be operated corresponding to the number keyed at the position. If the position (PD) is to be operated, the No. 5

key should be operated in the test circuit for those digits not transmitted from the position. Also the (RO) key should be operated to check the reorder feature of the sender. The (PTS) key should also be operated to pass terminating senders, when Fig. 1D is furnished.

16. POSITION CIRCUIT TEST

When it is desired to test a position circuit the test is made by two test men, one located at the "B" position to be test- and the other at the test frame. The "B" position circuits are tested by the test circuit in connection with a sender circuit. For this reason a sender should be selected and then, with the (REP) key operated, routined to assure satisfactory operation. After the sender has been routined, the (TP) key is operated. This key may be operated as the test circuit is progressing in its routine test of the senders. If the (TP) key is operated before the (CT2) relay operates, then the next operation of the (CT1) relay operates relay (TP). However, if the (TP) key is operated after the (CT2) relay operates the routine test in progress is completed and a new test started. During this new test the operation of the (CT1) operates relay (TP). The (TP) relay when operated, connects the "K1", "K2" and "K3" leads from the sender to the position test circuit for use in numerical registration from the position circuit under test. The position circuit to be tested is connected to the test circuit through the (S) 206AU selector. The (PP) key is operated and the (S) selector stepped to the desired position circuit. When the (PP) key is operated and the dial is moved off normal, a circuit is closed from ground on the (PP) key to operate the (DO) relay through the pulsing contacts of the dial. The (DO) relay operated energizes the selector magnet and when the dial pulsing contacts break the (DO) relay releases, releasing the selector magnet, thus stepping the selector one position for each opening and closure of the dial. When the desired position has been reached, the (PP) key is released and the (PT) key is operated. The test man at the position then plugs a telephone set into the regular telephone jacks of the selected "B" position. The (PT) key operated also operates the (PT) relay which connects battery and ground thru the winding of the (PT1) relay to 270 ohm battery over the "H" lead to the position circuit. This causes the (PT1) relay to operate to 270 ohms battery over the "H" lead.

The (PT1) relay will not operate if the resistance to battery over the "H" lead is greater than approx. 350 ohms or if the 270 ohms battery is shunted by a false ground to approx. 100 ohms or less. The (PT1) relay operated operates the (PT2) relay. The (PT2) relay operated, closes battery through the winding of the (PD) relay to the "K1" lead of the position circuit. This causes a relay in the position circuit to operate and the (LK) lamp at the position to flash. The man at the "B" position observing the flashing lamp depresses the (PD) key at the position. This causes the (PD) relay in the test circuit to operate which operates the (PD1) relay, extinguishing the (PD1) lamp. When the (PD) key at the position is released the (PD2) relay operates in series with the (PD1) relay and both relays hold through the front contact of the (PD1) relay. The (PD2) relay operated connects transmission battery and ground to the "T" and "R" leads of the position circuit. This operates the (T) relay in the position circuit which lights the (S) lamp at the position and also causes the position circuit to function and transmit order tones over the "T" and "R" leads after which the circuit for transmitting speech is established between the "B" position and the test circuit. The (T) relay in the position circuit operating also causes battery to be removed from the "H" lead. This releases the (PT1) relay. The "B" position will appear busy to any hunting selector however even though battery and ground thru the windings of the (PT1) relay remain connected to the "H" lead. With the "S" lamp lighted at the position the test man again depresses the (PD) key at the position. The (PD) key operates with "G" wiring the (DS) relay in the test circuit which operates the (TR) relay. The (TR) relay operated, extinguishes the (PD2) lamp and connects the K1, K2, K3 lead from the position circuit thru the test circuit to the K1, K2, and K3 lead respectively, of the sender circuit. Instead of operating the position circuit (PD) key the second time the test man may remove the operator's plug momentarily to test the ability of the position to send a PD signal in this manner. The circuit operation in the sender test circuit is the same in either case. The position circuit and sender circuit then function and prepare for registration and when ready, the (S) lamp at the position is extinguished. The test man at the position can then proceed to key up on the position numerical keys any number that the test man at the test frame has keyed up on the test circuit numerical keys. At any time before the units digit is pulsed, the position (RS) key may be operated to test this feature. When the last digit has been recorded by the sender and the key released, the sender circuit functions and opens the "T" and "R" leads. The test circuit and sender circuit then functions to advance to normal after a check has been made of the registration. It should be noted that once a sender has been seized its time out circuit starts to function and will sound

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its minor alarm in 30 to 60 seconds which means that all the digits should be keyed in less than this time. If the (REP) key is operated the test is repeated. The test circuit will advance and prepare for registration in connection with the position circuit. Another position circuit may be selected and tested or the same one retested. To release the position circuit the (PR) key in the test circuit is operated. This opens the "T" lead releasing the (T) relay in the position circuit which returns to normal and reconnects 270 ohms battery to the "H" lead. The (PR) key operated also releases the (PD1), (PD2), (TR) and (PT2) relays in the test circuit. With these relays released and battery again connected to the "H" lead the (PT1) relay reoperates and the test circuit and position circuit continue to function as previously described when the (PR) key is released. On subsequent tests of the position circuit the (PD) key in the test circuit may be operated in order to eliminate the operation of the (PD) key in the position circuit. When the (PT1) relay operates with the (PD) key operated the (PD1), (PD2) and (TR) relays operate and the test circuit functions without operating the position circuit (PD) key.

17. TIME OUT TEST

With class key No. 6 (TA) and (PTS) keys operated, and (APB) key normal, insert a plug in the hold sender jack. On this test the minor alarm will be sounded and the other members of the maintenance force should be advised accordingly. The (TM) relay will be operated from the No. 6 class key. The (KS) relay is operated which prevents sending key pulses to register a number in the sender. The (TH) lamp in the test circuit lights and the sender should start time out and in 28 to 58 seconds should cause the test circuit (CO) lamp and sender (TL) lamp to light. The time from the lighting of the (TH) lamp to where the (CO) lamp lights is the time out period of the sender and measured with a stop watch should be between 28 and 58 seconds. Five to 10 seconds after the (CO) lamp lights the minor alarm should sound. The (MGB) key is then operated to prevent interfering with service when the sender circuit is subsequently released with the test circuit attached. The hold plug is then removed from the jack and the (TL) lamp should be extinguished and the alarm silenced. The test circuit (S) lamp should then light. The (AV) key should then be momentarily operated to cause the test circuit to advance for starting test of the next sender or the same sender if the (REP) key is operated. When the (REP) key is operated the (AV) key should be held operated until the test circuit advances for the next test. Since the operation of the (MGB) key makes the sender group busy the (AV) key should be operated without undue delay.

18. REGISTERING OFFICE INDICATION OVER "T" AND "R" LEADS

18.1 The (OA-OB) key and (AB) and (AB1) relays unless Fig. AP is furnished and associated wiring and the double wound (CT1) relays will be installed where any of the "B" senders to be tested receive an office indication over the "T" and "R" leads from the "B" position circuits. See section -0106 par. 10 and section -0114 par. 3.6.

18.2 The signal that the "B" sender receives over the "T" and "R" leads from the position circuit is resistance battery or resistance ground. There are in the "B" sender two polarized differentially connected relays in series with the "T" and "R" leads. One of these relays operates when ground is connected to the "T" and "R" leads and the other relay operates when battery is connected. These relays in turn cause other relays to operate and thereby the office indication is registered in the sender circuit from keys in the position circuit. In order to test this feature of the sender the (OA) or (OB) key will be operated. This will cause the (AB) and (AB1) relays to be operated before the (TRA) and (TR1) relays operate as is described under registration. The test circuit will, after these relays operate, progress in a normal manner as has been described until the (KP5) and (KP6) relays have operated. The next operation of the (KP2) relay which normally transmits the "TH" digit to the "B" sender will instead cause either resistance battery or resistance ground to be connected to the midpoint of the primary and secondary windings of the (CT1) relay. The (CT1) relay is operated over the "T" and "R" leads from the "B" sender and therefore the connection of resistance battery or ground to its windings will cause one of the polarized relays in the "B" sender to operate as from the operation of one of the office keys in the position circuit. The (KP2) relay remains operated for a definite time as has been described and the resistance in series with the battery or ground to the "T" and "R" lead is such as to impose a severe operating condition on the sender polarized relays. The (KP4) relay operates with the (KP2) and (KP3) relays. The (KP4) relay shunts the (AB) relay winding and it releases and then when the (KP4) relay releases the (AB1) releases. The (AB1) relay transfers the circuits from the (KP2) and (KP3) relays contact for registering the thousands digit under control of the (TR1) relay as is described under registration.

18.3 The "B" senders may be arranged to transmit a signal over the "K2" lead to the "B" position when it is expected that the "B" operator set up on a key at her position the designation of the office desired when the senders are arranged for the completion of calls to multi-office units.

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18.4 To test the senders for properly transmitting the signal over the "K2" lead optional "L" wiring and apparatus in this section and in section 0106 will be provided.

18.5 With the (LOC) key -0106 operated the "K2"lead is connected to the winding of the (KG) relay in place of the (X) relay. Also the "K1" lead is opened and the (CT) relay can not operate until the (KG) relay has operated which it will if the sender connects ground to the "K2" lead as it should. If the (KG) relay does not operate then the (CT) relay will fail to be operated and the test circuit will block. Otherwise the operation of the (KG) relay from ground on the "K2" lead closes the path for operating the (CT) relay and the test circuit proceeds as has been outlined.

19. OFFICE REGISTRATION FROM "B" POSITION CIRCUIT - (TP) AND (PD) KEYS NORMAL

19.1 The "B" position circuits may be arranged to transmit a signal over the "T" and "R" leads to the "B" senders as to which office is wanted when the senders are arranged to complete calls to multi-office units. This signal from the position circuit consists of connecting either battery or ground to the "T" and "R" leads from the position circuit. In order to test the "B" positions for the proper transmission of the office indication over the "T" and "R" leads optional "H" wiring and apparatus will be furnished and also the double wound (CT1) relay which is optional "B" apparatus. When the "B" position circuit has been connected as is described under position circuit test the test man at the test frame will ask that one of the office keys in the position circuit be operated. The key that connects resistance ground to the "T" and "R" leads will cause the (OBP) relay in the test circuit to be operated. The key that connects battery to the "T" and "R" leads will cause the (OAP) relay to be operated. The (OAP) relay will operate the (OA) relay and then when the (OAP) relay has released, the (OP) relay operates in series with the (OA) relay and the two relays hold to ground. The (OA) relay lights the (OA) lamp as an indication that the office indication was properly transmitted from the office key. The (OBP) relay operating from ground on the "T" and "R" leads will operate the (OB) relay and then when the key is released the (OP) relay operates in series with the (OB) relay and they lock to ground. The (OB) relay lights the (OB) lamp as an indication that the key caused the proper registration in the test circuit. The (OBP) relay may also be operated when the position disconnect key in the position circuit is operated because this key also connects ground to the "T" and "R" leads. With the test circuit (PD) key normal, one or the other of the office keys or the position disconnect key must be operated in the position circuit. The operation of the (PD) key in the test circuit, however, eliminates the necessity of operating these keys in the position circuit as has been described under position circuit test.

19.2 Instead of operating the office keys as just outlined it may be desirable to test the "B" position circuit for transmitting two ground pulses to the "T" and "R" leads when the position is vacated. To make this test, after the "B" position has been seized by the test circuit, battery over the "K1" lead causes a flashing lamp at the "B" position and the test man will operate the (PD) key at the position. This will cause the test circuit (PD1) lamp to be extinguished as has been explained. The test man at the "B" position will then remove the operator's telephone set plug from the jack as though the position were vacated. This causes two pulses of ground to be connected to the "T" and "R" leads to the test circuit. The first of these pulses operates the (OBP) and (OB) relays and when the pulse ends the (OP) relay is operated as has been explained. The second ground pulse again operates the (OBP) relay and with (TP) key normal, as it will be for this test the (OA) lamp is lighted. The first pulse operates the (OB) relay lighting the (OB) lamp. The telephone plug should therefore be left out of the jack long enough for the test man at the test circuit to observe these lamps. It should then be reinserted, at which time the (OA) and (OB) lamps may be extinguished. The test circuit (PR) key should then be operated. When the (PR) key is released the "B" position is again seized and a lamp at the position again flashes as has been explained and the tests outlined can be repeated if desired, otherwise the test circuit (PD) and (TP) key should now be operated. The (PD) key operates the (PD1), (PD2) and (OP) relays. The (TP) key transfers the path, from the front contact of the (OP) relay, that lighted the (OA) lamp, to the windings of the (CT1) relay and also operates the (TP) relay. The (TP) relay closes the "K1", "K2" and "K3" leads from the position circuit thru the test circuit to the sender for registering in the sender the numerical digits as keyed at the "B" position circuit as has been outlined under "Position Circuit Test."

19.3 The (OP) relay operated, operates the (PD2) relay, transferring the "K1", "K2" and "K3" leads from the position circuit through to the "B" sender. The (OP) relay operated also closes a path from the midpoint of the primary and secondary windings of the (CT1) relay to the contacts of the (OAP) and (OBP) relays. This is for the purpose of relaying the signals from the office keys in the "B" position circuit

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under test through the test circuit to the "B" sender and registering the office indication in the "B" sender. One of the office keys in the "B" position should therefore be operated after the (PD2) relay has operated, connecting the position circuit through to the sender if the sender requires an office indication from the "B" position. The (OAP) or (OBP) relay will operate from the office key in the position circuit and the (OAP) relay connects resistance battery to the midpoint of the windings of the (CT1) relay and thus to the "T" and "R" leads to the sender while the (OBP) relay connects resistance ground to the windings of the (CT1) relay.

19.4 The "B" position circuits may be arranged for both 4 and 5 digit operation in which case they require a signal over the "K2" lead from the sender when 5 digits are to be set up by the operator. The signal over the "K2" lead causes a lamp at the "B" position to light and the position circuit to transmit a tandem order tone. Otherwise the lamp will not light and non-tandem order tone will be transmitted.

19.5 To test that the "B" position circuits will properly function under the above conditions optional "L" wiring and apparatus in this section and in section 0106 will be furnished.

19.6 With the (LOC) key - section 0106 - operated when the (PD1) relay operates as explained under "Position Circuit Test" ground will be connected to the "K2" lead to the position circuit under control of the (OP) relay. The (OP) relay will operate either after the office key has been operated and released at the "B" position or when the (PT1) relay releases after having operated the (PT2) relay with the (PD) key operated. In either event the (OP) relay removes the ground from the "K2" lead to the "B" position. With the (LOC) key - 0106 - operated the "K2" lead will be grounded and the "B" position should function as outlined above. In this case the desired office key at the "B" position must be operated. The particular key to be operated depends upon which position the (OAB) key -0112 - is placed. The operation of the "B" position office key causes the operation of the office relay in the "B" sender as outlined above. See Section 0106 Par. 10 and Section 0114 Par. 3.6.

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CIRCUIT UNIT - SECTION -0114
REGISTER CHECK CIRCUIT

1. PURPOSE OF CIRCUIT

This circuit is used in conjunction with other units of the test circuit to record and check the information which the sender transmits to the marker circuit.

2. WORKING LIMITS

None.

3. FUNCTIONS OF THE CIRCUIT UNIT

3.1 To check that the sender has selected a marker.

3.2 To record the information that is passed by the sender to the marker.

3.3 To release the marker after the record has been made.

3.4 To check the registration against the setting of the numerical keys, the frame keys, and the (RO) key. Also the office indication over the "OAB" lead.

Keys

3.5 (RO) key. This key is operated when a reorder test is made to permit check of the signal on the (RO) lead from the sender to the marker. When the (FKP) or (TFD) (section -0116 or -0118) is operated relay (RO1) Fig. AG will be operated.

3.6 (OAB) key optional. This key should be left in its normal position when it is expected that the sender will connect the "CK3" lead to the "OAB" lead to the marker. The (OAB) key should be operated when it is expected that the sender connects ground to the "OAB" lead to the marker. The following is a list of the conditions where the (OAB) key should be operated or left normal as indicated.

(OAB) key	Sender	Condition
Operated	Full Sel.	Grd. on Link "OB" Lead and normal "IG" Sel.
"	" "	Grd. on Link "OA" Lead and over 5 "IG" Sel.
Normal	Full Sel.	Grd. on Link "OB" Lead and Over 5 "IG" Sel.
"	" "	Grd. on Link "OA" Lead and Normal "IG" Sel.
Operated	Non-central "B" Swbd.	Grd. on Link "OB" Lead
Normal	Non-central "B" Swbd.	Grd. on Link "OA" Lead
Operated	Non-central "B" Swbd.	Grd. on Link "OC" Lead Grd. on "B" Pos. T and R
Normal	Non-central "B" Swbd.	Grd. on Link "OC" Lead Bat. on "B" Pos. T and R
Operated	Non-central "B" Swbd. All Comm. Trks.	No Grd. on Link Lead, Grd. on "B" Pos. T and R
Normal	Non-central "B" Swbd. All Comm. Trks.	No Grd. on Link Lead, Bat. on "B" Pos. T and R
Operated	MF Pulsing	Grd. on Link "OB" Lead
Normal	" "	Grd. on Link "OA" Lead
Operated	" "	Grd. on Link "OC" Lead, and a "B" "Office Identification" digit keyed
Normal	" "	Grd. on Link "OC" Lead and an "A" "Office Identification" digit keyed
Operated	"B" Swbd. (Term. Part)	Grd. on Link "OB" Lead
Normal	" "	Grd. on Link "OA" Lead
Operated	" "	Grd. on Link "OC" Lead and over 5 "IG" sel.
Normal	"B" Swbd. (Term. Part)	Grd. on Link "OC" Lead and Normal "IG" Sel.
Operated	Dial Pulse Term.	Grd. on Link "OB" Lead
Normal	"	Grd. on Link "OA" Lead
Operated	"	Grd. on Link "OC" Lead & "B" Office Code" digit is dialed
Normal	Dial Pulse Term	Grd. on Link "OC" Lead & an "A" "Office Code" digit is dialed

Lamps

3.7 The register check progress lamps are used to indicate which digit is being checked. These lamps are (TH), (H), (T), (U), (F), (F10), and (RO). Also (OAB) lamp when furnished.

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3.8 (TRL) lamp. This lamp lights on trouble release tests from the end of the first connection between a marker and test circuit, to the end of the second connection. It is used to indicate whether or not a second marker is seized.

4. CONNECTING CIRCUITS

When this circuit is listed on a keysheet the connecting information shown thereon is to be followed.

4.1 Crossbar Terminating Marker Circuit - SD-25283-01.

4.2 Connector Circuit - SD-25159-0102.

4.3 Sender Group Test Circuit - SD-25159-0106.

4.4 Revertive Pulsing Test Circuit SD-25159-0108.

4.5 "B" Switchboard Sender and Position Finder Test Circuit SD-25159-0112.

4.6 "B" Switchboard Sender and Position Finder and Multi-Frequency Pulsing Test Circuit SD-25159-0116.

4.7 Multi-frequency Pulsing Test Circuit SD-25159-0118.

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DESCRIPTION OF OPERATION

5. SEIZURE

When the revertive pulsing or key pulsing circuit is seized, ground is connected over the "C" lead to this circuit, operating the (C) relay. The (C) relay operated, operates the (G) relay, connects ground over the "GC" lead to the connector circuit, furnishes locking ground for the relays of this circuit, and operates the (CKG) relay which supplies ground to the "CK" leads and also operates relays (CK1), (CK2) and (CK3).

6. CONNECTION TO MARKER

Each marker has a multi-contact relay for connection to the test circuit and a means is provided for operating the multi-contact relay in that marker which is selected by the sender under test. The operating circuit for the multi-contact relay is as follows. Ground is supplied from the (C) relay of this circuit to the "GC" lead to the connector circuit. The connector circuit is one of the units of the test circuit and it functions to connect the grounded "GC" lead to a contact on the multi-contact relay of the Marker Connector which is associated with the sender under test. When the numerical code has been registered in the sender under test, the sender causes this marker connector to select a Marker, and the ground on the "GC" lead is extended thru a contact on the marker connector multi-contact relay corresponding to the Marker selected, operating the multi-contact relay of the Marker seized by the sender under test. This operated multi-contact relay connects all of the receiving leads of that marker to register relays in this circuit, and informs the marker that the call is a sender test call, and therefore, the marker must not function to set up the incoming and line choice switches.

Ground is supplied from the marker thru the Marker Connector and the test circuit connector to the "FC" lead, operating the (FC) relay. This operates relay (FC1) which locks.

7. REGISTRATION

Certain of the receiving leads are grounded by the sender and the remaining receiving leads are grounded thru contacts in the sender by means of ground supplied over the "CK1", "CK2" and "CK3" leads. The register relays of the test circuit are in multiple with the register relays of the marker. Therefore, all register relays of both the marker and the test circuit are operated. A circuit thru the front contacts of all of the register relays and the (CK1) (CK2) and (CK3) relays operates the (CK4) relay. The (CK4) relay operated, locks to ground on the "CKG" lead, and releases the (CKG) relay. This same checking procedure takes place in the Marker Circuit and when the Marker and test circuit have functioned to operate their respective (CK4) relays, ground is removed from the "CK1", "CK2" and "CK3" leads causing the release of all register relays not held operated by grounds supplied over the receiving leads by the sender under test. With the (CK4) relay operated and the rest of the (CK-) relays released, a circuit is closed to operate the (LU) relay and in turn operating the (LUA), (LUB) and (LUC) relays. These relays operated, provide a locking ground for each of the register relays which has remained operated and, therefore, lock in a record of the information which has been transmitted by the sender to the Marker. The (LU) relay is slow operate to allow time for all register relays, which are going to release, to do so. When the (LU-) relays have operated a circuit is closed

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from ground thru the front contact of (FC1) relay, front contact (LU-) relays, back contact of all of the progress relays to operate the (RL) relay which grounds the "RL" lead and causes the associated sender circuit to release. The (RL) relay is slow operate to allow all register locking circuits to close before releasing the sender. The sender in releasing releases the Marker Connector Circuit, the Marker Circuit and the (CK4) relay. The (LUC) relay operated and the (CK4) relay released closes a circuit to operate the (THA) relay.

The (W) relay operates when the (CK1) and (F1) relays operate, locks and signals over the (TC) lead that the sender has seized a marker. This operates the (TC) relay in either the Revertive Pulse or one of the MF Pulsing units which lights the (TH) lamp.

8. CHECKING THE THOUSANDS DIGIT

With the (THA) relay operated, the registration of the thousands digit on the (TH1), (TH2), (TH4) and (TH8) relays is checked against the setting of the (TH) key of the numerical keys of the revertive pulsing circuit. The (THA) relay operated, connects ground thru the contacts of the (TH-) relays to one of the numbered circle leads, numbered 0 to 9. These circled leads are connected to contacts on keys 0 to 9 of the (TH) row of the numerical key set. If the numbered lead grounded by the (TH-) group of relays corresponds to the key on the (TH) row of keys which is depressed, this ground will be extended from the numerical keys over lead "TH" thru the back contact of the (HA) relay to operate the (THB) relay. If the setting of the (TH-) register relays is such that a numbered lead is grounded which does not correspond to the operated key of the (TH) rows of keys, no circuit will be provided for operating the (THB) relay. The test circuit will block and the (TH) lamp as well as the lamp corresponding to the (TH-) relays operated will be lit.

9. CHECKING THE OTHER DIGITS OF THE NUMERICAL CODE

When the thousands digit check is completed the (THB) relay operates, locks and extinguishes the (TH) lamp, lights the (H) lamp, and operates the (HA) relay. The (HA) relay operated, extends ground thru the (H-) relays to one of the circle leads numbered 0 to 9. The hundreds check is made as described for thousands digit except that the (H-) relays and the (H) row on the numerical keys are involved. If the check is satisfactory the (HB) relay is operated over the "H" lead. The (HB) relay operated, locks, extinguishes the (H) lamp, lights the (T) lamp, and operates the (TA) relay for starting the check of the tens digit. The (T-) relays and the (T) row of the numerical keys are used for checking the tens digit and when the check is completed the (TB) relay is operated over the "T" lead. The (TB) relay operated, locks and operates the (UA) relay for the start of the units check. The units digit is checked in the same manner except that the (U) relays and the (U) row of numerical keys are involved. If the check is satisfactory the (UB) relay is operated over the "U" lead. The (UB) relay operated, locks and operates the (FA) relay.

10. CHECKING THE FRAME REGISTRATION

The (FA) relay operated, closes a circuit for checking the setting of the (F-) relays against the setting of the (F) row of keys of the group Test Circuit. This check is made in the same manner as the check of the numerical digits, except that the (F-) relays and the (F) row of keys are involved. When this check is completed the (FB) relay is operated over the "F" lead. The (FB) relay locks and operates the (FAA) relay which checks to determine if the (F10) relay is operated or not operated. The condition of the (F10) relay is checked against the (FA) row of keys and if the check is satisfactory, ground is returned, over the "FA" lead operating the (FAB) relay.

11. HE KING REORDER

When checking reorder on MF senders and (RO) key is operated the (OAB) key should be left normal.

11.1 Fig. AF or Fig. AG with (RO1) Relay Normal

The (FAB) relay operated, locks and operates the (ROA) relay. The (ROA) relay operated, closes a circuit for checking the setting of the (RO) relay against the (RO) key. If the check is satisfactory the (ROB) relay operates, extinguishing the (RO) lamp. If the check is not satisfactory the test circuit will block and the (RO) lamp will remain lit.

11.2 Fig. AG Relay (RO1) Operated

With relay (RO1) operated the check of the numerical digits is omitted and the operation of relay (TC) in section -0116 or -0118 lights the (F) lamp and the release of the (CK4) relay closes a circuit to operate relay (UB). The test will proceed from this point as above described.

12. CHECKING OFFICE INDICATION, "B" OPTION

When any of the senders to be tested are arranged to complete calls to multi-office units the (OAB) relay, lamp and key and the (LUD) relay and associated B ring will be furnished.

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This is to provide means for checking that the sender under test transmits the proper information to the terminating marker as to which office of multi-office units is wanted. The (OAB) key should be in its normal position when the sender connects the "OAB" lead to the "CK3" lead to the marker and the (OAB) key should be operated when it is expected that the sender under test will connect ground to the "OAB" lead to the marker.

13. RELEASE

When the check of the registration has been completed and the (ROB) relay operated ground from the (LUC) relay is connected to the "AV" lead. This causes the associated connector unit of the test circuit to function and remove ground from the "C" lead, releasing the (C) relay which restores the circuit to normal.

14. TROUBLE RELEASE

This test should be made during light load periods since it holds a marker out of service until it times out. In making this test the marker is caused to send two trouble release signals to the Marker Connector Circuit, the marker connector circuit in turn transmits a trouble release signal to the sender after the second trouble release is received from the marker. The test circuit checks to determine if the sender releases when the trouble release signal is received from the Marker Connector Circuit. In order to make this test the #4 class key of the connector circuit is operated which operates the (TRL) relay. The (TRL) relay when operated, opens the normal operating circuit of the (CK4) relay and prepares a circuit for advancing the test circuit after the (W) and (Z) relays have functioned. The (W) and (Z) relays are operated under control of the (CK1) and (F1) relays. When the first marker is selected the (S) relay operates and when the (CK1) relay releases, due to the marker timing out, the (Z) relay operates and locks thru the operated contacts of the (W) relay. When the second marker is seized the (CK1) and (F1) relays are again operated which causes the (W) relay to release. When the marker times out tje (CK1) relay releases causing the (Z) relay to release. The (W) and (Z) relays released, close ground to the "AV" lead advancing the test circuit through relay (TRL) operated.

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CIRCUIT UNIT - SECTION -0116
"B" SWBD. SENDER AND POSITION FINDER TEST CIRCUIT AND MF PULSING TEST CIRCUIT

1. PURPOSE OF CIRCUIT

1.1 This circuit unit in conjunction with other units of the test frame provides means of making tests on "B" switchboard senders and Position Finders and MF pulsing senders. It is intended for use where test frames already wired for "B" Switchboard Senders and Position Finders per Section 0112 are modified for testing MF key pulsing senders or where "B" Switchboard Senders and Position Finders and MF senders are to be installed.

2. WORKING LIMITS

2.1 None.

3. FUNCTIONS OF THIS CIRCUIT UNIT

3.101 To check the "H", "S", "CO", "D", "T" and "R" leads and their associated apparatus.

3.102 Provides means for transmitting fast pulses, to simulate fast keying service conditions to the "B" senders or "MF" senders.

3.103 Provides means for transmitting slow pulses, to simulate slow keying service conditions to the "B" senders or "MF" senders.

3.104 To check the reset of the register relays. "B" switchboard sender and position finder.

3.105 To test the talking circuit of the "B" senders for continuity.

3.106 To connect to any position circuit for test.

3.107 To check the ability of the position circuit to register a number in the sender by means of key pulses.

3.108 To test the position disconnect feature of the position circuit.

3.109 To test "B" senders for registering office designation from the "B" position.

3.110 To check for continuity of "T" and "R" leads in MF pulsing senders.

3.111 To test MF receiver and sender operation on short pulse closures.

3.112 To test MF receiver and sender operation on short open period between pulses.

3.113 To check that MF receiver will not function on three frequencies for "K.P." signal.

3.114 To check that MF receiver and sender will not register nor advance on a single frequency.

3.115 To check that MF receiver and sender will give a "reorder" in case of three frequencies for a numerical digit.

3.116 To check that MF receiver and sender will route to reorder in case of a second "K.P." signal.

3.117 To check that the MF sender gives the proper "OAB" lead indication for "office indication."

3.118 To check that the regular (ST) key operation at the toll position will not interfere with the registration already set up in the MF sender.

3.119 When an MF pulsing sender is to be tested relay (MF10) is operated to rearrange the functioning of the (D) and (CO) relays for operation with this type of sender.

3.120 To test the ability of the "B" position circuit to transmit over the "T" and "R" leads the office indication.

3.121 To make a non-operate test of the (K3) relay in the "B" Switchboard Sender and Position Finder.

3.122 To time the "Start Pulse" signal sent back by the MF sender.

3.123 To make an operate and release test on the "A" relay of the MF sender.

3.124 To check that the MF sender will give a reorder in case of a premature "ST" key operation.

3.2 Keys

3.201 (TT) key. This key when operated arranges the circuit for the tone test. In this test the sender selects a position and the order tone is passed through the sender to the test circuit.

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The test man may also talk thru this circuit to the operator.

3.202 (PP) key. This key, when operated permits the position selector switch to be advanced to any position by means of the dial.

3.203 (PT) key. This key arranges the circuit for testing position circuits.

3.204 (SKP) key. With this key operated the (KP-) relays generate slow pulses of (approximate) .250 sec. make and .250 sec. break. When testing "B" senders, this test makes non-operate tests of the sender register relays. When testing M.F. Senders, this test checks the locking circuit of the sender (TO) relay.

3.205 (TP) key. Before position is tested the sender to be used for this test is routined. The operation of the (TP) key stops the routine test of the sender at the end of the test then in progress, and causes the position test to start.

3.206 (PD) key. This key is operated to eliminate the test of the position disconnect feature.

3.207 (PR) key. This key is operated at the end of a position test to release the position circuit and the test circuit.

3.208 The (OA-OB) key. This key when operated to the (OB) position causes ground to be connected to T & R to "B" sender and in the (OA) position battery will be connected to T & R.

3.209 (FKP) key. This key when operated causes two "K.P." (key pulse) signals to be transmitted to test that the sender will block in case a false "K.P." signal is received.

3.210 (SF) key. This key when operated causes a single frequency to be transmitted to test that the MF receiver and sender will not register on a single frequency.

3.211 (TF) key. This key when operated adds one frequency to the two frequencies of a preliminary "K.P." signal to test that the receiver will not falsely respond to over two frequencies as an initial "K.P." signal.

3.212 (TFD) key. This key when operated adds one frequency to the two frequencies of the hundreds digit to test that the MF receiver and sender will block on three frequencies for a digit. This key operates relay (RO1) sheet -0114 to omit check of numerical digits.

3.213 (IL) key. This key when operated causes an increase in power from the volume limiter in the MF receiver circuit making the receiver more subject to transient operation.

3.214 (LL) key. This key when operated removes a high loss pad (HL) from the MF pulsing circuit to provide a high input to the receiver.

3.215 (TWT) key. This key when operated cuts a network across the MF pulsing circuit to simulate a difference in trunk attenuation with frequency conditions. It may also insert a 4 db. pad.

3.216 (DPR) key. This key when operated causes pulses with a minimum open period to be transmitted for all numerical digits.

3.217 (TFT) key. This key when operated inserts 250 ohms in the locking lead of relay (D) to prevent the operation of relays (TC1) and (TC2) in the sender on trunk disconnect test.

3.3 Lamps

3.301 The (CT) lamp lights while waiting for the "B" switchboard sender and position finder to close its talking circuit towards the position or for the MF pulsing sender to reverse the battery on the "T" and "R" leads.

3.302 The (RC) lamp lights while waiting for the sender to recognize that registration has been completed and an MF pulsing sender has opened the "T", "R" and "CO" leads.

3.303 The (L) lamp lights while waiting for the removal of battery from the "K3" lead in preparation for registration ("B" switchboard sender and position finder).

3.304 The (RR) lamp lights during the transmission of the first three digits for the first time ("B" switchboard sender and position finder). After the reset signal is sent to the sender and during the transmission of the number the second time the (RR) lamp is not lit.

3.305 The (P) lamp, on tone test or position test, lights while waiting for the position circuit to register a number in the sender and for the sender to find a marker. The (P) lamp also lights if the connector start key is restored without restoring the position test apparatus to normal ("B" switchboard sender and position finder).

3.306 The (PB) lamp lights while making the busy test of the position ("B" switchboard sender and position finder).

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3.307 The (PD1) lamp lights while waiting for the position disconnect signal from the position over the K1 lead ("B" switchboard sender and position finder).

3.308 The (PD2) lamp lights while waiting for the position disconnect signal from the position over the tip and ring leads ("B" switchboard sender and position finder).

3.309 The (FP), (KP), (OI), (TH), (H), (T), (U) and (ST) key pulsing progress lamps indicate which digit the circuit is ready to send. Also (OAB) lamp when furnished. These lamps are particularly useful in step-by-step operation. The (FP), (KP), (OI) and (ST) lamps apply only when testing MF senders.

3.310 The (OB) lamp lights when ground is connected to the T & R leads from the "B" position under test and the (OA) lamp lights when battery is connected.

3.311 The (MFB) lamp lights when the incoming trunk test set is connected to the multi-frequency current supply circuit.

4. CONNECTING CIRCUITS

When this circuit is listed on a key sheet the connecting information shown thereon is to be followed.

4.1 "B" Sender and Position Finder Circuit SD-25014-01.

4.2 "B" Position Circuit SD-21104-01.

4.3 Register Check Circuit SD-25159-014.

4.4 Sender Group Test Circuit SD-25159-0106.

4.5 Revertive Pulsing Test Circuit SD-25159-0108.

4.6 Connector Circuit SD-25159-0102.

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DESCRIPTION OF OPERATION

5. SELECTION

When a noncentral "B" switchboard or MF pulsing sender has been selected for test by the test circuit, the sender group test unit grounds the "C" lead to this circuit, operating the (C) relay. The (C) relay operated, operates the (G) relay and connects thru the individual leads from the sender. Ground is supplied over the "B" lead to the "B" switchboard sender and position finder to operate a relay in the sender circuit which transfers the six leads, which in service are connected to the position circuit to the key pulsing test circuit for test purposes. The "B" lead is closed through to the MF sender and receiver to control the volume control of the (IL) key.

6. CHECK OF "S" LEAD

The "S" lead is tested for ground in the sender group test circuit and this lead is extended into this unit operating the (C1) relay. The (C1) relay locks under control of the (C) relay. If the check of the "S" lead does not function properly the test circuit will block.

7. CHECK OF "D" AND "CO" LEADS

7.1 "B" Switchboard Sender and Position Finder.

The "D" lead is connected to a polarized (TC1) relay in the sender circuit and when the (C1) relay has operated, this polarized relay is connected to the (D) relay thru the (D) resistance. The (D) relay operates, extinguishes the (D) lamp, lights the (CO) lamp, connects the (CO) relay to the "CO" lead, and locks under control of the (C) relay. This locking ground over the "D" lead operates the sender polarized relay causing the sender to progress with the call. When the (CO) relay operates the (CO) lamp is extinguished, and the (CT) lamp is lit. If the check of the "D" lead or "CO" lead does not function properly the test circuit will block and the (D) lamp or (CO) lamp will remain lit.

7.2 MF Pulsing Sender

The MF pulsing sender does not ground the "D" lead until after the registration is completed but when relay (C1) operates the "D" lead is closed to the winding of relay (TD3). If there is a false ground on the "D" lead relay (TD3) will operate and lock. Relay (TD3), operated, also opens the lead to the winding of relay "D" so that relay (D) cannot be operated when the sender connects ground to the "D" lead. The (TD3) operated also opens the circuit to the (D) lamp transferring it to the (DG) lamp. The operation of relay (MF10) lights the (CO) lamp. When relay (MF10) is operated the "CO" lead is closed to the (CO) relay which operates operating (CO1) relay which locks under control of relay (MFS). Relay (CO1) operated transfers the "D" lead from relay (TD3) to the winding of relay (D). The operation of relay (CO) extinguishes the (CO) lamp and lights the (CT) lamp. If the check of the "CO" lead does not function properly the test circuit will block and the (CO) lamp will remain lit.

8. CHECK OF REGISTRATION LEADS (SENDER PREPARED FOR REGISTRATION)

8.1 "B" Switchboard Sender and Position Finder.

The operation of the (CO) and (D) relays lights the (CT) lamp. The relay in the sender circuit which operates over the "B" lead causes the sender "T1", "R1", "K1", "K2", "K3" and "H" leads to be connected to the test circuit. The resistance battery on the "H" lead causes the double test feature of the sender to function and close battery to the "T1" lead, ground to the "R1" lead, and battery thru a marginal relay to the "K1" lead. The (CT) relay operates over the "K1" lead but the marginal relay in the sender does not operate since the test circuit imposes a non-operate test condition. However, if the sender marginal relay operates falsely on this non-operate test condition, a reorder signal will be transmitted to the marker and the test circuit will block when checking the registration. With the (CT) relay operated a circuit is closed to operate the (CT1) relay over the "T1" and "R1" leads. The (CT1) relay operated, lights the (RC) lamp and operates the (CT2) relay. The "K2" lead should be open at this time, but if it is closed, the (X) relay will operate, and prevent (CT3) from operating. The (CT2) relay operated, operates the (CT3) relay and connects battery thru the (A) resistance to the "K2" lead and thru the (B) resistance to the "K1" lead. The (CT3) relay locks, extinguishes the (CT) lamp, lights the (K) lamp and removes the battery from the "H" lead.

Battery over the "K1" and "K2" leads causes the sender to function to prepare for registration and return battery over the "K3" lead operating the (K) relay. The (K) relay operated, locks and with "K" wiring operates the (TRA) and (TR1) relays in series. When Fig. AR is furnished relays (AB) and (AB1) will be operated first in turn operating (TRA) and (TR1) relays. The operation of relay (AB1) lights the (OAB) progress lamp. The (TR1) relay operated, lights the (TH) progress lamp if relay (AB1) is not furnished. The (TRA) relay locks under control of the (C) relay and operates the (TRB) and (TR2) relays in series. The (TRB) locks and operates the (TRC) and (TR3) relays in series. The (TRC) relay locks and operates the (TRD) and (TR4) relays in series. The (K1) relay then operates, in turn operating the (K2) relay.

The (K2) relay connects ground to the armature of the (KP1) relay. If the (SKP) key is normal, this causes the relay interrupter circuit, which is composed of the (KP1) to (KP6) relays, to start pulsing. If the (SKP) key is operated, the secondary winding of the (KP1) relay has previously been connected to ground by the operation of the (G) relay, so that pulsing cannot begin at this time since the (KP1) relay is operated to hold its back contact closed until this ground is removed. The placing of the (KP1) relay on its back contact is necessary in order to insure the start pulsing of the (KP1) relay later in the circuit. Should the (KP1) relay contact be floating, the (KP1) relay would not start pulsing without this conditioning. The (K2) relay also removes battery from the "K1" and "K2" leads causing the sender to function to remove battery from the "K3" lead. The removal of battery from the "K3" lead, releases the (K) relay. With the (K) relay released and the (K1) relay operated the (K3) relay operates and closes thru the "K1", "K2" and "K3" leads to the numerical register keys. The (K3) relay operated, extinguishes the (K) lamp and lights the (RR) lamp. If the check of the "K" leads fails to function properly the test circuit will block and the (K) lamp will be lighted. If the (SKP) key is operated the (K3) relay also removes the ground from the secondary winding of the (KP1) causing the relay interrupter circuit to start pulsing.

8.2 MF Pulsing Sender

The operation of relay (CO) closes ground to operate relays (KPA) and (KPS) in series. Relay (KPS) operated lights the (KP) lamp. The (KPA) relay locks under control of the (C) relay and operates relays (TRA) and (TR1) in series (relay (FD) normal). Relays (TRB), (TR2), (TRC), (TR3), (TRD) and (TR4) are operated and locked as described in above paragraph. The operation of relay (TRD) operates relay (STA) and (ST1) in series (relay (KPT) operated. Relay (STA) locks under control of the (C) relay.

As soon as the sender is selected battery is connected to the "T" lead and ground to the "R" lead. Relay (BSY) controls the "T" and "R" leads until ground is placed on the "RL" leads to signal that the sender is seized. With relay (C) operated, the polarized (A) relay is connected to the "T" and "R" leads and operates from battery and ground in the sender. The operation of the (A) removes the ground from the secondary winding of the condenser-timed (RVT) relay allowing it to start to operate. If the (A) relay is still operated when the (RVT) operates the (RV1) relay will operate and lock, the (SSP) lamlp will be extinguished indicating that the "Start Pulse" was long enough. When the (RV1) operates the slow release (RV2) relay will start to release. If the sender reverses the battery and ground, as it should, before the (RV2) releases, the release of the (A) followed by the release of the (RVT) will hold the (RV2) and operate the (RV3) relay. The (LSP) lamp will be extinguished indicating that the "Start Pulse" was not too long. The operation of (RV3) operates relay (A1) which locks under control of relays (CO) and (STA). Relay (A1) operated (a) extinguishes the (CT) lamp, (b) lights the (RC) lamp, (c) opens the lead which operated relay (KPA), (d) opens the shunting path to prevent false shunting of the (A1) relay when relay (ST1) releases, (e) closes ground to armature and windings of relay (KP1) to start pulsing, and (f) closes the circuit to the winding of relay (KP5).

9. REGISTER RELAYS RESET - "B" SWITCHBOARD SENDER AND POSITION FINDER

The register relays in the sender circuit are under control of the relay interrupter circuit, the (TR1) to (TR4) relays, and the numerical register keys in the test circuit. Before operating the (ST) key of the test circuit, the numerical keys corresponding to the number with which it is desired to test the sender shall be depressed. The (TR1) to (TR4) relays, releasing one by one after each digit, switch the transmitting leads from one set of numerical keys to the next. The purpose of the relay interrupter circuit (KP1) to (KP6) relays is to provide a definite closed period for operating the register relays in the sender.

Ground is supplied thru the front contacts of the (G) relay to the (L) resistance and to the windings of the (KP1) relay. This causes the operation of the (KP1) relay. When the (KP1) front contact closes, the (KP1) relay releases, and the opening of the front contact starts the (KP1) to operate again. The operation of this relay is delayed due to the fact that the condenser (KP) must be charged by a current flowing thru the (KP1) secondary winding before the relay can operate. This condenser charging current in the secondary winding is in the direction to prevent the relay operation, and, therefore, the relay will not operate until the charging current has been sufficiently reduced, so that the primary ampere turns are greater than the secondary. The release of the (KP1) relay is delayed in a similar manner due to the (KP) condenser discharging thru the secondary winding. The characteristics of the (KP1) relay and associated condenser and resistances are such that the relay contact furnishes pulses of approximately .050 sec. closed and .040 sec. open, when the (SKP) key is normal and approx. .250 sec. closed and .250 sec. open with the (SKP) key operated. The slower key pulses are used to detect certain troubles in the sender steering relays and in making nonoperate tests of the sender register marginal relays. The (KP2), (KP3) and (KP4) relays repeat the pulses supplied by the (KP1) contact for the purpose described below.

When the (KP4) relay closes its contact, ground is supplied to operate the (KP5) relay under control of the (TR4) and (K3) relays and when the (KP4) relay releases the (KP6) relay is operated. The operating circuit is closed through relay (MF7) normal. The (KP5) and (KP6) relays lock up under control of the (TR4) relay and their purpose is to absorb the first pulse of the relay interrupter so that the first pulse supplied to the sender register relays will be of full duration. The (KP6) relay operated closes battery to the contacts of

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the (KP2) and (KP3) relays and also extends the circuit from the (KP4) relay contact to the inner end of the winding of the (TR1) relay or relay (AB1) if Fig. AR is furnished. The contacts of the (KP2), (KP3) and (KP4) relays make and break simultaneously. When (KP2) and (KP3) relay contacts closed, battery is connected thru the front contacts of the (TR4), (TR3), (TR2) and (TR1) relays and thru the operated thousand numerical key to leads K1, K2 or K3 to the sender circuit for operating the sender register relays for thousands registration. Fig. AQ: The (KP4) relay contact closing, connects ground to the inner end of the winding of the (TR1) relay which holds this relay operated but shunts the (TRA) relay and it releases. When the (KP4) relay contact opens, the (TR1) relay also releases. Fig. AR: The (KP4) relay contact closing connects ground to the inner end of the winding of the (AB1) relay which holds this relay operated but shunts the (AB) relay and it releases. When the (KP4) relay contact opens the (AB1) relay also releases. The release of relay (AB1) (a) recloses the "TH" and "TH1" leads to the (TR1) relay, (b) transfers the pulse lead to the inner winding terminal of relay (TR1), (c) extinguishes the (OAB) lamp and lights the (TH) lamp. Unless the (OA) or (OB) key, if furnished, is operated as described in paragraph 19 the (AB) and (AB1) relays perform no useful function at this time. The next operation of relay (KP4) will connect ground to the inner end of the winding of the (TR1) relay and the call will progress as above for Fig. AO. The (TR1) relay released transfers the register leads for hundred registration, extinguishes the (TH) lamp, and lights the (H) lamp. Hundreds registration is accomplished in the same manner as thousands registration just described except that battery is connected thru the hundreds key to the "K1", "K2" and "K3" leads. The (KP4) relay contacts closing for hundreds registration shunt and release the (TRB) relay and when the contact opens it releases the (TR2) relay. The (TR2) relay transfers the register leads for tens registration, extinguishes the (H) lamp, and lights the (T) lamp. Tens registration is accomplished in the same manner as thousands and hundreds registration except that battery is placed on the "K-" leads thru the tens key and the (TRC) and (TR3) relays are released as were the (TRB) and (TR2) relays. On the next closure of the (KP4) relay contacts the (TRD) relay is shunted and released, and when the (KP4) relay contacts open the (TR4) relay is released. When the (KP3) relay contacts close with the (TR3) relay released, the (RR) relay is operated. This closure of the (KP2) and (KP3) relays does not, therefore, make unit registration and thereby complete the registration in the sender, but instead is used to prepare the test circuit to release the sender register relays which have been operated. The (RR) relay operated, releases the (K1), (K2) and (K3) relays and operates the (RR1) relay which locks and opens the operating circuit of the (RR) relay causing it to release. The (RR1) relay operated, extinguishes the (RR) lamp and closes a circuit for the (TC) lamp under control of the (K3) relay. The (K2) relay released closes a circuit from battery thru resistance to the "K1" and "K2" leads. This causes the sender to function and release the register relays that were operated during the registration just described. When the sender relays have released and the sender is again ready for registration battery thru a resistance is again connected to the "K3" lead from the sender. This operates the (K) relay. With the (K) relay operated, a circuit, is again closed for operating the (AB) and (AB1), if furnished, (TRA), (TR1), (TRB) and (TR2) etc. relays and the (K1) and (K2) relays then operate as previously described. The (K2) relay operated removes the battery from the "K1" and "K2" leads causing the sender to function and remove battery from the "K3" lead releasing the (K) relay. With the (K) relay released and the (K1) relay operated the (K3) relay is again operated which closes thru the "K1", "K2" and "K3" leads to the numerical register keys. The test circuit is now in the same condition as it was at the start of the "Register Relays Reset" test except that the (RR1) relay is locked operated. The test circuit and sender are now ready for registration.

10. REGISTRATION

10.1 "B" Switchboard Sender and Position Finder

10.11 Fig. AQ

Registration takes place as described in the previous paragraph. All four digits are registered this time, the (TR4) relay releasing as the transmission of the units digit is completed. The release of the (TR4) relay stops the interrupter relays.

10.12 Fig. AR. Nonoperate test (K3) Relay

Registration takes place as described in the previous paragraph except that when relay (KP3) is operated with relays (AB1) and (RR1) operated, ((OB) key, if furnished, nonoperated) battery will be connected thru resistance (AE) and (AF) to the "K3" lead giving a non-operate current to the (K3) relay in the sender. The call should proceed in the usual manner but if the (K3) relay should operate falsely on this current the sender would record a "5" on the thousands register and advance for hundreds registration prematurely. The test circuit will now proceed with the registration of the four digits releasing relay (TR4) as the transmission of the units digit is

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completed. The release of the (TR4) relay stops the interrupter relays. With any button other than a "5" operated on the thousand key the register check circuit would block with the No. 5 lamp lit for check of the thousands digit. When the (OF) key is operated this test is ineffective as the test circuit will apply ground in place of battery to the "K3" lead.

10.2 MF Pulsing Sender

The register relays in the sender circuit are under control of the relay interrupter circuit, the (TR1) to (TR4) relays and the numerical register keys in the test circuit. Before operating the (ST) key of the test circuit, the numerical keys corresponding to the number with which it is desired to test the sender shall be depressed. The (TR1) to (TR4) relays, releasing one by one after each digit, switch the pulsing leads from one set of numerical keys to the next. The purpose of the relay interrupter circuit (KP1) to (KP6) relays is to provide a definite closed period for operating the register relays in the sender.

With the (SKP) key operated, ground is supplied through a back contact of the normal (A1) relay to the winding of the (KP1) relay, to place the (KP1) relay on its back contact. The placing of the (KP1) relay on its back contact is necessary in order to insure the start pulsing of the (KP1) relay later in the circuit. Should the (KP1) relay contact be floating, the (KP1) relay would not start to pulse without this conditioning.

Ground is supplied through a front contact of the operated (A1) relay to the windings of the (KP1) relay. This causes the operation of the (KP1) relay. When the (KP1) relay front contact closes, the (KP1) relay releases, and the opening of the front contact starts the (KP1) relay to operate again. The operation of this relay is delayed due to the fact that the condenser (KP) must be charged by a current flowing through the (KP1) relay secondary winding before the relay can operate. This condenser charging current in the secondary winding is in the direction to prevent the relay operation, and therefore, the relay will not operate until the charging current has been sufficiently reduced, so that the primary ampere turns are greater than the secondary. The release of the (KP1) relay is delayed in a simular manner due to the (KP) condenser discharging through the secondary winding.

The characteristics of the (KP1) relay and associated condenser and resistances are such that the relay contacts furnish minimum pulses of .055 sec. closed and .055 sec. open for K.P. signal. For the numerical digits the resistances are replaced by other resistances so that the relay contacts furnish minumum pulses of approximately .027 sec. closed and .063 sec. open when (DPR) key is normal. When the (DPR) key is operated the length of the pulse closure and open, for the numerical digits, are reversed. The short pulse closure is to test that the receiver and sender will properly function on a minimum pulse closure and the short open between pulses is to test that the sender will make the transfer to the next register within this open period. With the (SKP) key operated, the pulses are increased to approximately .250 sec. closed and .250 sec. open. This will be described in Par. 10.22. The (KP2), (KP3) and (KP4) relays repeat the pulses supplied by the (KP1) contact for the purposes described below.

When the (KP4) relay closes its contact, ground is supplied to operate the (KP5) relay under control of the (CO1) relay, and when the (KP4) relay releases the (KP6) relay is operated. The (KP5) and (KP6) relays lock up under control of relay (KPS) and their purpose is to absorb the first pulse of the relay interrupter so that the first pulse supplied to the receiver and sender will be of full duration. The (KP6) relay operated closes the "T" and "R" leads from the contacts of the (KP2) and (KP3) relays toward the sender and also extends the circuit from the (KP4) relay contact to the inner end of the winding of the (KPS) relay through its front contact. When testing MF pulsing senders the wiring of the contacts of the (KP2) and (KP3) relays are changed so that relay (KP2) controls the "R" and relay (KP3) controls the "T" leads. The contacts of relays (KP2), (KP3) and (KP4) make and break simultaneously. When the contacts of relays (KP2) and (KP3) close for the first digit the multifrequencies for the K.P. signal "SPT" and "KPT" leads connected to the contacts of relay (KPS) (operated) are closed thru contacts of relays (TR1), (TR2), (TR3) and (TR4) (operated) contacts of relays (KP2), (KP3) (operated) thru repeating coil (A), 1C pads (HL) and (IN) and repeating coil (T) to sender. The (KP4) relay contact closing, connects ground to the inner end of the winding of relay (KPS) which holds this relay operated but shunts relay (KPA) which releases. When the (KP4) relay contact opens, relay (KPS) is released. Relay (KPS) released (a) transfers the "T" and "R" leads from the "KPT" and "KPR" leads to leads "TH" and "TH1" to the thousands register key through contacts on relay (OI1), (normal), (b) extinguishes the (KP) lamp, (c) lights the (TH) lamp, and (d) opens the operating circuit for the (KPT) relay. Relay (KPT) is held operated until relay (KP6) releases to prevent a false pulse in case the (KP2) and (KP3) relays again close their front contacts. When the (KPT) relay releases the interrupter is

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stopped to permit changing the interrupter network resistances to give the digit pulse timing in place of the "KP" signal timing. The release of relay (KPT) causes the operation of relay (PR) and also opens the operating circuit of slow release relay (PRS) which releases again closing the ground to the interrupter which resumes pulsing as above. The (TH, (H), (T), & (U) lamps referred to under "Registration" are the "Pulse Progress Lamps". The next closure and opening of the contacts of relays (KP2), (KP3) and (KP4) after relay (KP6) has operated completes the thousands registration in the sender and releases relay (TR1). Relay (TR1) releases (a) transfers the "T" and "R" leads to the hundreds register key over leads "H" and "H1" (b) extinguishes the (TH) lamp, and (c) lights the (H) lamp. The hundreds, tens and units registrations are completed in a similar manner as the thousands except that the "T" and "R" leads are connected to the hundreds, tens and units register keys in sequence. The release of relay (TR4) after units registration connects the "T" and "R" to the "Start" signal frequencies over leads "STT" and "STR" through contacts on relay (ST1) operated. The "start" signal will now be transmitted in the same manner as the previous digits to simulate service conditions but the sender should now have advanced to a condttion in which the start signal has no effect. The release of relay (ST1) (a) opens the "T" and "R" leads, (b) opens the ground from the interrupter stopping the interrupter relays (c) extinguishes the (ST) lamp and (d) lights the (D) lamp.

10.22 Long Pulse (SKP) Key Operated

With the (SKP) key operated, the pulses are increased to approximately .250 sec. closed and .25 sec. open.

When testing "B" terminating senders, with the (SKP) key operated, the "B" sender register relays are tested to insure meeting their operate and non-operate conditions imposed in service. The operation of the numerical keys (0) to (4) inclusive, and keys (6) and (8), imposes operate test conditions on the sender register relays. The number (9) numerical key when operated imposes non-operate test conditions on the "B" sender marginal relays. The number (7) key imposes an operate test condition to the (K3) relay on its secondary winding, and the number (5) key imposes an operate test to the (K3) relay on its primary winding.

When testing "MF" terminating senders, with the (SKP) key operated, the slow pulse is necessary to determine if the sender (TO) relay is functioning to prevent registering a digit on a particular group of sender register relays and then registering the same digit on the succeeding group of register relays. This will occur if the sender (TO) relay fails to remain locked operated during the full closure of any digit. The sender receiver is arranged to accept any digit, and then cause the sender to register the digit, after which the sender is prepared for reception of the succeeding digit by connecting a second group of register relays. If the first digit pulse is prolonged, such as might occur if the operator holds a digit key operated for an extended interval of time, or until the sender had connected the second group of register relays, then this same pulse would make two registrations. Sender relay (TO) locked operated, during this interval, prevents this.

Thos slow pulse test may also be used to assist the maintenance man in the detection of troubles in the sender register circuit.

10.3 Multi-Office Indication

When either MF or "B" senders are arranged to complete calls in multi-office terminating units there are three methods of controlling this indication as follows:

(a) Where there are only individual trunk groups.

(b) Where there are only common trunk groups.

(c) Where there are both individual and common trunk groups.

10.31 Individual Groups of Trunks With Arrangement (A) or (C)

In these cases the sender receives the office indication from the trunk group through the link. Calls from trunks to office "A" cause the "OA" lead to be grounded and the sender connects the marker "OAB" lead to the "CK3" lead. The call is thereby routed to office "A" without keying an office digit.

To test senders for this the (LOA) key -0106 will be operated and the (OAB) key -0114 will be normal. Calls from the trunks to office "B" cause the "OB" lead to be grounded and the sender grounds the "OAB" lead to the marker. No office digit is keyed. To test senders for this the (LOB) and (OAB) keys are operated. See Sections 0106, Par. 10.1 and 0114, Par. 3.6.

10.32 Common Group of Trunks - Arrangement (C)

The senders in this case receives an "OC" lead ground from the trunk group through the link and an office digit must be keyed. When testing senders so arranged the (LOC) key should be operated which indicates to the sender that a code digit will be received. The sender arranged itself

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for receiving five digits. In the "B" switchboard sender an indication will be received over the "T" and "R" leads from the "B" position as to whether the call is for "Office A" or "Office B" as outlined in Section 0112, par. 18. In the M-F sender there are cross-connections provided so that any digit may be used for either "Office A" or "Office B". In either sender when "Office B" is indicated the "OAB" lead to the marker will be grounded and the test circuit (OAB) key must be operated. The test circuit otherwise functions as described for a regular call.

10.33 Common Group of Trunks - Arrangement (B)

In this case an office digit must always be keyed. The sender does not receive an office indication from the link. The (LOA), (LOB) and (LOC) keys will be omitted if there is not some other type or group of senders that requires a link office indication. In any event the office digit is keyed to the sender as described in this section.

11. CHECK OF "D" LEAD - MF PULSING SENDER

When registration is completed in the sender ground is connected to the "D" lead and the "CO" lead is opened. The opening of the "CO" lead releases the (CO) relay. The "D" lead is connected to a polarized relay (TC1) in the sender circuit and when the (C1) relay has operated, this polarized relay is connected to the (D) relay thru the (D) resistance. The (D) relay operates and (a) locks under control of the (D) relay, extinguishes the (D) lamp and (b) lights the (TC) lamp. The locking ground from the test circuit over the "D" lead operates the sender polarized relay causing the sender to progress with the call. The (D) resistance in the (D) lead is used to make an operate test of the sender polarized relay. If the check of the "D" lead does not function properly the test circuit will block and the (D) lamp will remain lit.

12. SENDER REGISTER RELAYS - MARGINAL TESTS - "B" SWITCHBOARD SENDER AND POSITION FINDER (SKP) KEY OPERATED

The sender register relays are tested to insure meeting their operate and non-operate conditions imposed in service. The operation of the numerical keys (0) to (4) inclusive, and keys (6) and (8), imposes operate test conditions on the sender register relays. The number (9) numerical keys when operated impose non-operate test conditions on the sender marginal relays. These non-operate tests should be made with slow key pulses, (SKP) key operated. The number (7) key imposes an operate test condition of the (K3) relay on its secondary winding, and the number (5) key imposes an operate test of the (K3) relay on its primary winding.

13. REGISTRATION COMPLETED

13.1 "B" Switchboard Sender and Position Finder

When registration has been completed the sender functions to open the "T" and "R" leads releasing the (CT1) relay, which extinguishes the (RC) lamp.

13.2 MF Pulsing Sender

When registration has been completed the sender functions to open the "T", "R" and "CO" leads releasing the (A1) relay which extinguishes the (RC) lamp. Relay (CO) also opens the "BK" lead toward the Register Check circuit.

14. STEP-BY-STEP REGISTRATION

In order to aid in locating troubles the pulses may be transmitted to the sender one at a time under control of a key. The (SS) key in the revertive pulsing circuit is operated which grounds the "SS" lead and operates the (KS) relay. This opens the circuits of the (KP2) and (KP3) relay contacts, prevents the (KP-) relays from pulsing, and closes the path of the (KA) relay to the revertive pulsing circuit. Each operation of the (AV) key in the revertive pulsing circuit grounds the "AB" lead, operating the (KA) relay which closes the circuit ordinarily closed by the interrupter relays. In this manner a pulse is transmitted and the (KPA) and (KPS) relays on MF sender tests or (TRA) and (TR1) relays on "B" switchboard sender and position finder under tests function as on regular interrupter pulsing. The other steering relays are operated in this manner as they are on regular pulsing. Remote control jacks located at the sender frames may be used instead of the test frame key for operating the (KA) relay. A 32A test set is used for this purpose, using the key which shorts the sleeve to the tip.

15. TRUNK DISCONNECT TEST

15.1 "B" Switchboard Sender and Position Finder

There is a feature in the sender circuit which functions to restore the circuit to normal in case a premature disconnect signal is received from the trunk circuit. When this feature is to be tested the #5 class key of the connector circuit is operated which supplies ground over the "TD" lead operating the (TD1) relay. When the (C1) relay operates the "D" lead is closed from the connector circuit thru the front contacts of the (TD1) relay

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to the winding of the (TD) relay. The (TD) relay operates under this condition but the polarized relay in the sender does not operate. The (TD) operates and locks and the locking ground is supplied to the "D" lead which causes the sender polarized relay to operate. The (TD) relay operated also causes the (TD1) relay to release. The (TD1) relay is slow released in order to allow sufficient time for the sender relays to function. The (TD1) relay released, connects the "D" lead to relay (TD3), the sender polarized relay releases and the sender then functions to restore to normal. The sender opens the "S" lead which causes the (C1) relay to release. Ground thru the front contacts of the (TD) relay and back contacts of the (C1) relay is supplied over the "ADV" lead to the connector circuit causing the test circuit to advance. If the premature disconnect feature of the sender fails to function properly the "S" lead will not be opened by the time the (TD2) relay has released. The (TD2) relay released, furnishes a locking circuit for the (C1) relay. With the (C1) relay locked under this condition the test circuit will block and the (D) lamp will remain lit. If the sender fails to remove ground from the "D" lead, the (TD3) relay will operate and lock opening the "ADV" lead and blocking the test circuit with the (D) lamp lit. Precautions outlined in section -0102 under "Trunk Disconnect Test" should be observed.

15.2 MF Pulsing Sender (Over "T" and "R" Leads)
#5 Class Key and (DPR) key Operated.

There is a feature in the sender circuit which functions to restore the circuit to normal in case a premature disconnect signal is received from the trunk circuit. When this feature is to be tested the #5 class key of the connector circuit is operated supplying ground over the "TD" lead to operate relay (TD8) when relay (TR3) operates with relay (DLT) normal and relay (MF8) operated. Relay (TD8) operated (a) locks to the "ST" relay ground through a front contact of relay (C), (b) opens in part the pulsing circuit ground lead and (c) closes in part a circuit to operate relay (TD4). Relay (TR3) operated maintains a closure of the pulsing circuit ground. The sender test circuit proceeds to send pulses as previously described until (TR3) relay releases when the pulsing circuit is opened preventing further pulsing. The release of relay (TR3) now operates relay (TR4) in turn operating relay (TD5) which in turn operates relay (TD2). The operation of relay (TD4) and (TD5) closes the "T" and "R" leads from the sender to relay (TD6) which operates in turn operating relay (TD7). Relay (TD7) operated (a) locks to the "TD" lead under control of the (MF8) relay, (b) opens the operating winding of relay (TD5) which is slow release, and (c) closes in part a circuit to the "ADV" lead to the connector circuit. The release of relay (TD5) opens the "T" and "R" circuit through relay (TD6) but leaves a 30,000 ohm leak across them. The opening of the "T" and "R" leads causes the sender to restore, opening the "S" lead and permitting the (C1) to release. The release of relay (TD5) causes the release of relay (TD2). Relay (TD2) is slow release to time the release of the sender relay. Ground through the back contacts of relay (TD2) front contacts of relay (TD7) and back contacts on relay (TD3) and (C1) is supplied over the "ADV" lead to the connector circuit causing the test circuit to advance. If the premature disconnect feature of the sender fails to function properly the "S" lead will not be opened by the time the (TD2) relay has released. The (TD2) relay released furnishes a locking circuit for the (C1) relay. With the (C1) relay locked under this condition the test circuit will block and the (TD) lamp will remain lit. Precautions outlined in section -0102 under "Trunk Disconnect Test" should be observed.

15.3 MF Pulsing Senders - "D" Lead

In the MF pulsing sender ground is not closed to the "D" lead until all the registration is completed. There is a feature in the sender circuit which functions to restore the sender circuit to normal in case of a disconnect after the supervision has been transferred back to the trunk circuit. When this feature is to be tested the #9 class key of the connector circuit is operated which supplies ground over the "TD" lead operating the (TD1) relay and ground over lead "TDI" operating relay (DLT). The operation of the #6 class key should be delayed until the test frame has restored to normal from any previous tests. With the (C1) relay operated the "D" lead is closed from the connector circuit thru the front contacts of relay (TD1) to the winding of the (TD) relay. When the sender applies ground to the "D" lead after registration is completed relay (TD) operates but the polarized relay in the sender does not operate. The (TD) relay locks and the locking ground is supplied to the "D" lead through winding of relay (TCO), and the (EZ) resistance in parallel, causing the operation of the polarized relay in the sender. The (TD) relay operated, causes the release of relay (TD1). Relay (TCO) will not operate until relay (TC2) in the sender has operated due to insufficient current. The operation of relay (TC2) causes the operation of relay (TCO) which locks. Relay (TCO) must be operated and locked before relay (TD1) breaks its front contact. Relay (TD1) is slow release in order to allow sufficient time for the sender relay to function. The (TD1) relay released connects the "D" lead to

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relay (TD3). The sender polarized relay releases and the sender then functions to restore to normal. The sender opens the "S" lead which permits the (C1) relay to release. Ground through (TD2) relay released and the front contacts of the (TD) relay and back contacts of relays (TD3) and (C1) is supplied over the "ADV" lead to the connector circuit causing the test circuit to advance. If this disconnect feature of the sender fails to function properly the "S" lead will not be opened by the time the (TD2) relay has released. The (TD2) relay released furnished a locking circuit for the (C1) relay. If relay (TCO) is not operated by the operation of the sender (TC2) relay, ground under control of relay (DLT), through the back contact of relay (TCO) will hold relay (C1) operated although the "S" lead was opened. With the (C1) relay locked under this condition the test circuit will block and the (D) lamp will remain lit. If the sender fails to remove ground from the "D" lead the (TD3) relay will operate and lock, opening the "ADV" lead and blocking the test circuit. On a satisfactorily completed test the (D) lamp will remain lit until the release of relay (CO1). Precautions outlined in section -0102 under "Trunk Disconnect Test" should be observed.

15.4 MF Pulsing Sender - Test of Release of Sender (FT) Relay - (TFT) Key Operated

There is a feature in the sender to open the "S" lead in case certain functions are not completed within a definite time. The operation of the "TFT" key inserts 250 ohms into the locking circuit of relay (D). This resistance serves to lock relay (D) but prevents the operation of polarized relay (TC1) in the sender. As relays (TC1) and (TC2) in the sender are not operated the sender is not connected to a marker. The (TFT) key operated also operates relay (TD5), through a normal contact on relay (TD7), in turn operating relay (TD2). The operation of relay (D), after the completion of pulsing operates relay (TD7) opening the operating circuit of relay (TD5) which releases in turn releasing relay (TD2). If the (C1) relay has not released by the opening of lead "S", by the time relay (TD2) has released relay (C1) will be locked and the test circuit blocked, as previously described, with the (TC) lamp lit.

16. TEST OF ORDER TONE CIRCUIT - "B" SWITCHBOARD SENDER AND POSITION FINDER

When it is desired to check the order tone circuit and transmission circuit of the sender, the (TT) key is operated which allows the sender circuit to function and pick an idle occupied position circuit. The (TT) key also operates the (TP) relay lighting the (P) lamp. The "T" and "R" leads which in service are extended to the trunk circuit are connected to the telephone circuit of the test circuit. This enables the test man to check the quality of the order tone and transmission.

With the test circuit in this condition the test man may request the "B" operator to operate keys or perform any function which she normally does on a regular service call. The operation of the (PD) key of the position may be used to test the reorder feature of the sender. The numerical keys in the test circuit should be operated corresponding to the number keyed at the position. If the position (PD) is to be operated, the No. 5 key should be operated in the test circuit for those digits not transmitted from the position. Also the (RO) key should be operated to check the reorder feature of the sender.

17. POSITION CIRCUIT TEST - "B" SWITCHBOARD SENDER AND POSITION FINDER

When it is desired to test a position circuit the test is made by two test men, one located at the "B" position to be tested and the other at the test frame. The "B" position circuits are tested by the test circuit in connection with a sender circuit. For this reason a sender should be selected and then, with the (REP) key operated, routined to assure satisfactory operation. After the sender has been routined, the (TP) key is operated. This key may be operated as the test circuit is progressing in its routine test of the senders. If the (TP) key is operated before the (CT2) relay operates, then the next operation of the (CT1) relay operates relay (TP). However, if the (TP) key is operated after the (CT2) relay operates the routine test in progress is completed and a new test started. During this new test the operation of the (CT1) operates relay (TP). The (TP) relay when operated, connects the "K1", "K2" and "K3" leads from the sender to the position test circuit for use in numerical registration from the position circuit under test. The position circuit to be tested is connected to the test circuit thru the (S) 206AU selector. The (PP) key is operated and the (S) selector stepped to the desired position circuit. When the (PP) key is operated and the dial is moved off normal, a circuit is closed from ground on the (PP) key to operate the (DO) relay thru the pulsing contacts of the dial. The (DO) relay operated energizes the selector magnet and when the dial pulsing contacts break the (DO) relay releases, releasing the selector magnet, thus stepping the selector one position for each opening and closure of the dial. When the desired position has been reached, the (PP) key is released and the (PT) key is operated. The test-man at the position then plugs a telephone set into the regular telephone jacks of the selected "B" position. The (PT) key operated also operates

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the (PT) relay which connects battery and ground thru the winding of the (PT1) relay to 270 ohm battery over the "H" lead to the position circuit. This causes the (PT1) relay to operate to 270 ohms battery over the "H" lead. The (PT1) relay will not operate if the resistance to battery over the "H" lead is greater than approximately 350 ohms or if the 270 ohm battery is shunted by a false ground to approximately 100 ohms or less. The (PT1) relay operated operates the (PT2) relay. The (PT2) relay operated, closes battery thru the winding of the (PD) relay to the "K1" lead of the position circuit. This causes a relay in the position circuit to operate and the (LK) lamp at the position to finish. The man at the "B" position observing the flashing lamp depresses the (PD) key at the position. This causes the (PD) relay in the test circuit to operate which operates the (PD1) relay, extinguishing the (PD1) lamp. When the (PD) key at the position is released the (PD2) relay operates in series with the (PD1) relay and both relays hold through the front contact of the (PD1) relay. The (PD2) relay operated connects transmission battery and ground to the "T" and "R" leads of the position circuit. This operates the (T) relay in the position circuit which lights the (S) lamp at the position and also causes the position circuit to function and transmit order tones over the "T" and "R" leads after which the circuit for transmitting speech is established between the "B" position and the test circuit. The (T) relay in the position circuit operating also causes battery to be removed from the "H" lead. This releases the (PT1) relay. The "B" position will appear busy to any hunting selector however even though battery and ground thru the windings of the (PT1) relay remain connected to the "H" lead. With the (S) lamp lighted at the position the test man again depresses the (PD) key at the position. The (PD) key operates with "G" wiring the (DS) relay in the test circuit which operates the (TR) relay. The (TR) relay operated, extinguishes the (PD2) lamp and connects the K1, K2, K3 leads from the position circuit thru the test circuit to the K1, K2 and K3 leads respectively, of the sender circuit. Instead of operating the position circuit (PD) key the second time the test man any remove the operator's plug momentarily to test the ability of the position to send a PD signal in this manner. The circuit operation in the sender test circuit is the same in either case. The position circuit and sender circuit then function and prepare for registration and, when ready, the (S) lamp at the position is extinguished. The test man at the position can then proceed to key up on the position numerical keys any number that the test man at the test frame has keyed up on the test circuit numerical keys. At any time before the units digit is pulsed, the position (RS) key may be operated to test this feature. When the last digit has been recorded by the sender and the key released, the sender circuit functions and opens the "T" and "R" leads. The test circuit and sender circuit then function to advance to normal after a check has been made of the registration. It should be noted that once a sender has been seized its time out circuit starts to function and will sound its minor alarm in 30 to 60 seconds which means that all the digits should be keyed in less than this time. If the (REP) key is operated the test is repeated. The test circuit will advance and operate for registration in connection with the position circuit. Another position circuit may be selected and tested or the same one retested. To release the position circuit the (PR) key in the test circuit is operated. This opens the "T" lead releasing the (T) relay in the position circuit which returns to normal and reconnects 270 ohms battery to the "H" lead. The (PR) key operated also releases the (PD1), (PD2), (TR) and (PT2) relays in the test circuit. With these relays released and battery again connected to the "H" lead the (PT1) relay reoperates and the test circuit and position circuit continue to function as previously described when the (PR) key is released. On subsequent tests of the position circuit the (PD) key in the test circuit may be operated in order to eliminate the operation of the (PD) key in the position circuit. When the (PT1) relay operates with the (PD) key operated the (PD1), (PD2) and (TR) relay operate and the test circuit functions without operating the position circuit (PD) key.

18. TIME OUT TEST

18.1 "B" Switchboard Sender and Position Finder

With class key No. 6, (TA) and (PTS) or (BS) keys operated, and (APB) key normal, insert a plug in the hold sender jack. On this test the minor alarm will be sounded and the members of the maintenance force should be advised accordingly. The (TM) relay will be operated from the No. 6 class key. The (KS) relay is operated which prevents sending key pulses to register a number in the sender. The (TH) lamp in the test circuit lights and the sender should start time out and in 28 to 58 seconds should cause the test circuit (CO) lamp and sender (TL) lamp to light. The time from the lighting of the (TH) lamp to where the (CO) lamp lights is the time out period of the sender and measured with a stop watch should be between 28 to 58 seconds. Five to 10 seconds after the (CO) lamp lights the minor alarm should sound. The (MGB) key is then operated to prevent interfering with service when the sender circuit is subsequently released with the test circuit attached. The hold plug is then removed from the jack and the (TL) lamp should be extinguished and the

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alarm silenced. The test circuit (S) lamp should then light. The (AV) key should then be momentarily operated to cause the test circuit to advance for starting test of the next sender or the same sender if the (REP) key is operated. When the (REP) key is operated the (AV) key should be held operated until the test circuit advances for the next year. Since the operation of the (MGB) key makes the sender group busy the (AV) key should be operated without undue delay.

18.2 MF Pulsing Sender

With class key No. 6 (TA) and (MFS) keys operated, the (APB) key normal, insert a plug in the hold sender jack. On this test the minor alarm will be sounded and the other members of the maintenance force should be advised accordingly. The (TM) relay will be operated from the No. 6 class key operating the (KS) relay. The (KS) relay operated prevents sending MF pulses to register a number in the sender. The (KP) lamp in the test circuit lights and the sender should start time out and in 15 to 30 seconds should cause the sender (TL) lamp to light. The time from the lighting of the (KP) lamp to the lighting of sender (TL) lamp is the time out period of the sender and measured with a stop watch should be between 15 and 30 seconds. Five to 10 seconds after the (TL) lamp lights the minor alarm should sound. The (MCB) key is then operated to prevent interfering with service when the sender circircuit is subsequently released with the test circuit attached. The hold plug is then removed from the jack and the (TL) lamp should be extinguished and the alarm silenced. The test circuit (S) lamp should then light. The (AV) key should then be momentarily operated to cause the test circuit to advance for starting a test of the next sender or the same sender is the (REP) key is operated. When the (REP) key is operated the (AV) key should be held operated until the test circuit advances for the next test. Since the operation of the (MGB) key makes the sender group busy the (AV) key should be operated without undue delay.

19. REGISTERING OFFICE INDICATION OVER "T" AND "R" LEADS - "B" SWITCHBOARD SENDER AND POSITION FINDER

19.1 The (OA-OB) key and (AB) and (AB1) relays and associated wiring and the trouble wound (CT1) relays will be installed where any of the "B" senders to be tested receive an office indication over the "T" and "R" leads from the "B" position circuits.

19.2 The signal that the "B" sender receives over the "T" and "R" leads from the position circuit is resistance battery or resistance ground. There are in the "B" sender two polarized differentially connected relays in series with the "T" and "R" leads. One of these relays operates when ground is connected to the "T" and "R" leads and the other relay operated when battery is connected. These relays in turn cause other relays to operate and thereby the office indication is registered in the sender circuit from keys in the position circuit. In order to test this feature of the sender the (OA-OB) key will be operated either to the (OA) position or the (OB) position. This will cause the (AB) and (AB1) relays to be operated before the (TRA) and (TR1) relays operate as is described under registration. The test circuit will after these relays operate, progress in a normal manner as has been described until the (KP5) and (KP6) relays have operated. The next operation of the (KP2) relay which normally transmits the "TH" digit to the "B" sender will instead cause either resistance battery or resistance ground to be connected to the midpoint of the primary and secondary windings of the (CT1) relay. The (CT1) relay is operated over the "T" and "R" leads from the "B" sender and therefore the connection of resistance battery or ground to its winding will cause one of the polarized relays in the "B" sender to operate as from the operation of one of the office keys in the position circuit. The (KP2) relay remains operated for a definite time as has been described and the resistance in series with the battery or ground to the "T" and "R" lead is such as to impose a severe operating condition on the sender polarized relays. The (KP4) relay operates with the (KP2) and (KP3) relays. The (KP4) relay shunts the (AB) relay winding and it releases and then when the (KP4) relay releases the (AB1) releases. The (AB1) relay transfers the circuits from the (KP2) and (KP3) relays contact for registering the thousands digit under control of the (TR1) relay as is described under registration.

19.3 The "B" senders may be arranged to transmit a signal over the "K2" lead to the "B" position when it is expected that the "B" operator set up on a key at her position the designation of the office desired when the senders are arranged for the completion of calls to multi-office units.

19.4 To test the senders for properly transmitting the signal over the "K2" lead optional "L" wiring and apparatus in this section and in section 0106 will be provided.

19.5 With the (LOC) key - 0106 - operated the "K2" lead is connected to the winding of the (KG) relay in place of the (X) relay. Also the "K1" lead is opened and the (CT) relay can not operate until the (KG) relay has operated which it will if the sender connects ground to the "K2" lead as it should. If the (KG) relay does not operate then the (CT) relay will fail to be operated and the test circuit will block. Otherwise the operation of the (KG) relay from ground on the "K2" lead closes the path for operating the (CT) relay and the test circuit proceeds as has been outlined.

20. OFFICE REGISTRATION FROM "B" POSITION CIRCUIT - (TP) AND (PD) KEYS NORMAL

20.1 The "B" position circuits may be arranged to transmit a signal over the "T" and "R" leads to the "B" senders as to which office is wanted when the senders are arranged to complete calls to multi-office units. The signal from the position circuit consists of connecting either battery or ground to the "T" and "R" leads from the position circuit. In order to test the "B" positions for the proper transmission of the office indication over the "T" and "R" leads optional "H" wiring and apparatus will be furnished and also the double wound be furnished (CT1) relay which is optional "B" apparatus. When the "B" position circuit has been connected as is described under position circuit test the test man at the test frame will ask that one of the office keys in the position circuit be operated. The key that connects resistance ground to the "T" and "R" leads will cause the (OBP) relay in the test circuit to be operated. The key that connects battery to the "T" and "R" leads will cause the (OAP) relay to be operated. The (OAP) relay will operate the (OA) relay and then when the (OAP) relay has released, the (OP) relay operates in series with the (OA) relay and the two relays hold to ground. The (OA) relay lights the (OA) lamp as an indication that the office indication was properly transmitted from the office key. The (OBP) relay operating from ground on the "T" and "R" leads will operate the (OB) relay and then when the key is released the (OP) relay operated in series with the (OB) relay and they lock to ground. The (OB) relay lights the (OB) lamp as an indication that the key caused the proper registration in the test circuit. The (OBP) relay may also be operated when the position disconnect key in the position circuit is operated because this key also connects ground to the "T" and "R" leads. With the test circuit (PD) key normal, one or the other of the office keys or the position disconnect key must be operated in the position circuit. The operation of the (PD) key in the test circuit, however, eliminates the necessity of operating these keys in the position circuit as has been described under position circuit test.

20.2 Instead of operating the office keys as just outlined it may be desirable to test the "B" position circuit for transmitting two ground pulses to the "T" and "R" leads when the position is vacated. To make this test, after the "B" position has been seized by the test circuit, battery over the "K1" lead causes a flashing lamp at the "B" position and the test man will operate the (PD) key at the position. This will cause the test circuit (PD1) lamp to be extinguished as has been explained. The test man at the "B" position will then remove the operator's telephone set plug from the jack as though the position were vacated. This causes two pulses of ground to be connected to the "T" and "R" leads to the test circuit. The first of these pulses operates the (OBP) and (OB) relays and when the pulse ends the (OP) relay is operated as has been explained. The second ground pulse again operates the (OBP) relay and with the (TP) key normal, as it will be for this test the (OA) lamp is lighted. The first pulse operates the (OB) relay lighting the (OB) lamp. The telephone plug should therefore be left out of the jack long enough for the test man at the test circuit to observe these lamps. It should then be reinserted, at which time the (OA) and (OB) lamps may be extinguished. The test circuit (PR) key should then be operated. When the (PR) key is released the "B" position is again seized and a lamp at the position again flashes as has been explained and the tests outlined can be repeated if desired, otherwise the test circuit (PD) and (TP) key should now be operated. The (PD) key operates the (PD1), (PD2) and (OP) relays. The (TP) key transfers the path, from the front contact of the (OP) relay, that lighted the (OA) lamp, to the windings of the (CT1) relay and also operates the (TP) relay. The (TP) relay closes the "K1", "K2" and "K3" leads from the position circuit thru the test circuit to the sender for registering in the sender the numerical digit as keyed at the "B" position circuit as has been outlined under "Position Circuit Test."

20.3 The (OP) relay operated, operates the (PD2) relay, transferring the "K1", "K2" and "K3" leads from the position circuit through to the "B" sender. The (OP) relay operated also closes a path from the mid-point of the primary and secondary windings of the (CT1) relay to the contacts of the (OA) and (OBP) relays. This is for the purpose of relaying the signals from the office keys in the "B" position circuit under test through the test circuit to the "B" sender and registering the office indication in the "B" sender. One of the office keys in the "B" position should therefore be operated after the (PD2) relay has operated, connecting the position circuit through to the sender if the sender requires an office indication from the "B" position. The (OAP) or (OBP) relay will operate from the office key in the position circuit

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and the (OAP) relay connects resistance battery to the midpoint of the windings of the (CT1) relay and thus to the "T" and "R" leads to the sender while the (OBP) relay connects resistance ground to the windings of the (CT1) relay.

20.4 The "B" position circuits may be arranged for both 4 and 5 digit operation in which case they require a signal over the "K2" lead from the sender when 5 digits are to be set up by the operator. The signal over the "K2" lead causes a lamp at the "B" position to light and the position circuit to transmit a tandem order tone. Otherwise the lamp will not light and non-tandem order tone will be transmitted.

20.5 To test that the "B" position circuits will properly function under the above conditions optional "L" wiring and apparatus in this section and in section 0106 will be furnished.

20.6 With the (LOC) key - section 0106 - operated when the (PD1) relay operates as explained under "Position Circuit Test" ground will be connected to the "K2" lead to the position circuit under control of the (OP) relay. The (OP) relay will operate either after the office key has been operated and released at the "B" position or when the (PT1) relay releases after having operated the (PT2) relay with the (PD) key operated. In either event the (OP) relay removes the ground from the "K2" lead to the "B" position. With the (LOC) key -0106 - operated the "K2" lead will be grounded and the "B" position should function as outlined above. In this case the desired office key at the "B" position must be operated. The particular key to be operated depends upon which position the (OAB) key -0114 - is placed. The operation of the "B" position office key causes the operation of the office relay in the "B" sender as outlined above.

21. OFFICE INDICATION BY MEANS OF CODE DIGIT MF PULSING SENDER - (LOC) KEY OPERATED

21.1 The MF pulsing sender may be arranged to register an office indication by means of a code digit in advance of the thousands digit. When registration of this digit is to be tested one of the numerical buttons of the (OI) key must be operated. The depression of any one of these buttons ((LOC) key operated) causes the operation of relay (FD). Relay (FD) operated causes the operation of relay (OIA) and (OII) in series following relays (KPA) and (KPS). The operation of relay (OIA) operates relays (TRA) and (TR1) and following relays as previously described. The pulsing will now be as described, except that the office indication will be transmitted between the "KP" signal and the thousands digit in accordance with the button depressed. When any "Office B" button is depressed the (OAB) key should be operated to test that ground was connected to the (OAB) lead to the marker by the sender.

21.2 To test that the MF sender will function properly if an unused office indication is set up on the (OI) relays a test may be made with an unassigned code set up on the (OI) keys and the (RO) key operated. The test will be satisfactory if the sender is sent to reorder.

22. MULTI-FREQUENCY CURRENT SUPPLY - USED BY INCOMING TRUNK TEST SET

MF Pulsing Sender - U Option

When the MF current supply is furnished from a separate office building and is used in common with the incoming trunk test set the "U" option shall be furnished to prevent both test circuits being connected to the MF current supply circuit simultaneously. If the incoming trunk test set is not using the MF supply circuit when relay (TRD) is operated relay (STA) will be immediately operated as previously described. If the incoming trunk test set is using the MF current supply circuit battery will be connected to the CI lead operation relay (IT). The operation of relay (TRD) now connects ground to the (IT) interrupter. The first closure of the "F" contact operates relay (ITA) which locks. The following closure of contact "B" on (IT) interrupter operates relay (STA) and (ST1) in series. Relay (STA) locks and opens the ground from relay (IT) which releases removing ground from the (IT) interrupter. As long as relay (STA) is operated ground is removed from the "CI" lead and the incoming trunk test set cannot cut in on the MF current supply circuit. If the incoming trunk test set holds battery on the (CI) lead during the timing interval (approximately 2 to 4 seconds) the operation of relay (STA) will open the ground from the "CI" lead and the incoming trunk test set will be disconnected from the MF supply circuit. This circuit will now proceed as previously described.

23. FALSE "KP" SIGNAL - (FKP) AND (RO) KEYS OPERATED

The MF receiver and sender are arranged to route a call, on which a second "KP" signal is received by the MF receiver, to "Reorder". The (FKP) key operated causes the operation of (FPA) and (FP1) relays preceding the operation of relays (KPA) and (KPS). The (RO1) -0114 is also operated. The (FKP) key connects the "KP" signal frequencies to the contacts of relay (FP1) to be transmitted preceding the regular "KP" signal. The first "KP"

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signal will cause the MF receiver to cut through to the sender. The second "KP" signal will now cause the sender to route the call to "Reorder". The (RO) key should be operated when making this test. Under this condition the Register check circuit omits the check of the "TH", "H", "T", and "U" digits.

24. SINGLE FREQUENCY PULSE - (SF) KEY OPERATED

The MF receiver and associated sender are arranged to disregard a single frequency making no registration. With the (SF) key operated the (FPA) and (FP1) relays will be operated preceding the operation of relays (KPA) and (KPS). When pulsing starts the "KP" signal will be controlled by relay (FP1) followed by a single frequency (900 cycles) under control of relay (KPS). The MF receiver and sender should not respond to this single frequency and the remainder of the pulses should be registered in the manner above described.

25. THREE FREQUENCY PULSE - PRECEDING THE "KP" SIGNAL - (TF) KEY OPERATED

The MF receiver is arranged to disregard three simultaneous frequencies before a legitimate "KP" signal has been received. With the (TF) key operated the (FPA) and (FP1) relays will be operated preceding the operation of relays (KPA) and (KPS), and a single frequency (900 cycles) will be added to the two frequencies of the "KP" signal. When pulsing starts three frequencies will be transmitted first followed by the regular "KP" signal. The MF receiver should not react to the three frequency pulse but should proceed with the "KP" signal and subsequent pulsing as above described.

26. THREE FREQUENCIES IN PLACE OF A NUMERICAL DIGIT - (TFD) AND (RO) KEYS OPERATED

The MF receiver and sender are arranged to route a call to "Reorder" in case three frequencies are received in place of a numerical digit. The (TFD) key operated operates the (RO1) relay in -0114 and also connects a single frequency (900 cycles) with the regular two frequencies for the hundreds digit. Hundreds digit keys 0, 2, 4, 6, 7 or 9 only should be depressed when making this test. With the (TFD) key operated the call proceeds in the regular manner until the hundreds digit when the three frequencies will cause the sender to reroute the call to "Reorder." The (RO) key should be operated when making this test. Under this condition the regular check circuit omits the check of the "TH", "H", "T", and "U" digits.

27. SPECIAL TESTS FOR MF RECEIVER AND SENDER

These tests are to test particular condition or apparatus and are to be made in the same manner as above described but with keys operated as noted.

Test	Spl. Keys Operated	Signal Produced	Off. Ind. Key	Numerical Reg. Keys Thous.	Hunds.	Tens	Units	Results In
1. False K.P. Signal	(FKP)	KP KP						Reorder
2. Low Input		KP	1	1	3	7	7	Completed
3. Three Signals Present	(TFD) (LL)	KP	4	4	4	4	4	Reorder
4. High Input #1	(TF) (LL)	3 fr. KP	7	7	7	7	7	Completed
5. High Input #2	(SF) (DPR) (LL) (TWT)	KP 1 fr.	7	7	7	7	7	Completed

When the (FKP), (TF) or (SF) key is operated the lead for operating relay (KPA) is transferred to operate relay (FPA) first which in turn operates relay (KPA).

When an office indication key is depressed the (LOC) key must be operated.

If senders are not equipped with "Office Indication" register the "Office Indication" key may be omitted.

For tests #1 and #3 the (RO) key should be operated and the (RO1) relay is operated.

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When making test #4 (High Input #1) the operation of the (IL) key makes the receiver more subject to false operation by transients.

When making test #5 (TWT) key operated, twist network is added to reduce the power of the 1500 cycle frequency 6.25 ±.25 db "V" and "UX" option or 8.25 ±.25 db "UY" option below that of the 700 cycle frequency. This checks if the receiver will operate satisfactorily when frequency twist, that might be introduced by line facility, is present.

During location of trouble it may be desirable to use any digit for either low or high input tests regardless of above table.

When making test #2 (Low Input) the use of different digits insures that the channels indicated have adequate sensitivity.

Digit Used	Channels Have Adequate Sensitivity
4	700 & 1300 cycles
3	900 & 1100 cycles
0	1300 & 1500 cycles

When making test #4 (High Input #1) the use of different digits insures that the channels are not too sensitive.

Digit Used	Channel Is Not Too Sensitive
1	1100 cycle
5	1700 cycle
0	1100 & 1700 cycles
6	900 & 1500 cycles
2	1500 cycle
9	700 cycle

The use of the above digits provides a check on an adjacent channel above or below those being used, or of a combination frequency produced by the difference between the second harmonic of one frequency and the other frequency.

A test of the receiver to function in the interval between the "KP" signal and the first numerical digit (service condition) is made in test #1. If the receiver fails to function in the time interval between the two "KP" signals (045 mil. sec. min.) the sender will fail to route to reorder and the test circuit will block.

When (TFD) key is operated hundreds digit keys 1, 3, 5 or 8 must not be used.

28. REORDER ON TIME OUT - MF SENDER CLASS KEY #8 OPERATED

28.1 The MF pulsing sender is arranged to call in a marker and route a timed-out call to "Reorder." With the class key #8 operated for an MF pulsing sender the operation of relay (TR1) (relay (MF8) being operated) operates relay (TRO). Relay (TRO) operated closes ground to hold relay (PRS) operated and to operate relay (RO1) Fig. AG, sheet 0114. The call proceeds as usual until relays (KPS) and (KPT) release which stops the interrupter relays. The release of relay (KPS) lights the (D) lamp. This lamp remains lighted for 15-30 sec. As no more pulses are sent to the sender the sender starts to time out.

28.2 When the sender has timed out the "CO" lead is opened releasing the (CO) relay and the (D) relay is operated as is outlined under "Check of "D" lead." The sender (TC1) and (TC2) relays operate and connection is made to the marker for routing to "Reorder." If there is a delay in making connection to a marker the (TRO) lamp will light. When the marker is connected the (TC) relay operates, locks, opens the path to the (TRO) lamp and closes ground to the (TRL" lead to -0114 which then checks the Reorder routing from the marker and if this is satisfactory the "AV" lead from -0114 is grounded and with the (TC) and (CO1) operated and (CO) released this ground is extended to the "ADV" lead to -0103 as a signal that the test is completed.

When making this test a plug in the hold jack of the sender being tested should be removed.

29. PRELIMINARY "ST" KEY OPERATION TEST

The MF sender is designed to route a call to "Reorder" in case of a premature "ST" key operation. This feature is tested by the operation of the (LL), (RO), (DPR), (CL-O), (ACS), and (ST) keys with the (U-) keys all normal. With no (U-) key operated, the sender then registers TH, H, and T digit followed by the "ST" digit and should call for a marker asking for reorder. With the (RO) and (DPR) keys operated, provision is made for operating the (RO1) relay which allows the register check circuit to check the "RO" indication from the sender to the marker. If this check is satisfactory, the ADV lead is grounded and release takes place in a normal way.

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CIRCUIT UNIT - SECTION -0118
MF PULSING TEST CIRCUIT

1. PURPOSE OF CIRCUIT

1.1 This circuit unit in conjunction with other units of the test frame provides means of making tests on MF Terminating Senders. This unit is for use where only MF Terminating Senders are to be tested by this test circuit.

2. WORKING LIMITS

2.1 None.

3. FUNCTIONS OF THIS CIRCUIT UNIT

3.101 To check the "S", "CO", "D", "T" and "R" leads and their associated apparatus.

3.102 Provides means for transmitting fast pulses to simulate fast keying service conditions.

3.103 Provides means for transmitting slow pulses to simulate slow keying service conditions.

3.104 To check for continuity of "T" and "R" leads in MF pulsing sender.

3.105 To check the MF receiver and sender operation on short pulse closure.

3.106 To check the MF receiver and sender operation on short open period between pulses.

3.107 To check that the regular start "ST" key operation at the toll position will not interfere with the registration set up in the sender.

3.108 To check that the MF receiver will not function on three frequencies for "K.P." signal.

3.109 To check that the MF receiver and sender will not register nor advance on a single frequency.

3.110 To check that the MF receiver and sender will give a "reorder" in case of three frequencies for a numerical digit.

3.111 To check that the MF receiver and sender will route to reorder in case of a second "KP" signal.

3.112 To check that the MF sender will give the proper "OAB" lead indication for office indication.

3.113 When an MF pulsing sender is to be tested relay (MF8) is operated to reroute the "B" lead from the sender and close the (A) relay across the "T" and "R" leads.

3.114 To check that the MF sender will give a "reorder in case of a premature "ST" key operation.

3.115 To time the "Start Pulse" signal sent back by the MF sender.

3.116 To make an operate and release test on the (A) relay of the MF sender.

3.2 Keys

3.201 (FKP) key. This key when operated causes two "KP" (key pulse) signals to be transmitted to test that the sender will block in case a false preliminary "KP" signal is received.

3.202 (SF) key. This key when operated causes a single frequency to be transmitted following the "KP" signal to test that the MF receiver and sender will not register on a single frequency.

3.203 (TF) key. This key when operated adds one frequency to the two frequencies of a preliminary "KP" signal to test that the recorder will not falsely respond to three frequencies as an initial "KP" signal.

3.204 (IL) key. This key when operated causes an increase in the power from the volume limiter of the MF receiver circuit making the receiver more sensitive to transient operation.

3.205 (DPR) key. This key when operated causes pulses with a minimum open period to be transmitted for all digits.

3.206 (TFD) key. This key when operated adds one frequency to the two frequencies of the hundreds digit to test that the MF receiver and sender will block on three frequencies for a digit. This key operates relay (R01) sheet 0114 to omit check of numerical digits.

3.207 (LL) key. This key when operated removes a high loss pad (HL) from the MF pulsing circuit to provide a high input to the receiver.

3.208 (TWT) key. This key when operated connects a network across the MF

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pulsing circuit to simulate a difference in trunk attenuation with frequency conditions. It may also insert a 4 db pad.

3.209 (TFT) key. This key when operated inserts 250 ohms in the locking lead of relay (D) to prevent the operation of relays (TC1) and (TC2) in the sender on a trunk disconnect test.

3.210 (SKP) key. With this key operated the (KP-) relays generate slow pulses of approximately .250 sec. make and .250 sec. break. This test checks the locking circuit of the sender (TO) relay.

3.3 Lamps

3.301 The (CT) lamp lights while waiting for the sender to reverse the battery on the "T" and "R" leads.

3.302 The (RC) lamps light while waiting for the sender to recognize that registration is completed and has opened the "T", "R" and "CO" leads.

3.303 The (MFB) lamp lights when the MF supply is in use by the incoming trunk test circuit. This lamp applies only when the MF supply is obtained over cable conductors from another office and is used by the two circuits in common.

3.304 The (KP), (OF), (OI), (TH), (H), (T), (U) and (ST) key pulsing progress lamps indicate which digit the circuit is ready to send. These lamps are particularly useful in step-by-step operation.

4. CONNECTING CIRCUITS

When this circuit is listed on a key sheet the connecting information shown thereon is to be followed.

4.1 Connector Circuit, SD-25159-0102.

4.2 Sender Group Test Circuit, SD-25159-0106.

4.3 Revertive Pulsing Circuit, SD-25159-0108.

4.4 Register Check Circuit, SD-25159-0114.

4.5 Misc. Circuit Inc. Trk. Frame, SD-25159-01.

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DESCRIPTION OF OPERATION

5. SELECTION

When an MF pulsing terminating sender has been selected for test by the test circuit, the sender group test unit grounds the "C" lead to this circuit, operating the (C) relay. The (C) relay operated, lights the CO lamp, operates relay (G) and with the (C1) relay operated connects through the individual leads from the sender. The (MF8) relay is operated from the (MFS) relay in the sender groups test unit.

6. CHECK OF THE "S" LEAD

The "S" lead is tested for ground in the sender group test circuit and this lead is extended into this unit operating the (C1) relay. The (C1) relay locks under control of relay (C). If the check of the "S" lead does not function properly the test circuit will block.

7. CHECK OF THE "D" AND "CO" LEADS

7.1 "D" Lead for False Ground

The MF pulsing sender does not ground the "D" lead until after the registration is completed but when relay (C1) operates the "D" lead is closed to the winding of relay (TD3). If there is a false ground on the "D" lead relay (TD3) will operate and lock. Relay (TD3), operated, also opens the lead to the winding of relay "D" so that relay (D) cannot be operated when the sender connects ground to the "D"

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lead. Relay (TD3) also opens the lead from the "D" lamp transferring it to the (DG) lamp.

7.2 Check of the "CO" Lead

When relay (C1) is operated the "CO" lead is closed to the (CO) relay which operates, operating relay (CO1) which locks under control of relay (MFS). Relay (CO1) operated transfers the "D" lead from the (TD3) relay to the (D) relay winding. The operation of relay (CO) extinguishes the (CO) lamp and lights the (CT) lamp. If the check of the "CO" lead does not function properly the test circuit will block and the (CO) lamp will remain lit.

8. SEQUENCE RELAY PREPARATION

8.1 The operation of relay (CO) closes ground to operate relays (KPA) and (KPS) in series. Relay (KPA) locks. Relay (KPS) operated lights the (KP) lamp. Relay (KPA) operated operates relay (TRA) and (TR1) in series. The (TRA) relay operated locks and operates relays (TRB) and (TR2) in series. Relay (TRB) operated locks and operates relays (TRC) and (TR3) in series. Relay (TRC) operated locks and operates (TRD) and (TR4) in series. Relay (TRD) operated, locks and operates relays (STA) and (ST1) in series. Relay (STA) operated locks under control of relay (C). In case an office identification digit is to be transmitted relay (FD) will be operated by one of the (OI) keys. With relay (FD) operated the operation of relay (KPA) operates relays (OIA) and (OI1) in series. Relay (OIA) operated locks and operates relays (TRA) and (TR1) in series. The remaining relays operate as above described.

8.2 When the sender is selected it connects battery to the "T" lead and ground to the "R" lead. Relay (BSY) controls the "T" and "R" leads until ground is placed on the "RL" leads to signal that the sender is seized. With relay (MF8) operated the polarized (A) relay, Fig. 10, sheet 0110, is connected to the "T" and "R" leads and operates from battery and ground in the sender. The operation of the (A) relay removes ground from the secondary winding of the condenser-timed (RVT) relay allowing it to start to operate. If the (A) relay is still operated when the (RVT) operates the (RV1) relay will operate and lock, extinguishing the (SSP) lamp to indicate that the start pulse was long enough. When (RV1) operates the slow release (RV2) relay will start to release. If the sender reverses battery and ground, as it should, before (RV2) releases, the release of (A) followed by the release of (RVT) will hold (RV2) and operate the (RV3) relay. The (LSP) lamp will be extinguished, indicating that the start pulse was not too long. The operation of (RV3) operates (A1) which locks under control of relay (CO). Relay (A1) operated (a) extinguishes the (CT) lamp, (b) lights the (RC) lamp, (c) opens the lead which operated relay (KPA), (d) opens the shunting path to prevent false shunting of (A1) when (ST1) releases, (e) closes ground to the armature and windings of relay (KP1) to start pulsing, and (f) closes the circuit to the winding of relay (KP5).

9. CONTROL OF "T" AND "R" LEADS

The (FP1), (KPS), (OI1), (TR1), (TR2), (TR3), (TR4) and (ST1) relays control the closure of the "T" and "R" leads from the sender for false key pulse signal, key pulse (KP), office identification, thousands, hundreds, tens, units, digits and a start signal in sequence.

10. REGISTRATION

The register relays in the sender circuit are under control of the relay interrupter circuit, the (TR1) to (TR4) relays and the numerical register keys in the test circuit. The numerical keys corresponding to the number with which it is desired to test the sender shall be depressed. The (TR1) to (TR4) relays, releasing one by one after each digit, switch the pulsing lead from one set of numerical keys to the next. The purpose of the relay interrupter circuit (KP1) to (KP6) relays is to provide a definite closed period for operating the register relays in the sender.

With the (SKP) key operated, ground is supplied through a back contact of the normal (A1) relay to the winding of the (KP1) relay, to place the (KP1) relay on its back contact. The placing of the (KP1) relay on its back contact is necessary in order to insure the start pulsing of relay (KP1) later on in the circuit. Should the (KP1) relay contact be floating, the (KP1) relay would not start to pulse without this conditioning.

Ground is supplied through a front contact of the operated relay (A1) to the windings of the (KP1) relay. This causes the operation of the (KP1) relay. When the (KP1) relay front contact closes, the (KP1) relay releases and opening of the front contact starts the (KP1) relay to operate again. The operation of this relay is delayed due to the fact that the condenser (KP) must be charged by a current flowing through the (KP1) relay secondary winding before the relay can operate. This condenser charging current in the secondary winding is in the direction to prevent the relay operation, and therefore, the relay will not operate until the charging current has been sufficiently reduced, so that the primary ampere turns are greater than the secondary. The release of the (KP1) relay is delayed in a similar manner due

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to the (KP) condenser discharging through the secondary winding.

The characteristics of the (KP1) relay and associated condenser and resistances are such that the relay contacts furnish minimum pulses of 55 mil. sec. closed and 45 mil. sec. open for K.P. signal. For the numerical digits the resistances are replaced by other resistances so that the relay contacts furnish minimum pulses of approximately .027 sec. closed and .063 sec. open when (DPR) key is normal. When the (DPR) key is operated the length of the pulse closure and open for the numerical digits are reversed. The short pulse closure is to test that the receiver and sender will properly function on a minimum pulse closure and the short open between pulses is to test that the sender will make the transfer to the next register within this open period. With the (SKP) key operated, the pulses are .250 sec. closed and .250 sec. open. This will be described in Paragraph 10.1. The (KP2), (KP3) and (KP4) relays repeat the pulses supplied by the (KP1) contact for the purpose described below.

When the (KP4) relay closes its contact, ground is supplied to operate the (KP5) relay, and when the (KP4) relay releases the (KP6) relay operated. The (KP5) and (KP6) relays lock up under control of relay (KP6) and their purpose is to absorb the first pulse of the interrupter so that the first pulse supplied to the receiver and sender will be of full duration. The (KP6) relay operated closes the "T" and "R" leads from the contacts of the (KP2) and (KP3) relays toward the sender, and also extends the circuit from the (KP4) relay contact to the inner end of the winding of the (KPS) relay through its contact. The contacts of relays (KP2), (KP3) and (KP4) make and break simultaneously. When the contacts of relays (KP2) and (KP3) close for the first digit the multifrequencies for the (KP) signal, "KP" and "KPR" leads, connected to the contacts of relay (KPS) (operated) are closed through contacts of relays (TR1), (TR2), (TR3) and (TR4) (operated) contacts of relays (KP2), (KP3) operated through repeating coil A,1C pads (HL) and (IN) and repeating coil (T) to sender. The (KP4) relay contact closing, connects ground to the inner end of the winding of relay (KPS) which holds this relay operated but shunts relay (KPA) which releases. When the (KP4) relay contacts open relay (KPS) is released. Relay (KPS) released (a) transfers the "T" and "R" leads from the "KPT" and "KPR" leads to leads "TH" and "TH1" to the thousands register key through contacts on relay (OI1) normal, (b) extinguishes the (KP) lamp, (c) lights the (TH) lamp and (d) opens the operating circuit of the (KPT) relay which releases. Relay (KPT) is held operated until relay (KP6) releases to prevent a false pulse in case the (KP2) and (KP3) relays again close their front contacts. When the (KPT) relay releases the interrupter is stopped to permit changing the interrupter network resistances to give the digit pulse timing in place of the "KP" signal timing. The release of relay (KPT) causes the operation of relay (PR) and also opens the operating circuit of slow release relay (PRS) which releases, aga n closing the ground to the interrupter which resumes pulsing as above. The (TH), (H), (T) and (U) lamps referred to under registration are the "Pulse Progress Lamps." The closure and opening of the contacts of relays (KP2), (KP3), and (KP4) after relay (KP6) has operated completes the thousands registration in the sender and releases relay (TR1). Relay (TR1) releases (a) transfers the "T" and "R" leads to the hundreds register key over oeads "H" and "H1", (b) extinguishes the (TH) lamp and (c) lights the (H) lamp. The hundreds, tens and units digits registrations are completed in a similar manner as the thousands digit except that the "T" and "R" leads are connected to the hundreds, tens and units register keys n sequence. The release of relay (TR4) after units registration connects the "T" and "R" to the "start" signal frequencies over leads "STT" and "STR" through contacts on relay (ST1) operated. The "start" signal will now be transmitted in the same manner as the previous digits but the sender should now have advanced to a condition on which the "start" signal has no effect. The release of relay "ST1" (a) opens the "T" and "R" leads, (b) opens the ground from the interrupter, stopping the interrupter relays, (c) extinguishes the (ST) lamp and (d) lights the (D) lamp.

10.1 Long Pulse (SKP) Key Operated ("VG" Option)

With the (SKP) key operated, the pulses are increased to approximately .250 sec. closed and .250 sec. open.

This slow pulse is necessary to determine if the "MF" sender (TO) relay is functioning to prevent registering a digit on a particular group of sender register relays and then registering the same digit on the succeeding group of register relays. This will occur if the sender (TO) relay fails to remain locked operated during the full closure of any digit. The sender received is arranged to accept any digit, and then cause the sender to register the digit, after which the sender is prepared for reception of the succeeding digit by connecting a second group of register relays. If the first digit pulse is prolonged, such as might occur if the operator holds a digit key operated for an extended interval of time, or until the sender had connected the second group of register relays, then this same pulse would make two registrations. Sender relay (TO) locked operated, during this interval, prevents this.

The slow pulse test may also be used to assist the maintenance man in the detection of troubles in the sender register circuit.

10.2 Multi-office Indication

When senders are arranged to complete calls in multi-office terminating units there are three methods of controlling this indication as follows:

(a) Where there are only individual trunk groups.

(b) Where there are only common trunk groups.

(c) Where there are both individual and common trunk groups.

10.21 Individual Groups of Trunks

In these cases the sender receives the office indication from the trunk group through the link. Calls from trunks to office "A" cause the "OA" lead to be grounded and the sender connects the marked "OAB" lead to the "CK3" lead. The call is thereby routed to office "A" without keying an office digit.

To test senders for this the (LOA) key -0106 will be operated and the (OAB) key -0114 will be normal. Calls from the trunks to office "B" cause the "OB" lead to be grounded and the sender grounds the "OAB" lead to the marker. No office digit is keyed. To test senders for this the (LOB) and (OAB) keys are operated. See sections 0106, Par. 10.1 and 0114, Par. 3.6.

10.22 Common Group of Trunks

When the senders are arranged for completing calls to multi-office terminating units over common groups of trunks the (LOC) key should be operated which indicates to the sender that a code digit will be received. The sender arranged itself for receiving five digits. In the MF sender, cross-connections are provided so that any digit can be used as either "Office A" or "Office B". When "Office B" numerals are used for the code digit the "OAB" lead to the marker will be grounded the test circuit (OAB) key must be operated. The test circuit otherwise functions as described for a regular call. See 0114, Par. 3.6 and 0106, Par. 10.1.

10.23 Common Group of Trunks - Arrangement (b)

In this case an office digit must always be keyed. The sender does not receive an office indication from the link. The (LOA), (LOB) and (LOC) keys will be omitted if there is not some other type or group of senders that requires a link office indication. In any event the office digit is keyed to the sender as described in this section.

11. CHECK OF "D" LEAD

When registration is completed in the sender, ground is connected to the "D" lead and the "CO" lead is opened. The opening of the "CO" lead releases the (CO) relay. The "D" lead is connected to a polarized relay (TC1) in the sender circuit and when the (C1) relay has operated, this polarized relay is connected to the (D) relay through the (D) resistance. The (D) relay operates and locks under control of the (C) relay, extinguishes the (D) lamp and lights the (TC) lamp. The locking ground from the test circuit over the "D" lead operates the sender polarized relay causing the sender to progress with the call. The (D) resistance in the "D" lead is used to make an operate test of this sender polarized relay. If the check of the "D" lead does not function properly the test circuit will block and the (D) lamp will remain lit.

12. OFFICE INDICATION BY MEANS OF CODE DIGIT

(LOC) Key Operated

The MF pulsing sender may be arranged to register an office indication by means of a code digit in advance of the thousands digit. When registration of this digit is to be tested one of the numerical buttons of the (OI) key must be operated. The depression of any one of these buttons ((LOC) key being operated) causes the operation of relay (FD). Relay (FD) operated causes the operation of relay (OIA) and (OI1) in series following the operation of relays (KPA) and (KPS). The operation of relay (OIA) operates relays (TRA) and (TR1) and following relays as previously described. The pulsing will now be as described except that the office indication will be transmitted between the "KP" signal and the thousands digit in accordance with the button depressed. When any "B" office code button is depressed the (OAB) key should be operated to test that ground was connected to the (OAB) lead to the marker by the sender.

13. TRUNK DISCONNECT TEST

13.1 Over "T" and "R" leads #5 Class Key and (DPR) Key Operated

There is a feature in the sender circuit which functions to restore the circuit to normal in case a premature disconnect signal is received from the trunks. When this feature is to be tested the #5 class key of the connector circuit is operated supplying ground over the "TD" lead to operate relay (TD8) when relay (TR3) operates with relay (DLT) normal and relay (MF8) operated. Relay TD8 operated (a) locks to the (ST) relay ground through a front contact of (C) relay, (b) opens in part the pulsing circuit ground lead and (c) closes in part a circuit to operate relay (TD4). Relay (TR3) operated maintains a closure of the pulsing circuit ground. The sender test circuit proceeds to send pulses as previously dexcribed until (TR3) relay releases when the pulsing circuit is opened preventing further pulsing. The release of relay (TR3) now operates relay (TD4) in turn operating relay (TD5) which in turn operates relay (TD2). The operation of relay (TD4) and (TD5) closes the "T" and "R" leads from the sender to relay (TD6) which operates in turn operating relay (TD7). Relay (TD7) operated (a) locks to the (TD) lead, (b) opens the operating winding of relay (TD5) which is slow release and (c) closes in part a circuit to the "ADV" lead to the connector circuit. The release of relay (TD5) opens the "T" and "R" circuit through relay (TD6) but leaves a 30,000 ohm lead across them. The opening of the "T" and "R" leads causes the sender to restore, opening the "S" lead and permitting the (C1) relay to release. The release of relay (TD5) causes the release of relay (TD2). Relay (TD2) is slow release to time the release of the sender relay. Ground through the back contact of relay (TD2), front contacts of relay (TD7) and back contacts on relays (TD3) and (C1) is supplied over the "ADV" lead to the connector circuit causing the test circuit to advance. If the premature disconnect feature of the sender fails to function properly the "S" lead will not be opened by the time the (TD2) relay has released. The (TD2) relay released furnishes a locking circuit for the (C1) relay. With the (C1) relay locked under this condition the test circuit will block and the (TD) lamp will remain lit. Precautions outlined in section 0102 under "Trunk Disconnect Test" should be observed.

13.2 By Means of the "D" Lead

In the MF pulsing sender ground is not closed to the "D" lead until all the registration is completed. There is a feature in the sender circuit which functions to restore the sender circuit to normal in case of a disconnect after supervision has been transferred back to the trunk circuit. When this feature is to be tested #9 class key of the connector circuit is operated which supplies ground over the "TD" lead operating the (TD1) relay and ground over lead (TD1) operating relay (DLT). The operation of the #9 class key should be delayed until the test frame has restored to normal from any previous test. With the (C1) relay operated the "D" lead is closed from the connector circuit through the front contacts of relay (TD1) to the winding of the (TD) relay. When the sender applies ground to the "D" lead after registration is completed relay (TD) operates but the polarized relay in the sender does not operate. The (TD) relay operated locks and the locking ground is supplied to the "D" lead, through winding of relay (TC0), and the (EZ) resistance in parallel, causing the operation of the polarized relay in the sender. The (TD) relay operated causes the release of relay (TD1). Relay (TC0) will not operate until relay (TC2) in the sender has operated due to insufficient current. The operation of relay (TC2) causes the operation of relay (TC0) which locks. Relay (TC0) must be operated and locked before relay (TD1) breaks its front contact. Relay (TD1) is slow release in order to allow sufficient time for the sender relays to function. The (TD1) relay released connects the "D" lead to the (TD3) relay. The sender polarized relay releases and the sender then functions to restore to normal. The sender opens the "S" lead which permits the (C1) relay to release. Ground through (TD2) relay releases and the front contacts of the (TD) relay and back contacts of relays (TD3) and (C1) is supplied over the "ADV" lead to the connector circuit causing the test circuit to advance. If this disconnect feature of the sender fails to function properly the "S" lead will not be opened by the time the (TD2) relay has released. the (TD2) relay released furnishes a locking circuit for the (C1) relay. If relay (TC0) is not operated by the operation of the sender (TC2) relay ground through the back contact of relay (TC0) will hold relay (C1) operated although the "S" lead was opened. With the (C1) relay locked under this condition the test circuit will block and the (D) lamp will remain lit. If the sender fails to remove ground from the "D" lead, the (TD3) relay will operate and lock, opening the "ADV" lead and blocking the test circuit with the (D) lamp lit. On a satisfactorily completed test the (D) lamp will remain lit until the release of relay (CO1). Precautions outlined in section 0102 under Trunk Disconnect Test should be observed.

13.3 Test of Release of Sender (FT) Relay - (TFT) Key Operated

There is a feature in the sender to open the "S" lead in case certain features are not completed within a definite time. The operation of the "TFT" key inserts 250 ohms into the locking circuit of relay (D). This resistance serves to lock relay (D) but prevents the operation of polarized relay (TC1) in the sender. As relays (TC1) and (TC2) in the sender are not operated the sender is not connected to a marker. The (TFT) key operated also operates relay (TD5), through a normal contact on relay (TD7), in turn operating relay (TD2). The

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operation of relay (D), after the completion of pulsing, operates relay (TD7) opening the operating circuit of relay (TD5) which releases in turn releasing relay (TD2). If the (C1) relay has not released, by the opening of lead "S", by the time relay (TD2) has released relay (C1) will be locked and the test circuit blocked, as previously described, with the (TC) lamp lit.

14. TIME OUT TEST

With class key No. 6 (TA) and (MFS) keys operated, and (APB) key normal, insert a plug in the sender hold jack. On this test the minor alarm will be sounded and the other members of the maintenance force should be advised accordingly. The (TM) relay will be operated from the No. 6 class key operating the (KS) relay. The (KS) relay operated prevents sending MF pulses to register a number in the sender. The (KP) lamp in the test circuit lights and the sender should start time out and in 15 to 30 seconds should cause the sender (TL) lamp to light. The time from the lighting of the (KP) lamp to the lighting of the sender (TL) lamp is the time out period of the sender and measured with a stop watch should be between 15 and 30 seconds. Five to 10 seconds after the (TL) lamp lights the minor alarm should sound. The (MGB) key is then operated to prevent interfering with service when the sender circuit is subsequently released with the test circuit attached. The hold plug is then removed from the jack and the (TL) lamp should be extinguished and the alarm silenced. The test circuit (S) lamp should then light. The (AV) key should then be momentarily operated to cause the test circuit to advance for starting a test of the next sender or the same sender if the (REP) key is operated. When the (REP) key is operated the (AV) key should be held operated until the test circuit advances for the next test. Since the operation of the (MGB) key makes the sender group busy the (AV) key should be operated without undue delay.

15. MULTIFREQUENCY CURRENT SUPPLY - USE BY INCOMING TRUNK TEST SET - "U" OPTION

When the MF current supply is furnished from a separate office building and is used in common with the incoming trunk test set, the "U" option shall be furnished to prevent both test circuits being connected to the signal current supply circuit simultaneously. If the incoming trunk test set is not using the signal current supply circuit when relay (TRD) is operated relay (STA) will be immediately operated as previously described. If the incoming trunk test set is using the signal current supply a circuit battery will be connected to the "C1" lead operating relay (IT). The operation of relay (TRD) now connects ground to the (IT) interrupter. The first closure of the "F" contact operates relay (ITA) which locks. The following closure of the contact "B" on (IT) interrupter operates relay (STA) and (ST1) in series. Relay (STA) locks and opens the ground from relay (IT) which releases, removing ground from the (IT) interrupter. As long as relay (STA) is operated ground is removed from the "C1" lead and the incoming trunk test set cannot cut in on the signal current supply circuit. If the incoming trunk test set holds battery on the "C1" lead during the timing interval (approximately 2 to 4 seconds) the operation of relay (STA) will open the ground from the "C1" lead and the incoming trunk test set will be disconnected from the signal current supply circuit. This circuit will now proceed as previously described.

16. FALSE "KP" SIGNAL - (FKP) AND (RO) KEYS OPERATED

The MF receiver and sender are arranged to route a call, on which a second "KP" signal is received by the MF receiver, to "Reorder". The (FKP) keys operated causes the operation of (FPA) and (FP1) relays preceding the operation of relays (KPA) and (KPS). The (RO1) relay in -0114 is also operated. The (FKP) key connects the "KP" signal frequencies to the contacts of relay (FPI) to be transmitted preceding the regular "KP" signal. The first "KP" signal will cause the MF receiver to cut through to the sender. The second "KP" signal will now cause the sender to route the call to "Reorder". The (RO) key should be operated when making this test. Under this condition the register check circuit omits the check of the "TH", "H", "T", and "U" digits.

17. SINGLE FREQUENCY PULSE - (SF) KEY OPERATED

The MF receiver and associated sender are arranged to disregard a single frequency making no registration. With the (SF) key operated the (FPA) and (FP1) relays will be operated preceding the operation of relays (KPA) and (KPS). When pulsing starts the "KP" signal will be controlled by relay (FP1) followed by a single frequency (900 cycles) under control of relay (KPS). The MF receiver and sender should not respond to this single frequency and the remainder of the pulses should be registered in the manner above described.

18. THREE FREQUENCY PULSE - PRECEDING THE (KP) - (TF) KEY OPERATED

The MF receiver is arranged to disregard three simultaneous frequencies before a legitimate "KP" signal has been received. With the (FT) key operated the (FPA) and (FP1) relays will be operated preceding the operation of relays (KPA) and (KPS), and a single frequency (900 cycles) will be added to the two frequencies of the "KP" signal. When pulsing starts three frequencies will be transmitted first followed by the regular "KP" signal. The MF receiver should not react to the three frequency pulse but should proceed with the "KP" signal and subsequent pulsing as above described.

19. THREE FREQUENCIES IN PLACE OF A NUMERICAL DIGIT - (TFD) AND (RO) KEYS OPERATED

The MF receiver and sender are arranged to route a call to "Reorder in case three frequencies are received in place of a numerical digit. The (TFD) key operated operates the (R01) relay in 0114 and also connects a single frequency (900 cycles) with the regular two frequencies for the hundreds digit. Hundreds digit keys 0, 2, 4, 6, 7 or 9 only should be depressed when making this test. With the (TFD) key operated the call proceeds in the regular manner until the hundreds digit when the three frequencies will cause the sender to reroute the call to "Reorder". The (RO) key should be operated when making this test. Under this condition the regular check circuit omits the check of the "TH", "H", "T" and "U" digits.

20. SPECIAL TESTS FOR MF RECEIVER AND SENDER

These tests are to test particular conditions or apparatus and are to be made in the same manner as above described but with keys operated as noted:

Test	Spl. Keys Operated	Signal Produced	Off. Ind. Key	Numerical Reg. Keys Thous.	Hunds.	Tens	Units	Results In
1. False K.P. Signal	(FKP)	KP KP						Reorder
2. Low Input		KP	1	1	3	7	7	Completed
3. Three Signals Present	(TFD) (LL)	KP	4	4	4	4	4	Reorder
4. High Input #1	(TF) (LL)	3 fr. KP	7	7	7	7	7	Completed
5. High Input #2	(SF) (LL) (TWT) (DPR)	KP 1 fr.	7	7	7	7	7	Completed

When the (FKP), (TF) or (SF) key is operated the lead for operating relay (KPA) is transferred to operate relay (EPA) first which in turn operates relay (KPA).

When an "Office Indication" key is depressed the (LOC) key must be operated.

If senders are not equipped with "Office Indication" register the "Office Indication" key may be omitted.

For tests #1 and #3 the (RO) key should be operated and the (R01) relay is operated.

When making test #4 (high input #1) the operation of the (LL) key makes the receiver more subject to false operation by transients.

When making test #5, (TWT) key operated, twist network is added to reduce the power of the 1500 cycle frequency 6.25 $\pm$.25 db "V" and "UX" option or 8.25 $\pm$.25 db "UY" option below that of the 700 cycle frequency. This checks if the receiver will operate satisfactorily when frequency twist, that might be introduced by line facility, is present.

During location of trouble it may be desirable to use any digit for either low or high input tests regardless of above table.

When making test #2 (low input) the use of difference digits insures that the channels indicated have adequate sensitivity:

Digit Used	Channels Have Adequate Sensitivity
4	700 & 1300 cycles
3	900 & 1100 cycles
0	1300 & 1500 cycles

When making test #4 (high input #1) the use of different digits insures that the channels are not too sensitive.

Digit Used	Channel Is Not Too Sensitive
1	1100 cycles
5	1700 cycles

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Digit Used	Channel is Not Too Sensitive
0	1100 & 1700 cycles
6	900 & 1500 cycles
2	1500 cycles
9	700 cycles

The use of the above digits provides a check on an adjacent channel above or below those being used, or of a combination frequency produced by the difference between the second harmonic of one frequency and the other frequency.

A test of the receiver to function in the interval between the "KP" signal and the first numerical digit (service condition) is made in test #1. If the receiver fails to function in the time interval between the two "KP" signals (45 mil. sec. min.) the sender will fail to route to reorder and the test circuit will block.

When (TFD) key is operated numerical digits keys 1, 3, 5 or 8 must not be used.

21. REORDER ON TIME OUT - MF SENDER CLASS KEY #8 OPERATED

21.1 The MF pulsing sender is arranged to call in a marker and route a timed out call to "Reorder". With the class key #8 operated for an MF pulsing sender the operation of relay (TR1) operates relay (TRO). Relay (TRO) operated closes ground to hold relay (PRS) operated and to operate relay (RO1) Fig. AG, sheet 0114. The call proceeds as usual until relays (KPS) and (KPT) release which stops the interrupter relays. The release of relay (KPS) lights the (D) lamp. The (D) lamp remains lighted for 15 - 30 seconds. As no more pulses are sent to the sender the sender starts to time out. When making this test a plug in the hold jack of the sender being tested should be removed.

21.2 When the sender has timed out the "CO" lead is opened releasing the (CO) relay and the (D) relay operates as is outlined under "check of "D" lead". The sender (TC1) and (TC2) relays operate and sender makes connection to a marker for routing to "Reorder." If there is a delay in making connection to a marker the (TRO) lamp will light. When a marker is connected the (TC) operates, locks, opens the path to the (TRO) lamp and closes ground to the "TRL" lead to -0114 which then checks the Reorder routing from the marker. If this is found satisfactory the "AV" from -0114 is grounded with the (TC) and (CO1) relays operated and (CO) released this ground is extended to the "ADV" lead to -0103 as a signal that the test is completed.

22. PRELIMINARY "ST" KEY OPERATION TEST

The MF sender is designed to route a call to "reorder" in case of a premature "ST" key operation. This feature is tested by the operation of the (LL), (RO), (DPR), (CL-0), (ACS), and (ST) keys with the (U-) keys normal. With no (U-) key operated, the sender then registers TH, H, and T digit followed by the "ST" digit and should call for a marker asking for reorder. With the (RO) and (DPR) keys operated, provision is made for operating the (RO1) relay which allows the register check circuit to check the "RO" indication from the sender to the marker. If this check is satisfactory, the ADV lead is grounded and release takes place in a normal way.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2314-JFP-FBB

TERMINATING SENDER
TEST CIRCUIT SD-25159-01
TESTS
NO. 1 CROSSBAR OFFICES

1. GENERAL

1.01 This section describes a method of testing the terminating sender test circuit (SD-25159-01). The tests are intended to detect trouble not readily evident in the normal use of the test frame.

1.02 This section affects the Equipment Test List.

1.03 The tests covered are:

1.04 ***Lettered Steps:*** A letter a, b, c, etc, added to a step number in Part 3 of this section, indicates an action which may or may not be required depending on local conditions. The condition under which a lettered step or a series of lettered steps should be made is given in the ACTION column, and all steps governed by the same letter within a test. Where a condition does not apply, all steps designated by that letter should be omitted.

1.05 Tests B through I are required at test frames where revertive pulse senders are tested. Test J is required where dial pulse senders are tested. Tests K through Q are required where multi-frequency senders are tested.

2. APPARATUS

2.01 The apparatus required for each test is shown in Table A. The details for each item are covered in the indicated paragraphs.

2.02 Volt-ohm-milliammeter, KS-14510 List 1. This instrument is referred to throughout the section as VOM.

2.03 67C test set equipped with a KS-6278 tool.

2.04 35F test set with cords and tools as specified in relay adjustment practices.

TABLE A

APPARATUS	TESTS																
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Volt-ohm-milliammeter (2.02)		1	1	1	1		1			1		1	1	1	1		
322A Make-busy plug	1																
67C Test set (2.03)		1															
35F Test set (2.04)			1		1		1	1			1	1		1			
Test cord (2.05)						1										1	
Stopwatch, KS-3008									1								
310 Plug											1						
J-94723A Test set (2.06)												1					
Blocking tools, as req'd.		2		3	2		1	1	1		2	2		1			
23A TMS (2.07)																1	1

2.05 893 Cord, 6 feet long, equipped with two 360A tools (1W13B cord) and two 419A tools.

2.06 Pulse checking test set SD-96362-01 (J94723A) with two 3P15A cords.

2.07 J94023A (23A) transmission measuring set, equipped with 3P12H patching cord.

3. METHOD

STEP	ACTION	VERIFICATION
A. Busy Timing and Trouble Timing		
1	At terminating trouble indicator— Make busy any terminating sender.	
2	At terminating sender test frame— Set test frame to sender made busy in Step 1.	
3	Operate APB and ST keys.	BY lamp lighted. After 29 to 59 seconds— Test circuit advances to another sender. BY lamp extinguished.
4	Release APB and ST keys and restore test circuit to normal.	
5	Repeat Step 2.	
6	Operate ST key.	BY lamp lighted. After 60 to 90 seconds— TA lamp lighted. Minor alarm sounded.
7	Operate ACO key.	Minor alarm silenced.
8	Operate TA key and restore ACO key.	TA lamp extinguished.
9	At terminating trouble indicator— Release sender made busy in Step 1.	At terminating sender test frame— Test circuit proceeds to test sender, then blocks.
10	Release TA key.	Test circuit advances to next sender.
11	Release ST key and restore test circuit to normal.	
B. Maximum and Minimum Loop Resistance		
1	Restore all lever type keys to normal.	
2	Operate L key.	
3	Block operated BS and FO1 relays.	

STEP	ACTION	VERIFICATION
4	Connect VOM to 2B and 6T of G relay.	VOM reads 3125 to 3185 ohms.
5a	If senders are equipped for balanced revertive pulse circuits— Operate BAL key.	VOM reads 2782 to 2834 ohms.
6a	Change VOM connection from 2B of G relay to capacitor side of DS resistor.	
7a	Release BAL key.	VOM reads approximately 100 ohms.
8	Change VOM connections to AC (18FH) resistor in revertive pulse section.	VOM reads approximately 56 ohms.
9	Test for presence of ground at AC resistor.	Ground present.
10	Release L key.	
11	Connect VOM to 2B and 6T of G relay.	VOM reads 898 to 912 ohms.
12	Operate L key.	
13	Release BS and FO1 relays.	
14	Connect VOM to 4T of FO1 relay and 1T of T1 (40 AN) resistor.	VOM reads 29700 to 30300 ohms.
15	Disconnect VOM.	
16	Test for presence of ground at 1T of T1 resistor.	Ground present.
17	Restore L key to normal.	

C. Maximum and Minimum Time to Reclose Fundamental Circuit

STEP	ACTION	VERIFICATION
1	Perform current flow tests of BST relay (revertive pulsing test circuit) using 35F test set and circuit requirement table.	Circuit requirements are met.
2	Connect VOM to B11 of C relay and 2 terminal of BST relay.	VOM reads 322 to 328 ohms.
3	Operate LST key.	VOM reads 6930 to 7070 ohms.
4	Connect VOM to B11 of C relay and B6 of G relay.	VOM reads 2869 to 2927 ohms.

D. L and STP Relay Operate Resistance

STEP	ACTION	VERIFICATION
1	Operate STP-OPR key.	

STEP	ACTION	VERIFICATION
2	Block operated C, FTP, and FB relays.	
3	Connect VOM to T 1 LNO relay and bottom side of AA (19PS) resistor.	VOM reads 4030 to 4110 ohms.
4	Insulate T34 FRP relay.	
5	Connect VOM to bottom side of BC (18 FR) resistor and T4 FRP relay.	VOM reads 4103 to 4197 ohms.
6a	If WG option is provided— Release FTP relay.	
7a	Connect VOM to top side of BD (19RP) resistor and T3 FRP relay.	VOM reads 7435 to 7585 ohms.
8	Release C, FTP, and FB relays.	
9	Restore STP-OPR key to normal.	
10	Remove insulator T34 FRP relay.	

E. Reverse Battery Timing

STEP	ACTION	VERIFICATION
1	Restore all lever type keys to normal.	
2	Block operated CI relay.	
3	Insulate T56 contacts of CI relay.	
4	Connect VOM to 5T of CI relay and battery side of BB resistor.	VOM reads 921 to 939 ohms.
5	Operate LRB key.	VOM reads 4209 to 4291 ohms.
6	Remove insulator and blocking tool from CI relay.	
7	Connect VOM to T1 of BS relay and B11 of C relay.	VOM reads 3960 to 4040 ohms.
8	Release LRB key.	VOM reads 2772 to 2828 ohms.
9	Perform current flow tests of OF and OF1 relays (revertive pulsing test circuit) using 35F test set and circuit requirement table.	Circuit requirements are met.

F. TTSC Key Feature

STEP	ACTION	VERIFICATION
1	At terminating sender test frame— Set up keys TH6, H6, T6, U6, F9, Test Class 2, TT-SC.	

STEP	ACTION	VERIFICATION
2	Direct test frame to any FS terminating sender and operate with REP key.	Test frame makes repeated satisfactory test of sender.
3	At sender under test— With 893 cord, short circuit three stationary and movable contact terminals at any level at rear of IB vertical.	At test frame— Test circuit blocks.
4	At sender under test— Remove 893 cord.	
5	At test frame— Restore test circuit to normal.	

G. L Relay Nonoperate Resistance

STEP	ACTION	VERIFICATION
1	Operate test class key 7.	
2	Block operated C relay.	LNO relay operated.
3	Insulate T34 RB' relay.	
4	Connect VOM to 5T of BS relay and 2T of TF relay.	VOM reads 6148 to 6272 ohms (YH option) or 7757 to 7913 ohms (YG option).
5	Connect VOM to battery side of BB resistor and 4T of CI relay.	VOM reads 723 to 737 ohms.
6	Connect VOM to 3T and 5T of CI relay.	VOM reads 5346 to 5454 ohms.
7	Connect VOM to 11B of C relay and 1T of BS relay.	VOM reads 6603 to 6737 ohms.
8	Release C relay, class key 7, and disconnect VOM.	
9	Remove insulator T34 RB relay.	
10	Perform current flow test of OF and OF1 relays (revertive pulsing test circuit) using 35F test set and circuit requirement table. ***Note:*** This step may be omitted if performed in Step 9, Test E.	Circuit requirements are met.

H. RBT Key Features

STEP	ACTION	VERIFICATION
1	Operate RBT key.	
2	Block operated C relay.	
3	Momentarily operate STR relay.	RBT2 relay operated.

STEP	ACTION	VERIFICATION
4	Momentarily operate RB' relay.	RB2 relay operated.
5	Release C relay and RBT key.	
6	Perform current flow tests of RBT-2 relay using 35F test set and circuit requirement table.	Circuit requirements are met.

I. Minimum and Maximum Interdigital Timeout Interval

STEP	ACTION	VERIFICATION
1	Operate TH5, H5, T5, U5, F5, class key 0, and IDT keys.	
2	Set up test frame on any FS terminating sender and operate ST key.	Test frame proceeds to test sender, lighting IB, IG, and IDT lamps in succession.
3	With stopwatch, time lighted IDT lamp.	IDT lamp remains lighted for 2 to 2-1/2 seconds minimum.
4	Release ST and IDT keys.	
5	At terminating sender under test— Block non-operated TM3 relay.	
6	At test frame— Operate IDT1 and ST keys.	Test frame proceeds to test sender, lighting IB, IG, and IDT lamps in succession.
7	With stopwatch, time IDS relay holding time.	IDS relay releases in approximately 7 seconds. Test frame blocks.
8	Restore test frame to normal.	
9	At terminating sender under test— Release TM-3 relay.	

J. Maximum Dialing Loop Resistance

STEP	ACTION	VERIFICATION
1	Operate LTK key.	
2	Connect VOM to T1 of DP3 relay and T3 of DPD relay.	VOM reads approximately 2550 ohms. ***Note:*** VOM reads 3450 ohms when YA option is provided.

K. Start Pulse Timing

STEP	ACTION	VERIFICATION
1	Perform current flow test of RVT and RV2 relays using 35F test set and circuit requirement table.	Circuit requirements are met.
2	Insulate B23 and T23 of RV1 relay.	

STEP	ACTION	VERIFICATION
3	Place 310 plug in RVT jack.	
4	Connect VOM to FB resistor.	VOM reads 1584 to 1616 ohms, VS option, or 495 to 505 ohms, VR option.
5	Remove VOM, 310 plug, and insulators used in preceding steps.	

L. Pulse Timing

STEP	ACTION	VERIFICATION
1	Perform current flow test of KP1, KP2, KP3, KP4 relays, and pulse output test of KP2, KP3, KP4 relays using 35F test set, pulse checking test set, and circuit requirement tables.	Circuit requirements are met.
2	Insulate B45 and T12 of KA relay.	
3	Connect VOM to B5 of KA relay and 1 terminal of KP4 relay.	VOM reads 614 to 626 ohms.
4	Connect VOM to terminals of EB, EC, and ED resistors.	VOM reads 49.5 to 50.5 ohms.
5	Connect VOM to middle terminal of EA resistor and T3 KPT relay.	VOM reads 148 to 152 ohms.
6	Connect VOM to terminal of T, U, V, W, X resistors.	VOM reads 49.5 to 50.5 ohms.
7	Connect VOM to terminals of Y resistor.	VOM reads 99 to 101 ohms.
8	Connect VOM to midpoint of EE resistor and T1 KA relay.	VOM reads 247 to 253 ohms.
9	Disconnect VOM.	
10	Remove insulators from contacts of KA relay.	

M. Slow Pulse

STEP	ACTION	VERIFICATION
1	Operate SKP key.	
2	Insulate 12B and 45B KA relay.	
3	Connect VOM to 2B KA relay and 2B KS relay.	VOM reads 297 to 303 ohms.
4a	If Fig. 8 is furnished— Connect VOM to 2T PR relay and 2B KS relay.	VOM reads 6930 to 7070 ohms.

STEP	ACTION	VERIFICATION
5b	If Fig. 7 is furnished— Connect VOM to 2B KS relay and 7B MF9 relay.	VOM reads 6930 to 7070 ohms.
6	Connect VOM to B terminal of KP capacitor and 2B KS relay.	VOM reads 3491 to 3527 ohms.
7	Remove insulators from KA relay.	
8	Restore SKP key to normal.	

N. Sender Disconnect

STEP	ACTION	VERIFICATION
1	Perform current flow test of TD-1 and TD-2 relays using 35F test set and circuit requirement table.	Circuit requirements are met.
2	Connect VOM to T3 and T4 of TD5 relay.	VOM reads 29700 to 30300 ohms.
3	Connect VOM to T2 of TD relay and T1 of TD1 relay.	VOM reads 49.5 to 50.5 ohms.
4	Operate TFT key.	TD2 relay operated.
5	Block operated D relay.	
6	Connect VOM to T1 of CO1 relay and T9 of C relay.	VOM reads 297 to 303 ohms.
7	Release D relay and TFT key.	

O. A Relay Operate Resistance

STEP	ACTION	VERIFICATION
1	Connect VOM to 400-ohm terminals of EG resistor. ***Note:*** Omit this step if ZF option is wired. (400-ohm resistance strapped out.)	VOM reads 396 to 404 ohms.
2	Connect VOM to 800-ohm terminals EG resistor. ***Note:*** Omit this step if ZG option is wired. (800-ohm resistance strapped out.)	VOM reads 792 to 808 ohms.
3	Connect VOM to end terminals of EF resistor. ***Note:*** Omit this step if ZH option is wired. (1200-ohm resistance strapped out.)	VOM reads 1188 to 1212 ohms.
4	Connect VOM to end terminals of EY resistor.	VOM reads 5262 to 5368 ohms.

STEP	ACTION	VERIFICATION
P. TWT Key Feature		
1	Operate TWT key.	
2	Connect 23A TMS to VI jack.	
3	Operate V17 key.	TMS reading noted.
4	Release V17 key.	
5	Operate V10 key.	TMS reads 6 to 6.5 dB higher than in Step 3.
6	Release V10 and TWT keys and disconnect 23A TMS.	
Q. High Loss Pad		
1	Connect 23A TMS to T3 and B4 of MF8 relay.	
2	Operate LL key.	
3	Operate V17 key.	TMS reading noted.
4	Release LL key.	TMS reads higher dB value depending on type of HL pad in test frame.
5	Release V17 key and disconnect 23A TMS.	

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CROSSBAR SYSTEMS
NO. 1
MULTI-FREQUENCY PULSING
TERMINATING SENDER CIRCUIT

CHANGES

D. Description of Changes

D.1 On sheet -011 Note 109 added and paragraph 10 added to Note 104.

D.2 On sheet -012 YM option added to the B lead to the sender test circuit and to the BAT2 lead to 7/8T of ON2 relay. Also YM, YN option is added to the TC2 lead to 2/5B TC1 relay.

D.3 On sheet -014 YM option added to the B, N, and BAT2 leads in Fig. 50.

F. Changes in CD Sections

F.1 Change 4.3 to read:

4.3 Multi-frequency Pulsing Receiving Circuit SD-95087-01, SD-95536-01, or SD-99493-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5144-JRF-ABVL

WECo DEPT 335-JRF-PKP-PK

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CROSSBAR SYSTEMS
NO. 1
MULTI-FREQUENCY PULSING
TERMINATING SENDER CIRCUIT

CHANGES

D. Description of Changes

D.1 Circuit Note 104 application of Fig. 2 changed to read:

"When number series indications are required for direct inward dialing (DID)."

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DEPT 5615-CAA-DAJ-RP

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CROSSBAR SYSTEMS
NO. 1
MULTI-FREQUENCY PULSING
TERMINATING SENDER CIRCUIT

CHANGES

D. Description of Changes

D.1 The terminal strip designations in Fig. 52, 54, and 55 have been changed from OR-GC to OR'-GC'.

D.2 This change has been made on a no-record basis by agreement with the Western Electric Company.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5615-JIS-DAJ-RH

CROSSBAR SYSTEMS
NO. 1
MULTIFREQUENCY PULSING
TERMINATING SENDER CIRCUIT

CHANGES

A. Changed and Added Functions

A.1 Office selections can be used to generate DID number series for direct in dialing operation to PBX stations using LLP.

B. Changes in Apparatus

B.1 LL2-6 Relays U679 - Fig. 2

D. Description of Changes

D.1 Fig. 2 is added to sheet 012.

D.2 Equipment Note 201 is added to show DID cross-connections.

D.3 New leads "NS0", "NS1", "NS2", and "NS4" from Fig. 2 to the terminating marker connector are added.

D.4 CAD Fig. 50, 52, 54, and 55 are modified to include the above changes

F. Changes in CD Sections

F.1 Add paragraph 3.33.

3.33 Provides means to translate an office digit to a DID number series.

F.2 Change sentence five of 10.2 to read:

Any office may be associated with either office "A", office "B", a DID number series, or in the case of an unused digit give a reorder signal.

F.3 Add the following to the table of 10.2:

Digit Associated with	Connect "OR-" Punching to	Connect "CG-" Punching to
DID Number Series	LL-	LLA

F.4 Add to the end of 10.2:

When a digit assigned to a DID number series is received, ground supplied by the LLA punching through the cross-connection to the GC- punching, through the operated contacts of the OI- relays, to the OR- punching and cross-connecting to the LL- punching grounds a particular "LL-" lead which operates the associated LL- relay. The LL- relay grounds the proper two-out-of-four "NS-" leads to the terminating marker connector and connects the OAB punching to the CK3 punching through its operated contacts.

DID Number Series	Leads to Conn Grounded
2	"NS0", "NS2"
3	"NS1", "NS2"
4	"NS0", "NS4"
5	"NS1", "NS4"
6	"NS2", "NS4"

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DEPT 5615-RFB-TNL-WP

XH-14-

CROSSBAR SYSTEMS
NO. 1
MULTIFREQUENCY PULSING
TERMINATING SENDER CIRCUIT

CHANGES

B. CHANGES IN APPARATUS

B.1	Superseded	Superseded by
	1 - T Capacitor - 439A Option YK	Option YL

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE CAUSED BY CHANGES IN APPARATUS

C.1 Test clip data is changed for the TC1 relay to facilitate easier test connections.

C.2 Relay contacts of relays TH0 to TH7, H0 to H7, T0 to T7, U0 to U7, OI0 to OI7, and SP are insulated to prevent visual and audible alarms when testing.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Options "YL" and "YK" are added to Fig. 1.

These changes must be coordinated with associated changes on SD-95536-01 Issue 20B and SD-95087 Issue 29B.

D.2 Option "YL" and "YK" are added to Circuit Note 106 and the Options Used table.

D.3 The wiring designation on terminals 146 and 156 of the terminal strip on the Sender Unit Fig. 50 has been changed to include the connecting information for Item D-2.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2319-GWE-LF-JW

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CROSSBAR SYSTEMS
NO. 1
MULTI-FREQUENCY PULSING
TERMINATING SENDER CIRCUIT

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 Provision is made to supply maintenance busy and service busy information to the traffic usage recorder circuit.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Sheet 011

D.11 Option "YJ" is added to circuit note 106 and the options used table.

D.12 Leads SB and SBM, option "YJ" are added and shown connecting figure 1 to the traffic usage recorder.

D.2 Sheet 012

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

D.3 Sheet 013

D.31 On page 1 of the circuit requirements table block and insulate information is added for relay (ON1).

D.32 On page 3 of the circuit requirements table test note 1 is added and reference to test note 1 is added to relay (TM2).

D.33 On page 6 of the circuit requirements table test note 3 is added and reference to test note 3 is added to relay (MB).

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit is used to permit a toll operator or an MF out pulsing sender to establish a connection to a subscriber in a crossbar office. The desired number together with an office indication, if required is registered directly in this circuit from the MF Pulsing Receiving Circuit. Upon completion of registration, a terminating marker is summoned which then completes the connection from the incoming trunk circuit to the called subscriber's line. This circuit is permanently connected with an MF Pulsing Receiving Circuit and registers each digit on two relays of the five relay register.

This circuit is arranged to register a digit when two and only two frequencies are received.

2. WORKING LIMITS

2.1 Maximum resistance in the "D" lead from the (ON2) relay to the incoming trunk relay - 5 ohms.

2.2 Maximum resistance in the "H" lead to the receiving circuit - 4 ohms.

2.3 B608 Relay

Maximum External circuit Loop (not to exceed 40 miles)	6760 ohms
Minimum Insulation Resistance	30,000 ohms

2.4 Battery voltage 45 to 50 volts.

3. FUNCTIONS

3.01 Provides means when this circuit is selected by the terminating sender link to operate a relay in that circuit which will put a busy condition on this circuit.

3.02 Provides means of transferring the control of supervision from the incoming to the sender during pulsing.

3.03 Provides to restore the circuit to normal on a premature disconnect, providing the (TC1) and (TC2) relays have operated from trunk closure in the incoming circuit.

3.04 Provides means of reversing battery to the incoming trunks as an indication that the sender is ready to receive pulses.

3.05 Provides means to restore the circuit to normal on a premature disconnect, while the control of supervision is in the sender, if the (A) and (A1) relays have operated.

3.06 Provides means in part to check the continuity of the "S" lead through the primary and secondary crossbar switches of the terminating sender link.

3.07 Provides means in part to hold the primary and secondary links, thus maintaining continuity of leads to the incoming trunk circuit.

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3.08 Provides means to dismiss the terminating sender link control circuit to enable that circuit to handle other calls.

3.09 Provides means to lock in the incoming frame indication for later transmission to the marker.

3.10 Provides means to block the terminating sender link if, due to a trouble condition, two or more of the (F0) to (F9) relays are operated or if both the (F00) and (F10) relays are operated.

3.11 Provides a circuit closure to function the holding time recorder.

3.12 Provides means to operate under control of the MF Pulsing Receiving Circuit and lock register relays which transmit the office indication and line number to the terminating marker.

3.13 Provides means to switch pulsing leads from the MF Pulsing Receiving Circuit to the succeeding digit when two frequencies are received.

3.14 Provides means to give a reorder signal in case over two frequencies are received.

3.15 Provides means to give a reorder signal in case a second "K.P." signal is received or a premature "ST" signal is received.

3.16 Provides means to automatically release itself by means of the marker if this circuit fails to complete its function within a given interval.

3.17 Provides means to route a sender time out to a "reorder" condition.

3.18 Provides means to register the office indication, when individual groups of trunks are used in a multi-office unit, from the terminating link.

3.19 Provides means to register the office indication, when common groups of trunks are used in a multi-office unit, from the toll offices position.

3.20 Provides a means to close leads to the MF Pulsing Receiver Circuit and give an indication to the originating office when the sender is ready to receive pulses.

3.21 Provides means to disable the MF Pulsing Receiving Circuit as soon as registration is completed to prevent possible interference with the last register.

3.22 Provides means to record indication from the link, when the "Office Indication" will be received from the originating office by means of a preliminary digit.

3.23 Provides means in part to signal for a special marker when this circuit is connected to a special trunk.

3.24 Provides means in part to make this circuit busy either from the (MB) jack or the terminating marker connector circuit or from the trunk test selection circuit.

3.25 Provides means to hold this circuit for maintenance purposes in case the (HLD) plug is in the (HLD) jack and a time out occurs.

3.26 Provides means in part to disconnect the terminating marker connector after the marker has completed its function.

3.27 Provides means in part to disconnect the terminating marker connector in case the marker has failed to complete its functions on a second trial.

3.28 Provides means to immediately release the sender in case of a short closure across the tip and ring of the incoming trunk or an open tip or ring between the incoming and the sender.

3.29 Provides means to give a reorder signal in case an office digit other than a working digit is received.

3.30 Provides means to block and call in the trouble indicator in case more than 2 register relays are operated for any digit.

3.31 Provides means to close battery through the (CO) resistance lamp to shunt down the trunk (T) relay and thereby prevent a false charge.

3.32 Provides means to supply plugged busy service and test busy information to the traffic usage recorder.

4. CONNECTING CIRCUITS

When this circuit is listed on a key sheet the connecting information thereon is to be followed.

4.1 Crossbar system terminating marker connector circuit. SD-25036-01.

4.2 Crossbar system terminating sender link and control circuit. SD-25459-01.

4.3 Multi-frequency Pulsing Receiving Circuit. SD-95087-01.

4.4 Crossbar system terminating sender test circuit. SD-25159-01.

4.5 Misc. circuit for trouble indicator frame. SD-25064-01.

4.6 Interrupter frame circuit. SD-25062-01.

4.7 Test Selection Circuit. SD-25437-01.

4.8 Traffic Usage Recorder Circuit. SD-95738-01.

TABLE OF CONTENTS

DESCRIPTION OF OPERATION

5. SEIZURE

When the terminating sender link selects this circuit it connects ground to the "SC" lead, operating relay (SC1) which in turn operates relay (SC2). The (SC1) relay operated (a) closes the "F00" and "F10" leads to the (F00) and (F10) relays, respectively, (b) closes the "GS" lead to operate relay (ON1), (c) operates relay (FT) which locks under control of relay (BC), (d) closes the "S" lead to the "SL" lead, (e) closes the "TR" lead to relay (RL) and (f) closes lead "OA", "OB", ("Y" apparatus) and "OA", and "OC" ("X" apparatus) to relays (OA), (OB) and (OC) respectively. Relay (SC2) closes the "F0" to "F9" leads to relays (F0) to (F9) "K" to "V" apparatus respectively and closes the "RL" lead to the (ON2) relay. Under this condition one of the (F0) to (F9) relays will be operated in addition to the (F00) or (F10) relay. The (F0) to (F9) relay, operated, (a) either connects ground or the "CK4" lead to the "F1", "F2", "F4" and "F5" leads towards the terminating marker connector circuit to give an indication to the marker of the particular frame on which the call exists, (b) locks under control of the (ON1) and (RL) relays and (c) closes in part the circuit to operate relay (ON2). The (F00) relay operated locks under control of the (ON1) and (RL) relays, and connects lead "F10" to the "CK4" lead toward the terminating marker connector circuit. Relay (F10) operated locks under control of the (ON1) and (RL) relays and connects ground to the "F10" lead toward the terminating marker connector circuit.

6. SENDER LOCK IN

The sender link control circuit upon completing its double connection test connects ground to the "GS" lead which operates the (ON1) relay. The (ON1) relay operated, closes ground to the "SB" lead, which operates a relay in the sender link circuit. The relay in turn connects ground to the "BS" lead, which operates the (ON2) relay. The (ON2) relay closes ground to hold the (ON1) relay operated after the (SC1) relay releases. Thus the (ON2) relay, under control of the (F0) to (F9) relays holds the (ON1), which in turn, holds the relay in the sender link, as just described, and which in turn maintains a busy condition to other links attempting to select this sender.

7. LINK CONTROL CIRCUIT RELEASE

The (ON2) relay operated closes ground from the "BS" lead to the "SL" and "S" leads, providing a holding ground for the primary and secondary hold magnets of the sender link, and to the "RL" lead disconnecting the terminating sender link control circuit. When ground is removed from the "SC" lead by the sender link, the (SC1) and (SC2) relays release. The release of relay (SC2) closes ground to the winding of relay (BC) which operated (a) closes ground to the "CO" (b) closes the "T" and "R" leads, to relay (A), and (c) closes the operating circuit of relay (CKA). Ground on the "CO" lead operates the (T) relay in the

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incoming trunk to remove the battery and ground the "T" and "R" leads. Relay (A) will operate to the trunk circuit in the same manner as the (A) relay in the incoming trunk circuit operated. Relay (A) operated, operates relay (A1) which locks. Relay (A1) starts condenser timed relay (RV) to operate. The (A) relay battery and ground are in a direction to give "OFF HOOK" supervision to the originating end.

8. SENDER PREPARED FOR REGISTRATION

The operation of relay (ON1) closed ground through a contact on relays (SP) (RO) and (OC) (X Apparatus) to operate relay (TRA) which locks to the same ground and operates relay (TRB) which locks and in turn operates relay (TRC) which locks and in turn operates relay (TRD) which locks and in turn operates (TRE) which locks. When office indication is not required and "W" apparatus is omitted the operation of relay (ON1) operates relay (TRB) direct. Relays (TRC), (TRD) and (TRE) are operated as above described. Relays (TRA), (TRB), (TRC), (TRD) and (TRE) operated in series with (TR1), (TR2), (TR3), (TR4) and (C1) respectively which also operate. The operation of relay (NO) also closes battery to the MF Pulsing Receiving Circuit and closes the operating circuit for the time alarm relay (TM1). Relay (ON2), operated, closes ground to the biasing winding of the (TO) relay to insure that it is closed on its back contact by the time any frequencies are received in the receiver. The operation of relay (C1), (a) closes battery to the locking winding of the (TO) relay, (b) closes the circuit from the back contact of the (TO) relay to the Receiver circuit (c) opens in part battery from the "ST" lead toward the terminating marker connector circuit (d) closes battery to operate relay (SP) when (RV) is operated, and (e) closes a battery circuit to the winding of relay (BC). Relay (SP) operated reverses the battery towards the office (as a signal that the sender is ready for pulsing). Relay (SP) operated also opens the operating circuit for relay (TRA) or (TRB) and opens the original battery circuit to the winding of relay (BC).

9. REGISTRATION

9.1 The operation of relay (CI) indicates that the sender is in condition to register over the 0, 1, 2, 4, 7, 10 leads from the MF Pulsing Receiving Circuit. Each digit register consists of five relays which may be controlled directly by the corresponding MF channel relay over the leads 0, 1, 2, 4 and 7. The function of lead 10 will be described later. Each digit is registered on two relays only - and always two relays. The operation of relay (TR1) closes the 0, 1,2,4 and 7 leads to relays (OI0), (OI1), (OI2), (OI4) and (OI7) respectively.

9.2 The (OI-) relays are used to register the office indication (in multi-office areas) and are controlled by a digit pulsed in advance of the four numerical digits. They connect the "CK3" lead, the "OAB" lead, and "RO" lead for each digit keyed as explained in Paragraph 10.2.

9.3 As each (TR1) to (TR4) relay releases it transfers the 0, 1, 2, 4 and 7 leads to the succeeding digit register relays.

The numerical register relays are operated and close leads to the terminating marker connector as follows:

	Digits Pulsed									
	0	1	2	3	4	5	6	7	8	9
Reg. Rels. operated	4-7	0-1	0-2	1-2 TH1	0-4	1-4 TH1	2-4 TH2	0-7 TH1	1-7	2-7 TH1
Leads to connector grounded for Thous	None	TH1	TH2	TH2	TH4	TH4	TH4	TH2 TH4	TH8	TH8
Leads to connector grounded for other digit	None	-1	-2	-1 -2	-4	-5	-1 -5	-2 -5	-1 -2 -5	-4 -5

All leads to the terminating marker connector circuit not connected to ground for registration are connected to a check lead for checking purposes.

9.4 Assume the number pulsed to be 3-1479. The reception of the two frequencies for office code will cause the operation of relays (OI1) and (OI2). The reception of the two frequencies will also cause the MF Pulsing Receiving Circuit to ground lead "H" to this circuit, shunting down relay (TRA) but continuing to hold relay (TR1) operated. Also the receiving circuit closes lead "J" through the back contact of relay (TO), back to the receiver over lead "L", holding the "channel" relays to ensure the continuance of ground on leads "1" and "2" although the pulse has been terminated at the originating end. Relays (OI1) and (OI2) operated lock ground through a made contact on relay (TR1) operated, a normally made contact on relay (TRA) (released) and "P" winding of relay (TO) a normally made contact on relay (CKA) to ground on lead "K" from the Receiving circuit, operating relay (TO). The operation of relay (TO) closes the ground on lead "J" to its locking winding and opens the closure on lead "J" and "L" to the Receiving circuit permitting the release of the operated channel relays which in turn removes ground from lead "H" and relay (TR1) releases. As relay (TR1) releases the locking ground for the register relays is transferred from ground through relay (TO) to solid ground. Relay (TO) is marginal, operating only when two register relays have been operated and closed their locking circuits. In case one register relay only is operated this locking circuit will not be closed and at the termination of the pulse the operated register relay will release. The release of relay (TR1) also (a) transfers the 0, 1, 2, 4 and 7 leads to the thousands register relays, (b) transfers the "H" lead to relay (TR2) and (c) opens the lead to the winding of relay (TO) which releases. The transmission of the pulse for the thousands digit will operate register relays (TH0) and (TH1) which lock on their secondary windings through the made contact on relay (TR2) (operated) and normally made contact on relay (TRB) (released) normally made contact on relay (CKA) and winding of relay (TO) to ground.

9.5 Relay (TRB) will be shunted down and relay (TR2) will be held by ground over lead "H" as described above. The operation of relay (TO) caused the removal of ground from lead "H" transferring leads 0, 1, 2, 4, 7 and "H" to the hundred register relays. The sender is now ready for the hundreds digit and the transmission of the pulse causes the operation of relays (H0) and (H4) which lock and operate relay (TO) as above described. Relay (TRC) and (TR3) are released as before transferring leads 0, 1, 2, 4, 7 and "H" to the tens register relays. The sender is now ready for the tens digit and the transmission of the pulse causes the operation of register relays (T0) and (T7) which lock, operate relay (TO) releasing relays (TRD) and (TR4) as above transferring the various leads to the units register for the last digit. The transmission of the units pulse causes the operation of register relays (U2) and (U7) which lock and operate relay (TO) as before. Relays (TRE) and (CI) are released in a similar manner as relays above. Relay (CI) released (a) locks the units register relays to solid ground, (b) opens the circuit from the back contact of (TO) relay to the "channel" relays in the Receiving circuit preventing further operation of the channel relays, (c) opens battery from "S" winding of (TO) relay, (d) closes ground to lead "D" and closes in part battery to the "ST" lead to the terminating marker connector.

9.6 Transfer of Supervision back to the Incoming Trunk

The release of relay (CI) closes ground through 10 ohms to the "D" lead operating the (D) relay in the incoming trunk. The locking ground for relay (D) on lead "D" operates polarized relay (TC1) in turn operating relay (TC2) which locks. Relay (CI) released also opens battery from the winding of relay (BC) which releases. Relay (BC) released opens the "T" and "R" leads from relay (A) (which releases) and opens the "CO" lead. Relay (TC2) operated, (a) opens the ground from the "D" lead, (b) opens the circuit from the "FC" lead to relay (SPL), (c) closes in part the operating circuit of the (TC3) relay and (d) closes battery to the "ST" lead to the terminating marker connector.

9.7 The operation of relay (TC2) closes battery from relay (CI) through normal closed contacts on relays (RO), (RL), and (TRL) to the start lead to the terminating marker connector circuit.

9.8 The operation of relay (TC2) also closes battery through the (CO) resistance lamp to shunt the trunk (T) relay and thereby cause its release before a false charge condition has had time to be established. Such a condition could occur should a called subscriber fail to hang up before the same trunk was seized for another call.

10. OFFICE INDICATION REGISTRATION MULTIOFFICE AREAS

10.1 Individual Incoming Trunk Groups

When these senders are to complete calls to multioffice crossbar units and all trunks for each office are in individual groups "Y" apparatus ((OA) and (OB) relays) may be furnished. In this case the sender receives the office indication by ground over the "OA" or "OB" lead from the terminating link circuit (while the (SC1) relay is operated) operating relay (OA) or (OB) locking it to the ground which also holds the frame indication relays. One and only one of the (OA) or (OB) relays must be operated to close the operating circuit of the (ON2) relay. If both (OA) and (OB) relays operate, relay (LB) operates preventing the operation of relay (ON2). The link circuit will block and time out selecting another sender. The (OA) relay operated connects the "OAB" lead from the terminating marker connector to lead "CK3" for checking while relay (OB) operated connects ground to the "OAB" lead to indicate that the called line is in the "B" office of the unit.

10.2 Common Incoming Trunk Groups "W" Apparatus

To provide for completing calls over common trunk groups to two crossbar offices "W" apparatus may be furnished to register the office indication, described in paragraph 9.3. In areas where office code consists of two letters and a numerical digit, this numeral will be used as the office indication. When "W" apparatus is furnished the control of the pulsing leads is covered in paragraph 9.3. When "W" apparatus is omitted relays (TRB) and (TR2) are operated as covered in paragraph 8. Any office digit may be associated with either office "A" or office "B", or in case of an unused digit, give a reorder signal. To provide this arrangement across connect "GC-" and "OR-" punchings in accordance with the following:

Digit Associated With:	Connect "OR-" Punching To	Connect "CG-" Punching To
Office "A"	OAB	CK3
Office "B"	OAB	OBG
Unused	RO	ROG

When a digit, assigned as office "B", is received, ground supplied by the (OBG) punching thru the cross connection to the (GC) punching, thru the operated contacts of the (OI-) relay, to the (OR) punching and cross connecting to the (OAB) punching grounds the "OAB" lead which gives an office "B" indication to the termination marker. When office "A" is required the (GC) punching is cross connected to the (CK3) punching. This closes a path from the "CK3" to the "OAB" lead which satisfies the terminating marker continuity test of the "OAB" lead and gives an office "A" indication to the terminating marker. When an unused digit is recorded, ground supplied by the (ROG) punching thru the cross-connections and (OI-) relay operated contacts to (RO) punching, operates the (RO) relay to give a reorder signal as described in paragraph 14.

10.3 Both Individual and Common Incoming Trunk Groups. "W", "X" and "Y" Apparatus

When both individual and common groups of trunks are used to serve a multioffice terminating unit "Y" apparatus is required to register the office indications from the individual trunk groups as covered in paragraph 10.1. For the common group of trunks "W" and "X" apparatus are required. The (OC) relay ("X" apparatus) will be operated from ground in the link (when relay (SC1) is operated) to indicate that an office indication digit will be received preceding the numerical digits. When the call does not include a fifth digit for office indication relay (OA) must be operated. This office indication is registered on the (OI-) relays under control of the (TR1) and (TRA) relays as described in paragraph 10.2. One only of the (OA), (OB), or (OC) relays can be operated at a time. If two of these relays are operated simultaneously relay (LB) will operate and prevent the operation of relay (ON2). The link circuit will be blocked, time out and select another sender.

10.4 (F00) and (F10) Relays - "Z" Apparatus

The (F00) and (F10) relays with the "F10" lead to the terminating marker connector may also be used to transmit to the marker the number series designation. Relay (F00) operated connects lead "F10" to "CK4" lead and (F10) relay operated connects lead "F10" to ground.

11. CLOSURE TO TERMINATING MARKER CONNECTOR

The connection of battery to the "ST" lead towards the terminating marker connector circuit causes that circuit to function and connect to the terminating marker. The complete information as registered in the sender is now transferred to the terminating marker on a decimal basis for each digit. Each lead for the associated digits is either grounded or closed to one of the "CK1", "CK2", "CK3" or "CK4" leads. For example, in the number 1479, for the thousands digit "1" the "TH1" lead will be grounded while leads "TH2", "TH4" and "TH8" will be closed to lead "CK1". For the hundreds digit "4" the lead "H4" will be grounded while leads "H1", "H2" and "H5" will be connected to lead "CK3". For the tens digit "7" leads "T2" and "T5" will be grounded while leads "T1" and "T4" will be connected to lead "CK2". For the units digit "9" leads "U4" and "U5" will be grounded while leads "U1" and "U2" will be connected to lead "CK1". For transmitting the office indication, when used, the "OAB" lead is connected to ground for one office and to lead "CK3" for the other office. The office frame indication is transmitted over leads "F1", "F2", "F4" and "F5" as follows:

Frame	Leads
0 or 10	None
1 or 11	"F1"
2 or 12	"F2"
3 or 13	"F1" - "F2"
4 or 14	"F4"

Frame	Leads
5 or 15	"F5"
6 or 16	"F1" - "F5"
7 or 17	"F2" - "F5"
8 or 18	"F1" - "F2" - "F5"
9 or 19	"F4" - "F5"

If the frame number is 0 to 9 relay (F00) will be operated connecting lead "F10" to lead "CK4", or if the frame number is 10 to 19 relay "F10" will be operated connecting lead "F10" to ground.

After the terminating marker has properly established a connection ground is connected to the "RL" lead from the terminating marker which operates relay (RL) in the sender.

12. RESTORE TO NORMAL

The (RL) relay operated, (a) locks under control of relay (ON1), (b) removes battery from the "ST" lead, restoring the terminating marker connector and marker to normal, (c) removes ground for holding the (F00), (F10), (F0) to (F9), (OA), (OB), and (OC) relays, permitting any of these relays that are operated to release. When the (F0) to (F9) relay, which was operated, has released relay (ON2) with the hold magnets of primary and secondary terminating line switches release. With relay (ON2) released, (a) relays (TC1), (TC2), (TC3) and (RT) release, (b) relay (ON1) releases, and (c) all operated register and associated relays release. Relay (ON1) released, (a) releases relays (TM1) and (TM2), operated (b) opens the operating path for the sender link busy relay which releases when the (RL) relay releases and (c) releases the (RL) relay.

13. PREMATURE DISCONNECT

13.1 During Pulsing

The operation of relay (BC) caused the operation of relay (A) which in turn operated relay (A1) which locks. In case the originating end disconnects relay (A) will release operating relay (TC3) through the made contact of relay (A1), operated. The (TC3) relay operated, closes the circuit for operating relay (RL) to restore this circuit to normal.

13.2 Subsequent to Pulsing

The operation of relay (ON2) closed the "D" lead, from the Incoming trunk, through the winding of relay (TC1) to a bridge consisting of battery through resistance (C) and ground is open at this time at relay (CI). The release of relay (CI) at the completion of pulsing closes ground to resistance (E) to operate a relay in the incoming trunk. Relay (TC1) is poled in such a way as not to operate at this time. The relay of the incoming trunk circuit operating, closes its locking ground to the "D" lead as a trunk closure signal to the sender operating the (TC1) relay to battery through the resistance in the battery leg of the bridge. The (TC1) relay operated, operates the (TC2) relay which in turn locks under control of the(ON2) relay. The (TC1) relay remains operated to this ground on the "D" lead as long as the originating end does not abandon the call. If, however, the call is abandoned before the sender is dismissed the (TC1) relay will release when the incoming trunk removes ground from the "D" lead. With the (TC1) relay released and the (TC2) relay operated, the circuit is complete for operating the (TC3) relay which locks under control of the (ON2) relay. The (TC3) relay operated, closes the circuit for operating the (RL) relay to restore this circuit to normal as above.

14. REORDER

When an unused office digit is recorded the (RO) relay is operated by a ground supplied by the (ROG) punching thru the cross-connections and operated (OI-) relays also, in case of three or more channel relays in the receiving circuit being operated simultaneously the "RO" lead will be grounded operating relay (RO) also if a false "KP" signal or a premature "start" signal reaches the sender when numerical digits should be received the (RO) relay will be operated and locked. Relay (RO) operated (a) opens the locking circuit of relays (TRE) and (CI), (b) opens the operating circuit for the (TRA) relay and operates relays (RO1) and (RO2). Relays (RO1), (RO2) are used to open the ground from the registering leads toward the connector and connect the registering leads of their respective "check" leads except that relay (RO) opens the (RO) lead from "CK3" lead and connects it to solid ground which then signals the terminating marker to set up the connection to a "reorder" condition. In case more than two register relays are operated, due to a false short or ground in the sender, and the receiver, is not blocked causing the operation of the (RO) relay as outlined above, then when connection is made to the marker with three or more registers operated, ground will be falsely closed to the CK- lead. This will cause the marker to block and a trouble indicator record will be registered. After this a trouble release will be given the sender and the sender will again make connection to a marker. This trial will also fail and finally the (RL) relay is operated releasing the sender.

15. MAKING THE SENDER BUSY

Inserting plug in the make busy jack operates the (MB) relay. The (MB) relay

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operated (a) grounds the "SB" lead to operate a relay in the sender link to prevent this sender from being selected and (b) connects battery thru the (D) resistance to the "S" lead to permit the sender test circuit to identify a make busy plug condition. When the sender is being used by the "Test selector circuit for terminating senders" the "MB" lead is also grounded from that circuit as a means of selecting the desired sender.

16. TIME ALARM

To give an alarm in case the sender does not function within an allotted interval relays (TM1) and (TM2) are operated under control of interrupter (TM). The timing is divided into two intervals of minimum 15 seconds each. The first interval is from the operation of relay (ON1) to the completion of registration (release of relay (CI)). The second interval is from the completion of registration to the release of the sender (release of relay (ON1)). Upon the operation of relays (CI) and (SP) relay (RT) is operated opening in part the locking ground circuit to the (TM1) and (TM2) relays. This ground circuit is previously closed by relay (CI) operated. The release of relay (CI) after units registration opens the locking circuit of relays (TM1) and (TM2) and also opens the circuit to relay (RT) which will release but is slow enough to hold over after relay (CI) has released, to permit the release of relay (TM1), if operated, and then reclose the locking circuit again. The operation of relay (TM2) opens the operating circuit of relay (RT) which will release and hold the locking circuit closed.

If after a given time interval this circuit has failed to restore to normal the (TM1) and (TM2) relays will operate in turn operating relay (RO) which locks. The operation of relay (RO) routes the call to a "reorder" condition and the sender is released as described in paragraph 14 "Reorder". In case relays (CI) and (SP) have not been operated relay (TM2) also closes the "D" lead across the open contacts on relay (SP) and opens the battery from relay (BC) which releases to open the "CO" lead. The operation of relay (TM2) also closes circuits to a visual signal and an audible alarm circuit.

17. TERMINATING MARKER FAILS TO COMPLETE CONNECTION DUE TO TROUBLE CONDITION

If the terminating marker fails to complete a connection within a specified time, a second trial is made by a second terminating marker. If under this condition the second marker fails to complete the connection, the "TRL" lead is grounded, operating the (TRL) relay. The (TRL) relay operated (a) locks under control of the (ON2) relay and (b) operates the (RL) relay restoring the circuit to normal as previously described, and (c) opens the "RL" and "ST" leads to the marker.

18. SENDER LINK FAILURE TO PROPERLY SIGNAL SENDER

If, due to a trouble condition the sender link fails to signal the sender to take control, ground will be connected to the "TR" lead operating the "RL" relay which restores this circuit to normal.

19. FUNCTION OF THE (HLD) JACK

Inserting a plug in the (HLD) jack operates relay (HLD) which prevents the release of the sender when a time-out occurs and the (TM2) relay operates causing a route to "reorder". The operation of relay (HLD) also prevents the operation of relay (RL) on a trouble release from the marker, (Operation of relay (TRL)). The (TM2) relay operated gives a visual and audible alarm.

20. SIGNALING FOR A SPECIAL MARKER

When special incoming trunks, such as no test and number checking, are connected to this circuit, it is necessary to indicate to the marker connector circuit that the special marker is desired. This is accomplished by receiving ground from the incoming trunk over the "FC" lead to operate the (SPL) relay. The (SPL) relay locks under control of the (ON1) relay and also grounds the "SPL" lead to the terminating marker connector as an indication that a special marker is required. When this circuit is connected to the incoming trunk, as previously described, the (A) and (A1) relays operate. The operation of the (TC2) relay removes the (SPL) relay from the "FC" lead.

21. BLOCKING SENDER LINK IN CASE MORE THAN ONE (F0) TO (F9), (F00) AND (F10) OR (OA), (OB), AND (OC) RELAYS ARE OPERATED

If due to a trouble condition more than one (F0) to (F9) relay is operated or if both the (F00) and (F10) relays or two of the (OA), (OB), and (OC) relays are operated, at the same time, ground is connected to the "CK4" lead operating the (LB) relay. Relay (LB) operated prevents the operation of relay (ON2) blocking the sender link, causing it to time out and give an alarm.

22. IMMEDIATE RELEASE OF SENDER

Relay (FT) is operated from relay (SC1) operated and locked under control of relays (BC) and (A1). The operation of relay (BC) opens the locking circuit of relay (FT). With relay (BC) operated the operation of relay (A1) again closes the locking circuit of relay (FT). If relay (A1) has not operated within the releasing time of the slow release relay (FT) the locking circuit for relay (FT) will be opened and its back contact will be closed. Upon completion of registration relay (BC) is released again opening the locking circuit for relay (FT). If relay (TC2) is not operated to close the locking circuit of relay (FT) before its locking contacts are opened the circuit will be closed through its back contact. If relay (FT) releases in either of these cases relay (TC3) will be operated in turn operating relay (RL) which will restore the sender to normal.

23. CONTACT PROTECTION

A list of the contact protections is given in circuit note 105.

24. TAKING EQUIPMENT OUT OF SERVICE

This circuit is taken out of service by the insertion of a 322A make busy plug into the associated MB jack at the terminating trouble indicator frame.

25. ALARM INFORMATION

25.1 If this circuit is delayed in the progress of a call the sender trouble release feature will function and the individual sender (TL) lamp at the terminating trouble indicator frame will light as described in paragraph 16.

25.2 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 complete 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.

25.3 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.

25.4 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.

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

Note: This key should be operated for as short a time as possible since the operated ACO key cuts off the minor audible alarm for the terminating trouble indicator.

25.6 If an M.F. Pulsing 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 trunk closure feature in the sender is not satisfied this may indicate a failure in either the incoming trunk or originating circuits.

(d) 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.

25.7 If the trouble is located in the sender and cannot be cleared immediately, make the sender busy by placing a make busy plug into the sender MB jack and manually restore the sender to normal. Then remove the make busy plug from the HLD jack (if there is one in it) and restore the ACO key.

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26. TRAFFIC USAGE RECORDER

The traffic usage recorder circuit has access to this circuit over two leads designated SB and SBM. The information on these leads is as follows:

SB	Grounded when the sender is busy for any reason.
SBM	Grounded when the sender is plugged busy.

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