# PANEL SYSTEMS MF ADAPTER CIRCUIT FOR USE WITH AUTOMATIC TESTING CIRCUITS FOR SUBSCRIBER SENDERS ARRANGED FOR DIRECT DISTANCE DIALING IN PANEL BCO AND GCO OFFICES

# CHANGES

# A. CHANGED AND AND ADDED FUNCTIONS

A.l Provision is made to show changes required when this circuit is associated with Automatic Sender Test Circuits arranged to test the TOUCH-TONE signaling feature in subscriber senders.

D. DESCRIPTION OF CHANGES

D.1 On sheet -Oll three leads connecting to the TOUCH-TONE Signaling Circuit are added to Fig. 2. These leads are shown as "ZK" option.

- D.2 Option "ZK" is added to Circuit Notes 102 and 104 and to the Figures and Options Table.
- D.3 Leads "A", "B", and "C" connecting to the TOUCH-TONE signaling circuit are added to the Lead Index Table.
- D.4 On sheet -O15 leads "A", "B", and "C", shown as "ZK" option are added to CAD 2.
- F. CHANGES IN CD SECTIONS
- F.1 Under Section IV Connecting Circuits add:

1.7 SD-21985-01 TOUCH-TONE Signaling Circuit.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2364-LLS-JEM

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## PANEL SYSTEMS MF ADAPTER CIRCUIT FOR USE WITH AUTOMATIC TESTING CIRCUITS FOR SUBSCRIBER SENDERS ARRANGED FOR DIRECT DISTANCE DIALING IN PANEL BCO AND GCO OFFICES

## CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 Provision is made for an automatic "No Auxiliary Sender Available" test when this circuit is associated with Sender Test Circuit SD-21186-01, SD-21026-01 or SD-21026-02.

A.2 Provision is made for lighting a progress lamp designated (TC) located at the associated Sender Test Circuit SD-21186-01, SD-21026-01 or SD-21026-02.

B. CHANGES IN APPARATUS

B.1 Added

"ZH" option (Fig. 9) (ASB) 426A Diode

B.2 Added

"ZJ" option (Fig. 3) (MFA) 426A Diode

# D. DESCRIPTION OF CIRCUIT CHANGES

D.1 In Fig. 9 and Fig. 10 on sheet -013 "ZH" option is added and "ZG" option is designated. "ZH" option shows changes required when the automatic "No auxiliary Sender Available" test is to be furnished.

D.2 In Fig. 3 on sheet -012 and in Fig. 9 on sheet -013 "2J" option is added and "ZI" option is designated. "ZJ" option provides for lighting a lamp designated (TC) located at the Sender Test frame.

D.3 In CAD-2 on sheet -015 lead "TC" connecting to terminal 97 of TS (A) is added.

D.4 In CAD-5 on sheet -o15 terminal 30 of TS (B) is being shown connecting to relay (WO) instead of relay (TO). This change is made to correct a drawing error.

D.5 Options "ZG", "ZH", "ZI", and "ZJ" are added to the "Figures and Options" table and to Circuit Notes 102 and 104.

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### PANEL SYSTEMS MF ADAPTER CIRCUIT FOR USE WITH AUTOMATIC TESTING CIRCUITS FOR SUBSCRIBER SENDERS ARRANGED FOR DIRECT DISTANCE DIALING IN PANEL BCO AND GCO OFFICES

## CHANGES

B. CHANGES IN APPARATUS

B.1 Removed

Replaced By

(AF) 19TU Resistor (AF) 19RB Resistor (TO) 145A Resistor

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 In Fig. 3 on sheet -012 the (AFO 19TU resistor is replaced by the 19RB resistor and the (TO) 145A type resistor, connecting between 2T (Q) relay and the (TO) jack, is removed. 2T (Q) relay now connects directly to the (TO) jack. This change provides for increasing the (TO) relay fixed timing interval to prevent false blocking of the associated Sender Test frame while MF outpulsing is being checked.

D.2 Changes are made in Fig. 4 on sheet -Oll and in Fig. 3 on sheet -Ol2 to show the "PSC" lead coming from the Auto. Sender Test Ckt. connecting through a make contact on relay (CA) then to 1B (7DG) relay. The "PSC" lead was previously shown connected directly to 1B (7DG) relay. This change avoids having an Auxiliary Sender held out of service unnecessarily if a (PAS-) key is operated while the test frame is not in use or being used for other than MF type test calls.

D.3 In Fig. 3 on sheet -Ol2 1B and 2B (NST) relay are being shown connecting to terminals 16 and 15 respectively on arc 2 of the (MFK) selector switch. Previously 1B and 2B (NST) relay were shown connecting to terminals 16 and 15 respectively on arc 5 of the (MFK) selector switch. This change provides for having the (ST) lamp at the associated Sender Test frame remain lighted when an MF "Start Pulse" check failure occurs.

D.4 Changes are made in Fig. 9 on sheet -O13 and in Fig. 4 on sheet -O11 to show llT (WOC) relay connecting to l2T (MFC1) relay. Previously llT (WOC) relay was shown connected to direct ground. This change avoids a race condition which may cause the (R2) sequence switch at the associated Sender Test frame to spin unnecessarily when Auxiliary Sender Wipeout or Timeout tests are being made.

D.5 In CAD-2 on sheet -015, terminal 98 of TS(A) is being shown connecting to relay (CA). Previously it was shown connecting to relay (7DG).

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DEPT. 2364-LLS-RJJ-MD

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# CIRCUIT DESCRIPTION

CD-21971-01 Issue 6-D Dwg. Issue 9-D

### PANEL SYSTEMS MF ADAPTER CIRCUIT FOR USE WITH AUTOMATIC TESTING CIRCUITS FOR SUBSCRIBER SENDERS ARRANGED FOR DIRECT DISTANCE DIALING IN PANEL BCO AND GCO OFFICES

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1. GENERAL METHOD OF OPERATION	1	1.1 General
1.1 General 1.2 Multifrequency Receiver	1 1	The Multifrequency Adapter Circuit, working in conjunction with the Automatic Subscribers Sender Test Circuit provides a
SECTION II - WORKING LIMITS	2	means for testing the ability of a Sub- scriber Sender, together with an Auxiliary
SECTION III - FUNCTIONS	2	Sender, to simulate "Direct Distance Dial-
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<ol> <li>AUXILIARY SENDER W.O., T.O. &amp; OFL TESTS (FIG. 7)</li> </ol>	13	stored in its register circuit, to the Aux- iliary Sender by means of P.C.I. type of pulses. In the Auxiliary Sender the digits
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SECTION VI - REASONS FOR REISSUE	18	1.2 Multifrequency Receiver

The Multifrequency Adapter Circuit has, permanently associated with it, a multifrequency receiver circuit which reads the multifrequency pulses directed into it from the Auxiliary Sender Circuit and grounds leads to the Adapter Circuit on a two-out-of-five basis in the form of a "KP" (Key Pulse or gate opener) signal, Area Code when required, Office Code when required (Skip-2 or Skip-3 calls to local crossbar offices to which we have direct

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trunks would require the M.F. outpulsing of only one or none of the Office Code digits), numerical digits and Stations letter, when required, followed by an "ST" (Start) pulse or completion signal. In the Adapter Circuit, the digits outpulsed from the Auxiliary Sender Circuit on a multifrequency basis are checked against the digits set up on keys, sequence switches or jacks in the Sender Test Circuit, and if they match correctly, the Adapter Circuit causes the Sender Test Circuit to be advanced for completion of the call in the regular manner.

# SECTION II - WORKING LIMITS

1.1 None

### SECTION III - FUNCTIONS

1. FUNCTIONS - GENERAL

1.1 To provide for dialing 7, 8 or 10 digits are required from the Subscribers Sender Test Circuit to the Subscribers Sender and the Auxiliary Sender when required.

1.2 To provide for receiving and checking (in conjunction with the Subscribers Sender Test Circuit and the Multifrequency Receiving Circuit) of 4, 5, 7, 8 or 10 digits, as required, from the Auxiliary Sender Circuit.

1.3 To provide optional features which permit this circuit to function with Panel Systems Subscriber Sender Test Circuits arranged to test decoder type senders.

1.4 To send a blocking signal to the Subscriber Sender Test Circuit in the event of a failure in the matching or registering of digits. This will cause the Sender Test Circuit to bring in audible and visual alarms in the regular manner.

1.5 To provide means for testing auxiliary senders (in conjunction with the Subscriber Sender Test Circuit) for abandoned call handling, timeouts and overflow or reversed trunk conditions.

2. FUNCTIONS - DETAIL

The Adapter Circuit consists essentially of four principal parts:

- (a) The Area Code Digit Control Circuit
- (b) The Multifrequency Control Circuit
- (c) The Particular Auxiliary Sender Test Circuit
- (d) Auxiliary Sender W.O., T.O. & OFL Test Circuit

- 2.1 The Area Code Digit Control Circuit Provides:
- 2.11 Dialing paths for digits 2 to 9 inclusive for the Area Code "A" digit.
- 2.12 Dialing paths for digits 0 to 1 for the Area Code "B" digit.
- 2.13 Dialing paths for digits 0 to 9 inclusive for the Area Code "C" digit.
- 2.14 Lamps to indicate the digit being dialed or awaiting dialing.

2.15 A walking circuit for advancing the dialing through the Area Code A, B and C digits.

2.16 Dial class relays to prepare for dialing 7, 8 or 10 digits and receiving 4, 5, 7, 8 or 10 digit multifrequency pulsing with appropriate signal lamps to indicate the set up.

2.17 Check paths for the Area Code digits as received by the M.F. Receiver Circuit against the digits set up on relays in the Adapter Circuit by means of jacks in the Sender Test Circuit.

2.18 Check paths for the Office Code and numerical digits as received by the M.F. Receiver Circuit against those set up by means of keys or sequence switches in the Sender Test Circuit.

- 3.1 The Multifrequency Receiver Control Circuit provides:
- 3.11 A checking circuit for the received digit.

3.12 Switching of the checking leads against the digit setting in consecutive order by means of a 206 type selector.

3.13 Lamp indication of the digit being, checked, awaiting check or failing to check properly.

3.14 Lamp indication of the pulses actually received on a failure to check properly.

3.15 A lamp indication when awaiting the KP (gate opener) signal preceding multifrequency pulsing of the digits.

3.16 A PTF (pulse timing failure) lamp to indicate a failure of that circuit when timing the KP signal.

3.17 A lamp indication when awaiting the ST (start pulse) signal that pulsing is completed. 3.18 Means for signaling the Multifrequency Receiver to get ready for receiving pulses.

3.19 A trunk test loop battery and ground circuit to operate the (TGF) relay of the Auxiliary Sender Circuit.

3.20 A momentary "wink" signal (reversed battery and ground) to the Auxiliary Sender Circuit over the fundamental tip and ring to operate the (OF) relay of the Auxiliary Sender as a signal to complete assignment to the Subscriber Sender Circuit.

3.21 A dry loop over the fundamental tip and ring to the Multifrequency Receiver in preparation for receiving pulses.

3.22 A blocking circuit which grounds a lead to the Sender Test Circuit to bring in an audible and visual alarm in the event of a failure of the Adapter Circuit when:

- (a) A digit fails to check.
- (b) Three frequencies or only one frequency is received.
- (c) The right digit is received but the pulse is too long.
- (d) The local timing circuit in the Multifrequency Receiver fails.

3.23 A signal to the Sender Test Circuit that the ST (start pulse) has been received and checked and to advance for making fundamental test and talking selection.

3.24 An indication to the Sender Test Circuit that the multifrequency control circuit has restored to normal after the completion of a test call.

4.1 Particular Sender Test Circuit

4.11 Provides, by means of relays controlled by keys in the Sender Test
Circuit, a circuit which enables the tester to associate any Subscriber Sender Circuit with any Auxiliary Sender Circuit for routine purposes.

4.12 Provides a means of testing that the subscriber sender goes to overflow when it recognizes that no auxiliary senders are available.

5.1 Auxiliary Sender Wipeout, Timeout and Overflow Test Circuit

5.11 Provides facilities for testing auxiliary sender circuits by means of relays controlled by keys in the subscriber sender test circuit for; 1. abandoned calls during dialing

2. abandoned calls after dial completion but before sender attached wink is received

3. abandoned calls during M.F. outpulsing

- 4. timeouts between dialed digits
- 5. timeouts after dial completion
- 6. overflow or reversed trunk conditions encountered on trunk test

6.1 Jack RC provides remote control of the automatic sender test circuit from the multifrequency adapter unit.

#### SECTION IV - CONNECTING CIRCUITS

When a circuit is listed on a key sheet the information thereon shall be followed.

1.1 SD-21026-01 Automatic Testing Circuit for Subscribers Senders. Used with Sender Selectors or Rotary Link Circuits.

1.2 SD-21026-02 Automatic Testing Circuit for Subscribers Senders for use in Offices with Link Circuits.

1.3 SD-21186-01 Automatic Testing Circuit for Panel Link and Rotary Link Types Subscriber Senders and KP "A" Switchboard Senders.

1.4 SD-20013-01 Automatic Testing Circuit for 3 Digit Subscribers Senders with Link Type Sender Selectors.

1.5 ES-239493 Automatic Testing Circuit for 3 Digit Subscribers Senders.

1.6 SD-95536-01 Common Systems Signaling Receiving Circuit Multifrequency Pulsing.

## SECTION V - DESCRIPTION OF OPERATION

1. PREPARATION - GENERAL

The necessary preparation shall be made at the Sender Test Circuit for establishing the proper circuit conditions for the class of call to be tested.

2. TEN DIGIT CALL - M.F. OUTPULSING

The operation of the ST (start) key at the Sender Test Frame, advances the Sender Test Circuit in the regular manner up to the point where the test circuit is ready to dial the "A" digit of the Office Code. At this point, if the Sender Test Circuit has been arranged for a ten digit

multifrequency class of call, the Area Code will be dialed ahead of the Office Code.

2.1 Seizure

When the Sender Test Circuit advances to the point of grounding the off-normal ground leads, an effective ground is placed on the Adapter Circuit "MFC" lead, operating the relay (MFC) which in turn operates relay (MFC1). The operated (MFC) and (MFC1) relays;

1. Grounds lead "G" to the Sender Test Circuit where the ground is fed through the Area Code Jack and Lamp Circuit and back to the Adapter Circuit over leads ACA-, ACB- and ACC- to operate corresponding relays (A-), (B-) and (C-) in the Area Code Digit Control Circuit Fig.L

2. Grounds lead "C" and "G" to Fig. 3 which operates relays (C) and (G) to prepare the M.F. Checking Circuit for receiving and checking multifrequency outpulsing from the Auxiliary Sender.

3. Closes numerous control and check leads between the Sender Test Circuit and the Adapter Circuit for dialing digit control of the Area Code and the multifrequency pulse checking of digits.

Relay (C) operated; (Fig. 3)

- 1. Closes a path for the operation of relay (G).
- 2. Furnishes off-normal ground to the multifrequency checking circuit.

3. Holds a shunt ground on the "position multifrequency register" relay (PMR) until dialing is completed; make contacts of relay (C), are 2 of MFK selector, back contacts relay (PMR). This shunt is held until the "SA1" and "SA2" leads are bridged at the completion of dialing and the "multifrequency check" MFK selector is positioned for checking the first digit.

Relay CA operated;

1. Closes a shunt ground from the "K" lead of the M.F. Receiver Circuit through its make contacts, back contacts of relay (TO), normally closed contacts of jack (TO), back contacts of relay (BK3) to prevent the operation of blocking relay (BK3) until such time as a failure occurs. An additional shunt is closed over this same path from offnormal ground through the back contacts of relay (UL) until that relay operates after the "KP" (key pulse or gate opener) signal has been received and checked satisfactorily indicating that the M.F. Receiver is unlocked.  Furnishes off-normal ground to the particular sender test relays (Fig. 5).

Relay (G) operated; (Fig. 3)

1. Closes ground from the back contacts of the "pulse check lock" (PKL) relay to the "FT" lead to complete a trunk test loop to the Auxiliary Sender after dialing has been completed.

2. Furnishes ground to arc 5 of the MFK 206 type selector.

3. Operates relay WK.

The grounded off-normal leads initially prepare the M.F. Checking Circuit by:

 Placing ground on one side of the winding of blocking relay (BK3).

2. Placing ground on one side of the winding of "position multifrequency register" relay (PMR).

3. Operating relay (BAT).

4. Grounding an off-normal lead to the Particular Auxiliary Sender Test Circuit.

- 5. Advancing the MFK selector from position 22 to position 1 through arc 1 of the selector.
- 6. Grounding the "STK" and "TR" leads to the Sender Test Circuit.

7. Providing a ground to the biasing winding of "pulse timing" relay (TO), holding it on its back contacts.

Relay (BAT) operated;

1. Provides 48V. battery to the "BAT1" and "BAT2" leads of the M.F. Receiver to assist in preparing that circuit for translating pulses.

- 2. Provides 48V. battery to one side of the biasing winding of relay (TO).
- 3. Provides 48V. battery to one side of the winding of "blocking relay" (BK3).
- 2.2 Dialing the Area Code (Y Option)

Upon the advance of the dial control sequence switch in the Sender Test Circuit to the position normally used for dialing the office code "A" digit, the operated (MFC) and (MFC1) relays will cause the Sender Test Circuit to dial pulse the area code "A" digit instead. A circuit completed through the (DA-) relays, Fig. 2, normal over leads "FU" and "FUC" operates a relay in the Sender Test Circuit to start dial pulsing. Where Fig. 1 is provided, (A-) relays are operated on a 2 out of 5 basis under control of a (ACA-) area code jack located at the Sender Test Frame. This provides for connecting ground to a lead "20"-"29" to the Sender Test Circuit corresponding to the digit to be dialed. This controls the number of dial pulses sent out for the area code "A" digit. The (BO) and (B1) relays operated individually and the (C-) relays operated on a 2 out of 5 basis control dial pulsing of the area code "B" and "C" digits. When the Sender Test Frame is equipped with area code rotary switches instead of area code jacks, Fig. 1 is not provided and dial pulsing of the area code digits is under control of the area code rotary switches (ACA), (ACB) and (ACC).

After the required number of dial pulses have been sent out to the subscriber sender, the Sender Test Circuit connects ground to lead "COI" causing relay (DA1) to operate. Relay (DA1) operated opens the "PU" and "PUC" leads back to the Sender Test Circuit. The Sender Test Circuit in turn removes ground connected to lead "COI" allowing the (DA1') relay to operate in series with relay (DA1). Relay (DA1') operated recloses leads "PU" and "PUC" causing the Sender Test Circuit to start dial pulsing the area code "B" digit under control of the (BO) or (B1) relay, Fig. 1 or the (ACB) rotary switch at the Sender Test Frame. At the end of dial pulsing ground connected to lead "COI" as before operates relay (DA2) which is followed by relay (DA2') when this ground is removed to start dial pulsing the area code "C" digit. At the end of dial pulsing the "C" digit relays (DA3) and (DA3') operate under control of the "COI" lead. Relay (DA3) operated bridges leads "DA" and "DF" preparing the Sender Test Circuit for dialing the office code "A" digit. Dial pulsing of the remaining digits is controlled by the Sender Test Circuit as before. The operated (DA-) relays remain locked to ground under control of lead "DG".

Ground connected to leads "ADA", "ADB" and "ADC" under control of the (DA-) relays provides for lighting an area code dial progress lamp at the Sender Test Frame, Leads "AD" and "AD1" are bridged when relay (DA3') operates to light the "A" digit dial progress lamp at the Sender Test Frame indicating that the office code "A" digit is next to be dialed.

2.3 Dialing the Area Code (Z Option)

After the advance of the dial control switch in the Sender Test Circuit to the position for dialing the "A" digit of the Office Code and after the preliminary pulse and 1-1 pulses have been dialed, when this feature is being tested, a path is closed in the Sender Test Circuit to dial pulse the first digit of the Area Code. The proper lead is grounded "20-29" to the Sender Test Circuit corresponding to the digit set up on the (A-) relays in the Adapter Circuit.

The Sender Test Circuit, having sent out the required number of dial pulses to the Sender, as indicated by the grounded "20-29" lead, grounds the "COl" lead to the Adapter Circuit, operating relay (DA1) of Fig. 2. The operation of relay (DA1) closes a chain circuit, which bridges the "AV" and "AVC" leads which advances the Sender Test Circuit dial control relays, which in turn open the "COl" lead back to the Adapter Circuit, allowing relay (DA1') to operate in series with relay (DA1). This reopens the "AV" - "AVC" chain path and cause the Sender Test Circuit to dial pulse the second Area Code Digit and in turn the third digit, as set up on relays (B-) and (C-), in the same manner as the "A" digit. The chain sequence circuit advances as for the first digit, operating relay (DA2) followed by relay (DA2') and then relay (DA3) followed by relay (DA3), leads "DA" and "DF" are bridged together permitting the Sender Test Circuit to dial pulse the Office Code and numericals in the regular manner.

As the sequence chain relay circuit advances, it grounds leads "ADA", "ADB" and "ADC" which light lamps in the Sender Test Circuit to acquaint the tester with the digit being dialed. The "AD" and "ADI" leads are bridged at the make contacts of relay (DA3') to light the "A" dial progress lamp at the Sender Test Circuit as an indication that the "A" digit of the "Office Code" is the next to be dialed.

2,4 Checking Multifrequency Pulsing

2.41 General (E Option)

The dial control sequence switch of the Sender Test Circuit, having advanced past the position for dialing the last digit, provides a ground over the "DPC" lead through the make contacts of relay (MFC1) Fig. 4, back over the "DPC1" lead, operating relays in the dial pulse connector circuit, of the Sender Test Circuit, to assist the Adapter Circuit in checking multifrequency pulsing. The MFK 206 type selector is now advanced to position 4 by the bridging of the "SA1" and "SA2" leads at the Sender Test Circuit. Relay (PMR) operates at this time, when the shunt is removed from one side of its winding.

While the dial pulses are being sent out from the Sender Test Circuit, the Sender, as soon as the required number of

digits have been registered, calls in the Decoder and receives instructions as to the routing of the call. The Sender Test Circuit proceeds, by means of revertive puls-ing, to check the District and Office selections received in the Sender, against those set up in the Sender Test Circuit by the tester. Upon completion of these checks, the MF-PCI Check Sequence Switch in the sender test circuit is advanced to a point where a ground is placed on the "TF1" lead to the Adapter Circuit. Lead "TF1" is bridged at the make contacts of relay (MFC) Fig. 4, with lead "TF2" and extended back to the Sender Test Circuit to cause a transfer of the "FT" and "FR" leads, from the Sender Test Circuit to the Adapter Circuit. The Sender Test Circuit then grounds lead "TF", to the Adapter Circuit. operatlead "TF", to the Adapter Circuit, operat-ing relay (TRF2) of Fig. 3. The operation of relay (TRF2) opens lead "TR" to a slow The operation release relay in the Sender Test Circuit and at the same time grounds lead "ADV" to advance the MF-PCI check switch in the Sender Test Circuit, to a position for checking the first multifrequency pulsed digit. During the transfer of the funda-mental leads to the Adapter Circuit, the fundamental circuit is further opened in the Sender Test Circuit under control of the "TR" lead to prevent a premature trunk test which might cause a false assignment.

### 2.411 General (F Option)

After the area code digits have been registered in the subscriber sender it calls in a Decoder and receives information as to the routing of the call. When the Sender Test Circuit completes dial pulsing the office code digits it is ready to check district and office selections. Upon completion of these checks a relay operates in the Sender Test Circuit which transfers the "FT" and "FR" leads from the subscriber sender over similarly designated leads to this circuit.

After the last digit has been dial pulsed the Sender Test Circuit connects ground to lead "DPC". This ground is returned through relay (MFC1) operated over lead "DPC1" operating a relay in the Sender Test Circuit which advances a sequence switch in preparation for multifrequency pulse checking. At the same time the Sender Test Circuit bridges leads "SA1" and "SA2" completing a circuit for advancing the (MFK) 206 type selector. When the (MFK) selector reaches position 4 a shunt through arc 2 is removed from one side of the (PMR) relay winding allowing it to operate. This opens the circuit for advancing the (MFK) selector. The (MFK) selector remains in position 4 ready for MF checking the "KP" (key pulse) signal and the area code "A" digit.

# 2.42 Trunk Test and Trunk Closure

The Subscriber Sender calls in an Auxiliary Sender after seven digits are registered in it. When an Auxiliary Sender is attached it will make trunk test over the fundamental circuit, through the Subscriber Sender and Sender Test circuits to battery through the winding of relay (TC), Fig. 3 over lead "FT" and to ground through a back contact of relay (PKL) over lead "FR". This will operate a polar relay in the Auxiliary Sender circuit but relay (TC) in this circuit does not operate because of the high resistance (approx. 34,000 ohms) in the trunk test circuit at this time. After the ninth and tenth digits have been registered in the Auxiliary Sender, it signals the Subscriber Sender that dialing is completed. The Subscriber Sender in turn makes trunk closure to the Auxiliary Sender causing it to reduce the resistance in the trunk test circuit to approximately 400 ohms allowing relay (TC) to operate.

## 2.43 Wink Signal

Relay (TC) operated immediately closes a "wink" signal (a momentary closure of re-versed battery and ground) over the "FT" and "FR" leads causing relay (OF) in the Auxiliary Sender Circuit to operate. The Auxiliary Sender then makes an "assignment" to the Subscribers Sender which proceeds to outpulse the stored digits registered in it, to the Auxiliary Sender on a P.C.I. basis. Here they are converted to multifrequency pulses and outpulsed over the fundamental tip and ring. The TC relay operated, opens the operating path of relay WK and operates relay PKL. Relay WK is made slow release to insure that the wink signal is long enough to operate the OF relay in the Auxiliary Sender. The operated relay (PKL) provides a path to operate relay (CF). Relay (CF) operated closes the fundamental tip and ring leads to the M.F. Receiver Circuit. The operated relay (CF) also grounds a lead to the Sender Test Circuit to light a "PTF" lamp as an indication that the Adapter Circuit is prepared to check for a failure of the pulse timing circuit.

### 2.44 Prepare Pulse Check Circuit

Relay (PKL) operated closes a path to operate the (PK) "pulse check" relay through the back contacts of the (PKH) "pulse check help" relay, make contacts (PKL) "pulse check lock" relay to offnormal ground. The operated (PKL) relay also grounds a lead to the Sender Test Circuit, lighting the "KP" lamp as an indication that the Adapter Circuit is ready to receive multifrequency pulses. The operated (PK) relay closes a path to operate relay (KG) which locks to ground through the contacts of relay (FK). Relay (KG) operated closes a path to operate relay (FKH) and also connects ground to the primary winding of the (TO) "pulse timing" relay which does not operate at this time because the biasing winding is also energized.

# 2.45 Key Pulse Signal

The Auxiliary Sender immediately closes through a "KP" (Key Pulse or Gate Opener) pulse which consists of two frequencies of 1100 and 1700 cycles with a duration of approximately 0.100 seconds.

The following table illustrates the frequencies for each pulse or digit received. These frequencies are assigned designations 0, 1, 2, 4, 7, and 10 so as to fit in with standard additive two-out-offive arrangements.

DIGIT	700	900	FREQUE 1100 DESIGN	NCY 1300 ATTON	1500	1700
0	0	1	2	4 X	7 X	10
1	X X	x	x			
3	Y	X	x	Y		
5	<b>.</b>	X	v	X		
ž	x			•	X	
9		X	x		X	
KP ST *ST	• .	(x)	x	•	x	X X X

# \*On calls where a prefix "O" digit is dialed.

The M.F. Receiver, upon receiving the "KP" signal, grounds the "Q" lead to the Adapter Circuit, operating the (Q) relay at the same time, the "Q" lead is extended through the make contacts of relay (KG), back contacts of relay MKG, back contacts of relay (STK), make contacts of relay (PKL) back over the "L" lead to notify the M.F. Receiver that the checking circuit is ready and to take a reading.

If the "KP" signal is composed of the correct frequencies and is at least 0.1 seconds in duration, the M.F. Receiver is unlocked and upon completion of the signal, grounds the "UL" lead operating relay (UL), providing relay (TOK) is operated.

2.46 Pulse Timing Circuit Check

The operated (Q) relay removes the ground from one side of the biasing winding of relay (TO), which operate approximately 0.050 seconds later when the "TO" condenser becomes sufficiently charged. The operation of relay (TO), closes a path to ground on lead K to operate relay (TOK) which locks to off-normal ground. Relay (TOK) operated opens the "PTF" lead, extinguishing the "PTF" lamp as an indication that the pulse timing circuit is functioning properly. Any future operation of relay (TO) would serve as an indication that digital pulses were too long or failed to check properly and relay (EK3) would operate, blocking the test and opening the fundamental by releasing relay (CF), preventing the next incoming digit from overlapping and mutilating the digit record locked in by the operation of relay (BK3), which holds a ground on the "L" lead.

The timing of subsequent digits is approximately 0.050 seconds from the time the (Q) relay operates, indicating a signal is present, until the release of relay (KG) indicating the pulse checked satisfactorily. At this point the timing is extended from 0.050 to 0.090 seconds to check that the pulse received is not too long. A failure in either case would result in the operation of relay (BK3) and blocking of the test.

# 2.47 Check Circuit Advance

If the KP signal is received and checked satisfactorily the M.F. Receiver functions to ground lead "UL" at the termination of the pulse. Relay (UL) Fig. 3 operates through make contacts of relay (TOK). The termination of the "KP" signal also removes ground from the "Q" lead, re-leasing relay (Q), which closes ground to the biasing winding of relay (TO), forcing its release. Relay (UL) operated extinits release. Relay (UL) operated extin-guishes the "KP" lamp and grounds a lead to light the "AMA" lamp in the Sender Test Circuit as an indication that the Adapter Circuit is ready to receive the first dig-ital pulse. Relay (UL) operated, also closes a path to operate the MFK selector, which remains in an operated position until the digit is checked and then advanced to the next digit checking position. Relay (MKG) is momentarily operated at this time, through the interrupter springs of the MFK selector as a check that the selector fully operates. Failure to break the interrupter springs would leave relay (MKG) operated, resulting in the "L-Q" lead bridges circuit being held open, preventing any further progress of the test.

# 2.48 Checking the Area Code "A" Digit

The M.F. Checking Circuit is now awaiting the pulsing of the Area Code "A" digit. When the signal is present in the M.F. Receiver lead "Q" is grounded, operating relay (Q) which locks the operated (PKH) relay and removes a ground from one side of the biasing winding of relay (TO), starting the 0.050 second timing cycle.

For normal operation two and only two of the "0, 1, 2, 4 and 7" leads will be grounded, operating two (N-) relays of Fig. 3. With two (N-) relays operated, a ground will be connected to one of leads "20" to "29". If the correct lead is grounded, the circuit is continued through the two operated (A-) relays (when Fig. 1 is provided) or through the (ACA) rotary switch at the Sender Test Frame over lead "A" (when Fig. 11 is provided), through arc 4 of the MFK selector and relay (ST) normal to provide a shunt to relay (PK). This causes relay (PK) to release indicating that the digit checked satisfactorily. Relay (KG) is released by the release of relay (PK) and:

- 1. Extends the time out period of the (TO) relay to 0.090 seconds.
- Partly opens the operate path of the MFK selector.
- 3. Opens the path from the "Q" lead to the "L" lead from the M.F. Receiver, unlocking the channel relays.
- 2.49 Advancing Sender Test Circuit for Check of Subsequent Digits and M.F. Check Progress Lamps

With the MFK selector in position 4, an off-normal ground is extended through the make contacts of relay (UL), back contacts of relay (ST), arc 6 of the "MFK" selector over the "A" lead to Fig. 2.

# "Y" Option Fig. 2

Ground from arc 6 of the MFK selector is connected to lead "AA" to the Sender Test Circuit to provide for lighting the "AMA" MF progress and a match lamp, "O" to "9" at the Sender Test Frame. Where Fig. 1 is provided the circuit is through the "AMA" lamp, back over lead "AMA" through the two operated (A-) relays to an "M-" lead extending back to the Sender Test Circuit then through a match lamp to battery. Where Fig. 11 is used and (A-) relays are not provided, the AMA lamp circuit is through a section of the ACA rotary switch at the Sender Test Frame. The "AMA" lamp indicates the digit being checked while the match lamp "O" to "9" lighted in series with it indicates the numerical value of the digit being checked.

# "Z" Option Fig. 2

With certain types of Sender Test Circuits, the Area counting relays of Fig. 2 are reused for lighting the "AMA", "AMB" and "AMC" digit progress match lamps at the Sender Test Frame. The "DG" lead is opened, when the Sender Test Circuit Dial Control Sequence Switch is advanced past the last digit dialing position. The (DA1), (DA1'), (DA2), (DA2'), (DA3) and (DA3') relays release and the dial progress lamp circuit is made ineffective.

Ground on the "A" lead from Fig. 1 operates relay (DA1) which connects 48 volt battery to the "AA" lead to light the "AMA" pulse match progress lamp in the Sender Test Circuit and back to Fig. 1 over the "AMA" lead, where it is routed through the two operated (A-) relays to an "M" lead extending back to the Sender Test Circuit through match lamps to ground. The "AMA" lamp indicates the digit being checked and the match lamp 0 to 9, lighted in series with it indicates the numerical value of the digit being checked. At the end of the pulse, relays (Q) and (N-) are released and the biasing ground is placed back on the (TO) relay.

Upon the termination of the first digit pulse, relay (Q) releases, in turn releasing relay (PKH) which opens the ground to the "MFK" selector, allowing it to step to position 5. The "B" lead is grounded from Fig. 3, the "AMA" lamp extinguished, the "AMB" lamp lighted in series with the proper match lamp 0 to 9 and the check path advanced to the "P2" lead.

Relay (PK) operates when relay (PKH) releases and the circuit is prepared for the pulsing of the next digit. The checking of all numerical digits except the units is similar to "AMA" except for the progress lamp lighted, the position of the "MFK" selector and the "P-" lead checking path used. The "P-" lead check paths are controlled sequentially by relays (A-), (B-) and (C-) of Fig. 1 and key or sequence switch settings in the Sender Test Circuit.

The Sender Test Circuit MF-PCI Check Sequence switch is advanced from position to position after the checking of the Area Code by grounds applied over leads "BA", "CA", "THA", "HA", "TA" and "UA" from arc 6 of the "MFK" selector.

# 2.50 Units Digit

Checking of the units digit is accomplished in a little different manner insofar as preparing the Adapter Circuit for checking or not checking a "Stations" digit is concerned. Ten digit Direct Distance Dialing class of calls, not having a provision for "Stations" or "Over Ten Thousands" features will have the "NS3" lead grounded from the Sender Test Circuit operating relay (NST) of Fig. 3. The "MFK" selector is advanced to position 14 upon the completion of the tens digit check and the Sender Test Circuit grounds the "P10" lead to the Adapter Circuit if the pulsed digit matches the one set up in the Sender Test Circuit for the units digit. The units progress lamp is lighted through a bridge of leads "UK1" and "UK2" at the back

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contacts of relays (UK) and (ST). The ground on lead "PlO" to arc 4 of the "MFK" selector shunts down relay (PK) in the regular manner. The (KG) relay is released, the (Q) relay releases at the termination of the pulse, the (PKH) relay is released, and the "MFK" selector is advanced to position 15. In position 15, relay (UK) operates from ground on the operated (UL) & relay. The units progress lamp is extinguished, and with relay (NST) operated, the (ST) relay is operated through arc 5 of "MFK" selector to off-normal ground and through the make contacts of relay (G).

Relay (ST) operated;

- 1. Opens the locking ground to relay (UK) allowing it to release.
- 2. Closes the "ST" (start) pulse checking circuit to the winding of relay (STK).
- 3. Opens the digit check circuit.
- 4. Closes a path to light the "ST" (start) pulse progress lamp in the Sender Test Circuit.
- 5. Operates relay (SPC), "ZF" option, when "Prefix -O" key at Sender Test Frame is operated.

2.51 "ST" (Start) Pulse

When a "ST" signal is received in the MF Receiver Circuit, it operates relays (N7) and (N10) of Fig. 3. If a prefix zero digit has been dialed on this call, the "ST" signal is changed and relays (N1) and (N10) are operated instead. With relays (N7) and (N10) operated and relay (STC) normal or relays (N1), (N10) and (STC) operated (other (N-) relays hormal), a circuit is completed for operating relay (STK).

Relay (STK) operated;

- 1. Locks to off-normal ground.
- 2. Extinguishes lamp "ST".
- 3. Opens the "L" lead to unlock the channel relays in the M.F. Receiver.
- 4. Places ground on one side of the biasing winding of relay (TO) to deactivate the timing circuit.
- 5. Opens lead "STK" to the Sender Test Circuit, causing that circuit to transfer the fundamental tip and ring back to a local circuit for completion of fundamental closure and talk selections.

6. Grounds lead "STA" to the Sender Test Circuit to advance that circuit for completion of the test.

# 2.52 Restore to Normal

As the Sender Test Circuit restores to normal between test calls ground is removed from leads "C" and "G" releasing relays (C), (CA) and (G). With relays (C) and (CA) released, all relays which are held to off-normal ground in the Adapter Circuit are released and the "MFK" selector is restored to normal (position 22). The Adapter Circuit is now awaiting the next test call.

# 2.53 Blocking

Blocking will occur during M.F. pulse checking and operate the (BK3) relay under the following conditions;

- 1. Three frequencies present, causing the M.F. Receiver to open its "K" lead.
- 2. One or no frequencies present or M.F. pulse too short causing a mis-match of a succeeding digit and a time out of the pulse timing circuit.
- 3. M.F. pulse too long causing a time out of the pulse timing circuit.

Relay (BK3) operated;

- 1. Grounds the "BLK" lead to the Sender Test Circuit blocking the advance of that circuit.
- 2. Opens the fundamental tip and ring by releasing relay (CF) to prevent succeeding digits from operlapping and mutilating the digit record of the failure.
- 3. Grounds the "L" lead to lock in the channel relays in the M.F. Receiver, of the digit that failed.

4. Operates relay (IMP), closing paths for lighting pulse lamps at the Sender Test Frame corresponding to the digit received by the M.F. Receiver and recorded on (N-) relays of Fig. 3.

- 5. Operates and holds the "MFK" selector to prevent its advance from the check position where trouble was encountered.
- 3. PARTICULAR AUXILIARY SENDER TEST (FIG. 10)
- 3.1 Associating Any Auxiliary Sender With Any Subscribers Sender For Test Purposes

3.11 Ten PAS- keys are equipped on the automatic test frame, since ten auxiliary senders are the maximum in a group. When the subscriber senders tested by the test frame have access to a single group of

auxiliary senders, a particular auxiliary sender is selected by operating a PAS- key. Ground through the break contacts of relays (LO1) and (LOR), over lead "PSB," through the make contact of the PAS- key operated, and over lead "MB-" will make busy the selected auxiliary sender.

On a ten digit DDD call, prior to dialing the hundreds (H) digit, the U2 cam of the test frame grounds lead "H." This ground is extended through the MF Adapter to the back contacts of relays (OT1) and (7DG) normal, over lead "PSC," through the operated PAS- key make contact, back over lead "PC," to the back contacts of a continuity transfer on relay (LO3), and through the break contact of relay (LOR), to operate relays (LO1) and (LO2). Relays (LO1) and (LO2) operated:

 (a) Ground the "PAS-" leads through the normal PAS- keys to make busy all auxiliary senders that have not been made busy in service.

(b) Remove ground from the "MB-" lead of the selected auxiliary sender by opening the ground circuit on lead "PSB."

(c) Close the operate path for relay (LO3), through the back contact of relay (LOR) and through the make contacts of relays (LO1) and (LO2). Relay (LO3) operated:

 (1) Through a continuity transfer, locks relays (LO1) and (LO2) to off-normal ground, and removes the circuit from the test frame U2 cam and its associated (H) lamp.

(2) Closes a path to the (LOR) relay secondary winding to lead "PSB," through the normal ASB key.

(3) Closes the (LOR) relay primary winding through the (LOR) and (RL) relay continuity transfer contacts, to lead "LOR."

3.12 After the sender test frame dials the seventh digit into the subscriber sender, the subscriber sender selected auxiliary sender. Since, at this time, all other auxiliary senders are made busy by relays (LO1) and (LO2) or in service, only the selected auxiliary sender is seized. The selected auxiliary sender grounds the "MB-" lead, and through the operated PAS- key, over lead "PSB," through the operated (LO3) relay make contact, through the normal ASB key, operates relay (LOR) on its secondary winding. Relay (LOR) operated:

(a) Locks to its primary winding over its continuity transfer contact, to offnormal ground. (b) Opens the locking path of relays (LO1), (LO2) and (LO3), releasing these relays.

(c) Insures that ground is not extended from the "MB-" leads through the operated PAS- key to make busy the selected auxiliary sender for the second time, until the MF Adapter Circuit returns to normal and is ready for the next test.

3.13 When relays (LO1) and (LO2) release ground is removed from the "MB-" leads of all the auxiliary senders, thus making them all available for service.

3.2 Seven Digit MF Calls Using the Particular Auxiliary Sender Circuit

3.21 The circuit operates in a similar manner on seven digit MF calls. On this type of call, after the seventh digit is dialed into the subscriber sender, the test frame V2 cam grounds the "U" lead in position 12. This ground is extended to the MF Adapter to the transfer contacts of relay (OT1) normal, through the transfer contacts of relay (7DG) operated, and through the continuity transfer contacts of relay (LO3) to operate relays (LO1) and (LO2). These relays perform the same functions as described in paragraph 3.11. The auxiliary senders that are made busy are released when test frame cam V2 grounds lead "LOR" in position 13/17, to operate relay (LOR).

3.3 No Auxiliary Sender Available (ASB and CAN-SYN Keys Operated - 10 Digit DDD Class of Call Only)

3.31 Test can be made with the Particular Auxiliary Sender Circuit to determine if the subscriber sender under test will recognize the all auxiliary senders busy condition (no auxiliary senders available). These tests are performed in a similar manner to those described in paragraph 3.11.

3.32 The particular auxiliary sender to be selected with the PAS- key, is plugged busy at its Make Busy Jack. The ASB key is operated to prevent ground, from the auxiliary sender, from returning over lead "MB" - through the operated PAS-key and over lead "PSB", and falsely operating relay (LOR). The circuit functions as previously described in paragraph 3.11, but when relays (LO1) and (LO2) operate and make busy all other auxiliary senders, the subscriber sender will go to overflow because it cannot seize an auxiliary sender, the subscriber sender until all the digits are dialed, then it blocks. As the test frame dials into the 13/17 position, the test frame W2 cam grounds lead "LOR".

through a make contact on relay (LO3) and through the continuity transfer contacts of relay (LOR) to operate relay (LOR) on its primary winding. Relay (LOR) locks to off-normal ground and through its continuity contact, opens the path on lead "LOR" from its winding to the test frame. Relay (LOR) opens the holding path for relays (LO1), (LO2), and (LO3), which release, and in turn release the auxiliary senders for service.

The operation of the test frame CA key will restore the test frame and the MF Adapter to normal, thus releasing relay (LOR).

3.4 Auxiliary Sender Link Time Out

In the event of an Auxiliary Sender Link time out the R lead is grounded, operating relay RL. Relay RL operated through a continuity transfer contact opens lead "LOR" from the sender test frame and operates relay (LOR). Relay (LOR) operated, opens the holding path for relays (LO1) and (LO2) which will release, if they have been operated, and they will remove the grounds from leads "PAS-0" to "PAS-9".

3.5 Particular Auxiliary Sender Test (Figs. 5 & 6)

3.51 Ten (PAS-) keys are provided at the sender test frame with the keys being associated with auxiliary senders in a common group of ten or less.

3.52 When a (PAS-) key is operated it connects ground from relays (LO3) and (LO2) normal to the "MB" lead of the associated auxiliary sender to hold it busy.

As dialing progresses, pulses received over lead "P" from the sender test circuit are recognized by the (W-), and (Z-)relays of Fig. 6. When the sender test circuit is in position to dial the seventh digit, ground from this circuit will be connected to lead "TH" on a ten digit MF type call, lead "U" on a seven digit MF type call and lead "T" on a seven digit MF type call when a number over 10,000 is to be dialed. This ground is directed ov lead "PSC" to the sender test circuit, This ground is directed over through the operated (PAS-) key, back over lead "PC" to operate relay (LO). Relay lead "PC" to operate relay (LO). Rela (LO) in turn operates relays (LO1) and (LO2) which connect ground to the "MB" leads of the auxiliary senders associated with the (PAS-) keys that are normal to hold the unwanted auxiliary senders busy. Relay (LO1) also operates relay (LO3) which locks to off-normal ground and re-moves ground from the "MB" lead holding the desired auxiliary sender busy making it available. After the seventh digit is dialed, the sender test circuit dial control switch advances removing ground

connected to lead "P". Relays (W-) and (Z-) function to remove ground from lead "PSC" allowing slow release relay (LO) to release. Relay (LO) normal shunts relays (LO1) and (LO2) causing them to release. This removes ground on the "MB" leads holding the unwanted auxiliary senders restoring them to service: Slow release relay (LO) allows time for the subscriber sender to seize the preselected auxiliary sender before releasing the unwanted auxiliary senders.

3.53 Relay (RL), operated by ground over lead "R" in the event of an auxiliary sender link timeout or over lead "BLK" when the blocking relay of the sender test circuit operates, opens the (LO) relay operate circuit. This will inactivate the particular auxiliary sender test feature.

4. TEN DIGIT SKIP-3 CALL - M.F. OUTPULSING

This class of call is used, where a local office has a direct outgoing trunk group to a crossbar tandem office which serves only local offices in one particular "Foreign Area".

4.1 Seizure and Dialing

Seizure, dialing and dial registration for this class of call is almost identical to that for a ten digit no-skip class of call, the only difference being the operation of relay (SK3) Fig. 4 over the "SK3" lead from the Sender Test Circuit.

4.2 Checking Multifrequency Pulsing

The operated (SK3) relay bridges leads "PB1" and "PB2" together to Fig. 3 resulting in the advance of the "MFK" selector to position 7 for checking the first digit of the "office" code, as only seven digits will be multifrequency outpulsed from the Auxiliary Sender Circuit.

Multifrequency checking of digits and completion of call are the same as for a ten digit no-skip class of call.

5. SEVEN AND EIGHT DIGIT CALLS - M.F. OUTPULSING

This class of call is used, where a local office has a direct outgoing trunk group to a crossbar tandem or number 4, A4A, 4M or 4A system and the call is to be completed within the "Home Area".

5.1 Seizure

Seizure, on this class of call is similar to that for a ten digit no skip class of call except that relay (7DG) is operated over the "7DG" lead from the Sender Test Circuit.

# 5.2 Dialing

As no "Area" code will be dialed the Area Code Digit Control Circuit, Fig. 1, will not be used. Likewise the chain relay sequence relays of Fig. 2 will not be used.

Upon the advance of the dial control switch in the Sender Test Circuit to the position or dialing the "A" digit of the "Office Code" and after the preliminary pulse or 1-1 pulses have been sent, when these features are being tested, a path over the "PU" lead through the normal relays of the sequence chain relays of Fig.2 and back over the "PUC" lead prepares the Sender Test Circuit for dial pulsing the Office Code. The "DA" and "DF" leads are bridged at the contacts of operated relay (7DG), closing a path to the Sender Test Circuit to start the dial pulsing of the first digit of the Office Code. Dialing then progresses in the regular manner.

# 5.3 Checking Multifrequency Pulsing

The operated (7DG) relay, Fig. 4, bridges lead "PB1" and "PB2" together to Fig. 3 resulting in the advance of selection "MFK" to position 7, for checking the first digit of the Office Code, after dialing has been completed and the "SA1" and "SA2" leads are bridged in the Sender Test Circuit.

Multifrequency checking of digits and completion of call are the same as for a ten digit no-skip class of call.

## 5.4 Stations Digit

If relay (NST) is normal, indicating that a "Stations" digit is expected, the path for operating the (ST) relay for the "Start" signal check is not closed until position 16. In position 15, the completion of the pulse checking path is over lead "PSI" from the Sender Test Circuit through arc 4 of selector MFK. Relay (UK) operates and the "STA" progress lamp is lighted over lead "STL" to the Sender Test Circuit from ground through an operated (UK) relay, back over the "UK1" lead to ground in the Sender Test Circuit. Checking is otherwise completed in the same manner as the other digits.

### 5.5 Over Ten Thousands Digit

If the number being tested is over 9,999, ground is placed on the "OT1" lead from the Sender Test Circuit which operates relay (OT1) Fig. 3.

Normally on calls under 10,000, ground from relay C operated is connected through arc 2 of the "MFK" selector, to the winding of the MFK selector magnet winding causes the selector to pass by position 10.

With the selector in position 10, M.F. checking is completed over the "PTT" lead from the Sender Test Circuit through arc 4 of selector "MFK" in the same manner as the other digits.

Ground through arc 6 of the "MFK" selector in position 10, through make contacts of relay (OT1), over the "OTA" lead advances the MF-PCI check sequence switch in the Sender Test Circuit to the proper position for checking a ten thousands digit.

Relay (OT1) operated also transfers the "Particular Sender Control" lead "PSC" from the Subscribers Sender Test Circuit through an operated (7DG) relay of Fig. 4, to a "T" lead back to the Sender Test Circuit to a ground from the Dial Control Switch because the "tens" digit is now the seventh digit dialed instead of the "units" digit and that is the point where the Subscribers Sender attempts to seize an Auxiliary Sender.

6. SEVEN DIGIT SKIP-3 CALL - M.F. OUT-PULSING

This class of call is used where a local office has a direct outgoing trunk group to a single unit crossbar type of local office and the outpulsing of switching information by means of multifrequency is desirable.

## 6.1 Seizure and Dialing

Seizure, dialing and dial registration for this class of call are similar to that for a Seven Digit no-skip class of call except that relay (SK3) is operated over the "SK3" lead from the Sender Test Circuit.

### 6.2 Checking Multifrequency Pulsing

The operated (SK3) and (7DG) relays Fig. 4, bridge leads "PB1," "PB2," "PB3" and "PB4" together to Fig. 3, resulting in the advance of selector "MFK," to position 11, for checking the first digit of the numericals, after dialing is completed and the "SA1" and "SA2" leads are bridged at the Sender Test Circuit.

The completion of dialing and the resultant operation of relay (TRF2) during "fundamental transfer" grounds the "SK" lead to Fig. 4 and the operated (SK3) and (7DG) relays close this ground to leads "OTA," "SKA" and "SK3" to provide positive paths for advancing the MF-PCI check sequence switch in the Sender Test Circuit to synchronize its checking position with that of the "MFK" selector. Multifrequency pulse checking of digits and completion of call are the same as for a ten digit no-skip class of call.

7. SEVEN DIGIT SKIP-2 CALL - M.F. OUT-PULSING

This class of call is used where a local panel office has a direct outgoing trunk group to a multiunit crossbar type of local office and the outpulsing of switching information by means of multifrequency is desirable.

7.1 Seizure and Dialing

Seizure, dialing and dial registration for this class of call are similar to that for a seven digit no-skip class of call except that relay (SK2) is operated over lead "SK2" from the Sender Test Circuit.

7.2 Checking Multifrequency Pulsing

The operated (SK2) and (7DG) relays Fig. 4, bridge leads "PB1," "PB2" and "PB3" together to Fig. 3, resulting in the advance of selector "MFK" to position 9, for checking the "C" digit of the "Office" code as the first digit, after dialing is completed and the "SA1" and "SA2" leads are bridged at the Sender Test Circuit.

The completion of dialing and the resultant operation of relay (TRF2) during "fundamental transfer" grounds the "SK" lead to Fig. 4 and the operated (SK2) and (7DG) relays close this ground to leads. "SKA" and "SKB" to provide positive paths for advancing the MF-PCI Check sequence switch in the Sender Test Circuit to synchronize its checking position with that of the "MFK" selector.

Multifrequency pulse checking of digits and completion of call are the same as for a ten digit no-skip class of call.

- 8. AUXILIARY SENDER WIPEOUT, TIMEOUT AND OVERFLOW TESTS (FIG. 7)
- 8.1 Call Abandoned After Dialing the Ninth Digit of a Ten-Digit Call

When the subscribers sender test circuit reaches the point of dialing units, ground over lead W5 operates relay (WO) which locks to off-normal ground.

Relay (WO) operated;

- 1. Arranges the TOC tube timer for a five second timeout.
- 2. Grounds lead W6 to the test circuit.
- 3. Operates relay (WOC).

4. Bridges leads TST and TST1 to the sender test circuit.

Relay (WOC) operated;

1. Grounds leads AST, WT2, AT & AT1 to the sender test circuit.

2. Removes bridges on leads LD & LD1 and leads LD2 & LD3 to the sender test circuit.

3. Removes bridge on leads R & Rl to the sender test circuit to cause an abandoned call to be registered in the subscriber sender.

4. Bridges lead WT from the sender test circuit to lead WT1 causing a fundamental transfer in the sender test circuit permitting that circuit to arrange itself to check talk selections.

- 5. Closes a path from lead AD2 from the sender test circuit through back contacts of timing relay (TOC) to lead CA1 (Option V) or lead AD3 (Option T) for advancing the sender test circuit to normal on a satisfactory test.
- 8.2 Call Abandoned After Dialing Ten Digits but Before the Sender Attached Wink is Registered

When the subscribers sender test circuit reaches dial completion, ground is extended over lead W7, operating relay (WO1) which locks to off-normal ground.

Relay (WO1) operated;

1. Arranges the TOC tube timer for a five second timeout.

2. Opens a bridge of leads TT1 & TT2 and closes a bridge on leads TT1 & TT5 to provide trunk test battery and ground without a sender attached wink to be directed to the auxiliary sender.

3. Operates relay (WOC).

From this point call proceeds the same as Section 5.81.

8.3 Call Abandoned After Multifrequency Outpulsing has Begun

When MFK selector reaches position 7 (check A digit), ground on lead W8 operates relay (WO2) which locks to off-normal ground.

Relay (WO2) operated;

1. Arranges the TOC tube timer for a five second timeout.

2. Arranges the FP timing circuit for a 639-697 millisecond timeout.

3. Closes in part a bridge of leads SCl and AT to advance the sender test circuit to a position for recognizing link dismissal when relay (SCl) releases in the sender test circuit.

- 4. Closes a path from lead CA1 to the contacts of relay (L1).
- 5. Operates relay (WOC).

Relay (WOC) operated;

- 1. Completes bridge of leads SC1 & AT.
- 2. Grounds leads AST, WT2 & AT1 to the sender test circuit.

3. Removes bridge on leads LD & LD1 and leads LD2 & LD3 to the sender test circuit.

4. Removes bridge on leads R & Rl to the sender test circuit to cause an abandoned call to be registered in the subscriber sender.

5. Extends lead LD to the winding of relay (L1) to cause that relay to operate when link dismissal is received in the sender test circuit from the subscriber sender.

Relay (L1) operated;

Grounds lead CAl to restore the sender test circuit to normal.

### FP Condenser Timer (639-697MS)

Ground from the back contacts of relay (WO2) through resistor CA normally keeps condenser FP discharged and provides a path through resistor CB, jack FP and the 2600 ohm secondary winding of relay (FP) to hold relay (FP) on its back contacts. When relay (WO2) operates, this ground is removed and is applied through potentiometer DA, resistance CC and the 200 ohm primary winding of relay (FP) to energize relay (FP) which is held on its back contacts for 639-697 milliseconds while current continues to flow through its secondary winding charging condenser FP. When condenser FP is charged sufficiently and the current through the secondary winding diminishes, relay (FP) operates over its primary winding and closes ground to lead FP to Fig. 3. If multifrequency outpulsing has not been stopped in the auxiliary sender by the opening of the fundamental at relay (LR) in the adapter will result and ground will be extended back over lead BK4 to operate relay (BK4) blocking the test circuit and lighting lamp FP at the test circuit as an indication of a failure.

### 8.4 Auxiliary Sender Timeout After Dialing Nine Digits of a Ten Digit Call

When the sender test circuit reaches the point of dialing the units digit, ground over lead W9 operates relay (TO) which looks to off-normal ground.

Relay (TO) operated;

1. Arranges the TOC tube timer for a fifteen second timeout.

2. Removes bridge from leads L & Ll to the sender test circuit to prevent a false operation of relay (L) in that circuit while arranging itself for checking talk selections.

3. Grounds lead R to prevent any further dial pulses being sent to subscriber sender.

- 4. Disables five second timing feature of TOC tube timer.
- 5. Operates relay (WO1) which locks to off-normal ground.
- Relay (WO1) operated;

1. Opens a bridge of leads TT1 & TT2 and closes a bridge on leads TT1 & TT5 to provide trunk test battery and ground without a sender attached wink to be directed to the auxiliary sender.

2. Operates relay (WOC).

From this point call proceeds the same as Section 5.81 except that lead LD is extended to the winding of relay (L1) to cause that relay to operate when link dismissal is received in the sender test circuit, from the subscriber sender.

Relay (L1) operated;

Closes bridge to leads L & L1 to permit talk selections being checked.

8.5 Auxiliary Sender Timeout After Dialing Ten Digits

When dial pulse completion is reached in the sender test circuit, ground on lead W9 operates relay (TO).

From this point call proceeds the same as Section 5.84.

8.6 Overflow Test or Reversed Trunk On Seizure

When the test call reaches the point of dial pulse completion ground over lead W10 operates relay (RVT) which locks to off-normal ground.

Relay (RVT) operated;

1. Places a bridge on leads R & Rl to hold the dialing circuit closed when relay (WOC) operates.

2. Causes reversed battery and ground without sender attached wink to be directed to the auxiliary sender over the fundamental for trunk test (leads TT1 & TT3).

3. Operates relay (WO1).

From this point call progresses the same as for Section 5.82.

8.7 TOC Tube Timer Circuit

This timer is used to prevent the test circuit being advanced falsely by a timeout of the auxiliary sender in the case of abandoned call and overflow tests. It is used also to check that the auxiliary sender times out within the specified 6-12 seconds on timeout tests.

The cold cathode 313CC type tube TOC normally has +130 volts connected to its anode (terminal 2) and ground through the winding of relay (TOC) (when relay (WOC) operates) is connected to one cathode (terminal 4).

In the case of the five second timeout, operation of any one of relays (WO), (WO1) or (WO2) arranges the timing circuit so that +130 volts through resistor CE, potentiometer DB and resistor CH is connected to the other cathode (terminal 1) of tube TOC. Capacitor CE is then slowly charged to a point where the starter gap voltage between terminals 1 and 4 reaches 69-74 volts. The gas in the tube ionizes to the point where the transfer current between cathode 4 and anode 2 reaches a point sufficient to cause the tube to fire across the main gap and operate relay (TOC).

The fifteen second timeout occurs in a similar manner. The operation of relay (TO) arranges the timing circuit using resistors CD & CH, potentiometer DC and capacitor CD to form the control network.

Resistor CF is bridged across capacitors CD and CE when the circuit is normal to discharge them for the next cycle.

Relay (TOC) operated;

- 1. Grounds lead TO to the subscriber sender test circuit to light lamp TO as an indication of a timeout failure.
- 2. Opens the test circuit advance path bridge of leads AD2 and AD3.

- 9. AUXILIARY SENDER WIPEOUT, TIMEOUT AND OVERFLOW TESTS (FIG. 9)
- 9.1 Call Abandoned After Dialing Eight Digits of a Ten Digit Call

When the sender test circuit is in position to dial the eighth digit of a ten digit call it connects ground to lead "W5" operating relay (WO) which locks to offnormal ground.

Relay (WO) operated;

 (a) Connects ground to lead "AD3" which causes the sender circuit (R2) sequence switch to advance to a dialing completed position after dialing the eighth digit.

(b) Connects ground to lead "WT" to the sender test circuit as an indication that the check of talk selections is to be skipped.

- (c) Opens one of the shunts across leads "R" and "R1".
- (d) Prepares a circuit for operating relay (WOC).

When the sender test circuit completes the check of district and office selections it connects ground to lead "AT" operating relay (WOC) which locks to off-normal ground.

Relay (WOC) operated;

(a) Removes the remaining shunt across leads "R" and "R1" simulating an abandoned call.

(b) Connects ground to lead "AST" to light the (AST) lamp at the sender test frame.

- (c) Starts the 5 second (TOC) tube timer circuit.
- (d) Connects ground to lead "WT2" as an indication that the tip party test is to be skipped.
- (e) Prepares a circuit for advancing the sender test circuit (R4) sequence over lead "AT1".

When the subscriber sender recognizes the abandoned call condition it provides a line release signal (direct or low resistance ground) on its "SC" lead. This causes a relay in the sender test circuit to operate which completes a circuit for connecting ground to lead "AD2". Ground on lead "AD2" through relay (WO) operated, relays (TOC), (TO), (BK4) and (RVT) normal and relay (WOC) operated is returned to the sender test circuit over lead "AT1" to advance the (R4) sequence switch from position 9 to position 17.

Completion of the test is as described in the Circuit Description of the associated sender test circuit. At the end of the test the sender test circuit removes ground from lead "MFC" causing this circuit to restore to normal.

If the subscriber sender fails to recognize the abandoned call indication then when relay (TOC) operates after approximately 5 seconds it opens the circuit for advancing the sender test circuit (R4) sequence switch to position 17, blocking the test.

9.2 Call Abandoned After Dialing Ten Digits But Before Remote Sender Wink

After the sender test circuit has completed dialing all ten digits it connects ground to lead "W5" operating relay (W0) which locks to off-normal ground.

Relay (WO) operated;

(a) Connects ground to lead "WT" to the sender test circuit as an indication that talk selections check is to be skipped.

- (b) Prevents a "wink" signal from being returned to the auxiliary sender when it attempts to make trunk test.
- (c) Opens one of the shunts across leads "R" and "R1".
- (d) Prepares a circuit for operating relay (WOC).

When the sender test circuit completes the check of district and office selections it connects ground to lead "AT" operating relay (WOC) which locks to offnormal ground.

Subsequent operation is as described in paragraph 9.1, "Call abandoned after dialing eight digits of a ten digit call."

9.3 Call Abandoned After Sender Attached Wink But Before MF Outpulsing is Completed

When the (MFK) selector advances to position 7 for checking MF outpulsing of the "A" digit of the office code ground is connected to lead "W3" to the sender test circuit. This ground is returned through the plugged (WO2) jack over lead "W5" to operate relay (WO) which locks to offnormal ground.

Relay (WO) operated;

(a) Opens one of the shunts across leads "R" and "R1".

 (b) Opens the circuit for advancing the sender test circuit (R4) sequence
 switch under control of arc 6 of the (MFK) selector.

(c) Connects ground to lead "WT" to the sender test circuit as an indication that talk selections check is to be skipped.

(d) Closes a circuit for operating relay (WOC) from ground on lead "AT" from the sender test circuit.

Relay (WOC) operated;

(a) Locks to off-normal ground.

(b) Connects ground to lead "AST" to light the (AST) lamp at the sender test frame.

(c) Starts the 5 second (TOC) tube timer circuit.

(d) Connects ground to lead "WT2" as an indication that the tip party test is to be skipped.

(e) Prepares a circuit for advancing the sender test circuit (R4) sequence switch over lead "AT1".

(f) Connects off-normal ground to one side of the biasing winding circuit of relay (TP) to deactivate the pulse timing circuit.

(g) Removes the remaining shunt across leads "R" and "R1" simulating an abandoned call.

When the subscriber sender recognizes the abandoned call condition it provides a line release condition on its "SC" lead. This causes a relay in the sender test circuit to operate which closes a circuit for connecting ground to lead "AD2". Ground on lead "AD2" through relay (WO) operated, relays (TOC), (TO), (BK4) and (RVT) normal and relay (WOC) operated is returned to the sender test circuit over lead "AT1" to advance the (R4) sequence switch to position 17.

Completion of the test is as described in the Circuit Description of the associated sender test circuit. At the end of the test the sender test circuit removes ground from lead "MFC" causing this circuit to restore to normal.

If MF outpulsing continues after ground has been connected to lead "AD2", then when relay (G) operates indicating the presence of an MF pulse, it closes a circuit to operate relay (BK4). Relay (BK4) opens the circuit for advancing the sender test circuit (R4) sequence switch blocking the test and connects ground to lead "FP" lighting the (FP) lamp at the sender test frame.

9.4 Auxiliary Sender Timeout After Dialing Nine Digits of a Ten Digit Call

When the sender test circuit is in position to dial the ninth digit of a ten digit call it connects ground to lead "W6" operating relay (TO1) which locks to offnormal ground.

Relay (TO1) operated;

 (a) Connects ground to lead "AD3" which causes the sender test circuit to advance to a dialing completed position after dialing the ninth digit.

(b) Prepares a circuit for advancing the sender test circuit (R4) sequence switch.

(c) Closes a circuit for operating relay
 (WOC).

Relay (WOC) operated;

(a) Locks to off-normal ground.

(b) Connects ground to lead "AST" to light the (AST) lamp at the sender test frame.

(c) Starts the 5 second (TOC) tube timer circuit.

(d) Connects ground to lead "WT2" which will cause the tip party test feature and, if provided, the toll diversion test feature to be skipped.

The auxiliary sender is timing for 6-12 seconds waiting for the tenth (Units) digit to be dialed. At the end of this interval the auxiliary sender functions to set the call to overflow by providing the subscriber sender with a dialing completed signal and a reversed battery condition over the fundamental circuit. As the subscriber sender functions to set the call to overflow it provides a district advance indication on its "SC" lead. This causes a relay in the sender test circuit to release which in turn connects ground to lead "SC1". Ground on lead "SC1" through relays (TO1) and (TOC) operated, relays (BK4) and (RVT) normal and relay (WOC) operated is returned to the sender test circuit over lead "AT1" to advance the (R4) sequence switch to position 17.

Completion of the test is as described in the Circuit Description of the associated sender test circuit. At the end of the test the sender test circuit removes ground from lead "MFC" causing this circuit to restore to normal.

If the subscriber sender provides a district advance indication on its "SC" lead before the 5 second (TOC) tube timer circuit operates, then when the sender test circuit connects ground to lead "SCl", it will operate relay (EK4). This will open the circuit for advancing the sender test circuit (R4) sequence switch blocking the test.

9.5 Auxiliary Sender Timeout After Dialing Ten Digits

After the sender test circuit has completed dialing it connects ground to lead "W6" operating relay (TO1) which locks to off-normal ground.

Relay (TO1) operated;

- (a) Prevents a "wink" signal from being returned to the auxiliary sender when it attempts to make trunk test.
- (b) Closes a circuit for operating relay (WOC).

Subsequent operation is as described in paragraph 9.4, "Auxiliary sender timeout after dialing nine digits of a ten digit call."

9.6 Reversed Trunk Test

After the sender test circuit has completed dialing it connects ground to lead "W7" operating relay (RVT) which locks to off-normal ground.

Relay (RVT) operated;

 (a) Arranges the circuit to provide a reversed battery indication when the auxiliary sender attempts trunk test.

- (b) Opens a circuit which prevents the (TOC) tube timer from being activated.
- (c) Connects ground to lead "AT1" for advancing the sender test circuit (R4) sequence switch from position 9 to position 17.
- (d) Prepares a circuit for operating relay (WOC)

When the sender test circuit completes the check of district and office selections it connects ground to lead "AT" operating relay (WOC) which locks to off-normal ground.

- Relay (WOC) operated;
  - (a) Connects ground to lead "AST" to light the (AST) lamp at the sender test frame.

(b) Connects ground to lead "WT2" causing the tip party test feature to be skipped.

(c) Removes a shunt across leads "LD" and "LD1". For some test circuits this is necessary in order to introduce a timing interval controlled by an inter rupter when the sender test circuit (R4) sequence switch is advanced to position 17.

Completion of the test is as described in the Circuit Description of the associated sender test circuit. At the end of the test the sender test circuit removes ground from lead "MFC" causing this circuit to restore to normal.

SECTION VI - REASONS FOR REISSUE

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 Provision is made to test for a start pulse signal consisting of 900 and 1700 cycle frequencies instead of 1500 and 1700 cycles on test calls where a prefix "zero" digit is dialed.

Provision is made to work with Sender -A.2 Test circuits arranged to dial any digit as the "B" (second) digit of an area code. At present the Sender Test circuit can dial only the digits "zero" or "one" as the "B" digit of an area code.

в. CHANGES IN APPARATUS

B.1 Added

> "ZF" Option (SPC) U421 Relay

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B.2 When the associated Sender Test Circuit is equipped with rotary type switches to provide for dialing area codes that use any digit 0-9 for the "B" digit.

B.3 Superseded

> Fig. 1 (AO), (A1), (A7), (CO), (C4) & (C7) (A2), (A4), (C1), (C2), U-236 Relays U-624 Relays

(BO) & (B1)

B.4 Superseded By

Fig. 11 - (Wiring option)

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 The (SPC) relay, "ZF" option is added to Fig. 3. This provides for check-ing for a 900 and 1700 cycle start pulse signal on test calls where a prefix "zero" digit has been dialed.

D.2 Fig. 11 is added and replaces Fig. 1 to show wiring required when the associated Sender Test Circuit uses rotary circuit selector type switches for controlling the dialing of area code digits.

D.3 Fig. 11 and option "ZF" are added to the Feature or Option table, "Record of Figures" table and the "Options Used" table.

Cabling diagrams CAD6 and CAD7 are added. Changes are made in CAD2 to D.4 agree with the added cabling diagrams.

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