82

CROSSBAR SYSTEMS
NO. 1
SUBSCRIBER SENDER

CHANGES

B. Changes in Apparatus

B.1 Added

OPR Diode 446F, Fig. 17, Option KJ

D. Description of Changes

Sheet 0101

D.1 In Fig. 1, lead 11 from Fig. AU and AV is removed from contact 3B of the FO3 relay. Contact 3B is now connected to lead 15 from Fig. 2. This change brings this circuit into agreement with manufacturing drawings on a "D" no-record basis.

Sheet 0105

D.2 In Fig. AU, leads 11 and 12 are added which loop through to the contacts of relay NT3 of Fig. AX in order to complete the locking path for the AV2 relay when either Fig. AV or AU is provided.

Sheet 0106

D.3 In Fig. AX connecting information to Fig. AU is added.

Sheet 0108

D.4 In Fig. 12 leads 1 and 2 which connect to the diode OPR in Fig. 17 are added. Lead 9 is changed to connect to the proper terminal of diode OPR so as to prevent the false ground from appearing on lead 1 and thence operating the INF relay in the auxiliary sender by way of the DC lead.

Sheet 0120A

D.5 In the Circuit Requirements Table the data for diode OPR is added.

Sheet 0122

D.6 The OPR diode is added to Fig. 17 as part of KJ wiring option to provide the false ground isolation required for INF relay in the auxiliary sender.

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DEPT 5243-ABVL

WE DEPT 367-AFW-EER-JNC

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CROSSBAR SYSTEMS
NO. 1
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CHANGES

A. Changed and Added Functions

A.1 Reorder tone is provided as a standard for partial dial calls in senders with timed release. No such number tone is rated Mfr Disc. for this application.

A.2 The sender is modified for prefix identification of NO/1X ten-digit calls when the NO/1X codes are also used for office codes. The use of a 0 or 1 prefix denotes a ten-digit call and the use of no prefix denotes a seven-digit call.

B. Changes in Apparatus

B.1 Added

5L Diode - 446F - Fig. 7, Option NR

D. Description of Changes

Sheet 0101

D.01 In Fig. 1 add lead 3 from Fig. BG, V, or W under option NK.

Sheet 0103

D.02 In Fig. U change designation of leads 1A, 2A from Fig. 22 to leads 1, 2 respectively.

Sheet 0104

D.03 In Fig. A add lead OF to the interrupter frame circuit under option NH.

D.04 In Fig. BG and W add leads 3, 5 from Fig. 1 under option NK.

Sheet 0106

D.05 In Fig. AX add lead CK1 from Fig. 7.

Sheet 0107

D.06 In Fig. H add option NG to lead A from signal circuit no such number tone supply.

Sheet 0108

D.07 In Fig. 7 add lead CK1 and diode 5L from Fig. AW and AX under option NR. Also add lead 5L to transverter connector circuit and a ground to contact 7 top of the DPT relay under option NR.

D.08 In Fig. 7 add cross-connection terminal PC3 and lead 5 to Fig. BG or W under option NK.

D.09 In Fig. 7 add cross-connection terminals PC2 and PC1 under option NM.

D.10 In Fig. 7 add leads 4, 5, 6, and 7 from Fig. 16 under option NQ.

Sheet 0109A

D.11 In Circuit Note 107 add options NG, NH, NK, NL, NM, NN, NO, NP, NQ, and NR.

Sheet 0109D

D.12 In Circuit Note 109 add modified paragraphs 55, 56, and 60.

Sheet 0112

D.13 In Circuit Requirement Table add data for diode 5L.

Sheet 0114

D.14 In Fig. AK and HK add option NG.

D.15 In Fig. AK add OF leads from office interrupter frame and for multiple under option NH.

Sheet 0116

D.16 In Fig. 51, for miscellaneous terminal strip on sender frame, add option NG. Also add OF leads from office interrupter frame and for multiple under option NH.

D.17 In Fig. 51, for SB terminal strip on sender unit, add lead from terminal 8 to contact 6T of the DPT relay under option NR.

Sheet 0117

D.18 In CAD Fig. 61 add NM wiring to terminal 00, and NO wiring to terminal 01. Also add option NN.

Sheet 0118

D.19 In lead index add the OF lead to the interrupter frame circuit and the 5L lead to the TV connector circuit.

Sheet 0119

D.20 In Circuit Note 109 add paragraph 71.

D.21 Add Circuit Notes 167-171.

D.22 Add locations for options NG, NH, NK, NL, NM, NN, NO, NP, NQ, and NR.

Sheet 0121

D.23 In Fig. 16 add leads 4, 5, 6, and 7 from Fig. 7 under option NQ. Also add optional wiring NO and NN.

D.24 In Fig. 16 change the value of the ZO' resistor, 18BH, to 1000W.

Sheet 0125

D.25 Add CAD Fig. 64 and sheet Notes 1 and 2.

Sheet 0126

D.26 In Fig. 20 add looping symbols M at contacts EBM3 of the EDT relay.

Sheet 0127

D.27 In Fig. 22 correct bracketing of CN lead to Fig. 3. Also change designation of lead 2A to lead 2.

F. Changes in CD Section II

F.01 In 5.20, change the second sentence to read:

. . . Relay ET1 operated:

(a) cuts off dial tone to the calling customer,

(b) releases relay ET,

(c) grounds leads CC1 and PD1 to the marker as part of the extended toll signal, and

(d) controls sender recycle seizures (option NO) and auxiliary sender seizures (option NO or NQ). See 29. PREFIX IDENTIFICATION OF A TEN-DIGIT CALL.

F.02 Add the following to 5. DIAL REGISTRATION AND SWITCHHOOK CONTROL.

5.64 When options NK and NM are provided, a normal SD relay on marker release will initiate an auxiliary sender seizure. See 29. PREFIX IDENTIFICATION OF A TEN-DIGIT CALL.

F.03 Add the following new paragraph:

7.50 When options NK and NM are provided, a normal SD relay on marker release will initiate an auxiliary sender seizure. See 29. PREFIX IDENTIFICATION OF A TEN-DIGIT CALL.

F.04 Change numbering of former paragraphs 7.50 through 7.62 to 7.51 through 7.63.

F.05 Change the first sentence of 16.20 to read:

16.20 If TN operates, because dialing up to stations is not completed in the time allowed, it sends a distinctive tone - reorder, option NH, or no such number tone, option NG, Mfr Disc.

F.06 Add the following new paragraph:

21.03 When prefix identification of a ten-digit call is provided (see 29.), the sender requires a 0 or 1 prefix in addition to the conditions of 21.02, to operate the AS relay. Also the AS relay is operated by marker action when options NK and NM are provided.

F.07 Change the numbering of former paragraphs 21.03 through 21.13 to 21.04 through 21.14.

F.08 Add the following to 23. SIX-DIGIT TRANSLATION (SENDER RECYCLE).

23.06 When prefix identification of a 10-digit call is provided with sender recycle, a "1" prefix is required on all code compressed calls to initiate seizure of the sender recycle circuit. See 29.

F.09 Add the following new paragraph:

29. PREFIX IDENTIFICATION OF A TEN-DIGIT CALL

29.01 This feature is provided as an alternate to the interchangeable code feature. The sender is modified to require a 0 or 1 prefix in addition to the NO/1X code to initiate seizure of an auxiliary sender for a 10-digit call. Also the auxiliary sender seizures may be controlled exclusively by marker action.

29.02 Sender control is preferable since auxiliary sender seizure is not dependent on marker release as with marker control and therefore is less apt to block on delays in marker or auxiliary sender seizures. Marker control is required where unused NO/1X codes are used as office codes prior to the introduction of prefix identification; and in offices which serve two areas, one of which has not implemented the prefix identification feature. The ET1 make-contact is strapped during the application of marker control.

29.03 With options NM and NQ (no sender recycle) or NM and NO (with sender recycle) a cross-connection is required from PC1 to PC2 to implement sender control. Ground from a 0 or 1 in the B register, via DRL normal and either an operated AO (0 prefix) or an operated ET1 (1 prefix), X-connection PC2 to PC1, and normal DPT, SA, and AS relays operates relay AS when DST relay operates. When sender recycle is provided, the ground from the operate ET1 relay seizes the sender recycle circuit and, if the code is not compressed the ground is returned to the sender via the AS lead to the X-connection PC2 - PC1.

29.04 With option NL instead of option NM the X-connection PC1 to PC2 is replaced by direct wiring. Otherwise the circuit functions as described in 29.02.

29.05 With options NK and NM a cross-connection is required from PC3 to PC2 to implement marker control of the AS relay. Ground from an operated DRL, normal SD, DPT, SA, and AS relays operates the AS relay when the marker releases.

29.06 In LAMA offices, similar to the interchangeable code feature, the transverter must be signaled by ground on the 5L lead to initiate a 5 line entry. This is accomplished by contacts of the DPT relay which only operates on 10-digit non-compressed code call. Upcheck is provided by connection of the 5L lead to the CK1 lead via a diode to prevent feedback.

F.10 Change the first sentence of 3.52 to read:

3.52 If a partial dial is registered in a sender arranged for timed release, to send a reorder or no such number (Mfr Disc.) tone to the customer and operate a common partial dial register. . . .

F.11 Add the following to 3. FUNCTIONS:

3.93 To require a 0 or 1 prefix in addition to an NO/1X code to identify a 10-digit call by means of sender or marker control of auxiliary sender seizures.

3.94 To require a "1" prefix on all code compressed calls to enable seizure of the sender recycle circuit.

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DEPT 5143-ABVL

WECo DEPT 367-KGC-JBK-JF

CROSSBAR SYSTEMS
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CHANGES

D. Description of Changes

D.1 Wiring options MA and MB are added in Fig. AW and AX on sheet 2.

D.2 In Fig. 22, sheet 27, minor wiring changes are made at the CA1 relay.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5615-JAH-RBC-AB

CROSSBAR SYSTEMS
NO. 1
SUBSCRIBER SENDER

CHANGES

B. Changes in Apparatus

B.1 Added

LR Diode - 446F - Fig. 3, Option MI

D. Description of Changes

D.1 On sheet 2, in Fig. 2, IM wiring is added to the TG2 relay lock path.

D.2 On sheet 3, in Fig. U and 3 options ME, MF, MG, and MD are added to provide for a single dial-tone-first class of service.

(a) Notes 107 and 109 are changed to reflect the above change.

D.3 Note 164 is changed to accommodate the addition of dial-tone-first to timed release senders equipped for coin.

D.4 Options MH and MI are added to prevent possible stuck sender conditions due to a sneak path which allows the AV3 relay to lock falsely on MF calls.

(a) The LR diode option MI and wiring option MH are added in Fig. 3, sheet 3. Note 166 is added and Note 107 is changed to reflect the above change.

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DEPT 5615-JAH-RBC-JR

CROSSBAR SYSTEMS
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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit is for use in a crossbar office.

1.02 Mfr Disc:

(a) This sender may be arranged to function with 3-digit office codes only, with both 3-digit and 2-digit office codes, or with 2-digit office codes only.

(b) This sender may be arranged to function with 3-digit office codes only.

1.03 The sender may be arranged with coin features provided either by Fig. E or Fig. AL or Fig. 22. Fig. E and AL arrange the sender to either make coin test or to cancel it depending upon the class of service of the calling line. Fig. 22 provides the dial-tone-first feature as part of the coin service improvement program. It arranges the sender to either make or cancel coin test depending upon the class of service of the calling line and the code dialed.

1.04 This sender may be arranged for use with or without 2-party message rate service.

2. GENERAL DESCRIPTION OF OPERATION

2.01 When a sender is seized by a sender link and control circuit to serve on a call, it immediately registers the class of service of the calling line and the number of the district frame involved, by an indication from the link control circuit over the CS and F leads and, if a 2-party message rate line, which party is calling, the tip party connecting an indicative ground on the T and R leads. It then sends dial tone to the customer and registers all the digits dialed, using the T and R leads. When all of the office code is registered, the sender connects to a marker, sends it the office code, class of service, district frame and party line information, and receives the information required for completing its part in the selection of the called station.

2.02 When the marker has established a connection through the district and office frames, it notifies the sender, and the sender proceeds. The sender first directs the distant office selections over the FT and FR leads, if there are any to be made, and then tests the outgoing trunk to make sure it is normal at the distant end. If the call is an operator class, the sender has finished its selection and releases from the sender link. If the call is of a full selector class, the sender directs the selection of the incoming and final selectors, terminating or tandem sender, and notes the advance of the incoming selector or sender upon the completion of final selections, all over the FT and FR leads, and then releases from the sender link. If the call is a CI class, the sender waits until the trunk is assigned at the distant end, then sends CI pulses over the FT and FR leads for the called station, or office code and station for a tandem call, and then releases from the sender link.

2.03 If a panel selector or a crossbar terminating or tandem sender runs to telltale or overflow, the sender calls in a marker and notifies it to try again, using the alternate route if there is one.

2.04 If the calling customer abandons the call before the sender has finished, the sender first notifies the district junctor to release the calling line at once, then it takes any steps necessary to clear out distant selectors and a CI attendant, which may have been engaged, and releases from the sender link.

2.05 A timing circuit in the sender initiates the proper disposition of the call and the release of the sender if the customer fails to dial or dials an insufficient number of digits, or if the connection fails to complete because of a trouble condition.

2.06 A coin test circuit in the sender makes a preliminary coin test when dialing has been completed, if a deposit is required, and calls a sender monitor if no coin is found (Fig. E) or reseizes a marker to have the call routed to a coin announcement (Fig. 22).

2.07 With two-party service the party is identified before dial tone and after dialing.

SECTION II - DETAILED DESCRIPTION

1. TRANSIENT CONNECTIONS TO OTHER CIRCUITS

1.01 Ten senders mounted on two frames constitute a subgroup and all the senders in a number of such subgroups of ten are used in common as a large group to function with a number of subscriber lines and associated line links, district junctors, district links and subscriber sender links. The total number of senders which can be used in one large group is limited by the fact that they are arranged to function with a maximum of 20 district frames and a maximum of 24 classes of service. Two large groups of senders may make common use of the one group of markers, to which the senders are connected by marker connectors.

1.02 Each subgroup of 10 senders is connected to the sender link and control circuit by 26 leads, which are connected to any one individual sender for a short time when it is first seized for service. These are the GS, SL, ON, and RL leads which assist the link control circuit in its functions, 12 F leads for registering the number of the district frame in the sender, and 10 CS leads for registering the class of service of the calling line.

1.03 Each sender is individually connected to the sender link and control circuit by 12 leads. Of these, SB and SC assist the link control circuit in its functions: T, R, FT, FR, S, DC, TR, and LR are patched through to the district junctor by the link circuit; AS and BS are joined in the link control circuit when the sender is busy and serve to connect the GS lead to a contact of relay SR1.

(a) The T and R leads (tip and ring) are extended to the calling station and are used principally for transmitting tones and dial pulses, for switchhook supervision, for making preliminary coin test, for making 2-party message rate test, and for conversation with the sender monitor.

(b) The FT and FR (fundamental tip and ring) leads are extended out toward the called station, and are used principally for transmitting revertive pulses for full selector calls and CI pulses for calls through tandem or to manual offices.

(c) The S (sleeve) lead is used to hold the sender link switches and other switches while the sender is connected to a district junctor.

(d) The DC (district control) lead is used for mutual control between the marker, sender, and district junctor and transverter.

(e) The TR (trouble release) lead is used to send a trouble release signal from marker to sender by way of the district, and also to send an order from the sender for the district to cut through.

(f) The LR (line release) lead is used to hold certain class relays in the district and to send an order from the sender for the district to drop off the calling line at once.

1.04 The sender is connected through the marker connector to a marker for a fraction of a second on each call and, occasionally, two or three times on a call. About 60 leads are involved in this connection, for mutual control and for transmitting information both ways between sender and marker.

1.05 The sender is connected to the transverter and recorder, by approximately 90 leads when trunk test or dialing is complete and until recording is complete for all LAMA calls.

1.06 The sender is connected to an auxiliary sender by means of an auxiliary sender link circuit and it connects 12 leads between the two sender circuits used for pulsing and control.

2. PRINCIPAL PARTS OF SENDER AND OPTIONAL FEATURES

2.01 The elements of this sender may be roughly divided, in respect to their functions, into nine principal parts. Each of the following subsections gives a brief general statement of the functions of one of these principal parts. Any of its features that are optional may vary between different equipment.

A. Control Circuit

2.02 This circuit controls the connections between the sender and the "sender link and control" circuit, the connections between the sender and the marker, and it registers the party calling from a two-party message rate line. It consists of the following relays: sender control (SC1) and (SC2), and (SC3) if used; off-normal (ON1), (ON2), (ON3), and (ON4); make-busy (MB); district control (DC); advance (AV1), (AV2), (AV3), and (AV4); check (CK); marker start (DST); marker release (DRL); trouble release (TR1), (TR2), (TR3), and (TR4); two-party (TP), (TP1), (TP2) and (TPT); and two-party timing (TPT). Fig. G and all of these relays are furnished is the 2-party test is required; otherwise Fig. F is furnished and some of the relays are omitted. Accounting start (AST) and release (ARL) relays are also furnished with LAMA.

B. Dial Pulse and Switchhook Control Circuit

2.03 This circuit receives and counts the dial pulses of each digit and maintains switchhook supervision at all times except while a coin test is being made or the sender monitor is plugged into the talking jack. It consists of the following relays: line (L), (L1), (L2), (L3), (L4), and (L5); slow release SR and (SR1); pulse (P1), (P2), (P3), (P4), (P5) and (P6); and line release (LR). The one-one (11A), (11B), and (11C) relays register the "one-one" code prefix (Mfr Disc). The AO, AO1, ZO', ET, ET1, ET2, PTP, and STM control and store the preliminary digits and, with AOB and ET3, control and store the prefix code digits.

C. Dial Register

2.04 This registers all the digits dialed, consisting of three office code digits, four numerical digits, and a station digit at the most. It also registers the number of district frames involved, and the relays which register the class of service of the calling line may be included in this part of the sender. Beside the crossbar switch, which registers the dialed digits and the units digit of the district frame number, there are relays to register the class of service and the tens digit of the district frame number, relays to progress through the digits in dialing, and other relays to progress through the digits in sending CI pulses. The crossbar switch has ten verticals, designated F for the frame, A and AA for the first digit, and B, C, TH, H, T, U, and ST for the other digits. The full complement of relays consists of the following: district frame (FOO) and (F10); class of service (CSO), (CS1), (CS2), (CS3), (CS4), (CS5), (CS6), (CS7), (CS8), and (CS9); select magnet (SM1), (SM2) and (SM3); register advance (RA), (RA1), (RA2), (RA3), (RA4) and (RA5); dial lock (CL), (HL) and (STL); 2-digit (TD); CI progress (A), (A'), (B), (B'), (C), (C'), (STA), (STA'), (TH), (TH'), (H), (H'), (T), (T'), (U), (U'), (STB), and (STB'). The 7N, 7N', 10N, 1B, 1C, EDT, INF, INF1, and 10DG relays determine 7-digit, 10-digit, and 411 information calls.

2.05 The ten CS relays are furnished only as specified for each equipment. Any one of the first three may be used for coin classes; any of the second three for 2-party message rate classes, and any of the whole ten for other classes or combinations. If there are two large groups of senders serving different classes of service, permanent connections are made in each sender to lead D8 to discriminate between the different groups. The CS6 and CS8 relays are furnished in conjunction with the first three CS- relays when a combination of coin and other classes (not two-party) are required. When used for this purpose the CN relay (Fig. 22) will operate through contacts of the CSO-2, CS6, and CS8 relays only for those combinations assigned as DEF classes. The CS7 and CS9 relays are furnished in conjunction with the second three CS- relays when a combination of 2-party and other classes (not coin) are required. They may also supplement the number of classes in each group.

2.06 Relay TD (Mfr Disc) is furnished if the sender is to register both 3- and 2-digit office codes.

2.07 Usually the sender will be arranged to send all office codes to tandem as 3-digit codes, interpolating a zero between the actual digits of a 2-digit code (Mfr Disc). In the exceptional case where the tandem office is on a 2-digit basis, relays B and B' are omitted.

2.08 If 10,000 to 10,499 is the range of 5-digit numbers in manual offices to be dialed, B wiring is used. If 10,000 to 10,999 is the range, A wiring is used. Mfr Disc, KP option.

2.09 If no more than ten district frames are required, relays FOO and F10 may be omitted.

D. Selection Register

2.10 This is set up by the marker to record the class of call, the compensating resistances required, the distant office selections, if any, and other details of the routing which the sender requires to establish a connection to the called station. The full complement of relays consists of the following: class of call (CL1), (CL2), (CL3) and (CL4); compensating resistance (CR1), (CR2), (CR3), (CR4), and (CR5); office brush and group selection and skip office (OB1), (OB2), (OB4), (OB5), (OG1), (OG2), (OG4), (OG5), (SO); distant office (TW); and station delay (SD) and (SD1).

E. Fundamental Circuit and CTG Relays

2.11 This consists of the following relays which are either cut into the fundamental to recognize pulses and direct or reverse battery from the distant end of trunks, or are supplementary to such relays: stepper (STP); trunk guard and marginal trunk guard (TG), (TG1), (TG2), and (MTG); and overflow (OF), (OF1) and (OF2).

2.12 Counting relays are operated and locked up in successive pairs by the pulsing of relay STP, which is energized by the revertive pulses generated by distant panel selectors or crossbar tandem or terminating sender. The number of pairs to be operated is determined by the number of pulses required for the particular selection being made. The relays consist of counting relays 0, B0, F0, 1, 1', 2, 2', 3, 3', 4, 4', 5, 5', 6, 6', and the released counter (RC) relay which assists in the use of the counting relays for a second time on a selection requiring more than six pulses.

F. Selection Sequence Circuit

2.13 This makes the proper internal connections in the sender in a definite order as the sender progresses through its successive selections and trunk test, in building up a connection to the called office, and in a full selector call, to the called station. The full complement of relays consists of the following: selection (S1), (S1'), (S2), (S2'), (S3), (S3'), (S4), (S4'), (S5), (S5'), (S6), (S6'); full selector (FS1), (FS2), (FS3); incoming advance (IA); and (FO1), (FO2) and (FO3) which are generally supplementary to the counting relay (FO) and provide the required time between selections.

G. Accounting Charge

2.14 The AST relay summons the transverter connector for LAMA recording. Two out of five index relays (M10, 1, 2, 4, and 7) provide an index. The two-line (2L) relay provides a record for bulk billing and the ARL relay is operated from the transverter on the TR relay if recording fails on an M19 call.

Calling Line Register Circuit

2.15 The calling line register circuit registers and stores the equipment number of the calling line. This information is later passed on to the transverter for selection of the translator and for translation to directory number. The relays include the column hundreds (CHO), (CH1), (CH2), (CH4), and (CH7) and similarly designated relays for column tens (CT-), column units (CU-), switch (SW-), and vertical file (VF-). These 25 relays register the information in a 2-out-of-5 pattern while the class of service is being registered.

H. Call Indicator

2.16 The CI circuit generates alternative positive and negative CI pulses, and makes the necessary internal connection for transmitting them. It consists of the following relays: call indicator (CI1) and (CI2); pulse generating (PG), (PG1), (PG2), and (PG3); start pulse (SP); final pulse (FP); grounding (GR); pulse tip (PT); pulse ring (PR); and relays 12 and 34 which supplement the contracts of the dial register in modifying pulses. Relay FP is always furnished, but its winding is connected only in territories where a final heavy positive pulse is required to complete CI pulsing. See Circuit Note 108. Whether or not this is required depends upon the equipment at the call indicator offices. The CL5 and one-one B (11B) relays are furnished to send CI pulses in two stages.

I. Timing, Coin Test, and Monitoring Circuits

2.17 The timing circuit measures off maximum allowed times for the calling customer to start dialing, to finish dialing, except for a stations digit, and for the sender to release after that. If these times are exceeded, the timing circuit takes proper action to dispose of the call. If a timed release feature is employed whereby the calling customer is notified by a tone to hang up, and if he fails to do so, the sender is automatically released and Fig. A is furnished. Fig. B is furnished if a sender monitor is employed to request the calling customer h ng up and, if this fails, to release the sender manually. The timing circuit relays are listed in 16.01.

2.18 Independent of the timing circuit proper, which is actuated by an external interrupter, another external interrupter is used to measure off on some of the CI progress relays, a maximum allowed time for the calling customer to dial a station digit after he has dialed a units digit, where the dialing of a station digit is probable, or for coin test.

2.19 A timing circuit is also provided to give an indication of anuundue interval between dial pulls or for completion after dialing.

2.20 The coin test circuit (Fig. AL or Fig. E) is used where postpayment coin lines are to be served. It is used with both sender monitor and timed release. It tests for the presence of a coin in the box, and also for the presence of a false ground applied with intent to cheat the box. When coin test and monitoring are required Fig. E is furnished. When Fig. E is furnished the station delay interrupter is used to measure, on some of the CI progress relays, an interval in which the coin test may be made. When coin test and timed release are required, Fig. AL is furnished. When Fig. AL is furnished, the interval in which the coin test is made is part of the interval allowed for stations delay. The coin test relays are listed in 6.01 through 6.04.

2.21 If the sender is noncoin with monitoring, Fig. D is used for the monitoring circuit; if it is noncoin with timed release, Fig. C takes the place of a monitoring circuit.

J. Dial-Tone-First Operation

2.22 The sender recognizes calls from dial-tone-first coin stations by the class of service of the calling line. After receiving the appropriate number of digits the sender passes the dialed code and the dial-tone-first class of service to the marker. The marker will determine whether the call requires an initial deposit and, if it does not, will inform the sender through the marker connector that a coin test is not required. If the call requires an initial deposit the marker will not send a cancel-coin-test indication to the sender and, after dialing is complete, the sender will make a test for the presence of an initial deposit. If the coin is present the coin test will pass and the call will proceed normally. If a coin deposit has not been made the sender will fail coin test and will second trial to the marker to have the call routed to a coin announcement trunk.

3. SEIZURE, HOLDING, AND RELEASE OF SENDER

GENERAL

3.01 This section described how a sender is seized by a sender link for service or by a sender test circuit for test; how it is held busy when in service or under test; how it is made busy when in trouble; how it is released after functioning; and how the calling line is released before the sender if the call is abandoned. It also describes how a 2-party message rate line is tested and a record made of the particular party calling, with the precautions taken against a false record.

DETAILED DESCRIPTION

A. Sender Seized and Held for a Service Connection

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

3.03 When a line calls, the sender link control circuit chooses an idle sender and grounds its individual SC lead to operate its SC- relays. These relays connect not more than 26 common leads or 52 leads with LAMA from the link control circuit to this particular sender. Not more than 22 of these leads are used to register in the sender the class of service of the calling line and the number of the district frame involved (see Part 4.).

For LAMA service, 26 leads are used for registering the calling line number on register relays of the calling line register and the line observing signal. The four remaining leads, SL, ON, GS, and RL, are used for control purposes between the link control circuit and the sender.

3.04 After grounding the SC lead, as shown above, the link control circuit proceeds to operate the line link and sender link switches to connect the line to the district, and to connect the district to the sender over eight individual leads. Of these eight leads, T and R extend to the calling line, FT and FR will be later extended toward the called line. DC, TR, and LR are used in the control of the district, and S is used to hold the line link, sender link, district, and office switches while the sender remains engaged.

3.05 When the line link switches have operated, a ground is passed through the link control circuit to the ON lead, and that operates relay ON1 when the class of service and frame indications have been properly registered, as indicated by the normal relay CK and the operated RA4. If there is any trouble in this registration, ON1 cannot operate, there can be no further operations in the sender, it will fail to release the link control circuit, and that circuit will time out and pick another sender. Unless ON4 is used, the link may leave the sender off-normal and unguarded if any sender relays are stuck up. With CU option ON4 operates, following SC2, a select magnet and SM1, locking to G2 lead, and grounding G1 lead to start the timing. It also provides ground for the hold magnets SM- and RA- relays. With CT option and SM resistance, prevents overheating of the SM2 relay if the sender relays and magnets are locked through the 65-ohm winding to ground on 1 of AA.

(a) When ON1 operates it grounds three off-normal ground leads, one of which ground the timing circuit and energizes the tertiary biasing winding of relay L, and the other grounds lead ON to the converter circuit to prepare it for any pushbutton signals that may be keyed. The operation of the ON4 relay also energizes the tertiary biasing winding of relay L. When sender recycle and Fig. 16 are furnished, relay ON1 (option CT) or relay ON4 (option CU, FU) operated, operate relay RCY which in turn closes a ground to leads LA and CC7 to the marker.

(b) Relay ON1 grounds an individual SB lead to the link control circuit, operating a relay which is individual to the sender and marks the sender as busy to other links and test circuits, and it connects the individual AS and BS leads as a check on its operation.

(c) Relay ON1 also closes the T and R leads into the sender. If Fig. F is used because there are no 2-party message rate or 2-party LAMA lines, this will cause L to operate over the T and R leads, through the substation and the tone repeating coil (TN) to ground. If Fig. G is used because there are 2-party message rate lines, L will not operate until ON3 operates as well as ON1, to connect tone and L to the T and R leads. ON3 operates either very early or somewhat later, according to the class of service calling, as described for the 2-party test in 3.25 through 3.33.

(d) Relay ON1 also starts 2-party timing (TPT) relay if a 2-party message rate or 2-party LAMA line is calling, as described in 3.25 through 3.33.

(e) Relay ON1 also causes the CN relay (Fig. 22) to operate if a dial-tone-first class of service has been registered on the CS- relays.

3.06 When the sender link switches have operated, a ground is passed to the S lead. This goes back over the SL lead to the link controller circuit, causing the latter to make a double-connection test and to ground the GS lead. When L operates, as described above, it operates L1 and SR, and the latter operates SR1. The GS lead grounded, lead AS and BS joined in the link control, and SR1 operated, cause ON2 to operate.

(a) When ON2 operates, it connects ground to the RL and S leads. Lead RL gives a release signal to the link control circuit, and lead S holds the switches after the link controller circuit has disconnected. ON2 also closes a circuit which locks up both ON1 and itself when the release of the link control circuit and SC1 has broken the ON and GS leads which operated them. ON2 also closes a circuit through a back contact of SR to the winding of LR, so that the latter will operate to register an abandoned call if SR releases before the completion of a call, after having once operated.

3.07 Relay SC1 is released, and releases the SC4 relay, if used, to break the connection of the common leads into the sender when the sender link controller recognizes ground on the RL lead from the sender as a release signal and then removes ground from the SC lead. Relays SC2 and SC3 were released by the operation of the F hold magnet, as described in 4.05 and 4.06.

3.08 If the customer hangs up when the seizure of the sender has progressed far enough to operate ON1 but not ON2, the link control circuit times out and releases without giving an alarm because it receives a false start signal from the sender, consisting of ground through the back contact of SR1 and through leads BS, AS, and GS in series.

3.09 Whenever the sender is seized and is held busy either for service or maintenance, the SB lead will have ground on it when it is off-normal or plugged busy. This sender-busy indication is extended to the traffic usage recorder over lead SB, HQ option. A second lead SBM, HQ option, is provided and is grounded for indicating to the traffic usage recorder whenever the sender is busy for maintenance purposes. However, in the latter lead application it is not practical to provide it in addition to a plugged-busy indication stuck sender or routing test indications. Therefore, a subtraction of the plugged-busy indications from the total-busy indications would give the total service holding time only if there were no stuck sender and test indications during the scanning period.

B. Sender Seized and Held for Test

3.10 All the individual and common leads from the sender and the subgroup of ten senders, which connect to the sender link and controller circuit, also connect to the sender test circuit, except the individual leads SB, SC, AS, and BS.

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

3.12 If the sender is engaged on a call or is stuck on a call, the S lead is grounded by the ON2 relay. If the sender is made busy, the S lead is connected to resistance battery by the MB relay.

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

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

C. Sender Released After Service or Test

3.15 When the sender has established a connection or completed the desired test, or when it has made all possible attempts to do so, the AV1 relay is operated by some means depending upon the conditions, and it locks to an off-normal ground and operates AV2, which releases AV3 which has been operated to an off-normal ground.

3.16 With LAMA, if the marker has signaled a charge call by operating two index relays, the transverter connector is summoned, after recording the ARL relay is operated, operating the AV2 relay or AV1 after selections are completed. Final units selection is delayed for recording.

3.17 Relay AV1 connects ground to the TR lead, provided LR has not operated on an abandoned call, and operates a relay in the district junctor to cut it through for talking and to provide for the future holding of the line, district, and office switches. AV2 closes a 500-ohm resistance across the FT and FR leads, to furnish a trunk closure when it is required, as in an abandoned call through a distant office selector. The slow release of AV3 allows time for the district to function and for the trunk closure. AV1 also breaks ground from the contacts of L, to release SR so that it will have time to release before the sender is seized for another call. AV1 also breaks the circuit of the F hold magnet, and all the hold magnets release in cascade. AV1 breaks the operating path to the AA hold magnets to prevent its false reoperation.

3.18 The release of AV3 with AV1 operated, operates AV4. AV4 breaks the T and R leads so that the current in them shall not be broken at the sender link switches. AV4 also breaks the circuit which is locking ON2 and holding ground on the S lead, so that ON2 and the link switches release. For AMA service, the AV4 relay operated releases the ARL relay.

3.19 The release of ON2 releases ON1 and ON4 (CU and DZ options) unless they are held by some trouble as described in 3.24 or 3.33. ON1 releasing breaks the off-normal grounds, restoring the sender to normal, and breaks ground from the SB lead so that it shall no longer test busy. When used, ON4 breaks some of the grounds and releases the relays in Fig. 5 after AV1 operated (EA option).

D. Call Abandoned or Primed Out

3.20 If a call is abandoned or primed out, LR is operated and locked up. It substitutes low-resistance battery for ground on the LR lead, which operates relays in the district junctor to release the line switches.

3.21 The calling line is disconnected at once, but the sender will proceed with selections to a certain point, depending on the conditions, until finally AV1 is operated, as described in 3.15 through 3.19.

3.22 LR operated prevents AV1 from grounding the TR lead, which might delay the release of the calling line, and for LAMA service prevents connection to a transverter on an abandoned call.

E. Sender Made Busy for Maintenance

3.23 The sender is made busy by inserting a make-busy plug in the make-busy jack thereby operating relay MB. This grounds the SB lead to indicate that the sender is busy, just as relay ON1 would do. It also connects resistance battery to the S lead to serve as a busy signal to the sender test circuit.

3.24 If relay OF fails to release when a call is finished, it will hold OF1, and that will hold ON1. If any hold magnet sticks up, except ST, it will hold all following hold magnets and U will hold relay ON1. If MT is operated by a monitor cord left in the priming jack, or inserted by mistake in the priming jack of an idle sender, it will hold or operate ON1 with Fig. AA. If there is any trouble in the 2-party test relay, ON1 will be held as described in 3.32. A false ground on the S lead, preventing the release of the link switches, will also hold ON2 which will hold ON1. In any of these cases the sender will be held busy and will time out.

F. Two-Party Tests and Checks

3.25 If Fig. G is furnished, tests are made to determine whether the tip or the ring party is call ng when a 2-party message rate or a 2-party LAMA line calls, but these tests are omitted and the time intervals required to make them are eliminated when a call is from a line of any other class. The class of call is determined by the CS- relay which operates immediately after SC1 and SC2 when the link control circuit grounds the SC lead.

3.26 When a call is from a line of any other class, ON3 operates at once from a contact of a CS- relay, and it remains operated throughout the call. This cuts through the T and R leads so that L can operate at once after ON1. The call proceeds exactly as if Fig. G were not furnished.

3.27 On calls from a 2-party message rate or 2-party LAMA line, the line is tested for 1000-ohm ringer ground, which indicates a tip party by connecting the winding of relay TP to both sides of the line before dialing starts. The same test is made again after dialing is completed and, if the two tests agree, the call proceeds. If they disagree, it is blocked until LR operates and the sender times out. If TP does not operate on either test, indicating the ring party calling, it is operated locally through a resistance high enough to test its capability under extreme line conditions, after the sender has cut through the district and is ready for release. If it fails to operate, the call is not blocked, but the sender is held busy, times out, and cannot be restored by priming but must be attended to by the maintenance force. The details of these tests are described in the following.

3.28 Relays CS- and ON1 operated, connect the winding of TP to the T and R leads. If TP operates it operates TP1 to register the tip party for later transmission to the marker. TP1 will lock for the duration of the call and connect ground through the tone coil to the tip.

3.29 Time for TP to operate is measured by the slow operation of the capacitor timed relay TPT. When the CS- relay operates, it connects ground through a back contact of ON1 to the secondary winding of TPT which will set it on its back contact. The capacitor will have been discharged through this same back contact of ON1. When ON1 operates after the registration of the frame number and class of service, it breaks off this direct ground from the secondary winding of TPT, and connects it to the primary winding.

Current will start to flow through the primary winding, tending to move the armature over to the front contact, but current will also start to flow through the secondary winding to charge the capacitor. The secondary winding being stronger, the relay will hold to its back contact for a short time, but as the capacitor charges up, the secondary current decreases until finally the armature will move over to close the front contact, then ON3 will operate and lock through STL normal.

(a) Ground is connected through a back contact of STL to the secondary winding of TPT, restoring it to its back contact and discharging the capacitor.

(b) The T and R leads are disconnected from the winding of TP and connected to the TN transformer and the L relay. L can now operate and cause SR and SR1 to operate, starting dial tone and making the necessary connections for dialing. If the tip party is calling, TP1 connects the T lead to the TN transformer as soon as it operates, which is before ON3 operates. This is to discharge the line and prevent tapping the ring party bell when ON3 operates.

3.30 When dialing had been completed STL operates as will be described later. This releases ON3, breaks direct ground from the secondary winding of TPT, transfers the connection of the contact of TP from the winding of TP1 to that of TP2, and breaks the circuit just described for discharging the line through the TN transformer and a front contact of TP1. The release of ON3 connects the T and R leads again to the winding of TP, disconnecting them from the TN coil and the L relay. It also bridges a path about the front contact of L, so the incidental release of L will be without effect, SR holding up. If TP operates, it operates TP2 and that locks up.

3.31 Sufficient time for TP to operate is again measured by TPT. The breaking of ground from the secondary winding of TPT by the operation of STL does not stop the flow of current in that winding, but starts it charging the capacitor. When the capacitor is sufficiently charged TPT makes its front contact and reoperates ON3. This time ON3 neither locks nor restores TPT to its back contact, both those circuits having been broken at the back contacts of STL. But TPT continuing its front contact, holds ON3. ON3 transfers the T and R leads from the winding of TP to the TN coil and the L relay, and removes the bridge from the front contact of L to restore the ability of the sender to recognize an abandoned call. If the tip party is calling, TP2 connects the T lead to the TN transformer to discharge the line and prevent bell tapping.

3.32 With AH option (Mfr Disc):

(a) After dialing is completed and STL is operated, the sender completes its selections and operates AV1 by one of three paths, through front contact of IA, front of STB' or back of CL2 according to the class of call. But none of these paths are completed to the winding of AV1 until ON3 reoperates, after releasing upon the operation of STL, to provide time for the second 2-party test. Nor will those paths be complete to the winding of AV1 unless TP1 and TP2 are both operated or both normal. If one is operated and the other not, a disagreement between the two 2-party tests is indicated and the sender and district will block.

(b) The operation of AV1 is followed by the operation of AV2, the release of AV3, the operation of AV4 and the release of ON2 and the link switches. ON1 releases after ON2 if the tip party is calling, but if it is the ring party, ON1 is still held by a circuit through front contacts of CS and AV1, PS normal, and back contacts of TP2 and TP1 to ground. AV4 operated, connects ground to the secondary winding of TPT making it break its front contact and release ON3. TP now operates through both the tip and ring back contacts of ON3, a front contact of AV4, a 3050-ohm resistance, and back contacts of TPL, BZ and TP2. TP operates TP2, which breaks the circuit just described for holding ON1, and the circuit to the winding of TP. Until TP releases it holds ON1 through the locking contacts of TP2. If this operating test of TP fails, or if on any call TP sticks up, ON1 will be held until released manually.

3.33 With AF option:

(a) After dialing is complete STL operated, the sender releases the ON3 relay and makes the second test of a 2-party message rate or 2-party LAMA line as has been described, but instead of failing to complete the path for operating the AV1 relay, if the two tests disagree, other action, depending upon the class of call, will be taken as follows:

(b) On calls to panel and crossbar offices the sender will proceed with selections until final tens selection has been completed but final units selection will not be made until the second 2-party test has been made and found to agree with the indication received on the first test. This is because after final tens selection has been made, the F01 relay will be held from a back contact of the TPT relay. This relay will again operate on the second 2-party test after sufficient time has been allowed for the TP and TP2 relays to operate as has been explained. After the TPT relay has operated, if the first and second 2-party tests do not agree, the F01 relay will continue to be held through either the front contact of the TP1 and the back contact of the TP2 or through the back contact of the TP1 and front contact of the TP2. The TP1 or TP2 relay will be operated when the first and second 2-party tests do not agree. The F01 relay will be held operated if the first and second 2-party tests do not agree, final units selection will not be made, and the sender will block.

(c) For call indicator class calls, except two-stage CI class, trunk test is delayed until dialing has been completed and the second 2-party test has been made and found to agree with the first. This is because the F01 relay will be held operated from the back contact of the TPT, TP1 and TP2 relays holding the F01 relay. If the F02 relay on this class of call does not release, allowing trunk test to be made, the sender will block.

(d) For two-stage CI class calls, trunk test will not be held for dialing and the second 2-party test. As soon as the office code has been dialed and the originating marker has made connection to an outgoing trunk and office selection, if any, have been made, the sender will make a trunk test and send the CI pulses corresponding to the office code to the tandem sender. The CI pulses for the numerical digits will not be sent until dialing is complete and the second 2-party test has been made and found to agree with the first test. This is because the one-one B (11B) relay on this class of call will be held operated from the TPT, TP1, and TP2 relays, as explained above, for the F01 relay. On these 2-stage CI class calls, the 11B relay prevents sending the numerical digits to the tandem sender and the failure of this relay to release will result in a stuck sender.

(e) On calls to attendants, from 2-party message rate lines, the F01 and F02 relays are held and trunk test is delayed until the second 2-party test has been found to agree with the first test. Failure to make trunk test will block the sender unless CL3 is operated when Fig. BG is used. The operate test of the TP relay is as given for AH option unless the CL3 relay is operated when Fig. BG is used.

(f) When Fig. BG is used, 2-party test is canceled on attendant class calls with the CL3 relay operated. The CL3 relay operated transfers the F01 relay holding ground control through the TPT relay contacts from the F01 relay to the ON3 relay secondary winding. The F01 relay is released and allows the completion of trunk test as soon as relay STL operates. Since relay ON3 is held operated on either the make or break contact of relay TPT, the TP relay operate test for the ring party is not made and, in order to release relay ON1 without completing the TP relay operate test, the CL3 relay also opens the ON1 relay holding path if AV4 is operated.

4. CLASS OF SERVICE, CALLING LINE NUMBER, AND DISTRICT FRAME REGISTERED IN SENDER

4.01 This section describes how the class of service of the calling line and the number of the district frame involved are registered in the sender when it is first seized. The information comes from the sender link and control circuit in the form of grounds over a selection of the 22 leads common to the ten senders and designated CS0 to CS9, F00, F10 and F0 to F9. With LAMA 25 leads are used to register the code for the calling line number and the LO lead is added. Class of service and district frame are registered on relays CS0 to CS9, F00 and F10, and the F vertical of the crossbar register. When the sender is under test, the test circuit sends to the sender some class of service and district frame indication which are set up on keys in the test circuit. With only one class of service, no CS- relay is required but the CS0 lead is grounded by the link to provide early off-normal ground through BW option.

(a) When Fig. T is used, a maximum of 13 classes of service can be provided in two groups of senders, however, when 13 classes are provided, eight in the first group and five in the second group, and it is desired to duplicate in the second group certain classes of the first group, connections for two duplications are shown in Note 106.

4.02 When the sender is first seized and relays SC1, SC2, SC3, and SC4 operate, those relays connect the common leads described in 4.01 into this sender. When Fig. T is used one of the CS leads is grounded in the sender link and control circuit, according to the class of service of the calling line, and the corresponding relay will operate, locking to off-normal ground when ON4 operates. When Fig. U is used one or more groups of senders may serve a maximum of 12 classes of customers with CJ option. In this case, when the CS6 and CS7 relays are furnished, as outlined in circuit Note 106, the sender link grounds one of the CSO to CS5 and also the CS6 or CS7 lead. This will operate one of the CSO to CS5 relays and either the CS6 or CS7 relays. These relays lock to the ON1 relay.

(a) With CK and CL options a maximum of 24 classes of service are obtained by the use of the CS8 and CS9 relays. Only one CS6-CS9 relay is operated at a time.

(b) Before ON1 operates, the off-normal ground lead connected to the SM- relays is grounded from the link through the locking contacts of the operated CS- relay or CSO lead, the SEL magnet through SM1 and SM2 operated, and any relay FOO or F10 which is operated. Lead FOO or lead F10 is grounded according to whether the number of the district frame is under or over 10, and the corresponding relay will operate, locking to off-normal ground. One of the ten leads F0 to F9 is grounded according to the units digit of the district frame number, and the corresponding select magnet of the crossbar switch will operate, passing its operating ground on to operate relay SM1.

4.03 With CU option, ground from an operated CS- relay through SM1 or from the select magnet, operates ON4. ON4 provides off-normal ground to operate SM2 and locks the RA- relays and hold magnets.

4.04 SM1 operates SM2 by its primary windings, SM2 operates SM3, and SM3 releases SM1, and closes a circuit from ground through SM 75-ohm resistance, the secondary winding of SM2, back contacts of RA3, RA5, and CL to the winding of the F hold magnet. This circuit holds SM2 after SM1 releases, and operates the F hold magnet. When Fig. 16 is furnished, relay PTP will operate in parallel with the F hold magnet.

4.05 The F magnet closes the contacts of the crosspoint at the level of the operated select magnet. The hold magnet also releases SC2 breaking the operating circuit of the select magnet, which is still held by a contact of SM2.

4.06 The hold magnet locking contact short-circuits the secondary winding of SM2, which releases, followed by SM3 and the select magnet. The two ends of the secondary winding of SM2 are connected to the same off-normal ground lead, and thus are at the same potential.

4.07 When SM3 operates, RA2 also operates. Then when SM3 releases, RA3 operates and it operates RA4; RA2, RA3, and RA4 lock up until the first dialed digit is in process of registration.

4.08 The SM3 relay cannot operate until one of the CSO-5 and one CS6 to CS9 and either the FOO or F10, if furnished, has operated. This insures that the F hold magnet shall not operate and release SC2 before the CS- and F- relays are ready. It also insures that if some CS- relays are not operated or if no F- relay operates, RA will not operate and the operation of ON1 and the regular release of the link control circuit will be prevented, as described in 3.07.

4.09 If, due to a cross between two leads, failure of the CS- or F- relay to release from a previous call or some other trouble, two or more CS- relays are operated improperly, or FOO and F10, or two select magnets, resulting in the closing of two crosspoints on the F register, one of leads CK3 and CK4 to the marker connector will be grounded. This will operate relay CK and prevent the operation of ON1 and the release of the link controller circuit by the sender as described in 4.07 except that when the CS-6 and CS-9 or CS-7 and CS-9 relays are operated simultaneously the sender will ground the CK1, A, AR, OF, and TP leads to the marker which will establish connection to an overflow trunk or give a trouble release signal to the sender.

4.10 With CT option, if due to a resistance trouble condition, the F magnet fails to shunt SM2 and blocks the link, or some other hold magnet fails to shunt SM2 and blocks the sender and the link or sender is released manually, SM2 may remain locked or if the operating path for the F hold magnet is open, the SM- relay immediately advances the cycle and operates the A and AA hold magnets. If the link releases from time-out before ON1 operates removal of link ground, CS- and F-, reverses and holds SM2. AL1 operated grounds the timing circuit and alarms.

4.11 Options used with Fig. U provide features as follows:

E	To operate CSO.
F	Non-two-party in two-party areas.
GA	Mixed 2-party with CS7-9.
GB	Two-party only.
HA	Mixed coin and noncoin with CS6-8.
HB	Coin only.
J	To strap D and CK3 leads for only one class.
L	To ground or check D8 lead with CS6 and CS7.
LA or LC	To ground or check D8 lead.
LB	For early ground to operate SM3 without CS6 or CS7.
M	For more than 10 district frames with one sender group
N	Less than 10 district frames with this sender group.
R	Less than 10 district frames numbered 10-19 with this sender group.
AT, AU, AV, BI	Coin or noncoin apparatus.
AW, AX, AY, AZ, BA, BB, BG, BH	Two-party or other NC
CB, CC	Early off-normal ground - no M.
BW	Early off-normal ground - no CS-.
CF, CK, CL,	24 classes - duplicate CI and CJ.
CI, CJ	Replace BG, BH or BI.

4.12 For LAMA service the SC1 relay operates the SC4 relay to register the equipment number on the column hundreds (CH-), column tens (CT-), column units (CU-), switch (SW-), and vertical file (VF-) relays of the calling line register. The LO lead is also closed to operate the LO relay as a line observing signal in the sender when required. The SC4 relay also closes the ON lead when a calling line register is used. The CH-, CT-, CU-, SW-, and VF- relays are operated in a 2-out-of-5 pattern and lock to relay ON4 control, as does the LO relay when operated.

5. DIAL REGISTRATION AND SWITCHHOOK CONTROL

5.01 This section describes the control of the sender by the calling customer switchhook and dial, the sending of dial tone, and the registration of the called office code, number, and station on the crossbar register. It also describes how relay STL is operated to indicate the completion of dialing, and describes the station delay feature which employs the CT progress relays to measure a time interval during which the customer may dial a station of fifth numerical digit (also used for coin).

A. Dial and Switchhook Control

5.02 Polarized relay L operates when the T and R leads are connected to the calling line and it remains operated until the sender is disconnected unless the customer previously abandoned the call. On a dial pulse call, the sender L relay will operate and release in synchronism with the pulses received from the customer dial. On a pushbutton call, the sender L relay will remain operated during customer signaling, but the converter will operate and release its P relay to make and break the path through the normal contacts at the sender L relay in accordance with the keyed digits received. Relay L also operates through special bypass circuits when the T and R leads are being used for coin test or for conversation with the monitor. Its secondary winding, which is in series with a capacitor, reinforces the primary winding and makes its operation and release quicker and more energetic.

5.03 Its tertiary winding biases it and tends to keep its armature on the back contact. Jack L affords a means to patch the primary winding to a relay test set, disconnecting battery. Plugging into this jack also breaks battery from the winding of relay TPT so it can be operated in both directions by a relay test set.

5.04 Relays L1 and L2 operate and release with L to provide additional contacts.

5.05 Relays SR and SR1 operate on the first operation of L and release when the call is completed or abandoned permanently releasing L. They hold up continuously between those times regardless of the momentary releases of L due to dial breaks. Relay ON2 operates through SR1 operated and the BS lead.

5.06 Relay RA operates through a back contact of L1 on the first dial break of each digit dialed, and remains operated throughout that string of pulses despite the repeated momentary breaking of its operating path. It releases each time the dial comes to rest after sending pulses in reverse to RA1, except that it cannot operate for the first time until the F hold magnet operates. It provides additional contacts.

5.07 The RA relay has its primary winding strapped and this winding is held to an exact number of turns and its resistance to within ± 3 percent to hold it to the required slow release time.

5.08 Relays L3, L4, and L5 serve to transmit the dial pulses, represented by back contact closures of L, over two leads alternately to the pulse counting relays. L3 operates when L releases on the first dial break of each digit, and L5 operates by its primary winding in series with L3 when L operates on the following dial closure. L4 operates in series with the secondary winding of L5 when L releases on the second dial break, and that causes L3 to release, but L5 is still held up by its secondary winding. Then, when L operates on the following dial closure, L4 and L5 both release. Any possibility of L4 releasing before L3, and thereby preventing the release of L3 and L5, is prevented by locking the secondary winding of L4 to a front contact of L3. This cycle repeats every two pulses of the digit. If the number of pulses is even, the last pulse leaves the three relays normal. If the number is odd, L4 is left normal and L3 and L5 release after the last pulse because the operation of L2 and the release of RA break all holding ground connections. Thus each odd pulse of a digit operates L5 and each even pulse releases it.

5.09 The back contact of the converter P relay is wired in parallel with the back contact of the sender L relay and the front contact of the converter P relay is wired in series with the front contact of the sender L relay. On a pushbutton call, the converter P relay will pulse in accordance with the keyed digit and, in turn, operate and release the sender L3, L4, and L5 relays in a manner similar to that described for the sender L relay above, for a DP call.

5.10 Relay LR operates through a front contact of ON2 and back contacts of SR and L, with AV1 normal and locks to off-normal ground, if the calling customer hangs up to abandon the call after ON2 operates but before AV1 operates.

B. Dial Tone

5.11 One winding of tone transformer TN is in the T lead, and another in the ring lead with Fig. AN. The other winding is grounded at one end and connected through a capacitor to the source of dial tone at the other end from the time relay SR operates until relay AL1, AO, or ET1 operates. This sends an induced tone to the calling customer until the first digit has been registered.

C. Counting Pulses of Each Digit

5.12 The pulses of each digit are counted on relays P1 to P6, which are operated in rotation by alternate closure of the front and back bottom contacts of relay L5, each of which locks until released by the operation of another, or by the operation of RA1 and SM1 at the end of a string of pulses.

5.13 The closure, following the first open pulse of any digit, operates L5 as described in 5.08 and connects ground through back contacts of P4, P2, P3, and

P5 to operate P1, which locks through back contacts of P2, P3, P4, and P5. L5 releases after the second pulse and connects ground through the back contact of RA1 and front of P1 to operate P2, which releases P1 and locks itself through the same path which previously locks P1. The third pulse operates L5,and connects ground through the back contact of P4 and front of P2 to operate P3, which unlocks P2 and locks itself. The fourth pulse similarly operates P4 and releases P3, and the fifth pulse operates P5 and releases P4. The sixth pulse operates P6 through front contact of P5, and P6 locks up for the remainder of the digit but does not unlock P5. The seventh pulse operates P1 again, this time operating and locking through front contacts of P6, instead of back of P5, and that releases P5. The eighth, ninth and tenth pulses operate P2, P3, and P4, respectively; each P relay as it operates, unlocking the one ahead of it. The P relays operated after each pulse are as follows:

Pulse	P relays
1	P1
2	P2
3	P3
4	P4
5	P5
6	P5 - P6
7	P1 - P6
8	P2 - P6
9	P3 - P6
10	P4 - P6

Counting Pulses of Each Digit, Option LE

5.14 This is a preselect pulsing method which allows a TOUCH-TONE® converter to preoperate combinations of the P2, P4, and P6 relays. After the P- relays are preoperated, the converter outpulses either one or two pulses depending on whether the digit is odd or even, respectively. These final pulses operate the L- relays as described in 5.12 which advance the P-relays to indicate the desired digit to the sender. The required preset and final results are as follows:

Digit	Preset Relays	Final Registration
1	-	P1
2	-	P2
3	P2	P3
4	P2	P4
5	P4	P5
6	P4	P5,P6
7	P6	P1,P6
8	P6	P2,P6
9	P2,P6	P3,P6
0	P2,P6	P4,P6

5.15 The TOUCH-TONE converter opens the operate path of the select magnets until the pulses have been transmitted to prevent false registration of the preset relays. This method of pulsing is effective for the first eight digits. If other digits are received the digits will be counted as described in 5.13. The operate path of the select magnets will remain open on these digits until pulsing is completed even though counting relays are not preset.

Codes With Prefix One-One Fig. AD, AE - Mfr Disc

5.16 The sender can be arranged to record the digits 1-1 preceding the office code by providing options AJ and AG. Fig. AE and AD without AL apparatus. Also on a sender monitor type sender, Fig. AC must be furnished. When this feature is provided, the sender will absorb one preliminary pulse but, since a preliminary pulse is the same as a "1", the sender cannot absorb two preliminary pulses. When the customer dials a "1" preceding the office code, the P1 relay will remain operated after the dial restores to normal and a circuit is closed which operates the one-one A (11A) relay. This relay locks on its secondary winding and closes a path for operating the 11B relay when the P1 relay releases before the next digit is dialed. The 11A and 11B relays are operated as has been outlined on a preliminary pulse. When the second prefix "1" digit is dialed, the P1 relay is again operated, and with the 11B relay operated, a path is closed operating the 11C relay which locks as did the 11A and 11B relays. The 11C relay opens the dial tone circuit and terminates the transmission of dial tone to the customer. This is to inform customers, who may inadvertently send two preliminary pulses, that the sender is not ready for dialing and they should hang up and call again. The 11C relay also removes ground from the LA lead and connects ground to the EA lead to the originating marker. The marker circuit will accept this as a signal to call in an additional 800 codes. This arrangement is provided so that connections may be established to offices in adjacent areas whose office code is the same as the code of some office in the local area. To omit this operation the TC lead may be disconnected from 2T of 11B. The 11B relay is used in connection with the CL5 relay to send CI pulses in two stages. Under this condition the 11B relay should be slightly slow release so that when the sender is ready to send the pulses corresponding to the numerical digits and (one-two) 12 or 34 relay will have time to operate before the pulses start.

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Codes With Prefix Digit "0" - Person-to-Person Calls (Fig. 16 and Option JG)

5.17 When a prefix digit "0" is dialed or keyed, the operation of pulsing relays P4 and P6 will operate relays AO and AOA in parallel. Relay AOA will in turn operate relay ALB. Relays AO, AOA, and ALB operated:

(a) release relay PTP;

(b) connect ground to interrupter SD to start the timing for a zero attendant call;

(c) ground lead CCO as part of the person-to-person signal to the marker. Leads LA and CC7 to the marker were previously grounded when the sender off-normal relays operated;

(d) cut off dial tone to the calling customer;

(e) connect ground to lead 14 to the auxiliary sender. This will cause the auxiliary sender to outpulse a special start pulse as a signal to the CAMA sender that the call being handled is a prefix "0" call (option JQ); and

(f) when Fig. 21 and KS option are provided, the AOB relay is operated by the AO.

5.18 When the sender is not arranged for recycle (option JN provided), lead LA to the marker is not furnished.

5.19 The stations delay timing circuit is used for zero operator timing and times for 3 to 5 seconds for the start of the next digit. If another digit is dialed or keyed before the timing cycle is completed, relay RA1, which releases at the start of the next digit, operates relay STM. Relay STM operated, restores the timing circuit to normal and the remaining digits are registered as described in D.

Codes With Prefix Digit 1 Extended Toll Calls - (Fig. 16 and Option JG)

5.20 When a prefix digit 1 is dialed or keyed, the operation of pulsing relay P1 will operate relay ET and the subsequent release of relay P1 will operate relay ET1. Relay ET1 operated cuts off dial tone to the calling customer, releases relay ET, and grounds leads CC1 and PD1 to the marker as part of the extended toll signal.

5.21 When the sender is not arranged for recycle (option JN provided) leads LA and PD1 to the marker are not furnished.

11X Service Codes (Fig. 16 and Option JG)

5.22 When the first prefix digit "1" is dialed or keyed, relays ET and ET1 will operate as described above. When the second prefix digit "1" is dialed or keyed, only ET2 will operate, operate relay ET, and close a ground on leads CC2 and CC4 as part of the service call signal to the marker. Lead LA to the marker was previously grounded when the sender RCY relay was operated by the sender recycle circuit. When the digit X (1 to 9) of the 11X code is dialed or keyed, it will be registered on the "A" and "AA" crosspoints and relay AL1 will operate as described in 5.31 through 5.38, relays AL1 and ET2 operated close a ground to operate relay DST which in turn calls in the marker on an 11X service call.

5.23 When an 11X service code is registered, the L4 relay is operated from the operated ET2 and ALA relays and prevents further dialing or keying registration.

5.24 When the sender is not arranged for recycle (option JN provided), the PD1 and LA leads are not furnished.

Prefix Digits "1-0" Improper Customer Dialing - (Fig. 16 and Options JG Provided)

5.25 The prefix digit 1 operates relays ET and ET1 and the prefix digit "0" operates relays AO and AOA. Relays ET1 and AO operated close a ground to operate relay ZO' which calls in the marker on a zero operator call.

Prefix Digits "0-1" Improper Customer Dialing - (Fig. 116 and Options JG)

5.26 If the customer dials or keys prefix digits "0-1" in error, the digit "0" will operate relays AO and AOA, and the digit "1" will be registered on the A1 crosspoints. The marker will be called in and leads LA, CCO, CC7 and A1 will be grounded. Upon receiving this information the marker will route this call to overflow.

5.27 When the sender is not arranged for recycle (option JN provided), lead LA to the marker is not furnished.

Prefix Codes and Emergency Operation
Fig. 16 and 21 and Options JG and KS

5.28 When a "0-0" is dialed the circuit functions as described in 5.12 and 5.41 through 5.43 up to the operation of the ZO'. The AOB is shunted down at this time by the ground from the AO crosspoints. With the AOB released the CCO and CC7 are grounded as part of the emergency attendant signal to the marker. The "14" lead going to the auxiliary sender link is also grounded at this time as an emergency attendant signal to the auxiliary sender.

5.29 When "0-1" is dialed the ET3 is operated by the ET1 and grounds the CC1 and CC4 leads as a prefix "0-1" code signal to the marker.

5.30 When "1-0" is dialed the ET1 opens the operating path of the AOB and the ET3 operates when the AO operates. The PD1, CC1, and CC4 leads to the marker are grounded as a prefix "1-0" code signal to the marker.

D. Registering First Digit of the Office or Area Code

5.31 When relay RA releases at the end of the first digit, one of the ten select magnets operates in accordance with the number dialed and the P relay or relays operate. Before the release of RA can be effective in operating a select magnet, hold magnet F must have been properly operated by the district frame indication, to ground the contact of RA. This is to insure that the first dialed digit cannot be registered on the F vertical of the switch if the district frame registration fails for any reason.

5.32 The select magnet passes its operating ground on to operate relay SM1. SM1 operates SM2 by its primary winding, SM2 operates SM3, and SM3 releases SM1, but before so doing it closes a circuit from ground through the secondary winding of SM2, front contact of RA3, and back contacts of RA5, CL, and PS to the winding of the A hold magnet; and another circuit from ground through back contact of AV1, front contact of RA3, and back contacts of the C and B hold magnets to the winding of the AA hold magnets. These circuits operate the A and AA hold magnets, and the first of them also holds SM2 after SM1 releases.

5.33 The hold magnets close the contacts of the crosspoints at the level of the operated select magnet. Both hold magnets lock and when both have operated, the locking ground for A short-circuits the secondary winding of SM2 which releases, followed by SM3. Hold magnet AA operates relay AL1 in the timing circuit which cuts off the dial tone. ON1 or ON4 being operated at this time, the two ends of the secondary winding of SM2 are connected to the same ground lead, and are thus at the same potential.

5.34 Relay SM1 operated, breaks the last locking path for the P relays. RA1 having operated in parallel with the select magnet, whatever P relays that were operated now release. SM1 operated, also breaks the operating path of the select magnet, but before breaking either of these circuits SM1 closes a circuit to lock both itself and the selected magnet.

5.35 Relay SM2 operated, closes another circuit to lock the select magnet after SM1 has released. The select magnet releases when SM2 releases after the operation of both A and AA hold magnets.

5.36 When SM3 operated to register the district frame number, RA2 operated. When the F magnet operated and shunted SM2, releasing SM3, RA3, and RA4 operated. When SM3 operates for the first code digit A, RA2 releases, then SM3 and RA3 release and RA5 operates.

5.37 For the second code digit SM3 and RA2 operate, then SM3 releases and RA3 operates.

5.38 For the third code or thousands digit SM3 operates, RA2 and RA4 release, then SM3, RA3, and RA5 release. Thereafter this cycle is repeated.

No Prefix Digit 1 or 11X Codes Provided (Option JH)

5.39 If an accidental pulse is set by the customer switchhook before the first pull of the dial, or 1 is pulled in error for the first digit, RA operates and releases, as for any legitimate digit, but no magnets operate because the operating path from relay P1 to the number 1 select magnet is not closed until after the registration of the first digit, which closes some crosspoint of the AA register, when AH wiring is furnished or until the AL1 relay has operated when AJ wiring is used. Relay P1 will be unlocked by a back contact on RA1, which contact is ineffective for a 7 dialed or for subsequent digits because it is paralleled by front contacts on P6 and hold magnet A. When senders are arranged for recycle, Fig. BY and IT option of Fig. BQ parallel contacts of the AL1 relay with the P6 and hold magnet A to cause the back contact of the RA1 relay to be effective. Therefore, 1 is not recorded by the A register nor is the registering process advanced so as to register the first legitimate digit on the B register, nor is dial tone immediately cut off. Unless "one-one" prefix is to be registered, any number of preliminary pulses will be absorbed in the same way, provided they come far enough apart to allow RA to release between them. Otherwise they will register as a 2 or a higher number.

Zero Operator Call

Person-to-Person Prefix Digit "0" Not Provided - (Option JH)

5.40 When zero is dialed or keyed for the first digit, ground from the AA crosspoints operates relay DST to call in the marker on a zero operator call.

Person-to-Person Prefix Digit "0" Provided (Fig. 16 and Option JG)

5.41 When zero is dialed or keyed for the first digit, relays AO and AOA will operate in parallel and close a ground to the SD interrupter. The subsequent makes and breaks of interrupter SD will operate relays H, H', T, T', U, U', STB and ZO' successively. Relay ZO' operated, operates relay DST to call in the marker on a zero operator call, grounds leads A1, A4, and A5 to the marker and operates the L4 relay which prevents further dialing or keying registration.

5.42 If a second digit "0" is dialed or keyed before the 3- to 5-second time-out of the stations delay timing circuit (before ZO' relay operates), the release of the RA1 relay during the dialing of the second digit "0" will operate relay STM. Relay STM operated, removes ground from interrupter SD and releases any operated timing relays H, H', T, T', U, U' and STB. The second digit "0" is registered on the AO and AAO crosspoints. The marker is then called in on a zero operator call without waiting for the 3- to 5-second timing period.

5.43 If the customer dials prefix digits 1-0 the marker will be called in and route the call to a zero operator (see 5.26).

Zero Operator Calls Routed Through Tandem (Fig. 17 Option JO)

5.44 When the first digit dialed or keyed is "0" the closure of the AO crosspoints operates relay OPR. Relay OPR operated, cuts in the 14,500-ohm resistor Q in the fundamental T and R during TG test to provide the high-resistance TG test required by the tandem zero operator trunk.

E. Registering Successive Digits

5.45 As many digits as may be dialed after the first, are registered in the same way on the succeeding registers upon the successive releases of RA, followed by the operation of RA1 and a select magnet. There is no further restriction against registering a 1. Each register after the A has one hold magnet which closes the contacts of a crosspoint.

5.46 The hold magnet operating path from contact of SM3 through SM 75-ohm resistor and secondary winding of SM2 is steered to the successive hold magnets by transfer contacts on relays RA3, RA5, CL, TD Mfr Disc if furnished, and HL. The operating path from the contact of SM3 which does not go through secondary winding of SM2 is effective only to operate the AA hold magnet, being open at a front contact of RA3 during the registration of the frame and of the second dialed digit, and open at back contacts of the B and C hold magnets during later dialed registration. In general, a contact on each hold magnet provides a locking ground for the next one.

5.47 Every time a registration is made the operation and release of SM3 either operates RA2 and RA3 or releases them. The operation and release of RA3 on two registrations either operates RA4 and RA5, or releases them. CL operates from a contact of the C hold magnet when the C digit is dialed, and HL from a contact of the H hold magnet when the H digit is dialed. TD Mfr Disc operates from a crosspoint of the AA register when the A digit dialed is a 2-digit index.

5.48 If the office code has three digits, they are registered on the A, B, and C registers; if only two digits, they are registered on the A and C registers, the B register being passed over. If both

2- and 3-digit office codes are employed, relay TD is furnished, and it operates whenever the first digit dialed is one representing a block of 2-digit codes, in this case the second digit causes the operation of the C hold magnet. If a 3-digit code is dialed, TD is not operated and the second digit causes the operation of the B hold magnet. If only 3- or 2-digit codes are employed, relay TD is omitted and its contacts are strapped so that the second digit is registered on the B register if the codes are 3-digit or on the C register if they are 2-digit. The 2-digit office code is Mfr Disc.

5.49 The numerical digits, if any, are registered on the TH, H, T, and U registers, and the station or fifth numerical digit, if any, on the ST registers.

F. Indication That Dialing is Completed

5.50 Relay STL operates on all calls when dialing has been completed and the marker has sent a regular release signal to the sender, to indicate that certain functions may proceed and also to prevent false registration on the station register due to belated dialing or switchhook manipulation, by breaking the connection through back contact of L and front of SR to transfer of L5. To operate STL, LR is operated on a release call, STA if the call is for a manual office station with number 10,000 or over, STB' for all other calls.

5.51 A dialing-complete indication on DDD type calls is controlled from the auxiliary sender over the DC lead.

5.52 On permanent signal, dial zero, and official code calls, whether routed direct or through tandem, the marker operates relay CL3 to show that no number is expected and when it operates DRL to release its connection with the sender, STB and STB' operate in series through front contact of DRL, back of CL1, and front of CL3.

5.53 On calls where a number is dialed, but, from the character of the terminating office and the first few digits of the number, it is evident that no station or fifth numerical digit is to be expected, STB and STB' operate in series through the same front contact of DRL, a front contact of UL1 and other contacts depending upon the conditions, when the units digit has been registered. If relay CL1 is not operated by the marker as on a full selector call to panel or a CI tandem call with number, or a restricted code call which has been rerouted to an operator, the path between contacts of DRL and UL1 is through the back contact of the transfer of CL1. If CL1 is operated by the marker, as on a full selector call to crossbar or a CI direct call, relays C and C' operate in series through the front contact of DRL and the front contact of the transfer of CL1, and then the path from DRL to UL1 is through a front contact of C. There are two paths from UL1 to the winding of STB', as follows. First, when the number does not begin with three digits from 100 to 104 and relay SD is operated by the marker to show that the terminating office has no party lines with station letters, the path is through contacts on the TH or TH1 and registers and the front contact of the transfer of SD. Second, when the number does begin with three digits from 100 to 104, but relay SD1 is operated as well as SD, to show that there are no numbers of 10,000 and over in the terminating office as well as no party lines with station letters, the path is through contacts on the TH, H, and T registers and the front contacts of the transfers of the CL and SD. In some localities there are numbers over 10,499 and A option is used, which does not go through contacts on the T register, the criterion for a possible 5-digit number being that the first two digits are 10, Mfr Disc, KP option.

5.54 If a station digit is possible SD is not operated, and if it is actually dialed STB and STB' operate in series through one of the paths described in 5.53 up to the transfer of SD, and thence through its back contact and a front contact on the ST hold magnet, Mfr Disc, KP option.

5.55 If a 5-digit number is possible, SD1 is not operated, and if it is actually dialed STA and STA' operate in series through ST operated, SD1 normal, CL2 operated THO-4, HO, TH1, UL1 operated, CL1 normal or C operated to ground on DRL operated, Mfr Disc, KP option.

5.56 If a station digit or a 5-digit number is possible SD and SD1 normal, but is not actually dialed, a station delay period of time is measured, after units is dialed, and the STB and STB' are operated, all as described in 5.58 through 5.63, Mfr Disc, KP option.

5.57 The STB and STB' are precluded from operating whenever the sender requires use of an auxiliary sender on a DDD or 7DG call.

G. Timing for Station Delay

5.58 When a units digit has been dialed and the marker has sent a release signal, interrupter SD is grounded by the same path from off-normal ground through front contact of DRL and back of CL1, or front of C if CL1 is operated, thence through a different front contact of UL1 and a back contact of STL. This ground is maintained on the interrupter until STL operates. If no station or fifth numerical digit is expected, STL operates at once by the operation of STB' as described above. If one is expected, STL operates by the operation of STA or STB' when it is received or when from 3 to 5 seconds have elapsed.

5.59 Interrupter SD counts its cycles on relays H, H', T, T', U, U', STB, and STB' each cycle causing one pair of relays to operate and lock up. Each cycle takes about 1 second, and STB' operates in from 3 to 5 seconds after the interrupter is grounded.

5.60 Relay STB' operates STL and that unlocks H-H', H releasing unlocks T-T', and T releasing unlocks U-U', but STB-STB' remain locked to off-normal ground through back contact of STA.

5.61 If the calling customer starts to dial a fifth numerical digit when his time is nearly up, STB' may operate before the digit is registered, but it must not stay up nor must it be allowed to interfere with the registration of the digit. RA operating on the first pulse, breaks the circuit by which STB' normally operates STL, so that it cannot operate prematurely to stop the counting of pulses. When the digit is registered, STA and STA' operate, followed by STL, and STA breaks the locking circuit to STB-STB', releasing them. This locking circuit is closed again for use in CI pulsing by a front contact of C12. The back contact of RA which breaks the circuit by which STB' normally operates STL is bridged by a front contact of CL3, so that STB' can operate STL for a permanent signal condition caused by a foreign ac potential on the R lead, which causes L to pulse continuously and hold RA steadily operated.

5.62 Relay STL locks when operated, to prevent releasing if an additional accidental dial pulse should operate RA after the legitimate dialing has been completed. UL1 is operated from STL operated if the U hold magnet is not operated.

Extra-Digit Timing - Fig. 20 and Options KO, KQ, KR

5.63 The marker performs only decoding functions when an interchangeable code is first processed and does not ground the DC lead at this time. Station delay D, SD normal, SD1 operated, is the sender signal for an interchangeable code. The DRL operates the EDT through the SD normal and SD1 operated. The EDT opens the operating path of the STB STB' and places the 7N, 7N' in the timing chain after the U and U' relays. When the UL1 operates at the completion of registration of a digit on the U vertical, or the operation of the INF from a 411 registered on the TH, H, T verticals, the SD timing cycle starts as described earlier. If no further digits are dialed and the UL1 is operated the 7N and 7N' are operated by the timer. If the INF1 is operated the timer operates the 10N. The operated 7N' or 10N releases the DST and DRL. The EDT releases and re-establishes the operate path of the STB and STB' or the STA STA' if the call is for a multifrequency route. If another digit is dialed while timing, the 7N and 7N' digit is dialed while timing, the 7N and 7N' are operated if the INF1 is operated, or the 10N operates when the ST hold magnet operates. The EDT operate path is opened by the 7N or the 10N to prevent its reoperating on a subsequent marker seizure.

6. FIGURE AL OR E

6.01 This section describes the coin test features provided when post-pay coin box lines are to be served by the sender: (a) The method of testing for the presence of a coin and for the presence of a false ground applied for the purpose of getting free service; (b) How the coin test is canceled for noncoin calling lines and for special attendant and permanent signal calls; (c) How a time interval is measured for the coin test and an attendant signaled when Fig. E (sender monitor) is used, if the test is not satisfied in the time allowed; (d) How, when Fig. AL (timed release) is used, a disconnect tone is transmitted to the customer if the coin test is not satisfied during the interval while timing for release; and (e) How a time interval is measured for the coin test and, if it is not completed within a specified time, the sender is released (automatic priming).

6.02 The relays of the coin test circuit are as follows: coin test CT and CT1; ground test GT, solid ground test and auxiliary SGT and SGA; ground test transfer GTT; coin test release CTR; cancel coin test CCT; coin line release CLR; and CNL coin lamp. The SD interrupter and some of the PCI progress relays are used to measure the time interval allowed for satisfactory coin test when Fig. E is used in much the same way as they are used to measure the station delay interval.

6.03 Coin tests are provided with limits of varying types but reduced maintenance may be possible when limits are not reached. For example, commercial coin control voltage can be held to 116/120 volts on machines rated 115/120 volts by methods outlined in BSP A401.106, but a reduction of 60 ohms in maximum loop, or its equivalent will make 115 volts satisfactory.

6.04 Controlled high peak (full load) voltage and high insulation resistance tend to prevent false operation of the GT relay due to high cable capacity.

A. Coin Test Canceled

6.05 If a noncoin line is calling, relay CTR will not operate to prepare for the coin test, and relay CCT will operate through a back contact of CTR as soon as DRL operates on receipt of a release signal from the marker. CCT will lock to prevent release if DRL is released on a trouble release.

6.06 If a call is abandoned, CCT will operate through a back contact of SR1 if DRL is operated.

6.07 If the sender is primed by partial dialing not including a registration on the C register, the consequent operation of relay PS will release the A register. CCT will operate and lock when DRL operates.

6.08 The operation of CCT by any of these means or as outlined in 7.46 through 7.50 prevents the other coin test relays from being brought into action. Thus the coin test is not made and no sender functions are delayed to await it.

B. Coin Test Started

6.09 Relay CTR operates if a class-of-service relay has operated which indicates a coin class.

6.10 Relays CT and CT1 operate when STL operates to show that dialing is complete and, therefore, that the line is available for coin test if CCT has not operated.

6.11 While the CT1 relay is operated with Fig. AL, the interval which the timing circuit measures for disposing of the call is 20 to 40 seconds. This is to cancel the effect of an additional 20 seconds delay in sending the customer a disconnect signal if the coin test fails on a call routed through a distant office selector or is of a CI class. Release of CT1 upon completion of a satisfactory coin test restores the longer time-out period. The operation of the CT1 relay also opens the circuit to the stuck sender register circuit to prevent operation of the register when the sender becomes stuck due to the customer failing to deposit a coin and then failing to disconnect after receiving disconnect tone.

6.12 While the CT1 relay is operated with Fig. E, the interval which the timing circuit measures for disposing of the call is 20 to 40 seconds. This cancels an additional 20 seconds delay, see 6.11. Release of CT1 restores the longer time-out period. CT1 operated also opens the circuit, IG option, to the stuck sender register due to customer failure to deposit a coin and then failing to disconnect after receiving disconnect tone.

C. Ground Test

6.13 CT and CT1 together disconnect the T and R leads from the dialing circuit and connect them through windings of CLR, back contacts of GTT, windings of GT, and resistances, the T lead to ground and the R lead to negative 116-volt coin battery. The operating winding of L is grounded through a resistance, to hold the relay operated while it is cut off from the line, and CLR serves to maintain switchhook control as will be described. If the T lead is closed through the GT windings, after the R lead, it tends to cause false operation of the GT relay.

6.14 If there is no coin in the box or other ground on the line except the allowable 10,000 ohms leak, GT will not operate and the test will not progress. If there is a ground of from 0 to 1000 ohms, GT will operate and lock up, thus signifying the satisfaction of the ground test.

D. Solid Ground Test

6.15 When GT operates, it is followed by GTT, which disconnects the line from the windings of GT and connects it instead through windings of SGT to ground and to negative 116-volt battery without the interposition of resistances.

6.16 If the only ground on the line is the high-resistance one due to a coin in the box, SGT will not get enough current to operate, but if there is solid ground on the line it will operate and will be followed by SGA which locks up.

6.17 The operation of GTT breaks the operating circuit of CTR but if SGA operates it locks up CTR before that has time to release, so CTR remains locked up and the test will not progress.

6.18 If there is not solid ground on the line, so that SGA does not operate, CTR will release. This operates CCT which releases all operated coin test relays. The coin test is now fully satisfied and any sender function which awaited it may proceed.

6.19 A momentary surge due to line capacity or closing 110-volt before the T lead may operate SGT falsely, but not long enough to operate SGA.

E. Switchhook Control

6.20 While the line is connected to the coin test relays instead of to L, and the latter is held operated by a bypass, switchhook control is maintained by CLR. This is a polarized relay biased by its tertiary winding, and it remains operated as long as the receiver is off-hook, regardless of any ground condition on the line.

6.21 If the customer hangs up, CLR releases and shunts out the L relay by a 52-1/2 ohm resistance battery. L releases and the further action of the sender is the same as if the coin test had not been in progress when the call was abandoned.

F. Failure of Coin Test

6.22 When CT1 operates at the start of the coin test with Fig. E (sender monitor), it grounds interrupter SD and connects a locking ground to relay H. The interrupter cycles are counted on relays H, H', T, T', U, and U'; each cycle causing one pair of relays to operate and lock up. If the coin test fails, after the timing has continued from 2 to 3 seconds, and the above pairs of relays are all locked up, the next closure of the interrupter operates CNL, which locks up, lights the coin lamp, and grounds the auxiliary signal circuit.

6.23 When CT1 operates at the start of coin test with Fig. AL (timed release), it closes a circuit which controls the timing circuit which measures a stuck sender period of from 20 to 40 seconds (see 6.11). If the coin test fails then, after the timing has continued 20 to 40 seconds, CT1 being operated, TM4 operates and locks and causes REG to operate. REG, in turn, causes TN to operate and lock and closes part of a path to send out tone, TN operated releases REG and, with TN operated and REG released, CT and CT1 release and reclose the tip and ring leads to the tone coil. The timing continues and if the customer does not hang up and release the sender in 20 seconds more, a further action is taken as described in section 16.25 through 16.42.

G. Monitoring - Coin

6.24 Upon observing the lamp signal, the operator will plug into the talking jack with a talking cord connecting battery to the S lead. This operates relay MS, which extinguishes the lamp and cuts off the auxiliary signal while the plug is in the jack. MS operates MS1, closing the T and R leads to the talking jack and bypassing the circuit through the primary and secondary windings of CLR holding it operated. This transfer is made to prevent ground from the cord circuit falsely operating the coin test relays.

6.25 The transfer of the T and R leads from the coin test relays removes any ground which may have caused GT or SGT to operate, and the operation of MS1 breaks the locking circuit to GT; GT, and SGT release if operated, and the release of GT removes battery from the windings of GTT and SGA, and they release if operated. CTR holds through a back contact of GTT.

6.26 The attendant requests the deposit of a coin and disconnects, relighting the coin lamp. If a coin is then deposited a retest is made and, upon its satisfaction, CTR releases, CCT operates, all the other operated coin test relays release, and the lamp is extinguished, and the sender proceeds with its functions.

6.27 If the lamp is not soon extinguished, the attendant will cause the connection to be released by inserting the talking plug momentarily in the priming jack, as described in 16.25 through 16.42.

FIGURE 22

H. Dial-Tone-First

6.28 In dial-tone-first calls a coin test may be required to determine if the calling party has made an initial deposit. If the initial deposit is detected the call is allowed to proceed. If the deposit is not detected the sender will second trial to the marker to have the call routed to a coin announcement trunk.

6.29 On certain dial-tone-first calls an initial deposit is not required. On these calls the marker causes the sender to cancel the coin test by operating the SG5 relay through the marker connector.

6.30 When a dial-tone-first class of service is registered the CN relay will operate. The CN relay operated:

(a) operates the slow release relay ECT. EC1 is used to time the coin test interval;

(b) places a hold ground on the F01 and F02 relays to delay trunk test on MF, PCI, and straightforward calls and delay final units selections on RP calls until a coin test is completed; and

(c) closes the secondary of the GT relay to bias the relay in preparation for coin test.

6.31 Coin test is made when the SCT relay operates. SCT operates:

(a) after marker release in order to insure that the marker has had the opportunity to cancel coin test by operating the SG5 relay;

(b) if the SG5 relay is released;

(c) after registration is complete in order to prevent interferring with customer dialing.

6.32 The SCT is prevented from operating on abandoned calls and prior to second marker seizure on interchangeable code calls.

6.33 When SGT operates it opens the ring lead and places the GT relay primary winding on the tip lead. SCT also places a hold path on the L1 and SR relays to prevent them from releasing during coin test and starts the release of the ECT relay (118 to 180 ms). The GT relay is a biased polar relay that will operate through the 1000 ground that will be present at the coin station if an initial deposit is made. The GT relay may operate momentarily on line transients when it is switched onto the tip lead but will release (through a 10,000 leak resistance) unless the 1000 ground is present. The ECT relay release time provides an interval of sufficient duration to allow line transients to settle and the GT relay to stabilize. If the GT relay is operated when the ECT relay releases the CP relay will operate and lock. If GT is released the CA relay will operate and lock through a CA1 break contact. If the CP relay operates, indicating the presence of the initial deposit, it opens the hold path on the F01 and F02 relays allowing the call to proceed.

Coin Test Failures

6.34 If the CA relay operates, indicating the absence of the initial deposit, the hold path on the F01 and F02 relays is opened. The call is then processed as follows:

(a) RP call
A CA break contact opens the RP counting circuit causing the next selection to go to telltale. When the terminating end returns the reversal on the FT and FR leads the sender will second trial to the marker as described in 13.07 through 13.09.

(b) CI call (TW operated)
CA break contacts open the PR and PT operate paths causing all CI digits to be outpulsed as zeros. After pulsing is complete the TRL lead is grounded to operate the TR1 relay and start second trial as described in 7.16.

(c) CI call (TW not operated)
Office selections are completed and second trunk test will be made. After the TG2 relay operates the TR1 relay will operate through CA make, TW break, and a TG2 make contact. TR1 operated starts second trial as described in 7.16.

(d) Straightforward Call
Office selections are completed, if required, after which the SO relay will operate through a CA make contact. If office selections are not required the SO relay will be operated. With the CA and SO relays operated the TR1 will operate to start second trial as described in 7.16. The second trial will be delayed until the marker has completed its marking function as indicated by the DC relay released.

(e) MF calls
Second trial is started immediately after the CA relay operates by operating the TR1 relay. Subsequent operations are described in 7.16. The second trial will be delayed until the marker has completed its marking function as indicated by the DC relay released. When the DRL relay releases the CA1 relay will operate through a CA mode contact. The CA1 relay operated grounds the A2-A4-A5 leads to the marker and connects the A1 lead to the CK1 lead. This indicates to the marker that a coin test failure has occurred and that a coin announcement routing is required.

Coin Test Canceled

6.35 When the marker determines that a call does not require an initial deposit it operates the SG5 relay through the marker connector. When SG5 operates it:

(a) prevents the SGT relay from operating and starting coin test;

(b) opens the hold path on the FO1 and FO2 relays to allow the call to progress; and

(c) locks through DRL and DST contacts.

Ground Test Relay Checks

6.36 In order to insure that the GT relay releases properly on dial-tone-first coin calls the ON1 relay is prevented from releasing unless the GT is normal. In the event that GT does not release the ON1 will be held operated through on ECT break contact, a GT make, and a CP make to a CN ground. The sender will time out to stuck sender and hold itself out of service until the condition is corrected.

6.37 On coin test failure calls the GT relay is checked on sender release to insure that it is capable of operating through a coin ground. The AV4A relay will operate in parallel with AV4 on dial-tone-first calls when the sender is releasing. When AV4A operates the SCT will operate through a CA1 make contact. With AV4A and SCT relays operated, a 4750-ohm resistance ground is placed in series with the GT primary winding. If the GT relay is functional it should operate through this resistor. If it does not operate a CN ground is applied through a CA1 make and an AV1 make contact to hold the ON1 relay operated. This will cause the sender to time out to stuck sender and hold itself out of service until the condition is corrected.

6.38 If the GT relay operates it will operate the CP relay which in turn releases the CA1 relay. The CA1 relay released:

(a) opens the hold path on the ON1 relay; and

(b) releases the SCT relay which removes ground from the GT primary winding. GT should now release and allow the ON1 relay to release. If GT does not release the sender is held out of service as described above.

7. COMMUNICATION WITH MARKER

7.01 This section describes how the sender seizes a marker, sends to it the office or area code and other information receives all necessary information for the sender to make its selections, breaks down the direct connection by which the information was transmitted, and receives a signal by way of the district junctor when the marker has established a connection through district and office frames, so that the sender may proceed with its selections. It also describes how the sender rejects all information received from the marker and seizes a marker for a second or a third trial if the first or second marker encounters any trouble in its functions or the sender later encounters an overflow condition in its selections beyond.

A. First Trial With Marker

7.02 Relay DST operates when the operation of relay CL shows that a 2- (Mfr Disc) or 3-digit office or area code has been dialed; when the closed 0 crosspoint on the AA register or operated ZO' relay shows that zero has been dialed for the first digit, or when relay PS operates to indicate that dialing has not commenced in the time allowed by the timing circuit or that the sender has been primed out or that an 11X code has been dialed as indicated by the ET, ET1, and ET2 relays and a digit 0 to 9 crosspoint closed on the A and AA registers. DST closes a holding circuit for itself in parallel with the operating circuit furnished by CL or the AA register, to prevent premature release at the close of the call when the holding magnets release.

7.03 DST operated connects battery to leads ST and CBS to the marker connector, and the latter connects the sender to an idle marker over about 60 leads when the connector and a marker are available.

7.04 Office or area code and other information passes from the sender to the marker over some of these leads, described in 7.24 through 7.27, and after decoding, selection information passes from the marker to the sender over other leads, as described in 7.29 through 7.37.

7.05 After decoding and making some progress in its function of establishing a connection through district and office frames, the marker grounds lead DC through the marker connector, and operates relay DC, also operating a relay in the district over the DC lead running through the sender link, and that relay extends the lead through the district frame connector to another point in the marker, where ground is supplied to it. This second ground holds relay DC locked up for a time after the direct connection between sender and marker is broken by the release of the marker connector.

7.06 When the marker has sent its selection information to the sender, and has operated relay DC, it grounds lead RL through the marker connector. This operates relay DRL which locks up for as long as DST remains operated, which is for the duration of the call unless a second trial should be required. DRL breaks the ST lead, releasing the marker connector and breaking all direct connections between sender and marker. DRL also grounds the LR lead to the link to lock up certain relays in the district junctor which may have been operated directly by the marker.

7.07 The sender is still in indirect communication with the marker through the sender link and the direct junctor. When the marker has completed its work of establishing a connection from the calling line through district and office frames, it removes ground from the DC lead and relay DC releases. This signals the sender to proceed with its work.

7.08 When an interchangeable code is processed the first marker seizure does not ground the DC lead. When the 7N' or 10N operate, the DST releases. The TR1 and TR2 if operated also release. The EDT in releasing recloses the operating path of the DST. Marker seizure then takes place as described in 7.02.

B. Second Trial With Marker

7.09 If the first marker encounters trouble in receiving information from the sender, in decoding, or in transmitting information to the sender, it sends a trouble release by grounding lead TRL and so operates relay TR1, TR1 releases DST which breaks the ST lead, thereby releasing the connector and breaking all direct connections between the sender and the marker. Lead TRL being broken with the rest, TR2 operates in series with TR1. That operates DST again with the result that a second connection is made through the marker connector to a marker. This may be the same marker as before, but usually will be a different one, since the first marker holds itself busy momentarily after sending a trouble release. With TR2 operated, lead AR to the marker will be grounded to notify the marker to use the alternate route to the desired point. If there is an alternate route, the second marker will try to establish the connection functioning as described in 7.02 through 7.08.

7.10 If the first marker encounters either trouble or an all-paths-busy condition when trying to establish connection to a chosen idle trunk or overflow trunk after its direct connection with the sender through the marker connector has been broken down, with Fig. I, it sends a trouble release by grounding lead TR through the district and line for a moment only or when Fig. K is used, it grounds lead RO during first and second trial with all trunks busy per 7.59 including overflow. It also grounds the TRL lead on PS only. With all channels busy on first and second trial, the marker grounds TRL per

7.09. Relay DC being operated at that time, the TR lead is connected to the TRL lead and the momentary application of ground operates first TR1 and then TR2 in series with it. The operation of TR1 releases DST which releases DRL, all selection register relays, and all relays fed by off-normal battery. The operation of TR2 operates DST again, with the result that a second connection is made through the marker connector to a marker. TR2 being operated on the second trial, lead AR to the marker will be grounded to notify themarker to use the alternate route to the desired point if there is an alternate route. The second marker will try to establish the connection functioning as described in 7.02 through 7.08.

7.11 If the first marker functions successfully and is dismissed but the sender, in making selections beyond, receives an overflow signal because of a distant panel type selector running to overflow or telltale, or because of some trouble affecting a crossbar terminating sender, relays AV2 and AV3 will connect a momentary ground to the TRL lead, as described in 13.07 through 13.09. This application of ground operates first TR1 and then TR2 in series with it, as in 7.10. The timing cycle for stuck senders is restarted AG.

7.12 For the brief time between the first and second trial while DRL is normal, the ground on the LR lead through the sender link to the district is broken in order to release relays locked up in the district and allow it to start. If the marker signals a second trial on a permanent signal call, the sender operates AV1 at once.

7.13 If the first marker encounters any of the conditions in 7.10 on DDD calls after an auxiliary sender has been attached, SA operated, the second marker will try to establish the connection functioning as described in 7.02 through 7.08. This call will however be routed to overflow since the sender grounds lead OF on second trial with the marker. When a second marker comes in to reset the sender, relay AS is released and the start circuit to the auxiliary sender is opened.

7.14 On 7DG calls, the auxiliary sender is recalled on every trial with the marker. The class information is reset as on a local call. Relay 7DG restores each time and opens the SA hold circuit. When 7DG reoperates, it reoperates AS which recloses the start circuit to the auxiliary sender.

7.15 When IR option is equipped, it provides for alternate routing of 7-digit calls originally intended to go via an auxiliary sender. With this option, relay AS will remain released until the marker has sent its final class indications to the sender. The marker indicates this by operating the DRL relay. Relay AS is now permitted to operate provided relay 7DG remained operated. This wiring will also make it possible for 7DG calls associated with routes in marker ground supply 3 to go to overflow on dialing of 7 digits.

7.16 If a coin test is made and it is found that an initial deposit is not present a second marker trial is required. The TRL lead will be momentarily grounded as described in 6.28 through 6.33. This application of ground operates first the TR1 and then the TR2 relay in series with it as described in 7.10. On this trial leads A2-A4-A5 are grounded as a coin test failure indication to the marker.

C. Third Trial With Marker

7.17 If the first trial encounters one of the conditions outlined in 7.09 through 7.11 and the second trial encounters a similar condition, the TRL lead will be momentarily grounded a second time. The sender will release DST, DRL, and the selection register relays if operated, reoperate DST to call a third marker, similar to the second one, except that this time relays TR3 and TR4 will operate because TR1 and TR2 are already locked up.

7.18 The 1ON relay, if operated, is released by the TR3. This releases the auxiliary sender on third trial since auxiliary sender operation cannot take place on overflow routings.

7.19 With TR3 operated on the third trial, lead OF to the marker will be grounded to notify the marker to establish connection to an overflow trunk. The marker will send selection information to the sender, operate relays DC and DRL, connect the district to an overflow trunk, and release relay DC, as described in 7.02 through 7.08 for connecting to a regular trunk. If it cannot find an idle overflow trunk, or after finding one, cannot find an idle path to it, it will take the action described in 7.24 through 7.27.

7.20 For a brief time between a second and a third trial, while TR3 is operated and TR4 is normal, the LR lead through the sender link to the district is broken in order to release relays locked up in the district and allow it to restart.

7.21 If the third trial encounters any one of the trouble conditions which cause a retrial, the TRL lead will be momentarily grounded a third time. TR1, TR2, TR3, and TR4 all being locked up, this ground will shunt down and release TR3 but TR4 will hold by its secondary winding. With Fig. I, DST releases and breaks the ST lead, releasing the marker connector if it is still engaged. TR3 and DST cannot reoperate, and the sender will be blocked.

7.22 With Fig. K, ground on lead TRL operates DRL and breaks the ST lead, releasing the marker connector. Relay DRL holds the relays which were operated by the marker. When relay STL operates, indicating that dialing has been completed, relay AV1 operates through a make on TR4 and a break on TR3 or a make on S6'. With relay AV1 operated, the district is placed in the talking condition and the sender restores in the usual way, Though no connection is made to an out-trunk, the district will hold until the calling customer disconnects. The path through the break contact of TR3 is required if the S6' fails to operate and the path through the make contact of S6' is required if a regular release is received on third trial and the fundamental is open or reversed.

7.23 With Fig. I, relay DRL is operated over the RL lead on either "all trunks" or "all channels busy" and the district is advanced to "no trunk". With Fig. K, relay DRL is operated over the TRL lead in either case and "no trunk" results.

D. All Overflow Trunks Busy

Figure I

7.24 During the first or second trials, if all trunks of the called group are busy and all overflow trunks are busy, or if all channels to the desired trunk are found busy, the marker grounds the TRL lead which causes the sender to release the marker and seize another marker as described in 7.09 through 7.16.

7.25 On third trial under the above conditions, the marker operates the sender translator register relays and then the DRL relay over the RL lead. This releases the marker connector. With trunks busy, DC releases at once. With channels busy, DC releases after channel test. The DC relay released, operates the S6'. When the STL operates, indicating that dialing has been completed, the AV1 operates through a make on TR4 and S6'. The operation of AV1 causes the district to be placed in its talking condition and the sender to be restored in the usual way. No connection is made to an outtrunk and the district will restore when the calling customer disconnects.

Figure K

7.26 On first and second trials if all trunks to the called point and all overflow trunks are busy, the marker grounds lead RO, operating TR4, which locks and operates DRL. DRL locks the relays operated by the marker, and releases the marker connector. When STL operates, indicating that dialing has been completed, relay AV1 operates through a front contact of TR4 and a back contact of TR3. Relay AV1 causes the district to be placed in the talking condition and the sender to be restored in the usual manner.

7.27 On third trial, all trunks busy, the marker grounds lead TRL and shunts TR3 in 7.21 as described.

7.28 On first, second, and third trials, all channels busy, the marker grounds lead TRL through the district and the sender responds as to any trouble release signal as described in 7.21.

E. Information From Sender to Marker

7.29 The sender transfers to the marker the number of the district frame involved, the office or area code, the class of service of the calling line, the identification of the tip or ring party of a 2-party message rate or split 2-party LAMA line, and sometimes provides an alternate route or an overflow indication, by grounding a selection of leads F1, F2, F4, F5, F10, A1, A2, A4, A5, B1, B2, B4, B5, C1, C2, C4, C5, D1, D2, D4, D8, SGR, TP, AR and OF. Those leads not grounded are connected to lead CK1, CK2, CK3, or CK4.

7.30 The F register grounds leads F1, F2, F4, and F5 according to the district frame as follows, and connects the others to lead CK4.

Frame	Leads Grounded
0 or 10	None
1 or 11	F1
2 or 12	F2
3 or 13	F1-F2
4 or 14	F4
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 connects lead F10 to lead CK4, or if it is 10 to 19, relay F10 grounds lead F10.

7.31 When the senders are arranged for prefix digits 0 or 1, the sender will ground two CC- leads on nonrecycle calls. The CC- leads grounded are as follows:

(a) No Prefix Digit - CC4, CC7

(b) Prefix Digit "0" - CC0, CC7

(c) Prefix Digit "1" - CC1, CC7

7.32 When the senders are arranged for recycle and prefix digits 0 or 1, the sender will also ground lead EA on recycle calls or lead LA on nonrecycled calls. Two out of five CC- leads to the marker will be grounded by the sender recycle circuit on recycled calls. On prefix digit "1" calls, the PD1 lead to the marker is also grounded.

7.33 On 11X service codes, the sender will ground leads LA, CC2, CC4, and the A- leads described below depending upon the digit dialed as the X digit. When senders are not arranged for recycle (option JN provided), lead LA to the marker is not furnished.

7.34 The A register grounds leads A1, A2, A4, and A5 according to the first digit dialed as follows, and connects the others to lead CK1:

Digit	Leads Grounded
0	A1-A4-A5
2	A2
3	A1-A2
4	A4
5	A5
6	A1-A5
7	A2-A5
8	A1-A2-A5
9	A4-A5

If the first digit is not dialed, or relay PS is operated by priming, PS releases all the registers except the F and AA, grounds A1 and A4, and connects leads A2 and A5 to lead CK1. Relay ZO' if operated also grounds the A1-A4-A5 leads and connects A2 to the CK1 lead. If an initial coin deposit is required and is not made on a dial-tone-first call, the coin test will fail and the CA relay will ultimately operate (see 6.30). CA1 operated will ground the A2-A4-A5 leads and connect the A1 lead to the CK1 lead.

7.35 The B register grounds leads B1, B2, B4, and B5 according to the second digit of a 3-digit code, and the C register grounds leads C1, C2, C4, and C5 according to the last digit of any code, as follows, and both registers connect the other leads to lead CK2:

Digit	Leads Grounded
0	None
1	B1 or C1
2	B2 or C2
3	B1-B2 or C1-C2
4	B4 or C4
5	B5 or C5
6	B1-B5 or C1-C5
7	B2-B5 or C2-C5
8	B1-B2-B5 or C1-C2-C5
9	B4-B5 or C4-C5

For a 2-digit code, relay TD connects leads B1, B2, B4, and B5 to lead CK2 as if zero had been registered on the B register.

7.36 Leads D1, D2, D4, D8, and SGR are grounded according to the class of service, and those not grounded are connected to lead CK3 or CK1. Leads D1, D2, and D4 are grounded or are not grounded according to the operated relays CS0 to CS9; the sum of the numerical designations of the grounded leads equaling the numerical designation of the operated relay. Lead D8 is permanently grounded in the second group of senders if there are two groups. Lead SGR is grounded in one or more groups of senders and not grounded in the other groups. Groups of senders whose SGR lead is grounded may serve different classes of customers than those sender groups whose SGR lead is connected to CK1.

7.37 Leads TP, AR, and OF are grounded if relays TP1, TR2, and TR3, respectively, are operated, otherwise they are connected to lead CK1.

7.38 When the sender and marker are first connected, leads CK1, CK2, CK3, and CK4 are grounded in the marker, so the marker relays connected to all the F, A, B, C, D, SCR, TP, AR, and OF leads operate. That closes chain circuits in the marker breaking ground from leads CK1, CK2, CK3, and CK4. This releases all of these marker relays except those which were operated by ground originating in the sender. Operating all the relays in the marker and then releasing those not wanted, checks all the connecting leads for continuity and for freedom from grounds and crosses. The B and C leads are not checked when PS is operated or the A digit is 0. The TP signal is used to the marker with LAMA when split 2-party feature is provided.

F. Information From Marker to Sender

7.39 The marker transmits selection information to the sender by grounding a selection of leads to operate the correspondingly designated selection register relays in the sender. The relays do not lock up until relay DRL is operated by the marker, so they may be released and set up in a different pattern if the marker reroutes the call. After they are locked up, they may be released for a second or third trial by releasing DST.

7.40 The office selections are indicated by the OB and OG relays operated as follows:

OB Relays	Office Brush
None	0
OB1	1
OB2	2
OB1 - OB2	3
OB4	4
OB5	5
OB5 - OB1	6
OB5 - OB2	7
OB5 - OB2 - OB1	8
OB5 - OB4	9

OG Relays	Office Group
None	0
OG1	1
OG2	2
OG1 - OG2	3
OG4	4
OG5	5
OG1 - OG5	6
OG2 - OG5	7
OG1 - OG2 - OG5	8
OG4 - OG5	9

Note: If there is no office selector in the route, skip office relay SO is operated in place of the OB and OG relays.

7.41 Second office selections are never used.

7.42 The class of call is indicated by the operated CL1 to CL5 relays as follows:

None	Full selector to panel office
CL1	Full selector to crossbar or crossbar tandem office
CL2 - CL4	Call indicator tandem, panel sender tandem, CAMA tandem, and calls via auxiliary senders
CL1 - CL2 - CL4	Call indicator direct or through crossbar tandem
CL2 - CL3 - CL4	Call indicator tandem official code (attendant tandem)
CL2 - CL4 - CL5	Call indicator tandem, two-stage (panel sender tandem)
CL3 - CL4	Official code, special service, vacant code, vacant DDD codes, permanent signal, and overflow on calls to these trunk groups
CL4	Restricted code routed direct to operator and overflow except on above

7.43 The required compensating resistances are indicated by the CR relays operated (except CR5). The resistance during office test and selection is indicated by CR1 and CR2 as follows:

Neither	900
CR1	600
CR2	300
CR1 - CR2	0

7.44 The resistance during and after trunk test is indicated by CR3 and CR4 as follows:

Neither	0
CR3	300
CR4	600
CR3 - CR4	900

7.45 CR5 is operated on all calls over trunk groups containing trunks to nonrepeating ground cut-off panel incoming selectors. It serves to substitute relay MTG for TG, to close a cable discharge circuit before final brush selection, and to close an auxiliary path for operating the O, BO, and FO counting relays through a late making contact of relay IA.

7.46 In order to provide optimum CI pulsing conditions when pulsing to the auxiliary sender, the sender is arranged by the marker to supply a 600-ohm compensating resistor in the CI loop.

7.47 The SD relays operated indicate whether the called office requires the sender to delay after the fourth digit of the called number has been dialed, for a possible fifth numerical digit or a station digit. SD is operated on all calls except those to manual offices having some party lines with station letters. SD1 is operated on all calls except those to manual offices having some lines with 5-digit numbers.

7.48 The SD relay is also used in connection with the CL3 relay to cancel coin test on calls from coin lines to special codes, such as fire and police calls, for permanent signal calls, and for overflow on calls to these trunks. With such codes, the CL3 relay will be operated and the SD relay will also be operated if coin test is not to be canceled, while the SD will be left normal if coin test is to be canceled.

7.49 With the KO, KQ option, the SD and SD1 are also used for interchangeable codes and 10-digit calls. The extra-digit timing (EDT) relay operates from the SD normal and the SD1 operated. The 10DG operates from the SD and SD1 normal. When these options are provided no station or fifth digit timing will be possible.

7.50 Provide Fig. AG for completing calls over a common group of trunks to two crossbar offices. The customer sender will send the normal number of pulses for incoming group selection for one of the offices and will add five pulses to incoming group selection for the other office which is reached over the common trunk group. With SD1 relay operated from the marker, the normal number of pulses will be transmitted, or with SD1 normal, five additional pulses will be sent for incoming group.

7.51 The SD1 relay is operated on all calls except those to manual offices which have some lines with 5-digit numbers. On these calls the CL2 relay is also operated and the CL2 relay, which is not operated on crossbar calls, will cancel waiting for the possible fifth numerical digit, regardless of whether the SD1 relay is operated or not.

7.52 The TW relay is operated when the call is routed through full selector tandem equipment to extend the timing out period for stuck sender and to avoid the possibility of a line release causing a stuck tandem sender, and it is operated on calls to ADCI equipment to extend the timing out period for stuck sender and to avoid a trunk lockup condition if a release occurs just as the ADCI position is seized. It is also operated for attendant class calls on which trunk test normally returns reversed battery during trunk test, to short-circuit the OF relay. Relay TW is operated on all calls routed to CAMA and non-CAMA tandem offices to avoid immediate release of the customer sender when no assignment has been made and the call is abandoned.

7.53 Provide Fig. BM for toll diversion where certain calls originated by PBX customers equipped with toll diverting trunk circuits must be diverted to the PBX attendant or to the toll diverting tone circuit.

7.54 The originating marker will signal the sender by grounding the TDV lead whenever the particular route and zone translations occurring in the marker indicate that toll diversion is required on the call. The ground on lead TDV operates the TDR relay which registers the toll diversion information in the sender.

7.55 At the completion of dialing, the sender forces a line reversal to the customer, and if a PBX line equipped with a toll diverting trunk is attached, the diverting trunk will open the line to the central office and transfer the customer to the PBX operator or PBX tone diverting circuit. In all other cases the line reversal has no functional affect.

7.56 Relay 7DG in Fig. 12 is provided for 7- or 8-digit operation when the call is to a remote office on an MF pulsing basis. An auxiliary sender is therefore required on this call. Ground over the 7DG lead from the marker operates the 7DG relay and relay SK2 or SK3 may be operated at this time over similarly designated leads to the marker. When 7DG operates it closes a path to operate relay AS. When decoding is completed and relay AS is operated, a start signal is sent to the auxiliary sender link to call in the auxiliary sender. After it is attached, as indicated by SA operated, skip digit or no-skip digit information is sent to the auxiliary sender.

7.57 Lead CL transmits the skip signals set up in the customer sender as follows:

Type Call	Skip Signal From Marker	Ckt Fig.	Sdr Signal to Aux Sdr
7 or 10 digit	No skip	9 and 11	1711 Ω grd
7 or 10 digit	Skip 3	8	Grd
7 digit	Skip 2	10	317 Ω grd

G. Soaking Stepper Relay

7.58 Whenever relay DC is operated, it sends a current through the winding of relay STP, to soak it in the direction of its normal operation, removing the residual effect of any preceding reverse current.

H. Reroute of Calls for Special Code "OFF-9300" (Special for Chicago)

7.59 To provide for the possible rerouting of OFF-9300 to a different trunk group, for example, OFF-9100 Figure AH and BK wiring will be installed. With LAMA, the ORR relay also. The originating marker will be arranged to operate the SG5 relay when the code OFF is received from the sender. If the numerical digits 9100 follow this OFF code the connection will be set up to the group of trunks corresponding to the OFF code in a regular manner as is desired. If, however, the numerical digits 9300 follow the OFF code, then with the SG5 relay operated and the ORR relay operated or the No. 3 crosspoint of the H vertical of the register switch closed, a path is closed from the back contact of the OF relay for grounding the front contact of the STP relay. This will cause the pulsing of the STP relay to be ineffective for operating the counting relays in the sender and the terminating sender is forced to "telltale" after which it will return reverse battery prematurely to the originating sender. The sender will then proceed to make a second trial with a marker as is described under "overflow and telltale."

7.60 On the second trial, the marker will not cause the SG5 relay to be operated and the marker will set the call up to the group of trunks corresponding to the desired reroute point, and not to the trunks for the code OFF.

7.61 Provide Fig. 18 when outpulsing of the directory number is required. Operation of the ODN relay and the ZDN relay on attendant calls signal the sender, auxiliary sender, and the transverter when directory number outpulsing is required.

7.62 If Fig. 22 is provided and the marker determines that for the code dialed an initial deposit is not required on a dial-tone-first call, it will operate the SG5 relay. This has the effect of canceling coin test and allowing the call to proceed without it. The dial-tone-first feature (Fig. 22) and the OFF-9300 feature (Fig. AH) are mutually exclusive so that there is no conflict in the use of the SG5 relay.

8. GENERAL METHOD OF SELECTION AND PROGRESSION THROUGH THE SELECTIONS

8.01 This section describes how one typical selection is made, and how the selection sequence circuit is advanced step-by-step to make the necessary internal connections for the several selections also the office and trunk tests. Beside the crossbar dial register and certain relays of the selection register, the relays principally concerned are: stepper (STP); counting (0 to 6), (FO, BO, and 1' to 6'); release counter (RC); (FO1, FO2, and FO3) auxiliary to FO; trunk guard (TG2); sequence (S1 to S6), and (S1' to S6').

A. Typical Selection

8.02 Office group selection may be taken as typical. While it is being made, relays S5-S5' are locked up and the other S relays and the FS relays are normal. The OG relays in the selection register are locked up in a pattern appropriate to the office group desired.

8.03 When ready to start, the fundamental is closed through the windings of STP by the operation of FO3, and the distant circuit starts sending pulses. Each pulse operates and releases STP which, in turn, sends pulses to the counting relays through the normal contacts of counting relay 6'.

8.04 Relay RC is operated and the counting relays are normal. Assume OG1 and OG2 normal, OG4 and OG5 operated, which means that office group 9 is desired, requiring the distant circuit to return ten pulses. The path for the first pulse from contact of STP is through back of FS3, front of OF2 back of 6', back of 1', front of S5', back of FS2, front of OG4 and back of 4' to the windings of 4' and 4. When the pulse starts, 4 operates and, when it ends, 4' operates in series with 4 and they lock through front contact of 4, back of 6, and front of FO3. The second, third and fourth pulses operate 3-3', 2-2', and 1-1' similarly and they lock similarly except that 1-1' lock through a front contact of FO3 only.

8.05 The path for the fifth pulse is through the back contact of 6', front of 1', back of FS2 front of S5, and front of OG5 to the winding of 6 and 6'. This pulse operates 6-6', the sixth pulse operates 5-5' and these relays lock through the front contact of FO3 and back of FO2, respectively.

8.06 When 6 operates, 4-4', 3-3', and 2-2' release, and when 5 operates, RC releases. The seventh, eighth and ninth pulses operate 4-4', 3-3', and 2-2' a second time, and they now lock through back contact of RC. The tenth pulse operates 0, BO, and FO through back contact of RC and they lock through front contact of FO3.

8.07 Should OG1, OG2, and OG3 be set up in a different pattern, the first pulse would operate 3-3', or 2-2', or 1-1', or 6-6', and from one to four pulses less would be required to operate 0, BO, and FO. Should OG5 be normal, the pulse which has been described as operating 6-6', would operate 0, BO, and FO and this result would require five pulses less than when OG5 is operated.

8.08 The operation of BO and FO is the signal to stop the selection and get ready for the next selection. BO breaks the fundamental and stops the distant circuit. FO operates S6 through a front contact of S5'. S6 operates FO1, FO1 operates FO2, and that releases FO3. FO2 and FO3 make additional breaks in the fundamental, anticipating the release of BO, and release all the counting relays.

8.09 The release of FO allows S6' to operate in series with S6, and they lock up to make the proper connections for trunk test. The operation of S6' breaks the locking path for S5-S5' and they release. The release of S5' releases FO1 unless it is held for dialing, coin test, or recording.

8.10 When FO1 releases after the release of S5' the completion of dialing and coin test FO2 also releases, operating RC to prepare the counting relay circuit and then FO3 operates to close the fundamental for trunk test.

B. Progress of the Selection Sequence

8.11 On any class of call routed through office selectors, the sequence relays are operated as follows for the several stages up to and including trunk test:

S3-S3' - Office test
S4-S4' - Office brush selection
S5-S5' - Office group selection
S6-S6' - Trunk test

On a CI call, S6-S6' remain up from trunk test throughout the CI pulsing.

8.12 On a full selector (FS1) call, the sequence relays are operated as follows for the stages after trunk test:

S1-S1' - Incoming brush selection
S2-S2' - Incoming group selection
S3-S3' - Final brush selection
S4-S4' - Final tens selection
S5-S5' - Final units selection
S6-S6' - Incoming advance

9. DISTANT OFFICE SELECTIONS

9.01 This section describes the making of office selections on any call which may be routed through a panel office selector, of the distant office variety. On a skip-office call, the marker establishes a connection directly to a trunk of the full selector, CI, or attendant class. On a call through an office selector, the marker establishes a connection to the office selector and then that connects to the trunk under control of the sender. Attendant class calls cannot be routed through a distant office 2W selector.

9.02 Office selection consists of three stages, office test, office brush selection, and office group selection. Office test is made with relays S3 and S3' operated, office brush selection with S4 and S4' and office group with S5 and S5'.

A. Fundamental Circuit

9.03 During office test the fundamental is closed from the FT lead through back contact of AV2, front of FO3, back of FO2, front of S3, back of FS1, the winding either TG or MTG, back or front contact of CR5, back of CI2, 14,500-ohm resistance, front contact of S3' and the compensating resistance as determined by the transfer contacts of CR1 and CR2 to the FR lead.

9.04 During office brush and group selections, the fundamental is closed from the FT lead through the back contact of AV2, front of FO3, back of FO2, the operating winding of OF shunted by its noninductive winding, front contact of S4' or S5', winding of STP, back contacts of BO and FS2, front contacts of S4' or S5', and compensating resistance as above to the FR lead.

9.05 The purpose of the 14,500-ohm resistance in office test is to prevent the line relay of the panel office selector from operating until STP is in circuit and the sender is otherwise ready to count pulses.

B. Office Test

9.06 The fundamental is closed when relays S3' and FO3 are operated, S3' operates for the office test upon the release of DC when the marker establishes connection to the office selector. S3 having operated upon the operation of DC, FO3 operates for the office test when DST and RC operate.

9.07 Relay TG or MTG operates to battery from the normal distant circuit, TG operates TG1 and that in turn operates TG2, or MTG operates TG2 and that in turn operates TG1.

9.08 Relay TG2 operates O, BO, and FO through back contact of S6. FO operates S4, which operates FO2, which releases FO3. This breaks the fundamental and the locking circuit for TG1, O, BO and FO. Therefore all the TG and counting relays release.

9.09 The release of FO allows S4' to operate in series with S4 and they lock. S4' opens the locking circuit for S3-S3' and they release. S3' releasing, releases FO2 and then RC and FO3 operate for office brush selection.

C. Office Brush Selection

9.10 Office brush selection follows immediately after office test, starting when FO3 operates to close the fundamental.

9.11 Relay STP responds to pulses from the distant circuit, OF not operating because of its polarity, and STP sends from one to ten pulses to the counting relays through front contact of S4', back of FS2 and the contacts of the OB relays for the office selection. O, BO and FO operate on the last pulse and lock up.

9.12 Relay BO breaks the fundamental to stop the distant circuit. FO operates S5 through a front contact of S4'. S5 operates FO1, which operates FO2, and that releases FO3. FO2 and FO3 make additional breaks in the fundamental, anticipating the release of BO, and unlock the counting relays, which release.

9.13 The release of FO allows S5' to operate in series with S5 and they lock. S5' opens the locking circuit for S4-S4' and they release. S4' releasing releases FO1, which releases FO2 and then RC and FO3 operate for office group selection.

9.14 The OB5 relay provides 6 to 10 selections for use with crossbar distant office selections.

D. Office Group Selection

9.15 Office group selection follows immediately after office brush, starting when FO3 operates to close the fundamental.

9.16 Relay STP sends from one to ten pulses to the counting relays through contacts of S5', FS2, and the OG relays as described in detail in 8.02 through 8.10, eventually operating O, BO, and FO.

9.17 Rleya BO breaks the fundamental to stop the distant circuit. FO operates S6; S6 operates FO1, which operates FO2, and that releases FO3; FO2 and FO3 make additional breaks in the fundamental, anticipating the release of BO, and release the counting relays.

9.18 The release of FO allows S6' to operate in series with S6 and they lock. S6' opens the locking circuit for S5-S5' and they release. S5' releasing releases FO1, which releases FO2.

E. Skip Office

9.19 If there are no office selections, SO is operated by the marker. Then the operation and release of DC operates S6 and S6' for trunk test instead of operating S3 and S3' for office test.

The locking circuit for these S relays is not connected until DRL operates, so that they shall not remain locked up in case the marker, in shifting from one trunk group to another, first operates SO and then releases it.

10. FULL SELECTOR CALL

10.01 This section describes all the operations on a completed full selector call which are peculiar to that class of call. There are two full selector classes, both distinguished from CI and attendant calls by relay CL4 being normal, and further distinguished from CI calls by CL2 being normal. CL1 is not operated for calls to panel offices, but is operated for calls to crossbar offices, for which it serves to extend the time that trunk test must be delayed and to eliminate the use of relay FO1. On a call to panel, trunk test cannot be made until the thousands digit has been registered and an extra long time is required between certain selections. On a call to crossbar, trunk test cannot be made until the hundreds digit has been registered and extra long times between selections are not required. With these exceptions the two classes are treated similarly.

A. Fundamental Circuit

10.02 During trunk test the fundamental is closed from the FT lead through back contact of AV2, front of FO3, back of FO2, front of S6, back of CL4, back of FS1, the winding of either TG or MTG, back of front contact of CR5, back of CI2, 14,500 ohms resistance, back contact of CL4, front of S6', and compensating resistance as determined by the transfer contacts of CR3 and CR4 to the FR lead.

10.03 During the incoming and final selections and incoming advance, the fundamental is closed from the FT lead through back contact of AV2, front of FO3, back of FO2, the operating winding of OF shunted by its noninductive winding, front contact of FS1 winding of STP, back contact of BO, front of FS2 with Fig. R or FS1 with Fig. S and compensating resistance as above to the FR lead.

10.04 The 14,500-ohm resistance in trunk test prevents the line relay of the panel incoming selector or the crossbar incoming trunk from operating until STP is in circuit and the sender is otherwise ready to count pulses.

10.05 If relay CR5 is operated, then before the fundamental is closed through STP for final brush selection, it is momentarily closed through 25,500 ohms and the compensating resistance by back contacts of FO3 and S4, and front of S3 and CR5, to discharge the trunk cable and avoid the danger of a false pulse through STP.

B. Trunk Test

10.06 The fundamental is closed when relays S6' and FO3 are operated. S6' operates upon the release of DC when the marker establishes connection to a trunk if the call is skip office, S6 having operated from operation of DC, or upon the completion of distant office selections. RC and FO3 operate upon the release of FO1 and FO2, which occurs when the dialing proceeds far enough to operate the TH hold magnet on calls to panel offices or the H hold magnet on calls to crossbar offices, and the completion of distant office selections, if any, releases S5'.

10.07 If the trunk is in a group containing nonrepeating ground cut-off incomings, MTG is cut into the fundamental, otherwise TG may be used. Either relay operates by battery from the distant end of the normal trunk.

10.08 The operation of TG operates TG1 and that in turn operates TG2, or the operation of MTG operates TG2 and that in turn operates TG1. TG2 operates O, BO, and FO through front contact of S6 and back of CL4. FO operates S1, which operates FO2, which release FO3. This breaks the fundamental and the locking circuit for TG1, O, BO, and FO. All the TG and counting relays release.

10.09 The release of FO allows S1' to operate in series with S1 and they lock. S1' opens the locking circuit for S6-S6' and they release. S6' releasing, releases FO2 and then RC and FO3 operate for incoming brush selection.

10.10 The operation of S1' also operates FS1 which operates FS2 and they lock up and make proper connections for the incoming and final selections. FS1 also operated AST for 2-line AMA calls.

C. Incoming Brush Selection

10.11 Incoming brush selection is made with relays S1 and S1' operated. It follows trunk test without delay for dialing, starting when FO3 operates to close the fundamental.

10.12 STP responds to pulse from the distant end of the trunk OF not operating because of its polarity, and STP sends from 1 to 5 pulses through the contacts of relay S1' and the TH register to the counting relays. O, BO, and FO operate on the last pulse and lock up.

10.13 Relay BO breaks the fundamental to stop the distant circuit. FO operates S2 through a front contact of S1'. S2 operates FO2 and that releases FO3. FO2 and FO3 make additional breaks in the fundamental, anticipating the release of BO, and unlock the counting relays which release.

10.14 The release of FO allows S2' to operate in series with S2 and they lock. S2' releases S1-S1'. S1' releasing, releases FO2 unless it is held for dialing, and then RC and FO3 operate for incoming group selection. FO2 will not release nor FO3 operate until the dialing of the hundreds digit operates the H hold magnet.

D. Incoming Group Selection

10.15 Incoming group selection is made with relays S2 and S2' operated, starting when FO3 operates to close the fundamental after the completion of incoming brush selection and the dialing of hundreds, and functioning the same as incoming brush except as follows.

10.16 STP sends from 1 to 4 or 5 to 9 pulses through the contacts of relay S2' and the H and TH registers to the counting relays, eventually operating O, BO, and FO.

10.17 Relay FO operates S3 through a front contact of S2'. S3 operates FO1 which operates FO2 if the call is to panel with CL1 normal, or S3 operates FO2 directly if the call is to crossbar with CL1 operated. FO2 releases FO3, which releases the counting relays.

10.18 Incoming group selection requires one to four pulses. To provide for transmitting to the terminating sender a signal as to which office is wanted, when completing calls over a group of trunks common to two offices, five additional pulses may be transmitted as outlined under 7.39 through 7.57. This is under control of the SD1 relay. With this relay operated the regular number of pulses will be sent and with the SD1 relay normal five additional pulses will be transmitted before the O, BO, and FO relays are operated terminating the selection.

10.19 The release of FO allows S3' to operate in series with S3 and they lock. S3' releases S2-S2'. S2' releasing, releases FO1 which releases FO2, or releases FO2 directly and then RC and FO3 operate for final brush selection. There is no delay for dialing at this point.

E. Final Brush Selection

10.20 Final brush selection is made with relays S3 and S3' operated, starting when FO3 operates to close the fundamental, and functioning the same as incoming brush selection except as indicated in the following.

10.21 STP sends from 1 to 5 pulses through contacts of relays S3' and FS1 and the H register to the counting relays, eventually operating O, BO, and FO.

10.22 FO operates S4 through a front contact of S3'. S4 operates FO2 and that releases FO3, which releases the counting relays.

10.23 The release of FO allows S4' to operate in series with S4 and they lock. S4' releases S3-S3'. S3' releasing, releases FO2 unless it is held for dialing, and then RC and FO3 operate for final tens selection. FO2 will not release nor FO3 operate until the dialing of the tens digit operates the T hold magnet.

F. Final Tens Selection

10.24 Final tens selection is made with relays S4 and S4' operated, starting when FO3 operates to close the fundamental after the completion of incoming brush selection and the dialing of tens, and functioning the same as incoming brush except as indicated in the following. Relay FS3 operates with S4 and locks up to reverse the contacts of STP during the succeeding selections in order to minimize wear on them.

10.25 STP sends from 1 to 10 pulses through the contacts of relays S4' and S4 and the T register to the counting relays, eventually operating O, BO, and FO.

10.26 FO operates S5 through a front contact of S4'. S5 operates FO1 which operates FO2, or S5 operates FO2 directly, CL1 operated, and FO2 releases FO3, which releases the counting relays.

10.27 The release of FO allows S5' to operate in series with S5 and they lock. S5' opens the locking circuit for S4-S4' and they release. S4' releasing releases FO1 and FO2 in turn, or FO2 directly, unless one of them is held for dialing, and FO2 releasing operates RC and FO3 for final units selection. FO1 and FO2 will not release nor FO3 operate until the dialing of the units digit operates STL, the second 2-party test has been completed satisfactorily if 2-party service is provided as described in 3.25, and coin test has been completed if the coin features are provided as described in Part 6., or until LAMA recording has been completed.

G. Local Automatic Message Accounting Full Selector Call

10.28 When the dialed code indicates to the marker that a charge is to be recorded, the marker operates two of the five sender message index (M1-) relays. They lock under control of the ARL, SR1, DRL, and AV4 relays. If the charge is to be "bulk billed" with no record of the called number, the 2-line (2L) relay is also operated, locking as above if the LO relay is normal.

10.29 The line or service observing LO relay is operated from the observing circuit, locks to off-normal ground and cancels the 2L relay as a 4-line record is desired.

10.30 With two M1- relays and the 2L relays operated, ground from DRL operated, AV4 normal, CL3 normal, PS1 normal, SR1 operated for customer control between transverter trials and ARL normal (for release) operates AST to connect the TV connector when FS1 operated after trunk guard test. AST locks with the index relays, holds AV3 to prevent marker retrial during recording, holds FO1 to delay units selection until recording is complete, and connects battery to the RBS and STV leads to start the connector.

10.31 After recording is complete the transverter operates relay ARL releasing the M1-, 2L, and AST relays and the connector. ARL locks to DRL ground through AV4 normal and releases when that relay operates or when the marker is reseized. If it fails to release, ON1 is held operated.

10.32 The SR1 relay cannot release while a transverter is connected. If the transverter fails a second time, relay ARL is operated except with index 9, when TRL is operated, operating ARL and AV2, grounding the OF lead, recalling the marker and sending the call to overflow. All other indexes complete a call when recording fails.

10.33 If the 2L relay is not operated, the AST relay operates when STL operates (after all dialing) and a called number is sent for 4-line recording (or a detail-billed call,) otherwise this call is similar to a 2-line call.

10.34 When CL3 is operated for attendant classes, no accounting charge is made.

H. Final Units Selection

10.35 Final units selection is made with relays S5 and S5' operated, starting when FO3 operates to close the fundamental after the completion of final tens selection and the dialing of units, and functioning the same as incoming brush except in the following particulars.

10.36 Relay STP sends from 1 to 10 pulses through contacts of relays S5' and S5 and the U register to the counting relays, eventually operating O, BO, and FO.

10.37 Relay FO operates S6 through front contacts of S5', S6 operates FO1 which operates FO2, or S6 operates FO2 directly, and FO2 releases FO3, which releases the counting relays.

10.38 The release of FO allows S6' to operate in series with S6 and they lock. S6' opens the locking circuit for S5-S5' and they release. S5' releasing, releases FO1 and FO2, in turn, or FO2 directly, and FO2 releasing operates RC and FO3, for the incoming advance function.

I. Incoming Advance

10.39 Incoming advance is made with relays S6 and S6' operated, starting when FO3 operates to close the fundamental after the completion of final units selection.

10.40 STP and OF both respond to a single long pulse of reversed battery ground on FT lead from the distant end of the trunk, STP operating and releasing, OF operating, locking and operating IA.

10.41 When STP and IA are operated O operates, and when STP releases, BO and FO operate and lock in series with O.

10.42 Some nonrepeating, ground cut-off, panel incomings, give so short a reversed battery pulse that STP may not stay operated long enough after IA operates to effect the operation of O so the above-described method of operating BO and FO, at the end of the pulse may fail. To insure the operation of BO and FO, IA closes a supplementary path through a front contact of CR5 to operate O, BO, and FO simultaneously when STP releases, in case O was not operated before.

10.43 The supplementary path would cause BO and FO to operate too soon in case IA should close it before STP operates. This is a possibility on long trunks which cause STP to lag in operation behind OF. To prevent it, the supplementary path is carried through the above-mentioned front contact of CR5 and is therefore ineffective on trunks not requiring it.

10.44 When the incoming has cut off the reversed battery, it connects direct battery to the fundamental, and awaits a trunk closure bridge before proceeding to ring the called station. The operation of BO breaks the bridge across the fundamental in the sender to prevent its giving a premature trunk closure.

10.45 The operation of FO operates AV1 through a front contact of IA. AV1 locks up and marks the completion of the sender functions on the call, by starting the series of operations described in 3.15 through 3.19 and 13.10 through 13.13 to release the sender. AV1 also unlocks OF.

11. CALL INDICATOR CALL

11.01 This section describes all the operations on a completed CI call, which are peculiar to that class of call. There are three CI classes, all distinguished from full selector and attendant calls by relay CL2 being operated, and further distinguished from full selector calls by CL4 being operated. In addition to CL2 and CL4, either CL1 or CL3 may be operated by the marker, or neither CL2 and CL4 alone are operated for regular tandem CI calls, CL2, CL3, and CL4 for tandem calls to attendant not requiring a number to be dialed CL1, CL2 and CL4 for CI direct calls. CL3 serves to cancel the trunk test delay waiting for the dialing of a number and has no effect after the completion of dialing, an attendant tandem call being handled exactly like a regular tandem call with number under 10,000, a full set of CI pulses being sent for all digits, with zero for the digits not dialed. CL1 serves to cancel the sending out of the office code by CI impulses. The method of sending CI pulses differs according to whether the called number is under or over 10,000.

A. Fundamental Circuit

11.02 During trunk test the fundamental is closed from the FT lead through back contact of AV2, front of FO3, back of FO2, the operating winding of OF, not shunted by its noninductive winding, back contact of FS1, the winding of TG, back contact of CR5, back of Cl2, front of CL4, front of S6', and compensating resistance as determined by the transfer contacts of CR3 and CR4 to the FR lead.

11.03 While awaiting assignment after trunk test, all TG and CI relays being operated, the fundamental is closed from the FT lead through back contact of AV2, front of FO3, back of FO2, front of S6 and Cl2, back of FS1, winding of TG, back contact of DR5, front of TG2 and CI1 and compensating resistance as above to the FR lead. The operating winding of OF is now short-circuited so that it cannot respond to a delayed momentary false overflow indication, which may occur due to the trunk being disconnected from its previous connection after it has been seized for this connection.

11.04 When the trunk is assigned and the TG relays released but the CI relays still operated, the fundamental is closed from the FT lead through back contact of AV2, front of CI1, and back of TG2 to the CI pulsing circuit and back through another back contact of TG2 and another front of CI1, and compensating resistance as above to the FR lead.

B. Trunk Test

11.05 Trunk test and all of the following operations are made with relays S6 and S6' operated. The fundamental is closed when relays S6' and FO3 are operated. S6' operates upon the release of DC when the marker established connection to a trunk if the call is skip office, S6 having operated upon the operation of DC, or upon the completion of distant office selection. FO3 operates upon the release of FO2 and operation of RC, which occurs when the completion of dialing operates STL, and coin test has been completed if the coin features are provided as described in Part 6. and the completion of distant office selections, if any, releases S5'. Also on 2-party message rate calls the first and second tests must agree. See 3.25 through 3.33.

11.06 Relay TG operates from battery at the distant end of the trunk but OF does not operate while in circuit because of its polarity. TG operates TG1 and that operates TG2. TG2 operates CI1 through front contacts of S6, CL4, CL2, and OF1 normal. CI1 locks until AV1 operates, after CI pulses have been sent, and operates CI2 or NT3 which operates NT1, NT2, and CI2. The TG relays hold operated until the trunk is assigned at the distant end, when they release to start the CI pulsing.

11.07 On calls requiring use of an auxiliary sender the TG operates to battery and ground from the auxiliary sender. When a DDD call is dialed, the dialing complete signal is received over lead DC to operate STL from the auxiliary sender signal. When a 7DG call is dialed through units registration, STL may operate immediately (HJ option) or after timing (HI option) over a lead closed when AS operated.

11.08 When FO3 and S6' operate to close the fundamental, the auxiliary sender makes a high-resistance check toward the sender over leads FTI and FRI. At the same time another high-resistance check is made toward the remote office to determine whether its incoming trunk is normal. The auxiliary sender next closes a low-resistance loop to start the CAMA trunk and when a terminating sender is seized, the auxiliary sender closes a low-resistance wet loop toward the sender to operate the TG relay. After a reversal is received from the remote sender the auxiliary sender closes a dry loop toward the sender over the FTO and FRO leads.

C. Generation of CI Pulses

11.09 The CI pulsing circuit consists of start pulse (SP) relay, pulse generating (PG, PG1, PG2, and PG3) relays, grounding (GR) relay, pulse tip and ring (PT and PR) relays, relays 1-2 and 3-4 which supplement the contacts of the crossbar register, and final pulse (FP) relay.

11.10 Relay PG is a nonbiased capacitor-timed polarized relay. It cannot be said to operate and release, but it closes its front No. 3 contact when energized in one direction by its primary winding, closes its back contact when energized in the other direction by its primary winding, and remains on either contact or between the contacts when not energized. When current is first closed through the primary in either direction, its force is more than neutralized by an opposing current, in its secondary winding, the source of which is the charge or discharge of the timing capacitor. When the capacitor has been charged or discharged, current ceases to flow in the secondary and the primary causes the armature to move from one contact to the other. The actual time of operation varies somewhat with variations in voltage, resistance, and relay adjustment. It averages about 0.068 second per single operation. Jack PG affords a means to patch the windings of relay PG separately to a relay test set.

11.11 When PG closes its front contact, CI1 and SP being operated, it grounds out the 300-ohm battery and so starts opposing currents in the two windings. At first the effect of the secondary winding is stronger and the front No. 3 contact is held closed, but as the capacitor discharged, the current in the secondary dies down, until the effect of the primary becomes the stronger, when the relay breaks its front contact and closes its back contact. Now the battery through 300 ohms is not grounded out and currents start in the two windings in the reversed direction. At first the effect of the secondary winding is stronger and the back contact is held closed, but as the capacitor charges the current in the secondary dies down until the effect of the primary becomes the stronger, when the relay breaks its back contact and closes its front contact. Then the cycle repeats.

11.12 In sending out CI pulses after the trunk has been assigned and TG2 released, PG pulses as described with PG1 operating every time PG closes its back contact. The pulsing must start with the timing capacitor discharged and the PG relays in a definite condition, with PG closing its back contact. PG1 and PG2 operated and PG3 normal. The capacitor is discharged and PG set on its back contact. PG1 and PG2 operated and PG3 normal. The capacitor is dischanged and PG set on its back contact immediately after communication with a marker when CI2 operating with SP normal, grounds out the 300-ohm resistance. When trunk test is made and CI1 operates, PG1 and PG2 operate, but PG3 cannot operate because its winding is short-circuited.

11.13 When the trunk is assigned and TG2 is released, after PG2 and CI2 have operated, SP operates and then PG and PG1 start continuous pulsing. PG2 being operated and locked and PG3 normal before the pulsing begins, the first release of PG1 removes the short-circuit from PG3 and operates. The next operation of PG1 short-circuits PG2 and releases, leaving PG3 operated. The next release of PG1 releases PG3. The following operation of PG1 operates PG2 and so the cycle repeats. Each complete cycle, which generates four pulses to transmit one digit, proceeds as follows:

Pulse	PG1	PG2	PG3
1	Up	Up	Down
2	Down	Up	Up
3	Up	Down	Up
4	Down	Down	Down

11.14 When operated, PG1 grounds the FR lead for a positive or blank odd pulse, and when normal it grounds the FT lead for a negative even pulse. GR operates slightly later than PG1.

11.15 The winding of PG is connected to the dial register to be in the operated position when a positive odd pulse is required. Operated, it connects 6500-ohm battery to the FT lead, for the light positive pulse. Normal, it connects ground through back contact of GR to the FT lead, so that both sides of the trunk are grounded momentarily to discharge the trunk capacity, until GR operates immediately after PG1, after which the FT lead is open to give the blank pulse. For the first pulse, all of PG1 is operated in advance, but GR does not operate until SP operates to start the pulsing.

11.16 The winding of PR is connected to the dial register to be in the operated position when a heavy negative even pulse is required, or normal when a light negative even pulse is required. Operated, it connects 115-ohm battery to the FR lead, giving the heavy negative pulse. Normal, it leaves 6500-ohm battery connected to the FR lead, giving the light negative pulse.

11.17 After the entire number has been transmitted, relay FP is operated if its winding is connected. It breaks the operating circuit of PG1 when PG3 is also operated, reverses the FT and FR leads to send out a blank pulse and then a heavy positive pulse, as will be described.

11.18 The NT- relays are required for extra contacts on the dial registers. They are used for call indicator calls and free contacts for LAMA.

D. Connection of Pulsing Circuit to Dial Register

11.19 On the first and fourth pulse of each digit the winding of PT is connected through a back contact of PG3 to contacts of the crosspoints of the crossbar dial register, and on the second and third pulses through a front contact of PG3 to other crosspoint contacts on the register. These points are grounded or not according to the setting of the register and the progress through the digits. As the operation or nonoperation of PT is significant only in the first and third pulse, it has the preceding pulse to get ready.

11.20 Similarly the winding of PR is connected on the first and second pulse through a front contact of PG2 to crosspoint contacts, and on the third and fourth pulse through a back contact on PG2 to other crosspoint contacts.

11.21 Since there are not enough contacts on the crossbar register to give all the combinations required, relays 1-2 and 3-4 are furnished, with their windings connected to crosspoint contacts, and their contacts connected through the front and back contacts of PG2 and PG3 to the windings of PT and PR. If a certain digit requires PT operated for the first pulse and PR for the second, 1-2 operates from a crosspoint and, in turn, operates PT and PR for the periods during which they should be operated. Relay 3-4 performs a similar function for digits which require PT operated for the third pulse and PR for the fourth.

11.22 The pulses are transmitted in a continuous stream, four pulses to each digit. The first and third pulses of each digit are either blank or light positive, the second and fourth either light or heavy negative. The different combinations of four pulses determine the number transmitted for each digit. In addition, each negative pulse, whether light or heavy, serves to advance the distant control circuit which receives the pulse and registers the numbers transmitted.

11.23 Three different codes of pulse combinations are used, the regular one for the office code and all numericals except thousands, the thousands code, and the stations code. These codes are given in the following table, where "n" represents a light negative pulse, "N" heavy negative, "p" light positive and "-" a blank pulse. The four letters, J, M, R, and W corresponding to numerals 5, 6, 7, and 9, respectively, are the only stations designations provided for. If no station designation is dialed or if any other numeral is dialed in error, a zero will be transmitted. The stations code for 1 is not used in sending a stations digit, but is used in sending the first digit of a 10,000 number, which is not taken from the station register.

REGULAR	THOUSANDS	STATIONS
0 - n - n	0 - n - n	0 - n - n
1 p n - n	1 - n - N	1 p n - n
2 - N - n	2 p n - n	
3 p N - n	3 p n - N	
4 - n p n	4 - N - n	
5 - n - N	5 - N - N	5 (J) - n p n
6 p n - N	6 p N - n	6 (M) - n - N
7 - N - N	7 p N - N	7 (R) p N - n
8 p N - N	8 - n p n	
9 - n p N	9 - n p N	9 (W) - N - n

E. Tandem Call, Under 10,000

11.24 When a call is routed through tandem and the called number is under 10,000 relays, STB and STB' will have operated in advance as described in 5.50 through 5.63, and all the other CI progress relays A, A', B, B', C, C', STA, STA', TH, TH', H, H', T, T', U, and U' will be normal when the trunk is assigned and pulsing starts.

11.25 When the trunk is assigned, that is, when the distant battery and ground connection which operated TG is replaced by the sensitive and marginal pulse receiving relays of a CI control or a tandem sender, TG releases and is followed by TG1 and TG2. The capacitor-resistance bridge about the winding of TG absorbs its discharge to prevent a false pulse going out. The purpose of the slow release relay TG1 is to prevent a false assignment in case TG is momentarily released, as may happen if the trunk is still connected to a customer from the previous connection, and he should hang up while the sender is awaiting assignment. TG1 and TG2 are not permitted to release until CI2 and PG2 have both operated, to be sure that the pulsing circuit is ready to send pulses.

11.26 The release of TG2 connects the pulsing circuit to the FT and FR leads through front contacts of CI1 and operates SP to start the pulsing. The crosspoints of the AA register are already grounded through back contacts of relays A and A' and some connections are already set up from ground to the contacts of PG2 and PG3 to operate PR and PT as required for the four pulses of the A digit.

11.27 The release of PG2 at the end of the second pulse operates relay A, which transfers the ground operating PT and PR on the first and second pulse of a digit from the AA register to the B register. The next operation of PG2, at the end of the fourth pulse, allows relay A' to operate in series with A, and the pair lock in parallel with the winding of STL. A' operating transfers the ground for operating PT and PR on the third and fourth pulse of a digit from the AA register to the B register.

11.28 The pulsing proceeds, transferring the grounds for operating PT and PR two pulses at a time, through the AA, B, C, ST, TH, H, T, and U registers in turn, by operating the progress relays A, A', B, B', C, C', STA, STA', TH, TH', H, H', T, T', U and U'. Each pair of progress relays locks up either to the previous pair or to off-normal ground.

11.29 Relay U' operates at the end of the fourth pulse of the units digit, which is the last digit, STB' being already operated. U' operates FP if its winding is connected, S option, otherwise it operates AV1, T option.

11.30 If FP is connected, S option, a blank pulse is sent after the fourth pulse of the unit digit with PG on its back contact, PG1, PG2, and FP operated and PG3 normal. Then PG breaks its back contact, releasing PG1 which lets PG3 operate. FP operated reverses the connections between the FT and FR leads and the contacts of PG1, and also connects the 115-ohm resistance battery to the FT lead, so the release of PG1 starts a heavy positive pulse, by removing shunt from 115-ohm battery. The FP relay operated also eliminates other shunt paths from the BA resistance to prevent interference during the heavy positive pulse.

11.31 After the heavy positive pulse has lasted for the usual pulse time, PG closes its back contact. Usually that would operate PG1, terminating the pulse and releasing PG2; but this time, since FP and PG3 are both operated, the back contact of PG is cut off from the winding of PG1 but still connected to release PG2 directly. AV1 operates upon the release of PG2 or AV2 during LAMA recording. The heavy positive pulse continues until the fundamental is broken by the operation of AV2 or PG1 reoperates. The operating circuit for AV1 is wired through a front contact of SP so that it cannot be operated falsely while station delay is being measured.

11.32 The operation of AV1 either after the final pulse or after the units digit if no final pulse is provided for, marks the completion of the sender functions on the call. Beside starting the series of operation described in 3.15 through 3.19 to release the sender, it also immediately releases the CI relays, which stops the pulsing and breaks off the FT and FR leads from the pulsing circuit. With Fig. J if there is an unusually long interval between the break of 7-8T and the make of 9-10B, the AV1 may not lock on a CI call. With LAMA calls AV2 operates and locks through NT3 if AST is operated for recording, when the normal AV1 operating path is closed. When AST releases, AV1 operates from its normal source. When LAMA calls require use of an auxiliary sender, option IP is required for the proper method of operating relay AV1. The AV1 lead ground from the auxiliary sender is under control of relay SP and the regular AMA control relays, AST normal, and ARL operated.

F. Tandem Call, Number 10,000 or Over

11.33 When a call is routed through tandem and the called number is 10,000 or over, relays STA, and STA' will have operated in advance as described in 5.50 through 5.57 and all the other CI progress relays A, A', B, B', C, C', TH, TH', H, H', T, T', U, U', STB and STB' are normal when the trunk is assigned and pulsing starts.

11.34 The pulsing starts and finishes as described in the preceding and is the same throughout except that the digit registered on the ST register is sent last, after the one on the U register, instead of being sent between those on the C and TH registers, because of STA-STA' being operated in advance instead of in their regular order and STB-STB' in their regular order instead of in advance.

11.35 The code for the digit on the ST register is different and therefore different springs on the crosspoints are used.

11.36 The code for the digit on the TH register is also different but as the digit is invariably 1 for a number over 10,000 it is only necessary to provide a special code for the one crosspoint, and that is accomplished by wiring the two leads from that crosspoint through contacts on STB, one a front contact and the other a back contact.

11.37 On calls requiring use of an auxiliary sender it is required to maintain CI pulsing uniformity of the registered information sent to the auxiliary sender. This is accomplished by: (a) blocking operation of STB and STB' which operate on a normal over 10,000 call; and (b) operating relay SWF to convert, when a one is registered for a fourth dialed digit (thousands registration), the stations type CI pulse (p n - n) to a thousands type pulse (- n - N). Now all fourth dialed digits are pulsed as thousands type CI pulses. All other registered digits are pulsed as regular type CI pulses.

G. Direct Call

11.38 When a call is routed direct, the process of sending pulses is the same as for a tandem call, except that the A, B, and C digits are not sent, as controlled by CL1 operated, and the pulsing starts on the ST or the TH register, depending upon whether the number is under or over 10,000. CL2 and CL4 are also operated.

11.39 Relays C-C' are operated in advance as described in 5.53 and both the progress relay operating leads and the leads to the crosspoints are advanced to the stations or thousands relays and registers.

H. Two-Digit Office Code - Mfr Disc

11.40 If the tandem offices are arranged to receive 3-digit office codes, any 2-digit codes dialed are transmitted as 3-digit codes by interposing a zero between the two digits dialed. The progress through the registers is the same as if a 3-digit code were dialed, but as nothing is registered on the B register, a zero is sent for the second digit.

11.41 If the dialing area contains only 2-digit office codes and the tandem offices are arranged to receive 2-digit codes, relays B and B' are omitted and the wiring is looped past their contacts.

I. Two-Stage CI Class Calls

11.42 The sender can be arranged to transmit CI pulses in two stages by furnishing Fig. AD and AL option. On this class of call, the CL5 relay will be operated, also the CL2 and CL4 relays from the originating marker. The 11B relay will also operate from a contact of the CL5 relay.

11.43 When the customer has dialed the office code and the marker has set up the connection to an outgoing trunk and office selections, if there are any, have been completed, the sender will proceed to make trunk test as outlined in 11.05 through 11.08. The CI pulses corresponding to the office code will then be transmitted to the tandem sender in a normal manner.

11.44 When the C digit has been transmitted and the C' relay has operated, ground through a 90-ohm resistance from the contacts of the CL2 and 11B relays is connected to the No. 6 winding terminal of the PG relay. This causes the PG relay to stop pulsing and no further CI pulses are sent until the 11B relay has been released. This relay releases when dialing has been completed and coin test has been made and found satisfactory or when the second 2-party test has been made and found to agree with the first 2-party test. When the 11B relay releases, the 90-ohm ground is removed and the PG relay starts to pulse again. This causes the CI pulses corresponding to the numerical digits to be transmitted to the tandem sender.

11.45 This arrangement of transmitting the CI pulses in two stages is provided to reduce the time required to set up the connection. It also reduces the originating sender holding time but increases the tandem sender holding time.

11.46 The 11B relay may be released when the LR relay operates. This causes the sender to transmit zeros for the numerical digits if the call is abandoned while waiting for the numerical digits to be dialed.

12. ATTENDANT CALL

12.01 This section describes all the operations on a completed attendant call which are peculiar to that class of call. There are two attendant classes, both distinguished from full selector calls by relay CL4 being operated, and from CI calls by CI2 being normal. CL4 alone is operated on calls for restricted codes which the marker has rerouted to an attendant. On such calls the calling customer will dial a number, and trunk test is delayed until he does so. CL3 and CL4 are operated on calls made directly to an attendant, by dial zero and official codes and also permanent signals, CL3 serving to cancel the trunk test delay for numericals. With Fig. BG or Fig. W, coin test is canceled (Fig. E or AL). Figure BG also cancels 2-party test on attendant class calls (CL3 relay operated). If the trunk is one which normally returns reversed battery on trunk test, relay OF is prevented from operating at this time since it is required for TW to be operated.

A. Fundamental Circuit

12.02 During trunk test the fundamental is closed from the FT lead through back contact of AV2, front of FO3, back of FO2, operating winding of OF not shunted by its noninductive winding, back contact of FS1, winding of TG back contact of CR5, back of CI2, front of CL4, front of S6' and compensating resistance as determined by the transfer contact of CR3 and CR4 to the FR lead. If TW is operated, the operating winding of OF is short-circuited.

B. Trunk Test

12.03 An operator class call cannot be routed through a panel distant office selector and is therefore always skip office, because no provision is made to send a pulse of reverse battery to put a distant office selector in the cut-through position.

12.04 Trunk test is made with relays S6 and S6' operated. The fundamental is closed when relays S6' and FO3 are operated. S6' operates upon the release of DC when the marker established connection to a trunk, S6 having operated with DC. FO3 operates upon the release of FO2 and operation of RC after the completion of dialing operates STL, the second party test is completed satisfactorily, as described in 3.25, and coin test has been completed if the coin feature is provided as described in 7. and the satisfaction of coin test, if any, releases CTR, or from two-party message rate calls if the first and second tests have agreed. See 3.25 through 3.33.

12.05 TG operates to battery from the distant end of the trunk, TG operates TG1 and that operates TG2; TG2 operates AV1 through front contacts of S6 and CL4 and back of OF1 and CL2; front of ON3, TP1, and TP2. AV1 locks up and starts the series of operations described in 3.15 through 3.19 to release the sender. When the zero operator trunk is a tandem trunk, relay OPR operated inserts the 14,500-ohm resistor Q in the fundamental to provide the high-resistance TG test required by the tandem trunk.

C. Trunk Test Omitted

12.06 Trunk test is omitted on calls routed by the sender to overflow trunks, that is, on all third trial actual or simulated calls, marker grounds RO lead, and on permanent signal calls where a trouble release is received from the marker, because it is desired to have the sender cut the district through and release itself, whether or not the marker finds an idle overflow or permanent signal, trunk, or an idle path to one of these trunks. AV1 operates through a front contact of TR4 just as soon as STL and S6' operate. STL operates when dialing is completed, and S6' operates upon the release of DC. The marker operates and releases DC without regard to its success in establishing connection to a trunk.

D. Permanent Signal - MR

12.07 If the marker sends a trouble release on a permanent signal call, it cannot connect to a permanent signal trunk and AV1 is operated through front contacts of PS and TR2; PS breaks the operating path for DST through front contact of TR2 so a second marker will not be called.

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E. Permanent Signal LAMA

12.08 The PS relay is operated as described in 16.05 through 16.09 and in 16.17 through 16.19 and PS1 operates. The marker sets up the connection to a PS trunk or gives a trouble release as a no trunk signal. Relay PS1 provides a high-resistance trunk test which is opened when AST operates. It closes ground from TR2 as a "no trunk" signal, closes lead FT for PS trunk identification, also locks ARL. When ARL operates (see 10.28 through 10.34), AV1 is operated directly through PS1 operated.

13. OVERFLOW AND TELLTALE

13.01 This section describes the action taken by the sender if it receives an overflow indication, which is a reversed battery from the fundamental in any position of the sender except incoming advance on a full selector call. It may be occasioned by a panel type office, incoming, or final selector running to overflow of all trunks busy, or to telltale because of trouble, or by a crossbar tandem or terminating sender running to telltale, or by a trunk to CI or attendant with reversed conductors. Indication on a DDD call is when: (a) no auxiliary senders are available; or (b) the auxiliary sender times out, the call is abandoned, or battery on the fundamental circuit is reversed. Briefly, the action of the sender in the way of returning to normal, to restore the selection register and the selection sequence circuit to normal, and to call a marker to break down the connection forward and make another trial. The relays principally concerned are the incoming advance, overflow, and advance relays IA, OF, OF1, OF2, AV2, and AV3.

13.02 On a DDD call when an auxiliary sender is unavailable for any reason, as indicated by an unoperated SA relay, trunk test is made to the remote trunk since STA operated following stations registration, then STL operated. The remote sender returns a wink signal and relay OF operates. The marker would ordinarily attempt a second trial, but when it becomes attached, it sees both the AR and OF leads grounded and sets the call to overflow or announcement instead. If there was a marker delay, the dial pulses after stations registration (DPT operated) go via DPT and AS operated and SA normal to operate OF. The call is routed to overflow or announcement as above when OF operated. Or with an auxiliary sender attached (SA operated) it attempts to make trunk test with a remote trunk and receives a reversal. This reversal is repeated to the sender over leads FT1 and FRI and the call is routed to overflow or announcement. Likewise on partial dial and abandoned calls the sender is signaled by a reversal to set up overflow or to begin disconnection.

13.03 When the sender completes trunk test but before it is ready to CI pulse it may be necessary for the sender to be able to receive a reversal from the auxiliary sender. To meet this condition for DDD calls, a normal contact on relay AS is placed in the shunting loop consisting of S6 and CI2 operated and FS1 normal.

13.04 On a recycle call when a compressor circuit is not available, operate ground to relay S1 is extended to the subscriber sender recycle circuit for operating an overflow relay in that circuit. The call is then set to overflow as described for the DDD call in 13.02 for AR and OF leads grounded.

A. Action of Selector

13.05 The action of a panel selector, crossbar terminating, or tandem sender when it runs to overflow or telltale varies somewhat with the different conditions, but in general it connects reversed battery to the fundamental and recognizes a closure in the sender, then it connects direct battery to the fundamental and recognizes a second closure, known as trunk closure, and returns to normal.

13.06 In some cases the distant circuit holds the reverse battery on the fundamental for a definite time after recognizing the first closure and then breaks off of its own accord. In other cases it holds it on until the sender breaks the fundamental closure. When BM wiring and apparatus are used the sender will wait for the distant circuit to open the fundamental circuit for reverse battery in all cases except "office telltale", "office overflow" and "incoming brush telltale" where the sender will open the fundamental when the OF2 relay releases, if STP is operated.

B. Recognition by Sender of Reversed Battery

13.07 If a panel distant office selector runs to overflow in hunting for a

CI trunk, or if a trunk to CI or attendant, which has its conductors reversed, is seized, the sender at that time will be in trunk test position with TG and OF in the fundamental. They will both operate on the reversed battery. TG operates TG1 and TG2, buthwithout further effect because OF1 breaks the circuit to the contact of TG2, which would operate CI1. OF locks up and it operates OF1 through front contact of S6' and back of FS1. OF1 closes a circuit to operate IA. With AN wiring IA operated, shunts TG, lowering the fundamental to operate a relay in the distant office selector. The early closing front contact of IA is ineffective because STP is not operated, but its late closing front contact operates O, BO, and FO through a front contact of CI4. FO1 and FO2 operate, opening the fundamental. FO3 releases and AV2 operates, reclosing it when FO2 releases (AN wiring) for trunk closure. With AN wiring, ground from 1-3B of AV2 contacts of IA, CI4, and S6' operated, delays operation of FO and BO until OF2 releases.

13.08 If a panel office selector runs to overflow in hunting for an incoming selector, the sender at that time will be in trunk test position with TG or MTG and the 14,500-ohm resistance in the fundamental. OF is short-circuited to prevent its possible operation at this time when the fundamental bridge is too high in resistance to be recognized by the distant circuit as a closure. TG or MTG will operate on the reversed battery and the sender will advance to the incoming brush position where STP and OF are in the fundamental. They will both operate on the reversed battery. OF locks up and it operates OF1 through a back contact of S6'. OF1 closes a circuit to operate IA. The early closing front contact of IA operates O, and after a short interval slow relay OF2, its operating path broken by the operation of OF1, releases and breaks the circuit from the contact of STP, thereby allowing BO and FO to operate.

13.09 If a panel incoming selector runs to overflow in hunting for a final selector, or if an office incoming or final selector, or a terminating sender runs to telltale, the sender at that time will be in some selection position with STP and OF in the fundamental. They will both operate on the reversed battery. OF locks up and operates OF1 through a back contact of S6'. OF1 closes a circuit to operate IA. The early closing front contact of IA operates O, and when the distant selector opens the reversed battery and releases STP, or when OF2 releases, BO and FO operate. The late closing front contact of IA serves to insure the operation of O, BO, and FO with ground cut-off incoming selectors giving a very short pulse of reversed battery as described for "incoming advance" in 10.39 through 10.45.

C. Trunk Closure

13.10 When FO operates in any of the conditions described in the preceding, it operates FO1 through front contact of OF1. FO1 operates FO2 and that releases FO3. FO2 breaks the fundamental to give the signal required in some cases for the distant selector to apply direct battery if BO has not already done so.

13.11 Relay FO2 operating also: (a) operates AV2 and that locks up; and (b) opens a 500-ohm bridge circuit which is across the fundamental with AN option. The operation of AV2 and the release of FO3 remove all grounds holding O, BO, and FO and they release. The release of FO is followed by the release of FO1 and FO2.

13.12 The operation of AV2 and release of FO2 (AN option) bridges the 500-ohm resistance across the FT and FR leads to serve as a trunk closure for the distant selector, and opens the FT lead from the fundamental circuit to prevent STP or TG from operating on the trunk closure.

13.13 Relay FO2 releases slow relay AV3, and that releases after the trunk closure interval.

D. Recall of Marker

13.14 The release of AV3 with AV2 operated and AV1 normal, grounds the TRL lead. As described in 7.09 through 7.16, this causes the release of DST and DRL, all selection register relays locked to DST and all relays fed by off-normal battery, including OF. OF releases OF1, which in turn releases IA and AV2, and the release of AV2 removes ground from the TRL lead. A marker is called for a second or third trial as described in 7.09 through 7.23.

14. ABANDONED CALLS

SYNOPSIS

14.01 This section describes the procedure if a calling customer hangs up the receiver at any time before the sender has completed its normal functions on a call. If the train of connections to the called line has been partly built up, it is necessary that steps be taken to restore all selectors to normal. This may take some time and the calling customer may wish to start another call at once, so the first step is to release the line immediately. Next the selectors in the train are put in position to restore to normal, and finally the sender is released. The procedure depends upon the class of call and the stage to which it has advanced when it is abandoned. When the calling customer has hung up long enough to release SR and SR1, LR operates through a front contact of ON2 and back contacts of SR1 and L, and it locks up to off-normal ground. LR operates STL as if dialing had been completed, to stop timing if station delay is being measured at the moment the call is abandoned, and to permit the final test to be made, to operate TP if a ring party was calling. The LR relay also prevents seizure of a transverter for LAMA calls. As described in 3.20 through 3.22, LR causes the immediate disconnection of the calling line by connecting low-resistance battery to the LR lead, but the sender proceeds undisturbed until AV1 is operated in some way, when the sender link switches and the district and office switches are released and the sender returns to normal. The following describes how AV1 is operated under different conditions and the preliminary operations.

A. Call Abandoned Before Marker is Engaged

14.02 If the call is abandoned before the sender has engaged a marker, no connection has been made through the district and office switches, and there will be no reason for the sender not to be disconnected at once. If a marker has been used and dismissed, but DST AB or DRL AC option is momentarily normal prior to a second trial caused by an overflow condition or trouble release, there may be a connection build up to a distant selector, but the latter has been put in condition to return to normal as described in 13.10 through 13.13 so the sender may be disconnected at once.

14.03 With AC option, but not with AB, is relay DST has operated, but due to marker delay, no marker has been engaged, relay LR operated removes battery from the CBS lead. The LR relay operates only before ground on lead SB4 from the marker connector, indicating marker engaged, has prevented release of relay SR1.

14.04 Under any of these conditions, AV1 operates at once through LR operated.

B. Call Abandoned While Marker is Engaged

14.05 When a marker is engaged it operates DC; then DRL and establishes connection to a trunk and checks a ground supplied to the district by a front contact of DRL connected to the LR lead, and finally it releases DC. If it should not find this ground it would block.

14.06 The operation of LR on an abandoned call normally removes ground from the LR lead and substitutes low-resistance battery. To prevent such action at the critical time when the marker is testing for ground, a front contact of DC is arranged to bridge the back contact of LR, so the battery is grounded out for as long as DC remains operated.

14.07 After the marker releases the sender, relay LR may operate with results as indicated in the following.

C. Full Selector Call Abandoned

14.08 In order to restore any distant selectors which have been seized, the sender is allowed to proceed with its regular functions until the first opportunity arrives to force an incoming or final selector to telltale, and that is done by preventing the satisfaction of the counting relays in the sender.

14.09 The sender completes any distant office selections in the route, makes trunk test and attempts incoming brush selection; or if the sender has progressed beyond that point before the call was abandoned, it attempts the next selection in order. Neither trunk test nor any selection is delayed for dialing 2-party or coin test because the paths through the normal hold magnets which ordinarily delay the release of FO1 and FO2 are opened at back contacts of LR or STL relay.

14.10 The release of SR1 opens the circuit from the contact of STP to prevent interference with distant office selections, but an incoming or final selection sends the selector to telltale.

14.11 The distant incoming selector sends a pulse of reversed battery over the fundamental, the sender recognizes it as described in 13.09, and then the sender makes a trunk closure as described in 13.10 through 13.13.

14.12 On a telltale caused in any way except by an abandoned call, the trunk closure is followed by the recall of a marker to make another trial, as described in 13.14. When LR is operated, the release of AV3 with AV2 operated causes AV1 to operate instead of grounding the TRL lead.

D. CI Call Abandoned

14.13 On abandoned CI calls where the TW relay is operated, see 7.51, to restore any distant office selectors which have been seized and to satisfy a CI attendant who may have been signaled, the sender is allowed to proceed with its regular functions to the end, but as far as possible, zeros are substituted for the dialed digits in the transmission of CI pulses.

14.14 The sender completes any distant office selections in the route, makes trunk test, awaits assignment, and then sends out the CI pulses and operates AV1 in the usual manner. Trunk test is not delayed for dialing or coin test because the path which ordinarily delays the release of FO1 is broken at a back contact of LR. All digits transmitted after the release of SR1 are sent as zeros because the operating paths of PT and PR are broken at front contacts of SR1. If dialing has not progressed far enough to operate either STA-STA' or STB-STB', the latter pair will be operated through front contact of CI1 and back of STA'. This prevents sending nine digits. If the call is not routed through a distant office selector and is in the awaiting assignment position, this time is canceled and the sender releases immediately.

14.15 If the assignment is delayed to such an extent that the sender reaches the stuck-sender position without assignment having been made, AV1 will then operate by a path through back contact of SR1, front of TG1 and front of CL2, thence through front of SS if monitored or automatic primed timing is employed or front of TN if timed release is employed.

14.16 If the TW relay is normal, it is not necessary to wait for assignment of the call to satisfy any distant office selector so, as soon as the sender makes trunk test, the AV1 relay operates from a front contact of S6', back contact TW, front contacts of CL2 and TG1 and back contacts of SR1 relay. This extinguishes the trunk lamp at the attendant position as soon as possible.

Auxiliary Sender Abandon Call

14.17 When a call is abandoned after an auxiliary sender is attached, the LR lead ground is extended to the auxiliary sender to operate its line release relay LR: and (a) If the release relay operates during CI pulsing the auxiliary sender opens the MF pulse generating supply circuit to prevent MF pulsing on the fundamental forward. This action stops MF pulsing of zeros for any remaining digits following the abandonment. When the customer sender opens the start lead to the auxiliary sender link, the auxiliary sender and the loop circuit drop off; (b) If the call is abandoned before the trunk test is completed to the remote office, the LR relay in the auxiliary sender operates. The action in the auxiliary sender is to open the fundamental circuit toward the remote trunk and to return an overflow signal to the customer sender. With IN option and if dialing has not yet progressed beyond the point when an auxiliary sender has been called in (SA normal) and decoding is complete, abandonment under this condition proceeds as follows. Relay FO1 and FO2 release serially and FO3, operating, closes the trunk guard bridge to the remote trunk and trunk test is made. Relay SWF operates when the trunk guard relay TG2 comes up, NB option. With NA option, relay AS must also be operated. The slow operate relays CI1 and CI2 are released at this moment. Opening of the fundamental by SWF appears as if assignment had taken place and the trunk guard relays drop and PCI pulsing begins. The CI register relays operate as on a normal call and when pulsing is complete, AV1 operates to release the sender (see 14.19).

E. Attendant Call Abandoned

14.18 The sender makes trunk test and that operates AV1 in the usual way. Trunk test is not delayed for dialing or coin test because the path which ordinarily delays the release of FO1 is broken at a back contact of LR and the 2-party check path is opened by CL3 operated.

F. CI Call Abandoned - Option IN

14.19 If a call is abandoned and the sender is wired for IN option the sender operations are as follows. Trunk test is started as on a line release call when LR and LR1 operate. With LR1 and TG2 operated, an operate circuit is closed to the winding of relay SWF, NB option (CI1 and CI2 are slow operate and are released at this moment). SWF operated opens the fundamental toward the remote trunk which drops the supervisory relay in the trunk and the trunk guard relays in the sender. This action now appears as the signal for PCI pulsing to begin. The PCI pulsing does not, however, go out since SWF, which is holding the fundamental open, is locked under control of LR1. Therefore, with the IN and NB options the sender completes its CI functions and operates the AV1 relay as on a regular CI class of call without calling in a remote tandem sender to aid in the disposition of this type of call on abandonment. With NA option the above is true only for MF calls and for CI calls the sender releases (see 14.13 through 14.14).

15. TIMING CIRCUIT AND TROUBLE CONDITIONS, WITH MONITORING OR AUTOMATIC PRIMING

15.01 This section describes the timing circuit and the procedure for permanent-signal, partial-dial, and stuck-sender condition in equipment where the two latter conditions are handled by a sender monitor. Time is measured by timing interrupter TM which has a 20-second cycle, closing its contact for 10 seconds and breaking it for 10 seconds, and timing interrupter TM1 which has a 10-second cycle, closing its contacts for 0.4 seconds and breaking its contacts for 9.6 seconds. The relays of the timing and trouble circuits are as follows: AL1, AL2, UL1, and UL2 auxiliary to the dial register circuit; timing TM1, TM2, TM3 and TM4; permanent signal PS, stuck sender SS; monitor lamp ML; monitor tip MT; and monitor sleeve MS and MS1; the last required only if coin service is provided. Interrupter SD is used to flash the sender lamp when it is necessary to signal the monitor.

A. Measurement of Time Intervals

15.02 From ON1 operated or elsewhere, ground is connected to interrupter TM or TM1, the TM relays being normal, TM1 operates when the interrupter is closed, TM2 operates on the first break following, TM1 releases on the second break. This 40-second cycle for interrupter TM or 20-second cycle for interrupter TM1 is repeated as long as the respective interrupter remains grounded.

15.03 Relays TM3 and TM4 are actuated by a front contact of relay TM2. When interrupter TM is used, relay TM3 operates in 0 to 20 seconds after the connection of ground to interrupter TM; TM4 operates 20 seconds later; and TM3 releases after 20 seconds more. When interrupter TM1 is used, relay TM3 operates in 0 to 10 seconds after the connection of ground to interrupter TM1, TM4 operates 10 seconds later; and TM3 releases after 10 seconds more.

15.04 The ground connected to the interrupter is also the locking ground for the TM relays, and whenever it is broken all the operated TM relays release.

B. Timing for Dialing to Start

15.05 The interrupter is connected to an off-normal ground lead through back contact of relay AL1, and when ON1 or ON4 grounds that off-normal lead the TM relays start to function.

15.06 When the sender is seized the timing circuit starts to measure for a period of 20 to 30 seconds when option JT is furnished or 20 to 40 seconds when option JS (Mfr Disc) is furnished. If the first digit is registered within that time, the timing circuit is restored and starts again. Otherwise a permanent signal is registered and the call is routed to a permanent signal trunk.

15.07 If a digit is dialed in time it registers on the A and AA registers and AL1 operates from a front contact of the AA hold magnet, to lock up for the remainder of the call. AL1 breaks ground from the interrupter and any operated TM relays release. When they are all normal AL2 operates to lock up for the remainder of the call unless ML should operate.

20- to 30-Second Permanent Signal Timing (Option JT)

15.08 If a digit is not dialed in time, the release of relay TM2 operates relay TM4. The next closure of interrupter TM1 operates relay TM1 and the subsequent open operates relay TM2 which, in turn, operates relay PS to start the permanent signal routing. The timing continues and if the call is not disposed of in ten seconds more, TM3 and TM2 both release operating relay SS. Relay SS operated, operates relay MF which calls in the sender monitor and opens the path from lead LR to ground through the front contact of relay DC (Y wiring only) so that relay LR can substitute low-resistance battery for ground on lead LR and cause the district junctor to free the customer line.

20- to 40-Second Permanent Signal Timing Option JS (Mfr Disc)

15.09 If a digit is not dialed in time, TM4 operates and locks, and causes PS to operate and lock starting permanent signal routing. The timing continues and if the call is not disposed of in 40 more seconds, TM3 and TM2 both release, causing SS to operate and lock up. SS operates ML which calls in the monitor and opens the path for the LR lead to ground through the front contact of the DC relay (Y wiring only) so that the LR relay can substitute low-resistance battery for ground on the LR lead and cause the district junctor to free the customer lines.

C. Timing for Dialing to Finish Except Stations (See Part 18. for Sender Supervisory Meters)

15.10 When the first digit has been dialed, the timing circuit starts again to measure a period of from 30 to 50 seconds. If the units digit is registered in that time, or the office code completed for an attendant call without number, the timing circuit is restored and starts again. Otherwise the sender monitor is signaled.

15.11 When relay AL2 operates during restoration of the timing circuit after the registration of the first digit, it grounds the interrupter through a back contact of UL1. This starts the TM relay on another cycle.

15.12 If the units digit is dialed in time, it registers on the U register and UL1 operates from a front contact of the U hold magnet, to stay up for the remainder of the call. When the dialing is completed on an attendant call without numericals, relay STL is operated as described in 5.50 through 5.52 and STL operates UL1, to stay up for the remainder of the call. UL1 breaks ground from the interrupter and any operated TM relays release. When they are all normal, UL2 operates to lock up for the remainder of the call or until CNL or SS operates.

15.13 If the dialing is not completed in time, TM4 operates and locks in 20 to 40 seconds, and 10 seconds later TM1 operates and causes ML to operate and lock. This calls in the monitor, but if the dialing is completed before the monitor answers, UL1 operates, restores the TM relays and ML, and the connection proceeds as if there had been no delay.

D. Timing for Release

15.14 When dialing has been completed except for a registration on the station register, the timing circuit starts again to measure a period of from 30 to 50 seconds, unless the call is routed through a distant office selector or is of a CI class, when the period measured is from 60 to 80 seconds. If the call is not disposed of and the sender released in that time, the sender monitor is signaled.

15.15 When relay UL2 operates on the restoration of the timing circuit after the completion of dialing, it grounds the interrupter and so starts the TM relays on another cycle.

15.16 If the sender is not released within 30 to 50 seconds, TW and CL2 normal, TM4 operates and locks in 20 to 40 seconds, and 10 seconds later TM1 operates and causes SS to operate and lock. If the sender is not released in 60 to 80 seconds, TW and/or CL2 operated, TM3 and TM2 release and, with TM4 locked up, cause SS to operate and lock. SS operates ML which calls in the monitor, but if the sender is released before the monitor answers, SS and ML release with all the other relays, and the monitor signal is extinguished. The operation of the TW or CL2 relay is determined by cross-connections in the marker. If the equipment beyond this sender times out and gives the sender a reversed battery signal for a second trial, the timing is momentarily reduced by the release of the TW or CL2 relay and the SS relay may operate with AP option. With AQ option, the stuck sender timing is recycled when relays TR1 and TR2 operate for a trial second marker trial.

15.17 If a coin test is made and fails while the sender is timing for release, relay CNL operates to call in an attendant as described in 6.20 through 6.23.

CNL releases UL2, which stops the timing and restores the TM relays. If the coin test is then satisfied on a retest, CNL releases, UL2 reoperates, and the timing for release starts again.

E. Permanent Signal

15.18 If PS operates because dialing does not start in the time allowed, it calls in a marker and sends it the permanent signal indication as described in 7.02 through 7.07 and 7.24 through 7.27. A connection is then made to a permanent signal trunk in the same manner as other attendant class calls are completed. If the sender receives a trouble release signal from the marker, the sender releases as described under 12.07. With LAMA the sender connects to the maintenance recorder and transmits the calling line PS number, also a no-trunk signal if all PS trunks are busy.

F. Partial Dial

15.19 If ML operates because dialing is not finished in the time allowed, it releases AL2 and releases the TM relays. It also grounds interrupter SD and switches its connection to flash the sender lamp and grounds the auxiliary signal circuit at the A switchboard.

G. Stuck Sender

15.20 If SS operates because the sender is held beyond the time allowed after dialing is completed, it operates ML, which releases AL2 and signals the monitor as described in the preceding subsection.

15.21 Relay SS grounds the common SS lead to a stuck sender register operating the same. This ground is held on the common lead only while ML is operating and AL2 releasing.

15.22 If SS operates because the sender is held 40 seconds after PS operates on a permanent signal, it operates ML to signal the monitor as above, but does not operate the stuck sender register because AL2 has not been operated.

15.23 Relay SS operated, removes direct ground from the LR lead (Y wiring only) which permits the LR relay to substitute low-resistance battery for ground on the LR lead and causes the district junctor to free the customer line.

Pushbutton Call, Stuck Sender - Option IZ

15.24 In case the converter circuit detects a mutilated digit, it will connect ground to lead MTD and prevent the operation of relay AV1 when the CTR key in the sender make-busy frame is operated. The converter circuit also connects overflow tone to lead OF to return overflow to the calling customer, when the converter encounters a trouble condition.

H. Monitoring

15.25 A sender which is stuck due to failure to release, may be released as on an abandoned call if the customer hangs up either before the monitor answers the lamp or after disconnect.

15.26 Upon observing a lamp signal the monitor will plug into the talking jack with a talking cord. Battery on S operates relay MS, which extinguishes the lamp and cuts off the auxiliary signal while the plug is in the jack. MS operates MS1 if furnished, the operation of MS or both relays opening leads T and R from the dialing circuit so no further registration can be effected if it is a partial dial, and closing them to the talking jack. These relays close a local circuit to hold relay L operated, to prevent breaking the connection between line district and sender.

15.27 The monitor will request the customer to clear the connection by hanging up, and will then remove the cord plug. This failing, the monitor can frequently cause a release by inserting the talking plug momentarily in the priming jack. Ground from the tip of the talking cord operates relay MT.

15.28 If relay DST has not operated, the dialing not having progressed far enough to call for a marker, PS will operate through front contacts of MT and RA1 or L2 and back contacts of TR1 and DST. The calling line will then be connected to a permanent-signal trunk. The front contact of RA1 or L2 prevents the operation of PS if the sender is primed by mistake while idle.

15.29 If DST has been operated, either DST or TR1 will be operated and ground through two front contacts of MT and a front contact of DST or TR1, will operate LR if not already operated when SR1 is released by the customer hanging up. If LR was not already operated, the district will disconnect the calling line, releaseing L, SR, and SR1, and AV1 will not operate until SR1 has released. AV1 will cause the disconnect of the sender as usual. The operating leads for LR and AV1 are carried through back contacts of PS, so they cannot operate on an early stuck sender release which operates PS and then DST.

15.30 If the attempt to release a stuck sender fails, the lamp will light again when the plug is withdrawn.

15.31 If the plug of the talking cord is left in the priming jack instead of being immediately withdrawn, or if it is inserted in the priming jack of an idle sender by mistake, it will hold the sender busy by MT operating ON1 and will, in time, flash the monitor lamp if it is not already flashing.

15.32 Whenever relay MB is operated, the lamp burns steadily.

I. Automatic Priming After Time-Out

15.33 When the ML relay is operated by either a partial-dial or stuck-sender condition, it locks to off-normal ground and operates the MT relay. The operation of MT relay will light the SS lamp at the sender make-busy frame and will automatically prime the sender as occurs with sender monitoring, described in 15.27 through 15.29, and when the operator inserts the talking cord plug in the priming jack.

15.34 If the attempt to release the sender fails, the SS lamp will remain lighted and after an interval of 6 to 13 seconds, the associated delay alarm circuit (AL) lamp will light and the aisle pilot and audible alarms will operate. A make-busy plug inserted in the MB jack operates the MB relay and also retires the alarm signals.

15.35 If Fig. AA Mfr Disc is equipped, the SS lamp signal will be flashing instead of steady.

16. TIMING CIRCUIT AND TROUBLE CONDITIONS WITH TIMED RELEASE - A&M ONLY

16.01 This section describes the timing circuit and the procedure for permanent-signal, partial-dial, and stuck-sender conditions, in equipment where under the two latter conditions the connection is automatically released. Time is measured by a timing (TM) interrupter which has a 20-second cycle, closing its contact for 10 seconds and breaking it for 10 seconds, and timing TM1 which has a 10-second cycle closing its contacts for 0.4 seconds and breaking its contacts for 9.6 seconds. The relays of the timing and trouble circuits are as follows: AL1, AL2, UL1, and UL2 auxiliary to the dial register circuit; timing TM1, TM2, TM3, and TM4; permanent signal PS; tone TN; stuck sender SS; and register REG.

A. Measurement of Time Intervals

16.02 Whenever ground is connected to interrupter TM or TM1 with the TM relays normal, TM1 operates when the interrupter is closed, TM2 operates on the first break following, TM1 releases on the second closure, and TM2 releases on the second break. This 40-second cycle for interrupter TM, or 20-second cycle for interrupter TM1 is repeated as long as the respective interrupter remains grounded.

16.03 Relays TM3 and TM4 are actuated by a front contact of relay TM2. When interrupter TM is used, relay TM3 operates in 0 to 20 seconds after the connection of ground to interrupter TM, relay TM4 operates 20 seconds later and relay TM3 releases after 20 seconds more. When interrupter TM1 is used, relay TM3 operates in 0 to 10 seconds after the connection of ground to interrupter TM1, relay TM4 operates 10 seconds later, and relay TM3 releases after 10 second more.

16.04 The ground connected to the interrupter is also the locking ground for the TM relays and, whenever it is broken, all the operated TM relays release.

B. Timing for Dialing to Start

16.05 The interrupter is connected to an off-normal ground lead through back contacts of relays AL1 and SS, and when ON1 grounds that off-normal lead, the TM relays start to function.

16.06 The timing circuit starts to measure a period of 20 to 30 seconds when option JT is furnished or 20 to 40 seconds when option JS (Mfr Disc) is furnished. If the first digit is registered within that time, the timing circuit is restored and starts again. Otherwise, a permanent signal is registered and the call is routed to a permanent-signal trunk.

16.07 If a digit is dialed in time it registers on the A register and AL1 operates from a front contact of the AA hold magnet to lock up for the remainder of the call. AL1 breaks ground from the interrupter and any operated TM relays release. When they are normal AL2 operates to lock up for the remainder of the call unless SS should be operated.

20- to 30-Second Permanent-Signal Timing (Option JT)

16.08 If a digit is not dialed in time, the release of relay TM2 operates relay TM4. The next closure of interrupter TM1 operates relay TM1 and the subsequent open operates relay TM2 which in turn operates relay PS. Relay PS operates relay TN when option CD is furnished, or SS when option CE is furnished. The timing continues and if the call is not disposed of in 10 seconds more, further action is taken as described in 16.17 and 16.18.

20- to 40-Second Permanent-Signal Timing - Option JS (Mfr Disc)

16.09 If a digit is not dialed in time, TM4 operates and locks, and causes PS to operate and lock up, and that, in turn, operates TN, with CD option, or SS with CE option. The timing continues and if the call is not disposed of in 10 seconds more, further action is taken as described in 16.17 and 16.18.

C. Timing for Dialing to Finish Except Stations - (see Part 18. for Sender Supervisory Meters)

16.10 When the first digit has been dialed, the timing circuit starts again to measure a period of from 20 to 40 seconds. If the units digit is registered in that time, or the office code completed for an attendant call without numericals, the timing circuit is restored and starts again. Otherwise a disconnect tone is sent to the calling customer.

16.11 When relay AL2 operates on the restoration of the timing circuit after the registration of the first digit, it grounds the interrupter through a back contact of UL1. This starts the TM relays on another cycle.

16.12 If the units digit is dialed in time, it registers on the U register and UL1 operates from a front contact of the U hold magnet, to stay up for the remainder of the call. When the dialing is completed on an attendant call without numericals, relay STL is operated as described in 5.50 through 5.52, and STL operates UL1, to stay up for the remainder of the call. UL1 breaks ground from the interrupter and any operated TM- relays release. When they are all normal, UL2 operates to lock up for the remainder of the call unless SS should operate or for second trial.

16.13 If the dialing is not completed in time, TM4 operates and locks and causes REG to operate, operating TN which locks up to send out the tone. Then TN releases REG. The timing continues and if the customer does not hang up and release the sender in 20 seconds more, further action is taken as described in 16.20 through 16.24.

D. Timing for Release

16.14 When dialing has been completed, except for a registration on the stations register, the timing circuit starts again to measure a period of from 20 to 40 seconds unless the call is routed through a distant office selector, crossbar tandem, or is of a CI class, when the period measure is from 60 to 80 seconds. If the call is not disposed of and the sender released in that time, a disconnect tone is sent to the calling customer.

16.15 When relay UL2 operates on the restoration of the timing circuit after the completion of dialing, it grounds the interrupter and starts the TM relays on another cycle.

16.16 If the sender is not released within 20 to 40 seconds, TW and CL2 normal TM4 operates and locks, and operates REG. REG, in turn, causes TN to operate and lock up to send out the tone. Then TN releases REG. If the sender is not released in 60 to 80 seconds, TW and/or CL2 operated, TM3 and TM2 release and with TM4 locked up, cause REG and TN to operate. The timing continues and if the customer does not hang up and release the sender in 20 seconds more, further action is taken as described in 16.25 through 16.42. The operation of TW or CL2 relay is determined by cross-connections in the marker. Timing is recycled on a second trial with AQ option.

E. Permanent Signal

16.17 With CD option, if PS and TN operate because dialing does not start in the time allowed, PS calls in a marker and sends it the permanent-signal indication as described in 7.02 through 7.08 and 7.24 through 7.27. A connection is then made to a permanent-signal trunk in the same manner as other attendant class calls that complete, see Part 12. The operated PS relay locks to off-normal ground; operates relay DST calling in a marker; grounds marker leads A1 and A4;

connects leads A2 and A5 to the CK1 lead; releases the A register; opens the TP operate test path; partially closes the AV1 operate path and operates the TN and then the SS relay after a delay.

16.18 With CE option, the TN relay does not operate, the SS relay operates 10 seconds after the PS relay operates and no disconnect tone is given. If the sender is not released in 10 seconds after PS operates, TM1 will operate and SS then operates through front contacts of TM1 and a back contact of AL2. SS locks up and releases all other timing circuit relays except PS. When TM4 releases, it lights an individual sender lamp and energizes the auxiliary signal at the sender make-busy frame.

16.19 If relay MB is operated to keep the sender out of service, the auxiliary signal lead is broken.

F. Partial Dial

16.20 If TN operates, because dialing up to stations is not completed in the time allowed, it sends out a distinctive tone. REG operates momentarily in the process of operating TN, and grounds a common partial dial register circuit long enough to operate the register.

16.21 If the calling customer does not hang up and release the sender within 20 seconds after TN operates, TM1 will operate and then TM2, causing the operation of PS if the dialing has not progressed far enough to operate DST, or LR if DST or TR1 is operated. If PS operates, the customer is connected to a permanent-signal trunk; if LR operates, the line is disconnected and the sender released as if the customer had hung up, as described for abandoned calls.

16.22 If the sender is not released in 10 seconds after PS or LR operates, TM1 releases and operates UL1, which locks. This releases the TM relays, operates UL2 and starts timing for release as if the dialing had been completed.

Auxiliary Sender Partial Dial

16.23 Handling of DDD calls on partial dial deviates considerably from ordinary local operation. Since the auxiliary sender is under control of the subscriber sender, release of the former circuit after time-out must be through some expedient to start a satisfactory disconnect of both senders. Ordinarily if dialing has progressed to the point where an auxiliary sender has become attached, SA operated, release conditions are derived by setting up overflow in the subscriber sender. When the auxiliary sender times out in 6 to 12 seconds, it sends a reversal to operate OF and at the same time grounds lead DC to operate STL. OF and STL operated begin a series of relay operations to release and reoperate relay DST. When the marker attempts second trial the sender indications to it are for overflow since operation of SA has extended the TR2 ground on lead AR to be on lead OF also.

16.24 When no auxiliary senders are available on either DDD or 7DG calls and the customer stopped dialing after the seventh digit the following circuit operation ensue: (a) on the DDD call after short timing 3 to 5 seconds, STB operates to a front closure of interrupter SD. STB' operates when interrupter SD leaves its front contact. STB' closes a path to operate STL. STL operated starts a chain of relay releases and operations to close the fundamental for trunk test. A wink signal returned by the remote sender operates OF. The call now goes to overflow on the third trial, because neither SA nor DPT was operated under these conditions; (b) on the 7DG call when dialing is complete STL operates either immediately, HJ option, or after 3 to 5 seconds timing, HI option, to allow time for a possible eighth digit and after the fundamental is closed, the remote trunk returns a reversal and the call is rerouted to exclude the auxiliary sender and if no trunks are available for a new sender class setting the call goes to overflow immediately on the second marker operation; (c) when dialing is stopped after the sixth digit on a 7DG call where HJ wiring is applied, the call must await sender time-out to release itself and the auxiliary sender.

G. Stuck Sender

16.25 If TN operates because the sender is held beyond the time allowed after dialing is completed, or after an ineffectual effort to dismiss it following a partial dial, it sends out an interrupted tone. REG operates momentarily in the process of operating TN, and grounds a subgroup stuck sender register circuit long enough to operate the register except where the sender is stuck due to coin test failure when Fig. AL is used.

16.26 If the calling customer does not hang up and release the sender within 20 seconds after TN operates, TM1 will operate and then TM2, causing the operation of LR. This causes the disconnection of the line and perhaps the release of the sender as if the customer had hung up as described for abandoned calls.

16.27 To release the sender on an abandoned call requires the operation of AV1. If it is not operate in the normal manner after LR starts the disconnection, SS will be operated 10 seconds later by the release of TM1, and that operates AV1 unless PS is operated, when it is not desired to so disconnect.

16.28 If the sender still fails to release, TM2 releases after another 10 seconds and breaks the locking circuit for TM4 and TN, which was partially broken by the operation of SS. The release of TM4 with SS still locked up, lights the individual sender lamp and energizes the auxiliary signal at the sender make-busy frame.

16.29 The operated SS relay removes direct ground from the LR lead which permits the operated LR relay to substitute low-resistance battery for ground on the LR lead and causes the district junctor to free the customer line.

16.30 If relay MB is operated to keep the sender out of service the auxiliary signal lead is broken.

16.31 If the equipment in train times out and gives this sender a reversed battery signal for a second trial, the timing is momentarily reduced by the release of the TW or CL2 relay and the REG relay may operate, with AP option but not with AQ option as the timing is recycled.

Pushbutton Call, Stuck Sender - Option IZ

16.32 In case the converter circuit detects a mutilated digit, it will connect ground to lead MTD and prevent the operation of relay AV1 when the CTR key in the sender make-busy frame is operated. The converter circuit also connects overflow tone to lead OF to return overflow to the calling customer, when the converter encounters a trouble condition.

H. Priming Canceled

16.33 To prevent the forced operation of AV1 to hold the sender for tracing trouble, the cancel priming key (CTR) at the sender make-busy frame is operated. This opens the circuit through front contact of SS to the winding of AV1, but it interferes in no way with the operation of SS or the lighting of the lamp. If the key is restored after SS has operated and locked up, the circuit is closed to operate AV1 and to clear out the sender if possible.

17. SENDER LOAD CONTROL CIRCUIT - FIG. L TO Q INCLUSIVE - MFR DISC

17.01 When a number of the senders in the unit are busy, the sender load register circuit connects battery to the LC lead through relay ON1 normal, operating the load control relay LC, used in part of the senders. This opens the lead to the pulsing relays to prevent the recording of any pulses, grounds leads A2 and A4 to the marker and connects leads A1 and A5 to the CK1 checking lead.

17.02 When the sender is seized, operating relays L, SR, and SR1, relay CL operates, operating relay DST to seize the marker. The call is routed to a special group of attendant trunks or to overflow and the customer is cut through by the district junctor, releasing the sender. Relay ON1 operated, opens the operating path of relay LC and that relay remains locked to off-normal ground through the contacts of relay CTA, if used.

17.03 Relay AL1 is operated to remove dial tone and prevent permanent signal routing.

17.04 If it is desired to handle coin service calls (Fig. E and AL only) in a different manner from the noncoin service, relay CTA is furnished to open the locking path of relay LC. The load control feature may not be desired for coin service (either of the coin first or dial-tone-first type) therefore, Fig. Q will be required and Fig. P omitted. Figures M and O will be provided when specified and Fig. Q is provided only when coin service is to be routed differently from noncoin service with the load control feature. When coin senders with a preliminary coin test feature are used, the class wiring, which formerly operated the CTR relay, now operates relay CTA from local ground and the CTR relay is operated from controlled ground through the operated contacts of the CTA relay. For noncoin senders, the HA or HB wiring is also used to operate relay CTA when coin distribution is required (coin first service). The operation of relay CTA releases relay LC as soon as relay ON1 operates, and permits the call to proceed in the usual manner.

17.05 When Fig. G (2-party MR) is used with AF wiring, the blocking path is opened when relay LC operates.

18. SENDER SUPERVISORY METERS

18.01 Figure 4 is provided to operate the load measuring meters shown on the sender make-busy frame circuit. That circuit provides two MAM, one to show the number of senders that have remained in one dialing position for more than the SSM (slow sender meter) interrupter cycle period of 5 to 12 seconds. The other meter indicates the number of senders that have not completed their functions in 5 to 12 seconds after dialing had been completed.

18.02 As soon as the first regular code digit has been dialed, relay AL1 operates (see 5.33) connecting ground through RA1 operated (see 5.08) to the SSM interrupter. The B closure operates relay LM which locks to the interrupter ground. Five seconds later, relay LM1 operates, locking to the operating ground and connecting ground through 1900 ohms to the partial dial meter circuit. If the RA1 relay releases due to the dialing of another digit, the LM relay releases and this cycle is repeated until the UL1 or UL2 relay operates. This indicates the completion of dialing and the 1900-ohm ground path is transferred to the other meter circuit and the timing cycle is repeated for slow termination.

18.03 Figure AS is required for time release senders and Fig. AX or AY for sender monitor operation.

19. TOLL DIVERSION OF PBX TRAFFIC - FIG. BM

SYNOPSIS

19.01 When toll calls dialed by PBX customers are to be denied machine completion, the crossbar system previously required these PBX lines to be segregated so that the service class signal could be established,which the originating marker translates for denied route. The use of local or centralized automatic message accounting, extended area dialing or DDD makes it important to divert these PBX toll calls without requiring line segregation or service class marks, and without loading this denied traffic on the DSA switchboard.

19.02 This circuit has been arranged to provide a feature for toll diversion, which causes the sender to reverse the dialing tip and ring after dialing completion under control of a signal received from the originating marker on all toll calls requiring it. The reversal serves no purpose on non-PBX line, however, on PBX lines equipped for toll diversion, a polar relay in the PBX trunk circuit responds to the reversal and diverts the call to the PBX operator. Crossbar central office equipment thereby is released early.

A. Full Selector Call

19.03 The TDV lead is grounded by the marker when the dialed code indicates that the toll diversion signal is required. The TDR relay Fig. BM operates from ground on lead TDV and locks to relay TDS normal.

19.04 The sender functions as described in Part 10; full selector call, and when dialing is completed, relay STL is operated. Relay TDR operated transfers an operating path of relay AV1 from IA and FO relays operated to relay TDC normal, and closes the winding of relay TDC to a make contact on STL to off-normal ground. Relay TDC operated locks independently of the TDR relay to the locking circuit of relay STL under control of AV1 HH option. This allows TDC to release sooner to prevent a false supervision signal to a PBX operator on a toll call which is being established for nontoll diverted line. Although the toll diversion feature is not involved in coin service at the present time, the operate path of relay TDC is brought through contacts of relay CCT, Fig. E or AL, when the circuit is equipped for coin service. This is done to give the feature greater flexibility. Figure BN is provided where the coin test feature, Fig. E or AL, is not equipped to enable the operation of relay TDC. The make-before-break contacts 1-2-3 top and bottom of relay TDC provide means for connecting battery and ground through the windings of the TDS relay in opposite polarity, and in parallel with the battery and ground on leads T and R at the L relay and coil TN without opening the circuit to the customer. The TDC relay fully operated removes the L relay and coil TN from the T and R leads leaving relay TDS across the line, and providing battery to the tip and ground to the ring, constituting a line reversal.

19.05 With relays TDR and TDC operated, the operating path of relay AV1 is opened, pending the operation of relay TDS and the release of relay TDR.

19.06 Relay TDS operated places a holding ground to relays L1 and SR, maintaining switchhook supervision and, should the customer hang up, relay TDS will release, releasing relays L1 and SR to permit the LR relay to operate, enabling this circuit to release as described in Part 14.

19.07 If a PBX customer, equipped with a toll diverting trunk, is attached, the operation of a polarized relay in that circuit will cause the diverting trunk to open the tip and ring and transfer the PBX customer to the PBX operator or PBX tone diverting circuit. The tip and ring opened constitutes an abandoned call, and this circuit functions to operate relay LR, as previously described.

19.08 In all other cases, the line reversal has no functional effect, and when relay TDS operates relay TDR is released reclosing the operate path of the AV1 relay. Relay AV1 operated locks and removes ground from the bottom 2 contact of relay TDS releasing relays L1 and SR, and starts a series of operations described in 3.15 through 3.19 to release the sender.

19.09 When this circuit is serving 2-party lines, a test is made after dialing for party verification. The test is started when relay STL operates by releasing the ON3 relay of Fig. G.

19.10 If the code dialed necessitates the toll diversion feature, the TDR relay is operated and when relay STL operates, the TDC relay operates in parallel with relay STL and locks around relay TDR to the locking circuit of relay STL.

19.11 The operation of relay TDC removes relay L and coil TN from the tip and ring leads and closes battery to the tip and ground to the ring through the primary and secondary winding of the TDS relay. As relay TDC operates the sequence contacts will momentarily close the L relay winding and tone coil ground to the windings of relay TDS. The TDS will start to operate and when the TDC relay is completely operated, the L relay and TN coil are removed, and the tip and ring closed to the TDS relay windings to hold relay TDS. However, the ON3 relay is releasing due to the party test. The tip and ring opened by the released ON3 relay will cause the TDS relay to release. The ON3 relay released also provides a circuit to hold relays L1 and SR operated preventing a false line release. At the completion of party test, assuming that the test was satisfactory, the ON3 relay is reoperated and closes the TDS relay windings to the dialing tip and ring. The TDS relay operates and releases relay TDR. With relay TDR released, the operating path for relay AV1 is closed in preparation for the ground signal received at incoming advance selection. Relay AV1 operated, locks and starts a series of operations described in 3.15 through 3.19 to release the sender.

B. Toll Diversion and LAMA

19.12 When the toll diversion feature is used in conjunction with LAMA options, wiring IL is associated with Fig. BM and AV. The circuit action is essentially the same as described in 19.03 through 19.11. When the dialed code indicates a PCI class, relay STL is operated as described in 5.53 and relay TDC is operated in parallel with it. The operate path to AV1 is opened by the operated TDR and TDC relays. Relay TDS, which is in the subscriber line circuit, partly restores the AV1 operate path when TDC operates. Relay ON3 releases when STL operates upon completion of dialing and releases the TDS. TDS operated drops TDR and relay AV1 now operates. For a dialed DDD code, AV1 operates from a ground signal over the AV1 lead from the auxiliary sender.

20. TAKING EQUIPMENT OUT OF SERVICE

20.01 When necessary a sender may be taken out of service by the insertion of a 322A plug into the MB jack on the sender make-busy frame associated with the subscriber sender to remove it from service. The MB jack is equipped for each subscriber sender on the make-busy frame.

20.02 The following precautions must be observed when working on relays under the stated conditions listed in table below.

RELAY	BLOCK RELAY	INSULATE	TO PREVENT	CONDITION IN SENDER
AST	ARL Operated		Seizing Transverter Connector	LAMA
CNL	MS Operated		(a) Lighting Coin Lamp at Sdr Monitoring Pos (b) Alarm at "A" Switchboard	
CT1	CNL Nonoperated		Alarm at "A" Swbd	Coin Senders Arranged for Monitoring
LM1		(a) 8B UL1 Fig. AY or 6B UL1 Fig. AQ		- Sdr Arranged for Monitoring
		(b) 7B UL1 Fig. BC		- Sdr Arranged for Timed Release
		(c) 6B UL1 Fig. AS		- Sdr Arranged for Timed Release and Message Register
ML	MS Operated		Alarm at "A" Swbd	

20.03 When maintenance is required on sender connect (SC1, SC2, SC3, and SC4) relays the sender may be taken out of service by the insertion of a 322A plug into the GB- jack of the associated sender group. The associated lighted GB lamp indicates that all senders associated with the same link and controller group are busy.

21. DIRECT DISTANCT DIALING (DDD) - FIG. 7

21.01 A direct distance dialed (DDD) 10-digit call, is initiated by the customer upon dialing an XOX or XIX code. On this type call an auxiliary sender will be required to register and send two additional dialed digits. Eight of the dialed digits are registered as usual in the subscriber sender crossbar switch, see Part 5., and the two additional digits are registered in the auxiliary sender. After trunk test is completed by the auxiliary sender a PC1 assignment is made on this class of call, eight registrations (the area and office codes and thousands and hundreds of the numericals) are CI pulsed to the auxiliary sender. When the first digit of the area code is pulsed to the auxiliary sender and upon receiving this digit, the KP signal being outpulsed at this time is stopped toward the remote office. When the subscriber sender is pulsing the second digit, the auxiliary sender MF pulses forward the first digit sent by the subscriber sender. Similarly this process continues until the auxiliary sender is MF pulsing forward the seventh digit and the subscriber sender is CI pulsing its eighth and last digit registered in it. The remaining two digits, which were pulsed directly into the auxiliary sender over a single pulsing lead, are MF outpulsed to the remote office after outpulsing the eighth digit received from the subscriber sender.

21.02 The sender recognizes a 10-digit call from a registration of 0 or 1 on the B register switch. If the registration 0 or 1 is present relay AS in Fig. 7 operates through its own early make contact and locks to direct ground providing: (a) relays DPT and SA in Fig. 7 are normal; and (b) the decoder start (DST) relay is operated. The early make contacts are necessary so that the lead from the common B register contact may be disassociated with ground to prevent false CI pulses later.

21.03 When KO option is furnished the AS relay is operated by the 10 DG relay which operates from marker action.

21.04 Relay AS operated partly closes a start (ST) lead toward the auxiliary sender link. It also closes the sender attached (SA) lead toward the auxiliary sender link. After registration of units, the start lead is grounded to the auxiliary sender link. If an auxiliary sender is available the sender is connected to it.

21.05 Operation of the sender SA relay indicates that an auxiliary sender is attached. Crosspoints on the auxiliary sender link crossbar switch close 9 control leads between the two sender circuits. The leads are designated CL, DC, AV1, P1, LR, FTI, and FRI (inward fundamental leads toward the auxiliary sender), and FTO and FRO (outward fundamental leads out of the auxiliary sender).

21.06 Upon dialing of the eighth or stations digit, transfer of the dial pulsing lead is effected when relay DPT operates. When AS operated, 10-digit call, the operate path to the stations register hold magnet was directed to DPT instead of ST hold. Ground to operate the DPT is closed from a contact of SM3, through SM, 75-ohm resistor, and the 65-ohm secondary winding of SM2 and steered by back contacts of RA3, RA5, front contacts of CL, HL, AS and through an early make on the DPT. DPT operated locks through resistor DPT (250 ohms) to off-normal ground and reverts the normal operate path to the stations hold magnet. ST operated returns ground over its operate path which, in addition, now contains a make on DPT, and SM2 releases as it normally would to indicate a completed registration.

21.07 Relay DPT operated transfers the pulsing off the L relay for the ninth and tenth digits into the auxiliary sender. The pulsing off the back contact of L is directed by DPT to a dial pulse repeater circuit in the auxiliary sender over lead P1. The repeater provides two counting leads to dial pulse counting relays. To provide better pulsing by the subscriber sender L relay, the other L-relays are removed from the L relay circuit by DPT operated. Register advance in the auxiliary sender is provided by the repeater circuit.

21.08 Relay SWF follows the operation of relay SA when relay CL2 (LO option provided) is operated. The operation of the SA relay indicates a sender is available and the operation of the CL2 relay indicates the marker has determined an auxiliary sender is required. These operations should occur before the fundamental is switched. SWF operated, switches the fundamental tip and ring of the subscriber sender to the inward fundamental circuit of the auxiliary sender. The subscriber sender trunk guard bridge now is connected to the auxiliary sender instead of the usual remote trunk. SWF also closes an outward fundamental circuit toward the sender link from the auxiliary sender for trunk test and multifrequency pulsing.

21.09 After the ninth and tenth digit dialing is completed, the auxiliary sender returns ground over the DC lead which operates the STL relay to indicate that dialing is complete. The subscriber sender receives an AV1 lead ground after the auxiliary sender completes MF pulsing.

21.10 The subscriber sender provides skip information over its CL lead, and on abandoned calls grounds its LR lead to the auxiliary sender.

21.11 Seven-digit calls (7DG) requiring an auxiliary sender on tandem or toll codes are treated similarly to 10-digit calls. When the marker recognizes that the dialed code requires 7-digit treatment, it returns ground to the sender over the 7DG lead to operate the 7DG class relay. The SK2 or SK3 relay is operated as required on the call over the SK2 or SK3 from the marker. These relays lock under control of the decoder start and release relays, DST and DRL. The auxiliary sender recognizes the 7DG call when CI trunk test is made to it by the subscriber sender and if no digits have been dialed into it. Under this class condition, relay DPT is prevented from operating, when a stations digit is registered, by the operated 7DG.

21.12 When the marker operates the 7DG relay, a start signal is sent toward the auxiliary link after units is registered, HI option, or after tens is registered, HJ option. The 7DG relay operated partly prepared the start circuit path when it operated AS. 7DG operated closes a DC lead into the auxiliary sender from the stations register. Ground over this lead indicates to the auxiliary sender that an eighth digit has been registered. AS and 7DG operated partly close the dialing complete path to relay STL.

21.13 The SWF relay operates as on a 10-digit call which is after the SA relay and CL2 relay (LO option) operates. The operation of the SA relay indicates an auxiliary relay is available and the CL2 relay indicates the marker has determined an auxiliary relay is required. It is not desirable to switch the fundamental until these operations have occurred. This method of operating SWF also prevents its unneeded operation on service code calls where additional digits might be dialed. SWF operated prevents operation of STB' to: (a) prevent a premature operation of STL on an 8-digit call; and (b) to allow the stations digit or eighth dialed digit to be CI pulsed as a regular ten thousands type rather than a stations type digit.

22. INTERSENDER TIMING (IT) - FIG. 15

22.01 In order to facilitate release of the sender in the event that selection or assignment cannot be made following trunk test, a virtual work timing of 3 to 6 seconds is, in effect, substituted for the long real work timing. The shorter timing becomes effective only if a signal is present from the load register circuit indicating that a minimum percentage sender group busy condition exists. This timing begins at start of trunk test. If a remote trunk is not able to seize a terminating sender in the 3- to 6-second interval, the call is routed to announcement or overflow.

A. IT and Full Selector Calls

22.02 On trunk guard when relay TG2 operates, ground closure is completed on lead IT to the operate side of relay IT. On the mechanical type call, IT is locked to the FO relay through a normal contact on the CI2 relay. If no selections are made, the IT lead ground is extended and maintained on the armature or interrupter IT. The interrupter pulses are counted by one cycle of W-Z operation on relays IT1 and IT2. When the cycle is completed after 3 to 6 seconds, which occurs when IT1 is released and IT2 is operated, this combination locks under control of a normal contact on IT1, a front contact on IT2 and AV1 normal with DST operated and extending ground from ON4 operated. The IT interrupter, upon returning to its back contact, extends the IT ground to operate relays OF. With this combination of operated relays, the circuit functions to recall a marker and set the call to announcement or overflow. Both the AR and OF leads are grounded toward the marker by TR2 and IT2 operated.

B. IT and CI Calls

22.03 A similar set of functions occurs when the class is a CI type. Under these conditions, however, the locking circuit to the IT relay is unnecessary and is canceled by CI2 operated. Ground on the IT lead now persists as long as the minimum busy condition exists and, if no assignment is made, relay OF is operated in 3 to 6 seconds to start a part of the overflow cycle.

C. IT and DDD Calls

22.04 Since the auxiliary sender is intermediary to the sender and the remote office, intersender timing would not become effective under these conditions. The auxiliary sender controls a low-resistance wet loop to be closed toward the subscriber sender only after a terminating sender is seized. Therefore IT is meaningless since the auxiliary sender waits for the assignment and closes the wet loop only upon completing assignment, hence IT is not effective under these conditions.

23. SIX-DIGIT TRANSLATION (SENDER RECYCLE)

23.01 Registration of any DDD area code on the A, B, and C registers of the subscriber sender will operate a start relay in the subscriber sender recycle circuit associated with the sender when registration of these three dialed digits is complete, as indicated by an operated CL relay. An idle connector in a code compressor connector circuit brought in by the operated start relay connects the recycle circuit and code leads, which normally carry this registered information to the marker, to an available code compressor circuit. If the code requires it, the compressor circuit translates and compresses the code to a single digit and registers it in the recycle circuit on a two-out-of-five basis. If compression of the code is not required, an auxiliary sender start signal is sent back to the sender via the subscriber sender recycle circuit for auxiliary sender treatment.

23.02 If the code is one requiring compression and after this is accomplished, as described by the compressor circuit, the subscriber sender is recycled to release the A, B, and C registers to permit a subsequently dialed local code to be registered on the A, B, and C registers as on a local call with the digits following registered in their usual TH, H, etc, slots. When registration of the local code is complete, the marker is called in and it processes the local and compressed codes by calling in an available foreign area translator to mark the required trunk routing of the call.

23.03 Handling of an auxiliary sender call is similar to that described in Part 21; except that with recycle the auxiliary sender start signal is derived from the subscriber sender recycle circuit. This is effected when reference of the DDD area code to the compressor circuit proved it was one which did not require compression.

23.04 After processing of each type code, of the three circuits used by the sender in the 6-digit translation, only the subscriber sender recycle circuit remains. It is held for the entire holding time of the sender while the connector and compressor circuits are released for use by other senders in the group.

23.05 If processing of a code compression call cannot be completed in the interdigital interval, the subscriber sender recycle circuit returns an overflow indication to the subscriber sender. Now when the marker is called in it sees grounded AR and OF leads and sets up the call to an overflow trunk.

24. SIX-DIGIT TRANSLATION (SENDER RECYCLE) CANCELED

A. Option JG

24.01 When a DDD call is dialed or keyed with a prefix digit 0, relay AO will be operated and will cancel the sender recycle feature. This call will then be processed as an auxiliary sender call.

25. OUTPULSING DIRECTORY NUMBER - FIG. 18

25.01 Relay ODN is operated on DDD and zero calls in LAMA offices when outpulsing of the directory number of the calling customer to a tandem office is required. After the called number has been outpulsed, the tandem sender signals the auxiliary sender to outpulse the calling number. The ground condition on the ODN lead to the auxiliary sender determines what information is to be outpulsed. The three following conditions may be sent to the auxiliary sender and cause it to outpulse the information indicated.

ODN LEAD	CONDITION INDICATED	INFORMATION OUTPULSED
317-ohm Ground	Multiparty lines	Special party signal
Ground	Observed Multiparty lines	Special observed party signal
1711-ohm Ground	All other lines	Directory number

25.02 The marker will indicate a multiparty line requiring attendant identification by operating in the sender the ODN relay and withholding the MI 2 to 7 information. The sender cancels transverter functions for these calls. On observed lines, the operated LO relay shunts the ODN resistance which grounds the ODN lead to the auxiliary sender.

25.03 When the directory number is to be outpulsed the sender signals for a special transverter by grounding the SPL and ODN leads to the transverter connector. The directory number when received in the special transverter from the translator is transmitted to the auxiliary sender through the auxiliary sender directory number connector. The transverter then is released from the sender and the connector.

25.04 With the ODN relay operated this ground will release the transverter by operating the ARL and shunting the ZO', if operated, to release the auxiliary sender link and will then be extended to advance and release the sender.

25.05 Transverter failures with the ODN relay operated cause the ARL to operate instead of the TRL relay. The auxiliary sender, in these cases as with other ODN time-outs of the auxiliary sender, outpulses a special failure-to-identify signal to the tandem sender.

25.06 On automatically identified lines, line observed information is transmitted to the auxiliary sender through the auxiliary sender directory number connector from the transverter.

25.07 When zero attendant calls are routed via tandem to a traffic service position the OPR relay is operated from the operated ZO' relay. The ODN relay when operated by the marker operates relay ZDN through the operated OPR relay. The ZDN relay changes the ground condition on lead 14 to the auxiliary sender which determines the handling of zero attendant and zero prefix calls as indicated below.

LEAD 14	CONNECTION INDICATED	INFORMATION OUTPULSED
1711-ohm Ground	Zero prefix	Special start signal after outpulsing called number
317-ohm Ground	Zero Attendant call	Calling number only is outpulsed
Ground	Emergency attendant	Special start pulse

25.08 The operated ZDN relay operates the AS relay, closes the auxiliary sender link start lead, releases the operated STM relay, closes the transverter start lead in part, closes the operating path in part of the ZOT relay, shunts down the STB' relay through the normal contacts of the ZOT relay, operates the STB relay when the STM releases, transfers the attendant class AV1 operating path to the AST relay, and partly closes the operate path of the SWF relay to ground.

25.09 When an auxiliary sender is seized the operating ground for the SWF relay is extended to operate the STM relay which releases the STB relay. The operation of the SA relay removes the shunting ground from the winding of the STB' relay which operates and closes the operating path of the STL relay. The operated STL relay advances the sender which closes its trunk test bridge to the auxiliary sender. The auxiliary sender will operate the sender TG relay as an indication that the tandem trunk test has been made. When the TG2 relay operates, if MI relays have been operated by the marker, the AST relay is operated and a special transverter is seized as on ODN calls. The directory number is transmitted to the auxiliary sender and when the auxiliary sender has completed outpulsing it grounds the AV1 lead to the sender as a signal to advance and release. Operated relay ZDN closes the AV1 path around the SP relay contacts.

25.10 The sender will time for a certain period for the connection to an auxiliary sender on zero attendant ODN calls. If no sender is seized in the alotted time, the ZDN relay is released and the sender handles the call as a regular attendant class call. Trunk test is made to the tandem trunk, the sender advances and sets the district junctor in attendant talking position and releases. The tandem trunk seizes a tandem sender which, after timing out, connects the trunk to the attendant for identification of the calling party.

25.11 The SD timer is restarted by the release of the STM relay, the operated ZDN providing the locking ground. The timing cycle progresses as described in 5.58 through 5.62 until the U and U' relays have operated. The STB relay has been replaced by ZOT relay in the timing chain when the ZDN operated and on the next closure of the interrupter the ZOT operates, opens the STL relay operate path, opens the auxiliary sender link start lead, and opens the STB' relay shunt of the operated ZDN relay. The STB' does not operate at this time since it is shunted by the SD interrupter. When the interrupter contacts open, the STB' operates and extends the timing cycle path. The next closure of the interrupter operates the ZDR relay. The ZDR relay locks and releases the ZDN relay. The release of the ZDN relay releases the ZOT relay, operates the STM relay, releases the timing chain, and removes the shunt from the STB' relay allowing this relay to operate thus operating the STL relay. The call now proceeds as an attendant class call, trunk test being made to the tandem trunk and the advance of the sender occurring as described in Part 12. The tandem sender waits for MF pulses but since none are received, routes the call after timing out as described in 25.10.

25.12 Transverter functions are canceled on zero attendant calls which fail to seize an auxiliary sender since the release of the ZDN relay opens the transverter start lead.

25.13 When a zero attendant ODN call is abandoned by the customer the ZDR relay is operated from the released SR1 and releases the ZDN as described in 25.11. The sender then releases as described in 14.18.

26. AUTOMATIC IDENTIFIED OUTWARD DIALING

26.01 The marker operates the sender AID relay on these calls. The ground on the RP lead to the transverter is transferred to the TP lead by the operated AID relay. This is recognized as an automatic identified outward dialing signal by the transverter.

27. INTERCHANGEABLE CODES

27.01 The marker operates the SD1 (D delay) on these calls and then releases. The EDT operates and opens the STB, STB' operating path, the locking path of the SA, operates the AS, provides an operate path for the INF1 and 10N, places the DST holding path under control of the 7N' and 10N, and places the 7N and 7N' after the U and U' in the SD timing chain.

27.02 When the seventh digit is registered the start lead to the auxiliary sender link is grounded and the UL1 starts the delay timing as described in 5.59. If no further digits are registered the next closure of the interrupter, after the U' has operated, operates the 7N. The 7N opens the start lead to the auxiliary sender link and the operating path of the 10N relay. The 7N' operates and locks in series with the 7N to the U crosspoint ground when the SD interrupter contacts open. The 7N' closes the CC0 and CC1 leads as a 7-digit call signal to the marker or the CC1 and CC2 leads as a zero prefix 7-digit call signal. If an eighth digit is registered before the 7N operates the 10N operates from the ST hold magnet contacts. The 10N opens the operating path of the 7N and the holding path of the H, H', T, T', U, U', which release, closes the CC0 and CC4 leads as a 10-digit call signal to the marker or the CC0 and CC2 leads as a zero prefix digit call signal and transfers the AS relay battery supply to hold the auxiliary sender when the DST releases.

27.03 The operated 7N or 10N releases the DST which releases the SD1 and DRL. The DRL releases the EDT which recloses the operating path of the DST for the second marker seizure. The CC-lead information is now used to resolve the code conflict. The marker operates the 7DG or 10DG as required on multifrequency routes. If the TR1, TR2 are operated on the first marker seizure they release with the DST before the EDT releases. The 10N is released on third trial calls to the marker so that the auxiliary sender link can release on overflow calls.

28. 411 INFORMATION CALLS

28.01 The 411 information calls may be routed in three ways: 411 to 3-digit operator; 1 + 411 to 3-digit operator; or 3-digit multifrequency tandem; and NPA + 411 or 6-digit multifrequency tandem. Calls using multifrequence routes have the 7DG or 10DG operated and the CL2, CL4 class relays operated by the marker.

28.02 When 411 is registered on the ABC verticals the 1B and 1C operate and operate the INF if the 7DG is operated for a multifrequency routing. The INF is also operated when a NPA code followed by 411 is registered and the 10DG is operated. The INF operates the CL3, grounds the INF lead to the marker and transverter, grounds the auxiliary sender link ST and DC leads, places the STB and STB' operating path under control of the SD timing cycle, closes a path around the CL3 contacts to hold the AST, closes a path to operate the STA, STA' from the SA relay, opens the operate path for the AST. This last path can be closed by operating the INF key at the transverter trouble indicator which causes the operation of the sender frame IEC relay. Multifrequency information calls are then placed on the AMA tape. The SD timing cycle continues until an auxiliary sender is seized which will operate the STA and STA', or the STB and STB' will be operated at the completion of the timing period. If the STB and STB' operate the call is routed to overflow as described in 16.24. Outpulsing of a 1 + 411 or NPA 411 to the auxiliary sender is done as described under DDD and 7DG operation. The ground on the DC lead serves as a signal to the auxiliary sender that an information call is being sent.

28.03 When the NPA code is an interchangeable code and is followed by 411 the EDT operates the INF1 instead of the INF from the 411 registered in the TH, H, and T crosspoints. The INF1 starts the SD interrupter timing cycle and provides paths to operate the 7N, 7N', and 10N relays. If no U digit is dialed the timer operates the 10N which is an indication that the call is for a 10-digit route and the call is handled as described in 26.01 and 27.02. If a U digit is registered the 7N and 7N' operate indicating that a 7-digit route is required and that the call is not an information call. The call is handled as described in 26.01. The INF1 releases when the DRL releases before the second seizure of the marker. On interchangeable NPA codes followed by 411 the INF operates only after the second marker seizure.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 The use of this circuit is limited as to the external customer line or PBX trunk loop with which it may be used, to the operating limits of relay L, SGT, CLR, GT, and TP and is limited with regard to the external outgoing trunks by the operating limits of the STP and TG relays. The operating limits of these relays are as follows:

(a) L Relay 239HE FO option, 280W FP option:

	Customer Lines		PBX Ext Lines	20 PPS Dials
	8-11 PPS Dials	7-15 PPS Dials	7-15 PPS Dials	Attendant Trunks
Max Ext Ckt Loop Res	1,500 Ω	1,500 Ω	1,500 Ω	1,500 Ω
Min Ins Res	10,000 Ω	10,000 Ω	10,000 Ω	15,000 Ω
Allowable Rate Bridged Capacity at Customer Sets	4μf	2μf*	3μf	None
Allowable Rated Capacity to Ground on Either Side of Line		2.5μf		
Max Trk Conductor Res				1,400

* The allowable bridged capacity for side tone coin collector with antiside tone subset is 3μf.

(b) SGT Relay 239HD FM option, 280CC FN option:

Ground potential limits	-4 to +18 volts	-5 to +18 volts
Coin Battery Limits	100 to 120 volts	116 to 120 volts
Max Ext Ckt Loop Res	850 Ω	1,240 Ω
Min Insulation Res	10,000 Ω	10,000 Ω

Note: (1) When the earth potential is in excess of 4 volts negative when 100- to 120-volt coin battery is used or 5 volt negative when 116- to 120-volt coin battery is used, the SGT relay may not always operate on a solid ground.

(2) For each volt of positive earth potential subtract 28 Ω from "Max Ext Ckt Loop Res"

(c) CLR Relay 239HC FK option, 280DF FL option:

Coin Battery Limits	100 to 120 volts	116 to 120 volts
Max Ext Ckt Loop Res	1,500 Ω	1,500 Ω
Min Insulation Res	10,000 Ω	10,000 Ω

(d) GT Relay (Fig. AL or E):

Ground Pot. Limits	-15.5 to +18 volts	-18 to +18 volts	-15 to +15 volts
Coin Battery Limits	100 to 120 volts	116 to 120 volts	116 to 120 volts
Max Ext Ckt Loop Res	850 Ω	1,240 Ω	1,480 Ω
Min Insulation Res	10,000 Ω	10,000 Ω	10,000 Ω

(e) TP Relay:

Max Line Conductor Res	1,500 Ω
Min Insulation Res	4,950 Ω
Ground Potential Limits	-20 to +20 volts

(f) STP Relay 207A D option, 268A P option: **

Max Ext Ckt Loop Res *	3,330 Ω	
Min Insulation Res	30,000 Ω	
Voltage limits in office, incoming, and final selectors		40-50 volts

* The trunk resistance shall not exceed 2900 Ω or 32 miles of cable.

** When working into a distance panel selector, the trunk conductor resistance, plus any compensating resistance in the distant selector circuit, shall be compensated in the sender to a minimum of 1200 Ω when an L relay of 650 Ω or less is used and to minimum 900 Ω when an L relay of 900 Ω or more is used. When working into a crossbar terminating or tandem sender. the trunk resistance shall be compensated to minimum 900 Ω.

(g) TG Relay B421:

	OFFICE TEST
Max Ext Ckt Loop Res	12,780 Ω
Min Voltage	45 volts
Min Insulation Res	30,000 Ω

(h) GT Relay, Fig. 22:

Ground potential limits	±10 volts
Max Ext Ckt Loop Res	1,500 Ω
Min Insulation Res	10,000 Ω

TRUNK TEST		
Class of Call	Min Trunk Voltage	Max Ext Ckt Loop Res
Full Selector	45	12,780 Ω
CI and Attendant	20	13,130 Ω
	21	13,810 Ω
	40	25,820 Ω
	45	28,720 Ω
	Minimum insulation resistance 30,000 Ω	

Note: Trunk loops for all CI pulsing shall be compensated to a minimum of 900 Ω.

1.02 The operating limits of the MTG relay in connection with outgoing trunks are as follows:

(a) MTG Relay B167:

	Ext Ckt Loop-Voltage
Operate	2,350 Ω max 45 volts min
Nonoperate *	
Including Comp Res in Sender	1,805 Ω min 26 volts max

* For all fundamental selections, trunk loop shall be compensated to a minimum of 900 Ω. Minimum insulation resistance 30,000 Ω.

(b) OF Relay 239FU FQ option, 280G FR option:

	FS CLASS	CI CLASS
Max Ext Ckt Loop Res	3,330 Ω	3,700 Ω
Min Voltage	45 volts	20 volts
Min Insulation Res	30,000 Ω	30,000 Ω

(c) TDS Relay, UA81:

Max Ext Ckt Loop Res	1,500 Ω
Min Ins Res	10,000 Ω

2. FUNCTIONAL DESIGNATIONS

2.01 None.

3. FUNCTIONS

3.01 This sender is designed to perform the following functions some of which may be omitted if not required in the particular area where the sender is to be used, as described in Section II, Part 3.

3.02 To indicate its nonavailability to the associated sender link and control circuit and to the sender test circuit under any of the following conditions: (a) sender engaged on a service call; (b) sender being tested by sender test circuit; (c) sender made busy by a plug in a make-busy jack, either individual to the sender or common to a subgroup of senders; (d) a sender monitor cord left in the priming jack; (e) false ground on S lead to link; (f) relay OF fails to release; (g) a hold magnet in the dial register fails to release; (h) failure in the 2-party test.

3.03 When seized by the sender link and control circuit and having received an indication that the dialing leads are closed by the link, then to close them in the sender and test for their closure and finding them closed, to hold the link switches and release the link control circuit or not finding them closed to release the link control circuit after operating a false start register associated with it. Also to connect the S lead to the SL lead so the link control circuit may make certain continuity and double-connection tests.

3.04 When seized by the sender link and control circuit, to register the class of service of the calling line and the associated district frame. If a deficiency or superfluity of class or frame indication is received, to block the release of the link control circuit or to cause a marker time-out when certain class-of-service leads are crossed or grounded falsely. If the class registration shows that the call is from a 2-party message rate or LAMA line, to determine whether the tip or ring party is calling, testing both before and after dialing. If the two tests do not agree, to block the sender and the district. If the tests indicate a ring party, to make a local operation test of the test relay and if it fails, to block the sender only.

3.05 To send dial tone to the calling customer as soon as ready to register the first digit, and to cut off dial tone when the first digit has been registered.

3.06 To refuse to register any digits unless the district frame is first registered.

3.07 To register a permanent signal in case the first digit is not registered in a certain time after the sender is seized.

3.08 To absorb one or more single preliminary pulses caused by accidental movement of the switchhook before dialing or keying without wrong registration or premature stopping of the dial tone.

3.09 To register dialed or keyed digits within commercial limits of length and insulation of line, speed of dial, percentage make and break of dial, interval between digits.

3.10 To register any 3-digit office code or a XOX or XIX area code registered on the A, B, and C registers, or any 2-digit office code (Mfr Disc) on the A and C registers.

3.11 To register one digit when that is zero, 2 or 3 digits for an official attendant code, 6 or 7 digits for a 2- or 3-digit office code and a 4-digit customer number, and 7 or 8 digits for a 2- or 3-digit office code and a 5-digit manual customer line, the fifth digit being either numerical or a party line letter. 2-digit office code is Mfr Disc.

3.12 To establish connection with a marker through a marker connector when a permanent signal is registered, or when zero is the first digit dialed, or when the last digit of the office code or the area code is registered on the C register.

3.13 To send to the marker the class of service, the district frame and the office code or the area code, zero or permanent signal registration, and to check with the marker the transmitting leads for opens, grounds, and crosses. Any trouble encountered prevents the marker from returning information to the sender. A maximum of 25 classes of service can be provided, see Section II, 4.01.

3.14 To receive from the marker and register all information which the sender requires to complete the connection to the called office, and to check with the marker all the transmitting leads employed for opens, grounds, and crosses, also all transmitting leads not employed for grounds and crosses. Any such trouble encountered prevents and marker from sending a regular release signal to the sender. At the same time, the marker transmits certain information directly to the district junctor. The information registered in both sender and district is subject to revision from the marker at any time before the receipt of a release signal.

3.15 To receive a regular release signal from the marker and to lock in the latest information received from the marker, both in the sender and in the district, and to release the connection between sender and marker through the marker connector.

3.16 Before the receipt of a regular release signal, to receive a signal from the marker that it is ready to establish connection through the district and office frames, and to forward that signal to the district junctor.

3.17 After the receipt of a regular release signal, to receive a signal from the marker by way of the sender link and the district junctor, that it has established connection through the district and office frames, and thereupon to proceed with any selections beyond, after any necessary delay for further dialing or for coin test.

3.18 To receive a trouble release signal from the marker through the marker connector if the marker encounters any trouble prior to sending a regular release signal, and to release any information received from the marker, both in sender and district, to release the connection with the marker through the marker connector. To reestablish connection with a marker for a second trial, and to attempt on the second trial, except on direct distance dialing calls, the same setup as on the first trial except that the sender sends an alternate route signal to the marker over a lead checked for trouble like the code leads. To function for a third trial of the marker as described for the second trial if a second trouble release signal is received from the marker except that the sender sends an overflow trunk signal to the marker over a lead checked for trouble like the code leads. Treatment for DDD calls is similar to that for a second trial except that the sender sends an overflow trunk signal to the marker over a lead checked for trouble like the code leads.

3.19 To receive a trouble release signal from the marker through the sender link and the district junctor if the marker encounters any trouble after sending a regular release signal but before signaling the establishment of a connection through district and office frames. To release the information received, both in sender and district, to reestablish connection with a marker for a second or third trial, and to function on the second or third trial as in 3.18.

3.20 To receive a reversed battery overflow signal over the fundamental, either a steady battery or a pulse, if a distant panel selector or crossbar terminating or tandem sender runs to overflow or telltale. Thereupon, to close the trunk momentarily to signal the distant circuit to return to normal, to release the information received from a marker. To reestablish connection with a marker for a second or third trial, and to function on the second or third trial as in 3.18.

3.21 If any condition which would cause a second or third trial occurs during or after a third trial, no other trial is made but the sender will block if Fig. I is used, and will restore to normal if Fig. K is used. See 3.18.

3.22 To guide the selections of a distant office selector, if information from the marker shows it to be in the route to the called point, immediately after receiving a signal that the marker has established connection through the local district and office frames. The office selector is first tested to be sure it is in condition to use, with a high resistance in the fundamental to prevent the premature operation of the line relay in the selector. Brush and group selections are then made by counting the revertive pulses sent by the office selector in accordance with information from the marker, with a compensating resistance inserted in the fundamental also according to information from the marker. The fundamental is held open between selections long enough to prevent a false secondary closure on the preceding selection or a premature closure on the following selection.

3.23 To recognize completion of dialing, that is, when all the dial pulls to be expected on a call have been registered, the number to be expected being indicated principally by information from the marker. Thus the marker will indicate when no number should follow the office code, when a four pull number should follow it, and when either four or five pulls may follow it. In the last case, the possibility of there being five pulls is partly determined by whether or not the first two digits of the number are 10, and if so, whether the third digit is under 5.

3.24 When five pulls may be made after the office code, but the fifth pull is not actually forthcoming, to assume that dialing has been completed after measuring a certain time following the fourth pull.

3.25 To refuse to register any pulls or false dial pulse after accepting any of the above indications that dialing has been completed.

3.26 To make a preliminary coin test of the calling line after dialing has been completed, if the class of service of the calling line requires it. This test is for the presence of a high-resistance ground such as would be caused by a coin in the coin box, and for the absence of a low-resistance ground such as might be caused by a false ground. Switchhook supervision is maintained during the coin test to permit the customer to free the line immediately.

3.27 To call in a sender monitor when Fig. E is used, if the coin test fails to find conditions on the line as they should be, to allow the monitor to plug in on the sender to talk to the customer without falsely operating the coin test relays, and to repeat the coin test after the monitor withdraws, the successful completion of the second test having the same effect as the first test.

3.28 To give the calling customer a disconnect tone, when Fig. AL is used, if the coin test fails to find conditions on the line as they should be and to disconnect the line if the customer fails to disconnect after the tone interval.

3.29 To cancel the coin test if the class of service does not require it, or if the call is for zero attendant, or if any attempt is made to a signal trunk. Also, on certain official fire and police codes where the CL3 relay is operated and SD relay not operated.

3.30 To make a test of the trunk to be sure it is in condition to use, in accordance with the class of call as indicated by information from the marker. Trunk test is made immediately following the distant office selections, or the receipt of a signal that the marker has established connection through the local district and office frames if there is not distant office selection to be made, unless it is delayed by one of the following conditions: (a) on a full selector call to panel, the thousandths digit must be registered; before trunk test can be made; (b) on a full selector call to crossbar, the hundredths digit must be registered; (c) on any PCI or attendant class call, dialing must be completed and two-party or coin test satisfied if not canceled. For a full selector call, trunk test is made with a high resistance in the fundamental to prevent the premature operation of the line relay in the incoming selector or trunk, with a marginal or nonmarginal trunk guard relay as indicated by information from the marker, and with the polarized overflow relay not in circuit.

3.31 For a CI or attendant call, trunk test is made with a compensating resistance in the fundamental as determined by information from the decoder, the nonmarginal trunk guard relay and the polarized overflow relay not short-circuited, nor shunted by its noninductive winding, except that for certain classes of attendant calls, which normally return reversed battery, the overflow relay is short-circuited.

3.32 On a full selector call, to follow trunk test by guiding the selections of the incoming and final selectors, crossbar terminating, or tandem sender in accordance with the number set up on the dial register, by counting the revertive pulses sent back, with a compensating resistance in the fundamental according to information from the marker, and the polarized overflow relay in the circuit but shunted by its noninductive winding. The fundamental is held open between selections long enough to prevent a false secondary closure on the preceding selection or a premature closure on the following selection. On starting the final brush selection on calls to some incoming selectors, the fundamental is momentarily closed through a high resistance to discharge the trunk conductors. Incoming brush selection follows trunk test, incoming group awaits the registration of the hundreds digit if that was not previously registered, final brush follows incoming group, final tens awaits the registration of the tens digit, and final units awaits the registrations of the units digit and the satisfaction of 2-party or coin test and LAMA recording unless canceled.

3.33 On a full selector call, to recognize reversed battery by the polarized overflow relay when the incoming selector advances after the completion of the final selections, and to recognize the cutting off of the reversed battery on the further advance of the incoming selector. The overflow relay is shunted by its noninductive winding. Short trunks requiring the use of the marginal trunk guard relay on trunk test, may advance too rapidly for the sender to follow the application and removal of the reversed battery in its usual manner, and a special connection is made in the sender to enable it to recognize the reversal.

3.34 On a CI call after trunk test to wait for trunk assignment with the trunk guard relay still held operated in the fundamental, with provision against its accidental momentary release being accepted as a trunk assignment, and with the polarized overflow relay short-circuited.

3.35 When the trunk is assigned, to release the trunk guard relay without causing a false pulse.

3.36 After the release of the trunk guard relay to start the transmission of CI pulses through the same compensating resistance as was used in trunk test.

3.37 To hold all CI pulses to close limits for length, including the first pulse which requires special treatment to prevent its being shortened, and to ground both sides of the trunk momentarily at the start of a blank pulse to prevent its discharge causing a false pulse.

3.38 On a tandem CI call, to transmit the office code according to the setting of the A, B, and C dial registers, unless the sender is specially arranged to send two digits (Mfr Disc) only, when they are sent according to the setting of the A and C registers.

3.39 Following the office code on a tandem CI call, or at once on a direct CI call, to transmit five digits according to the setting of the ST, TH, H, T, and U registers. If the called number is under 10,000 they are sent in that order; if 10,000 or over the ST digit is sent after the U instead of before the TH. Zero is sent for the ST digit if the number is under 10,000 and no station or an unused station digit was dialed.

3.40 Following the last digit, to transmit a special signal consisting of a blank pulse followed by a heavy positive pulse of extra length.

3.41 After incoming advance on a full selector call, the sending of pulses on a CI call, or trunk test on an operator call, to signal the district junctor to assume its cut-through position, measure a short time for the district to do so, meanwhile closing the trunk through a resistance, and then return to normal and disconnect itself by releasing the sender link.

3.42 After completion of a connection to an originating marker, if so signaled by the marker or a link, to connect to the transverter connector for LAMA recording of the calling line number and the called number if desired.

3.43 If the calling customer abandons the call while the sender is engaged, to signal the district junctor to free the line at once, delaying this signal while a marker or transverter is engaged.

3.44 On an abandoned call, to return to normal and disconnect by releasing the sender link at once if a marker has not yet been engaged by the marker connector, or if the sender is in an intermediate position between a first and a second marker trial, or if the call is of an attendant class and has just been established.

3.45 On an abandoned full selector call when distant selectors have been seized, to proceed with distant office selections and trunk test, cause the incoming of final selector to run to telltale, recognize the overflow signal, and then return to normal and release the sender link.

3.46 On an abandoned CI call when a distant office selector or a CI trunk has been seized, to proceed with distant office selections and trunk test, await assignment, and send out CI pulses as usual except that all digits not already sent out are replaced by zeros. Then to return to normal and release the sender link as usual. When a distant office selector is not used and a CI call is abandoned in the awaiting assignment position, then to return to normal and release the link immediately.

3.47 If assignment is not made on an abandoned CI call, to return to normal and release the sender link when the timing circuit reaches the stuck sender position.

3.48 If a permanent signal is registered, to call a marker and route the connection to a permanent signal trunk, making only one trial and cutting the district through and releasing it, if a trouble release signal is received. With LAMA to connect to a maintenance recorder and record the calling line PS number also a no-trunk signal if no PS trunk is available.

3.49 To register a partial dial if dialing is not completed except for a station digit in a certain time after the first digit is registered.

3.50 If a partial dial is registered in a sender arranged for monitoring, to flash the individual lamp and light the auxiliary signal. If the dialing is completed except for stations before the monitor answers, to extinguish the lamps and proceed with the connection.

3.51 If a partial dial remains from 5 to 12 seconds without advancing, to close a lead through a resistance to a signal circuit for accumulated failures to be recorded.

3.52 If a partial dial is registered in a sender arranged for timed release, to send an intermittent tone to the customer and operate a common partial dial register. If the customer does not then hang up in a certain time, to register a permanent signal and proceed accordingly, if the office code had not been dialed, or otherwise to register an abandoned call and proceed accordingly. If the sender is still not released in a further time, to register a stuck sender and proceed accordingly.

3.53 To register a stuck sender if the sender is not released and returned to normal in a certain time after dialing has been completed,except for a possible station digit, the time to be longer if the call is routed through a distant office selector or is of any CI class. The increased time to be recycled if a late second marker trial results.

3.54 If a stuck sender is registered in a sender arranged for monitoring, to light the individual sender lamp, light the auxiliary signal, and operate a common stuck sender register. If the sender is stuck while attempting to connect to a permanent signal trunk, the register is not operated. If the sender is released before the monitor answers, to extinguish the lamps.

3.55 If a stuck sender is registered in a sender arranged for timed release, to send an intermittent tone to the customer and operate a common stuck sender register. If a customer does not then hang up in a certain time, to register an abandoned call and proceed accordingly. If the sender is still not released in a further time, to operate relay AV1 in an attempt to force its release, unless a permanent signal has been registered. If the sender still fails to release after a still further time, to light an individual sender lamp and an auxiliary signal.

3.56 Not to operate AV1, as described in the previous paragraph if key CTR is operated, but to operate it if the key is later restored.

3.57 For a sender arranged for monitoring, to extinguish the lamp signals and prevent further dial registration, while still holding the connection when the monitor plugs into the talking jack. To register a permanent signal and proceed accordingly if the monitor plugs into the priming jack before the office code has been dialed. To release the sender if the monitor plugs in the priming jack after the office code has been dialed. If the priming fails to effect the release of the sender, the lamp will flash again when the plug is withdrawn.

3.58 To prevent any reaction from the sender monitor unless the sender has timed out.

3.59 To stick the sender if any of its hold magnets fail to release at the close of the call, except the ST magnet.

3.60 To soak relay STP in its normal operating direction whenever the sender is engaged with a marker, to erase any soak remaining from a previous application of reversed battery.

3.61 To provide for registering the prefix "one-one" preceding the office code, only when required.

3.62 To provide for sending CI pulses in two stages. That is, send the office code as soon as dialed and an outgoing trunk has been selected. The numerical digits are sent when dialing is completed.

3.63 To provide for completing calls over a common group of trunks to two crossbar offices. This consists of sending the regular number of pulses for incoming group selection for one unit and adding five pulses (add five) for the other unit.

3 64 To provide for rerouting special code OFF-9300.

3.65 To set the district in talking position with no district and office crosspoints closed, when all overflow trunks are found busy. With Fig. I, this takes place on third trial only and with Fig. K, this takes place on any trial.

3.66 To provide for additional routes to crossbar tandem equipment by using 10 office brush selections.

3.67 To provide automatic priming after time-out for noncoin senders, or coin senders with or without coin test.

3.68 To initiate an automatic disconnection of the line when Fig. E is used if the coin test fails to find conditions on the line as they should be.

3.69 To provide for making the CTR keys ineffective when alarm circuits are transferred for off-premises maintenance personnel.

3.70 To give the calling customer a disconnect tone when Fig. AL is used, if the coin test fails to find conditions on the line as they should be and to automatically disconnect the line if the customer fails to disconnect after the tone interval.

3.71 To provide toll diversion by reversing the line to the customer after dialing under control of information received from the originating marker.

3.72 If a stuck sender is registered in a sender arranged for automatic priming, to light the individual sender lamp, light the auxiliary signal, and operate a common stuck sender register. If the sender is stuck while attempting to connect to a permanent signal trunk, the register is not operated. If the sender is released before the automatic priming is completed, to extinguish the lamp.

3.73 For a sender arranged to handle direct distance dialing (DDD) calls to call in an auxiliary sender by sending a start signal to an auxiliary sender link when 0 or 1 of an (XOX or X1X) area code is registered on the B register and units registration is completed. To transfer pulsing off the L relay for the ninth digit into the auxiliary sender immediately after the eighth digit of this type call is dialed. To switch the fundamental circuit to be located between the customer sender and sender link circuits.

3.74 If a stuck sender is registered in a sender arranged for automatic priming to cancel sending of the intermittent tone to the customer and prevent operation of a common stuck sender register. If a customer does not then hang up in a certain time, to register an abandoned call and proceed accordingly. If the sender is still not released in a further time, to operate relay AVI in an attempt to force its release, unless a permanent signal has been registered. If the sender fails to release after a still further time, to light an individual sender lamp and an auxiliary signal.

3.75 For a sender arranged to CI outpulse 7- or 8-digit (7DG) calls to an auxiliary sender. To send a start signal after units are dialed to an auxiliary sender link when the marker recognizes this class of call. To switch the fundamental circuit to interpose the auxiliary sender circuit to be located between the customer sender and sender link circuits. To allow the marker to reset class information as on a second trial.

3.76 To prevent the automatic release of the sender arranged with automatic priming when an individual CTR key is previously operated.

3.77 To provide for sending skip class signals to the auxiliary sender on all calls requiring use of an auxiliary sender.

3.78 For a sender arranged for 6-digit translation (customer sender recycle) to call in a customer sender recycle circuit which connects to a code compressor circuit by means of a code compressor connector circuit to recycle the sender A, B, and C registers after the compressor circuit reduces the DDD area code to a single digit; to call a marker after three more digits (local code) are dialed and registered; to refer an overflow indication set in the recycle circuit to the marker if an idle code compressor circuit is not available in the interdigital interval between the third and fourth digit dialed; to extend an auxiliary sender start signal from the recycle circuit to the auxiliary sender link when the dialed DDD code requires auxiliary sender handling.

3.79 To stick the sender when the converter attempts to outpulse a mutilated digit into the sender.

3.80 To recognize a person-to-person prefix digit "0".

3.81 To recognize an extended-toll prefix digit "1".

3.82 To recognize an 11X service call.

3.83 To make a high-resistance TG test on zero attendant calls routed through tandem.

3.84 When equipped for LAMA operation and arranged for outpulsing the calling customer directory number; to send a start signal and special mark to the transverter connector after trunk test; to send a start signal and special mark to the auxiliary sender link; to cancel the start signal to the transverter on calls from certain classes of service when signaled to do so by the marker; to release the transverter and transverter connector when informed by an auxiliary sender which has timed out; to connect to an auxiliary sender on zero attendant calls which require outpulsing of the directory number; to time for the connection of an auxiliary sender on zero attendant calls; to cancel the request for an auxiliary sender after timing out, close the connection through to the trunk, and release the sender; to send a special zero attendant signal in addition to the outpulse directory number signal to the auxiliary sender when required.

3.85 Provision is made for AMA-equipped senders to receive a signal from the originating marker when "automatic identified outward dialing" is required and to give a signal to the transverter to make such identification.

3.86 Provision is made to determine if an interchangeable code is for a 7- or 10-digit call and to transmit this information to the marker. Provision is also made to recognize a 411 information call and to take an AMA record of multifrequency routed 411 calls as required.

3.87 Provision is made for storing prefix code digits and transmitting the information to the required equipment.

3.88 To recognize a dial-tone-first class of service.

3.89 To make a coin test to check for the initial deposit on a DTF call.

3.90 To second trial to the marker if a coin test failure occurs.

3.91 To cancel coin test under control of the marker.

3.92 To routine test the ground test relay on dial-tone-first calls.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a keysheet, the information thereon is to be followed. This circuit will function with the following crossbar system circuits.

(a) Subscriber Sender Link and Control Circuit - SD-25604-01, SD-25554-01, or SD-25004-01.

(b) Originating Marker Connector Circuit - SD-25035-01.

(c) Sender Monitoring Circuits - SD-21521-01.

(d) Miscellaneous Circuits for Sender Make-Busy Frame - SD-25076-01.

(e) Fuse and Time Alarm Circuits - SD-25046-01.

(f) Automatic Sender Test Circuits - SD-25221-01.

(g) Fuse Alarm Circuit for Fuse Bays - SD-96444-01.

(h) Interrupter Frame Circuit - SD-25062-01.

(i) Signal Circuit, No Such Number Tone Supply - SD-96357-01.

(j) Transverter Connector - SD-25804-01.

(k) Alarm Transfer Circuit - SD-25885-01.

(ℓ) Traffic Usage Recorder Circuit - SD-95738-01.

(m) Auxiliary Sender Link Circuit - SD-96483-01.

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(n) Miscellaneous Circuit for Subscriber Sender Frame, KP Sender Frame - SD-25052-01.

(o) Subscriber Sender Recycle Circuit - SD-96525-01.

(p) Code Compressor Connector Circuit - SD-96526-01.

(q) Pushbutton Calling Signal to Dial Pulse Converter Circuit - SD-26184-01.

SECTION IV - REASONS FOR REISSUE

A. Changed and Added Functions

A.1 The dial-tone-first feature is added to this circuit. This feature is part of the coin service improvement program.

B. Changes in Apparatus

B.1 Added

AV4A Relay - 1/2 AK47 - Fig. 22
CA Relay - AJ103 - Fig. 22
CA1 Relay - AJ15 - Fig. 22
CN Relay - AF134 - Fig. 22
CP Relay - AJ15 - Fig. 22
ECT Relay - AG59 - Fig. 22
SCT Relay - 1/2AK47 - Fig. 22
SGS Relay - 1/2AK47 - Fig. 22
GT Relay - 316L - Fig. 22
SC 500Ω Resistor - 18AC - Fig. 22
GT 4750Ω Resistor - KS16314L1A - Fig. 22
GTA 1870Ω Resistor - 147A - Fig. 22
GTB 3200Ω Resistor - 144E - Fig. 22
SCT Diode - 446K - Fig. 22
CL2 Relay - U667 - Fig. CB or CC
S2 Relay - U162 - Fig. CB
S2 Relay - U285 - Fig. CC
SD1 Relay - U157 - Fig. CB
SD1 Relay - U113 - Fig. CC

B.2

Superseded	Superseded By
SO Relay - U113 Fig. R - Option MA	SO Relay - U158 Fig. R - Option MB

D. Description of Changes

D.1 Options MA, MB, and MC, and Fig. 22, CB, and CC are added at the circuit locations listed in the option index and sheet index.

D.2 Relays AV4A, CA, CA1, CN, CP, ECT, SCT, SGS, and GT are added. Resistor SC, GT, GTA, and GTB are added. Relay CL2, S2, and SD1 are added. The SCT diode is added and relay SD is replaced.

D.3 Options MA, MB, and MC and Fig. 22, CB, and CC are added to Circuit Notes 107, 109, 143, 127, and 134.

D.4 Note 164 and 165 are added.

D.5 The working limits of the coin test circuitry are added to the working limits table.

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