CIRCUIT DESCRIPTION



PANEL SYSTEMS SUBSCRIBER SENDER CIRCUIT 3-, 3-2, OR 2 DIGIT NONCOIN ARRANGED WHEN REQUIRED FOR FOUR CLASSES OF SERVICE FOR USE WITH SENDER SELECTORS AND DECODER CIRCUITS

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 Crimping requirements on the SS2-D1 switch are removed to prevent a possible false permanent signal when DDD is provided.

A.2 Wiring is added (1) to prevent wrong PCI pulsing to a tandem office due to a slipping (R1) switch and (2) to eliminate stuck sender time outs on 7-digit MF calls.

A.3 Wiring is added to provide for preventing a possible objectionable crossfire of the dial tone when the sender is equipped with sender recycle and the sender recycle circuits are cabled in excess of 100 feet.

D. DESCRIPTION OF CHANGES

D.1 Sheet - 0201

D.1.1 "See Note 282" is added to existing Note 156.

D.1.2 Options "HM" and "HL" are added to the "Options Used" table.

D.1.3 The wiring Option "CB", as provided for by Note 128, sh.-0201, is rated Mfr. Disc. to agree with decoder test information when panel senders and decoders are equipped for 6 digit translation sender recycle.

D.2 · Sheet - 0202

D.2.1 Options "HM" and "HL" and reference to Note 283 are added to the main figure.

D.2.2 Application of "HM" wiring prevents wrong PCI pulsing to tandem due to a slipping (R-1) switch and eliminates stuck sender time outs on 7-digit auxiliary sender calls due to a race condition.

D.3 Sheet - 0203

D.3.1 "See Note 282" is added to the main figure at sequence switch (D1).

D.4 Sheet - 0204

D.4.1 "See Note 282" is added to Fig. AN.

D.4.2 "See Note 287" is added to Figs. AF and AE.

D.4.3 Option "ER" is added in Figs. AF and AE for leads "DTG" and "DTGI" which are shown as connecting to Fig. CL and sh.-0210.

D.4.4 The "ER" wiring provides for preventing a possible dial tone crossfire when senders with recycle are remotely installed with respect to their sender recycle circuits.

D.5 Sheet - 0205

D.5.1 Note 283 is added to correct a condition by applying "HM"option whereby a slipping (R1) switch is prevented from allowing wrong PCI pulsing or eliminated from causing stuck sender time outs on 7-digit MF calls due to a race condition.

D.5.2 Note 282 is added to provide for preventing a false permanent signal when DDD is furnished and Fig. AN and "Y" wiring is used crimping of the sequence switch spring (SS2-D1) shall not be required. The original crimping requirements are covered by Note 156.

D.6 Sheet - 0206

D.6.1 Note 287 is added and is concerned with the dial tone crossfire prevention.

D.7 Sheet - 0210

D.7.1 Leads "DTG" and "DTG1" as covered by Option "ER" are added to Fig. CL and are shown as connecting to Figs. AE or AF on sheet-0204.

D.7.2 A reference to Note 287 is added to Fig. CL.

1. PURPOSE OF CIRCUIT

1.1 This circuit is for use in a panel office in connection with decoder circuits and a noncoin district which selects the sender.

1.2 This circuit may be arranged to function with 2-digit office codes only, with 3-digit office codes only or with 2-digit and 3-digit office codes.

Printed in U. S. A.

CD-21193-02 - ISSUE 20B

This circuit may be arranged to pro-vide for completion of 10 digit DDD 1.3 or 7-digit MF calls via the auxiliary sender.

This circuit may be arranged to

2. WORKING LIMITS

2.1 The use of this circuit is limited, as to the external subscribers line or PBX trunk loop with which it may be used, to the operating limits of relay L, 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:

handle calls originated from: (a) rotary dial sets only or (b) touch-tone and rotary dial sets or pushbutton sets only.

1.4

Page 2

2.11 Sub's Line and PEX Trunks-Dialing - (L) Relay

2.111 Rotary Dial Sets Only - Option EA

		10 P.P.S	S. Dials	4. · · ·	20 P.P.S	. Dials*
	Subs. 1 (includin & 2 parts	Lines ng coin y M.R.)	P.B.X. E	xt. Lines	Operator	's Trunks
Type of (L) Rel.	L Rel. Short Range	239 or 280 Rel. Long Range	L Rel. Short Range	239 or 280 Rel. Long Range	L Rel. Short Range	239 or 280 Rel. Long Range
Max. ext. ckt. loop res. Min. ins. res. Allowable rated	1,000w 10,000w	1,500w 10,000w	1,000w 10,000w	1,500w 10,000w	15,000	1,500w 15,000w
bridged capacity	4 M.F.	2 M.F.++	3 M.F.	3 M.F.	None	None
Max. trk. con- ductor res.		•	· · · · · · · · · · · · · · · · · · ·		350w	1,400w

*No capacity other than capacity of line or trunk loop shall be bridged across the dial contacts.

++With 4 M.F. bridged cap., dial speeds should be maintained at 8 to 11 P.P.S. otherwise 7 to 15 P.P.S.

Optio circu over the t CD-21	With the touch-tone feat m EB, instead of the (L) it, the PB converter (L) the subscriber's tip and ouch-tone or rotary dial 976-01 for working limits	ure provided, relay in this relay operates ring to either set. See	selector circuit shall be on the sender to maintain a min loop resistance of 1200 ohms lay of 650 ohmsor less is us mum 900 ohms when an (L) re or more is used. When work	ompensated in nimum pulsing when an (L) re- sed and to mini- lay of 900 ohms ing with crossbar
2.12	**(STP) Relay 207A or 26 Max. ext. ckt. loop res.	8A 3,330 ohms	resistance shall be compensa mun of 900 ohms. The trunk not exceed 2900 ohms or 32 r	r the trank ated to a mini- resistance shall niles of cable,
	Voltage limits in district, office, incoming and final selectors	45-50 volts	2.13 (TG) Relay B421 OFFICE TEST	
	Minimum insulation resistance	30,000 ohms	Max. ext. ckt. loop res.	12,780 ohins
			Min. voltage	45 volts
t <i>r</i> unk pensa	**For all fundamental se conductor resistance plus ting resistance in the dis	lections s any com- stant panel	Min. insulation res.	30,000 ohms

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TRUNK TEST

Class of Call	Vc	Min. Frunk Sltage	Max. Ex Loop	t. Ckt. Res.	Min. Insulation Res.
Full Selector Operator & C.I.		45 20 21 40 45	12,780 13,180 13,180 25,820 28,720	ohms ohms ohms ohms ohms	30,000 ohms 30,000 ohms 30,000 ohms 30,000 ohms 30,000 ohms

Trunk loops on C.I. and F.S. class calls shall be compensated to a minimum of 900 ohms.

2.2 The operating limits of the (MTG) and (OF) relays in connection with outgoing trunks are as follows:

2.21 (MTG) Relay B167

Max. external circuit loop resistance (operate)	2350 ohms
Min. voltage (operate)	45 volts
Min. external circuit loop resistance (nonoperate)	1805 ohms
Max, voltage (nonoperate)	26 volts

For all fundamental selections, trunk loop shall be compensated to a minimum of 900 ohms.

2.22 (OF) Relay 231GA or 239FU or 280G

Max, external circui loop rest.	t 45V min.	3330 ohms
	50 V "	(F.S. class) 3700 ohms (CI)
resistance		30000 ohms

2.23 (TDS) Relay H120

Max. external circuit loop resistance 1500 ohms Min. insulation resistance 10000 ohms

3. FUNCTIONS

This sender is arranged to work with noncoin subscriber's lines. It is selected by a district selector circuit upon the origination of a call. The functions are as follows:

3.101 To control the hunting lead to district selectors to prevent being seized by a district selector (a) while the sender is busy completing a connection, or (b) while it is made busy at the sender make busy frame, or (c) while a sender monitor's cord is in the priming jack, or (d) while the selection switch or the RCI switch is off normal, or (e) while the sender frame driving motor is stopped.

3.102 When busy under any of the conditions (a) to (e) above, to ground a lead which may be connected to a sender holding time recorder.

3.103 To control a circuit for operating a register when all senders in a group are busy or for a load register.

3.104 When one group of senders serves two or more classes of subscribers which

must be given different zone privileges of different routings to special service and long distance operators, to register the class of subscriber in the sender for later transmission to the decoder. The information is given to the sender by the district over the FR and FT leads at the time the district seizes the sender. The FR lead is cut off from the class register (FR) relay when selection switch leaves position 1. The FT lead is cut off from the class register at the time the decoder is released, in order to be free for use in district brush selection. A maximum of four classes are provided for in a sender group, and eight classes altogether in several sender groups connecting with one group of decoders.

3.105 When separate groups of senders are furnished, no group serving more than one class, permanent connections are made in each group to transmit the class information to the decoder.

3.106 To send dial tone to the subscriber as soon as ready to register the first dialed digit and to cut off dial tone when first dialed digit has been registered.

3.107 To absorb one or more preliminary pulses caused by accidental movement of the switchhook before dialing, without causing wrong registration or premature stoppage of the dial tone.

3.108 When used as a straight 3-digit sender to receive and register the pulses for the first, second and third dialed digits respectively on the (A), (B) and (C) dial register relays.

When used as a 3-2 digit sender, if a 3-digit code is dialed the pulses are registered as above but if a 2-digit code

is dialed the first dialed digit is registered on the (A) dial register relays and the second dialed digit on the (C) dial register relays, no registration occurring on the (B) dial register.

3.109 Option EA, with rotary dial sets only, to receive and register the pulses directly from the subscribers dial on from one to eight pulls, one for dial zero, three for an official operator's code, six to seven (depending on the number of digits in office code - two or three) for the of-fice code and number of a four-digit subscriber line and seven or eight for a five digit manual subscriber line or a manual party line with station letter. Will function correctly within commercial limits of length and insulation of subscriber's line, speed of dial, percentage make and break of dial, and rapidity with which one pull Option EB, with touchfollows another. tone sets, to receive and register dc pulses (at 20 PPS) from the TT converter for digits dialed from either rotary dial or touch-tone.

3,110 To register a permanent signal in case the first dialed digit is not registered within from 30 to 60 seconds after the sender is seized.

3.111 To establish connection with a decoder through the decoder connector, when the code digits have been registered, or dial zero, or a permanent signal, provided that the selection switch has not failed to move to its second position, where it is ready to furnish battery to the connector.

3.112 To transmit to the decoder the class of subscriber and the office code as registered from the first two or three dialed digits, or dial zero, or permanent signal, as the case may be. This information is transmitted by grounding a selection of leads, and this is done in such a way as to check all of the leads for absence of opens and grounds, any trouble encountered preventing the decoder from returning information to the sender.

3.113 To receive from the decoder and to register full information for completing the calls as far as the operations required are affected by the office called. The decoder sends this information by grounding a selection of leads, and does it in such a way as to check all the leads used for opens and grounds, and all the leads not used for grounds. Any trouble encountered prevents the decoder from sending a regular release signal to the sender.

3.114 To receive from the decoder a regular release signal and thereupon to lock in the information received from it, to release the decoder and the decoder connector, and to start district brush selection. 3.115 In case the decoder encounters any trouble internal to itself or in the leads connecting it to the sender, it will not send a regular release signal to the sender, but will time out and send a trouble release signal. On receipt of this the sender will release the decoder and connector, will discharge any information it may have received from the decoder, and will then re-establish connection with a decoder, usually not the same one.

3.116 If the decoder on this second trial fails to send a regular release signal, the sender will make no further trial, but will stick, calling in the sender monitor (or will automatically prime and release) unless previously released by the subscriber.

3.117 The information received from the decoder is as follows:

Class of call, whether full selector, CI direct, CI tandem, CI tandem official code, direct call to operator, or call for restricted code referred by decoder to an operator. District brush and group selections. Office brush and group selections or skip office. Talking selection and zone of called office (no charge, one or more charges or talking to operator).

Stations delay (whether or not there may be occasion to wait for seventh or eighth dialed digit).

Whether there is a distant office selector, panel tandem, crossbar tandem or ADCI in the route; this feature is not always provided for.

Value of compensating resistance to be used on short trunks to office selectors and that to be used on selections beyond the office selector, Whether the trunk guard test relay (TG) or (MTG) is to be used on full mechanical calls.

Whether call being handled requires a route or involves a zone where toll diversion may be required; this feature is not always provided.

3.118 When zone registration is provided for, to operate a sensitive relay, or both a sensitive relay and a marginal relay, in the district during district group selection, to indicate together with the talking selections that the called office is in a certain distant zone.

3.119 To control the brush and group selections of the district selector on all calls, according to information received from the decoder, and by means of counting relays responding to revertive pulses from the selector. In these and all other selections of the same kind, to hold the fundamental circuit open after

satisfaction of the counting relays, for a sufficient time to prevent a false secondary closure on the same selection or a premature closure on the following selection,

3.120 Except on skip office calls, to make an office test to ascertain that the district has properly selected an office selector which is in condition for use. For this test and the following office selection, a compensating resistance is inserted in the fundamental if the trunk is short, of value determined by information from the decoder. For this test a high trunk guard resistance is also inserted in the fundamental, to prevent the premature operation of the line relay in the office selector. On full selector calls where the maximum trunk loop resistance is 1300 ohms or less for the office trunk test to panel the MTG relay is used for the office test, otherwise and on all other classes of call the TG relay is used. The noninductive winding normally shunting the operating winding of relay (OF) is opened for the office test.

3.121 To control the brush and group selections of the office selector according to information from the decoder, and by means of the counting relays; except on skip office calls for which the office test and office selections are omitted as the result of information received from the decoder, due to there being no office selector in the route.

3.122 On all calls to make a trunk test to ascertain that the office selector, or the district in skip office calls, has properly selected a trunk which is in condition for use. For this test on all except operator class calls, and for the incoming and final selections on all full selector calls or for XCI pulsing, a compensating resistance is inserted in the fundamental if the trunk is short of value determined by information from the decoder. For this test a high trunk guard resistance is inserted in the fundamental on full selector calls, to prevent the premature operation of the line relay in the incoming selector. On full selector calls when the maximum trunk loop resistance for trunk test is 1300 ohms or less the MTG relay is used, for panel only, otherwise the TG relay is used. The noninductive winding normally shunting and operating winding of relay (OF) is opened for the trunk test in all cases. On CI calls the operating wind-ing of (OF) is short-circuited after trunk test.

3.123 To delay the making of trunk test on a full selector call until the thousands digit has been registered.

3.124 To delay the making of trunk test on all CI calls until the PCI switch has reached its starting position, to which it goes after receipt of class of call information from the decoder.

3.125 To delay the making of trunk test on CI calls, except official code calls through CI tandem, until the units digits has been registered, and in certain cases until the stations or fifth numerical digit has been registered or until about four seconds has elapsed since the registration of the units digit. This four seconds stations delay is allowed only on calls where a combination of information from the decoder and the first two or three numerical digits registered shows that the call may be for a party line with station letter or a line with five-digit number.

3.126 To delay the making of trunk test on a call for a restricted code which the decoder referred to an operator, if desired, until the units digit has been registered, or until the stations of fifth numerical digit has been registered, or the stations delay measured.

3.127 On full selector calls to control the brush and group selections of the incoming selector, and the brush, tens and units selections of the final selector, according to the numerical digits registered, the incoming trunk group control and by means of the counting relays.

3.128 On full selector calls to discharge the trunk cable conductors after incoming groups selections, in order to prevent false operation of the stepping relay when it is connected for the next selection.

3.129 On full selector calls to delay the closing of the fundamental circuit to start incoming group, final tens and final units selections until the registration of the hundreds, tens and units digits respectively.

3.130 On full selector calls to record receipt of reverse battery from the incoming selector when it advances on the completion of the final selections, and to record the cutting off of reverse battery on the further advance of the incoming.

3.131 On CI calls to start sending CI pulses when relays TG, TGl, and TG2 release upon the assignment of the trunk at the distant end, they having been operated by the trunk test.

3.132 By the slow release of relay TGL to prevent a momentary opening of the fundamental while awaiting assignment, starting the CI pulsing.

3.133 By a condenser and resistance bridged around the winding of relay TG to absorb its discharge on release and prevent a false PCI pulse.

3.134 By the use of relay SP to increase the length of the first pulse, which otherwise might be abbreviated, and to prevent untimely grounding of 44 type resistance (A) through the PCI impulser switch.

3.135 To ground both sides of a CI trunk momentarily during blank pulses, to discharge it.

3.136 On direct CI calls to four numerical digit numbers, to transmit pulses according to the numerical and stations digits registered, first stations and the numerical, sending zero for stations when none is registered or an impossible station letter is registered.

3.137 On direct CI calls to five numerical digit numbers to transmit pulses according to the numerical digits registered, sending those registered on the stations register last instead of first as in the preceding paragraph.

3.138 On tandem CI calls to four or five numerical digit numbers to transmit pulses according to the office code registered (except that zero is transmitted as the tandem tens pulse when a 2-digit code is dialed), and then pulses for the stations and number or the five digit number, as above.

3.139 On tandem CI calls for official codes when all office codes are three digit codes, to transmit pulses according to the official code registered, and then five zeros.

3.140 On tandem CI calls for official codes, when any 2-digit office codes are used, to transmit pulses according to the setting of the office code register relays except that zero is transmitted for the tandem tens digit if the initial dialed digit of the official code is the same as the initial dialed digit of a 2-digit office code. When the initial dialed digit of an official code is the same as the initial dialed digit for a 3-digit code, the pulses for the office code are transmitted according to the setting of the office code register relays. In the latter case on this class of call five zeros are transmitted In the latter case on this following the transmission of the office code. In the former case the last digit of the official codes being registered on the thousands register relays, is transmitted after the transmission of office. followed by four zeros.

3.141 On all CI calls, to follow the pulses by a final heavy positive pulse (optional).

3.142 On a tandem CI call, if zero is dialed for the second or third digit of the office code to translate it to 6 or by optional wiring to send out the zero. 3.143 On full selector calls when incoming advance has been recorded, on CI calls when the CI pulsing has been completed, and on operator calls immediately after trunk test, to advance the district to a position where it is ready for the talking selection, and to record that such district advance has been effected.

3.144 When the decoder has signaled the sender that toll diversion may be required, to reverse the polarity of the subscriber's tip and ring. This will divert calls from PBX subscribers whose line circuits are equipped with the toll diversion feature. 140

3.145 When district advance has been effected and not before, to control a

talking selection to advance the district to the proper talking position, by means of the counting relays. It is advanced to the first, second or talking to operator position according to information from the decoder. When zone registration is provided, for the talking selection assist in determining the zone.

3.146 When talking selection is completed, the district removes ground from the "TR" lead releasing the (T) relay which advances the selection switch to normal where it releases the (SB) and (SC) relays making the sender available to other districts.

3.147 If the district selector runs to telltale in making brush or group selection, the district becomes stuck and holds the sender until restored manually.

3.148 If an office selector of the type which does not return reverse battery from tell-tale runs to tell-tale, the sender will stick.

3.149 If the district, office or incoming selector runs to overflow, or if a CI or operator trunk is found with its conductors reversed, or if an incoming or final selector runs to tell-tale, or if an office selector of the type which returns reverse battery from tell-tale, runs to tell-tale, the sender will record reverse battery, skip the remaining selections, advance the district to the overflow position and return to normal.

3.150 In recording reverse battery in overflow on trunk test, to hold the trunk closed for a definite period measured by the advance of the selection switch, to insure the advance of a distant office selector if one is in the route.

3.151 In case of certain types of incoming advancing too quickly after running to tell-tale, and not returning reverse current long enough, the operation of relay FO in the sender is insured by a special contact on relay IA.

3.152 To release the calling subscriber's line at once if he hangs up at any stage of the sender operations, except that if he hangs up before the time measure switch has returned to normal from the preceding call, disconnection will await its return to normal and advance off normal.

3.153 To prevent reoperation of relay SR in case the receiver is again lifted from the hook before the sender is disconnected.

3.154 To release all circuits involved in a connection in case a call is abandoned at any stage, unless the sender is stuck by a trouble condition.

3.155 In case any call is abandoned before the completion of district group selection, the district causes the sender to return to normal at once.

3.156 On a full selector call abandoned after district group selection is completed, to complete office test, office selection and trunk test if not already completed in accordance with the information from the decoder and just the same as if the call had not been abandoned. Trunk test having been completed either before or after the call was abandoned, to send the incoming or final selector, in the next selection to tell-tale, recording the reverse battery received there from, advance the district and return to normal. If the final selections have just been finished, the regular advance of the incoming will send reverse battery with the same effect.

3.157 On a CI call abandoned after district group selection is completed but before the trunk is assigned at the distant end, to complete office test, office selections and trunk test the same as if the call had not been abandoned.

3.158 If in the above case there is no distant office selector or full selector tandem equipment in the train, according to the information from the decoder, to advance the district and return to normal at once.

3.159 If in the above case there is a distant office selector or panel tandem crossbar tandem or ADCI equipment in the train, to hold the connection awaiting assignment or from 60 to 90 seconds to allow that equipment to time out, and if the trunk is still not assigned to signal the monitor for a stuck sender.

3.160 If the trunk should be assigned during the delay just mentioned, to send out a set of PCI impulses, but substituting zeros for the number registered.

3.161 On a CI call abandoned after the trunk is assigned but before the CI

impulses are completed, to complete them, substituting zeros for the remaining numbers.

3.162 In either of the cases described in the two preceding paragraphs, after completing the CI impulses, to advance the district and return to normal.

3.163 On an operator call abandoned after district group selection is completed, to complete office test, office selections and trunk test the same as if the call had not been abandoned, and then to advance the district and return to normal at once.

3.164 On any call abandoned so late that the sender is already advancing the district to the position ready for talking selection, it is too late to give the calling subscriber an immediate disconnect. The district then disconnects as after a completed connection, and sends a full set of talking selection pulses to the sender, which returns to normal in the usual manner as if the call had not been abandoned.

3.165 In case of a permanent signal to so advise the decoder. The decoder will route the district to a permanent signal trunk. On trunk test, reverse battery will be sent to the sender, whether an idle trunk is found or the district runs to overflow. The sender will record reverse battery, advance the district and return to normal. The district will advance to the overflow position only in case it runs to the overflow terminal. If it finds an idle trunk it will stop in the talking to operator position, on account of grounded sleeve wiring on the permanent signal trunk.

3.166 On a permanent signal to advance the time measure switch so that a stuck sender signal will be given if the sender gets stuck in attempting to complete the connection to a permanent signal trunk.

3.167 On any class of call which requires the dialing of a number, to display a partial dial signal individual to the sender before the sender monitor in case units is not registered, in from 30 to 60 seconds after the first digits is registered. This is a flashing signal the same as the stuck sender signal. A steady auxiliary signal is given at the same time with the individual signal.

3.168 To extinguish the partial dial signal and proceed with the connection in case units is registered before the monitor answers the signal by plugging into the talking jack associated with it.

3.169 On any class of call which does not require the dialing of a number, to advance the time measure switch so that a stuck sender signal will be given if the sender gets stuck in attempting to complete the connection.

3.170 To display a stuck sender signal

before the sender monitor in case the sender is not released in a measured time after dialing is completed. This time is from 60 to 90 seconds in the case of CI calls where the delay occurs after trunk test has been completed and on calls routed through distant office selectors or panel tandem equipment, as reported by the decoder. For all other calls the time is from 30 to 60 seconds. The signal is a flashing lamp individual to the sender, with a steady auxiliary signal.

3.171 To control a circuit for operating a register when any sender in a group becomes stuck.

3.172 To extinguish the stuck sender signal in case the sender is released before the monitor answers the signal by plugging into the talking jack associated with it.

3.173 To hold low resistance ground on the SC lead so as to afford a means for the "Stuck Sender Selector" circuit to pick out the particular district selector which is connected to the sender in case it sticks on an abandoned call, with the (AV) relays normal.

3.174 To be released as on an abandoned call if the subscriber hangs up while the sender is in the stuck or the partial dial condition.

3.175 To extinguish the signal and to prevent further dialing or false registration, without breaking down the connection when the monitor plugs into the talking jack.

3.176 To call in a decoder and connect the district to a permanent signal trunk
1f the monitor primes the sender before relay ST has operated except in cases which prevent the R2 switch from leaving normal.
Priming is done by inserting a talking plug in the priming jack P at the A swbd.

3.177 If the monitor primes after relay ST has operated, to release the calling line and advance the district and restore to normal.

3.178 If the attempt to release a stuck sender fails, to continue the signal until the trouble is cleared.

3.179 If an idle sender is primed in error, to make it test busy.

3.1791 Where automatic priming after timeout is employed, instead of a sender monitor signal, the sender automatically operates the priming feature, and the same functions are performed as when an operator primes the sender.

3.180 To protect the sender in case it becomes idle while a sender selector is passing over its terminal. 3.181 Arranged for sérvice observing.

3.182 To stick the sender in case a selection register relay or a class of

service relay is falsely operated or in case there is false battery on the FR lead in such a way as to cause a district selector to overcharge.

3.183 To prevent the sender resetting to normal unless the chain circuit through the back contacts on relays (Pl') to (P5') inclusive is closed.

3.184 To prevent false charge on reversed CI or operator trunks.

3.185 To prevent false overflow on CI calls in awaiting assignment position.

3.186 To control a signal indicating that all sender in a group are busy, or what part of the senders in a group are busy.

3.187 To stick the sender and alarm if any dial register locking leads are grounded.

3.188 To ground a lead (SB) which may be connected to the traffic usage recorder to indicate that the sender is busy on a service call, a stuck sender or a test call.

3.189 To ground a lead (SBM) which may be connected to the traffic usage recorder to indicate that the sender is plugged busy.

3.190 When Fig. CF is furnished, is arranged for completion of 10-digit DDD or 7digit MF calls via the auxiliary sender.

3.191 Fig. CF. Recognizes a 10-digit call by the second digit 0 or 1 dialed by the subscriber.

3.192 Fig. CF. Receives indication of a 7-digit MF call from the decoder.

3.193 Fig. CF. In addition to the class information required for a tandem C.I.
call, receives an indication from the decoder when 2 or 3 digits are to be skipped on outpulsing.

3.194 Fig. CF. Prepares a circuit for calling in the auxiliary sender when a 10-digit DDD or 7-digit MF call is to be completed.

3.195 Fig. CF. Grounds the start lead to the auxiliary sender link circuit when the seventh digit has been dialed by the subscriber.

3.196 Fig. CF. Recognizes seizure of an auxiliary sender by the auxiliary sender link circuit. 3.197 Fig. CF. Provides a class indication on the CL lead to the auxiliary sender.

3.198 Fig. CF. On 10-digit operation, when 8-digits have been recorded on the register relays, transfers the pulsing lead to the auxiliary sender for registering the succeeding digits dialed by the subscriber.

3.199 Fig. CF. On 10-digit operation sends the call to overflow if an auxiliary sender is not attached when the 9th digit is dialed by the subscriber.

3.200 Fig. CF. On 10-digit operation, waits for a dialing completion signal from the auxiliary sender before advancing into timing for release.

3.201 Fig. CF. When the selections have advanced to trunk test, switches the fundamental into the auxiliary sender so that trunk test toward the terminating end is made by the auxiliary sender which in turn makes CI loop assignment toward the subscriber sender.

3.202 Fig. CP. Causes the digits recorded on the dial register relays to be

C.I. pulsed into the auxiliary sender in the order in which they were dialed, the decoder having operated the relays required for a tandem C.I. call. These digits are MF pulsed forward to the terminating end by the auxiliary sender.

3.203 Fig. CF. Recognizes an advance signal from the auxiliary sender when its functions are completed and switches the fundamental back into the subscriber sender so that talking selections may be made.

3.204 Fig. CF. On release, removes ground from the start lead releasing the link crosspoints in the auxiliary sender link, causing the link and auxiliary sender to return to normal.

3.205 Fig. CF. On a 10-digit call, advances to close the trunk loop when the DC lead is grounded by the auxiliary sender on trouble release.

3.206 Fig. CF. During trunk test, recognizes reversal on the tip and ring leads as a signal to go to overflow.

3.207 To time for 3-6 seconds before sending the call to overflow when ninety per cent of the subscriber senders are busy and a delay is encountered in selecting a terminating sender.

3,208 To cancel the 3-6 second time delay feature in the event a terminating sender is seized before the intersender timing cycle is completed. 3.209 For a sender arranged for six-digit translation (sender recycle) to call

in a subscriber 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 decoder after three more digits (local code) are dialed and registered; to register an overflow indication set in the recycle circuit if an idle code compressor circuit is not available in the interdigital interval between the 3rd and 4th digits 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.

3.210 To provide for automatic release of circuits when a sender is simultaneously seized by two district selector circuits.

3.211 This circuit may be arranged to handle calls originated from (a) rotary dial sets only, Option EA, or (b) with OptionsEB and EC, touch-tone and rotary dial sets or touch-tone sets only. With touch-tone sets provided this circuit functions with the touch-tone calling signal to dial pulse converter circuit (TT converter) as follows:

3.2111 To seize the TT converter with ground on lead "ON" to that circuit when relay (T) in this circuit operates.

3.2112 Subscriber leads "T" and "R" are connected through this circuit to the TT converter, to connect the subscriber to a TT converter (L) relay. Relay (L) in this circuit is operated over lead "R1" under control of: The TT converter (L) relay on rotary dial calls or the TT converter verter pulse generator on touch-tone calls. On TT calls the converter in conjunction with a connected TT receiver detects, translates and outpulses dial pulses at 20 PPS in response to multifrequency digit signals from the TT set.

3.2113 Connection to the dial tone supply and connection of tone to the subscriber's line are made in the TT converter; however control of dial tone connection is in this circuit as for offices not arranged for touch-tone sets.

3.2114 Troubles detected by the TT converter on TT calls cause outpulsing to this circuit to either be stopped or not started, causing a "partial dial" or "permanent signal" time out in this circuit. In addition, for senders arranged for automatic priming, on all troubles overflow tone is connected to the subscriber's line, and for "mutilated digit" troubles, this circuit is caused to stick with ground over lead "MTD", if the misc. ckt. for sender make busy frame (CTR) key is operated or OUT.

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3.212 Fig. CS. Registers a prefix 0 and starts a timer whose expired interval of 3 to 6 seconds operates the (AZ) register	4.11 Auxiliary Sender Link Circuit - SD-96483-01.
for a zero operator call, otherwise addi- tional digits and signals on the "LA" and "PF" leads direct the call to be a CAMA op-	4.12 Auxiliary Sender Circuit - SD-96479-01.
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3.213 Fig. CT. Registers on a prefix 1 and signals on the "PF" to the decoder that this is an access type call destined for detail billing	4.14 Alarm Transfer Circuit - SD-20733-01, SD-20736-01.
3.214 Fig. CU. Transfers the first and	4.15 Misc. Ckt. for Sub. Sdr. Frame - SD-21234-01.
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CONNECTING CIRCUITS 6.

The senders are furnished in groups, each group connecting with one or more 6.1 groups of district selectors. The district selectors are furnished in groups according to the class of service of the subscriber's lines which they serve. Each sender connects with the districts by means of six leads, as follows: T(tip), R(ring),
FT(fundamental tip), FR(fundamental ring), T(tip), R(ring), TR(test), and SC(sender control). A district which requires to connect with a sender causes its sender selectors to hunt over the associated groups of senders test ing their TR leads, and seizes the first The sender test circuit also idle one. connects with the sender over these same leads.

6.2 The senders of all groups also connect with a common group of decoders, through the medium of a decoder connecto circuit which consists of multicontact relays and a noninterference circuit. Each sender connects with the connector by 55 leads, of which 13 are for transmitting the office code from the sender to the decoder, 4 for transmitting the class of subscriber or operator from the sender to the decoder 32 for transmitting the decoder information for establishing a call from the decoder to the sender, and 6 for control purposes.

When senders are arranged for comple-tion of 10-digit DDD calls and 7-digit 6.3 MF calls via an auxiliary sender, connection is provided to an auxiliary sender link. The subscriber senders are associated with the auxiliary senders through the crossbar switches of the auxiliary sender link. The subscriber sender connects to the link cir-cuit by means of 11 leads, nine of which are closed through the crosspoints of a crossbar switch to the auxiliary sender: The two leads which terminate in the link

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circuit are used to control the connection. The nine leads which connect through to the auxiliary sender are used for transmitting the calling information into the auxiliary sender and for switching the control paths for completing the call into the auxiliary sender.

6.4 When senders are arranged to handle calls from touch-tone sets, a touch-tone calling signal to dial pulse converter circuit (TT converter) is provided for and directly connected to each sender. In addition, a touch-tone calling receiving circuit (PB receiver) is provided per sender.
8 leads connect the sender to the TT converter and the TT receiver is connected in multiple on two of these leads, "T" and "R",

7. PRINCIPAL PARTS OF SENDER

7.1 The control circuit, which controls the connections between the sender and the district, and between the sender and the decoder.

7.2 The dial register, which receives and records the office code, number and station as dialed, is connected directly through the district selector to the subscriber's line over lead "T" and "R", with Option EA for rotary dial sets. With Option EB for TT sets, the subscriber's line is connected through the district selector and this circuit to the TT converter, which controls the dial register in this circuit over lead "R1". By adding the numerical designations of the relays which are operated for each digit dialed the number dialed is obtained. For example Al, A2 and A5 relays operated indicate an 8 was dialed as the first digit.

7.3 The selection register, which is set up partly from the decoder according to the office code, and partly from the dial register according to the called number.
This circuit guides the sender in making its selection.

7.4 The fundamental circuit which connects with the district and other selectors over leads FT and FR, and which mutually controls the sender during selections and the district and other selectors beyond it in making selections of the proper group of trunks, including the PBX trunk group on the final frame unless the call is for an individual line in which case it controls the selection of the particular line terminal by the final selector. CI impulses are also transmitted over the FT and FR leads.

7.5 The counting relays, used to count off a predetermined number of revertive pulses sent back by the district and other selectors.

7.6 The time measure switch, which measures off allowed times for the calling subscriber to start dialing, to finish dialing the number, to start dialing Page 12 stations if a fifth numerical digit is desired, and an interval for the sender to complete its work if the above actions are completed.

7.7 The selection switch, which advances from position to position for the several selections and trunk tests as each one is completed, making the proper connections in the sender for the succeeding one.

7.8 The PCI impulser switch, which by its rotation generates CI impulses for transmission either to manual offices equipped with relay call indicator positions or to panel tandem centers, or terminating senders.

gilla.

8. SENDER SEIZED BY DISTRICT SELECTOR

8.1 An idle sender normally holds battery through the (T) relay on its test lead TR, which connects with the test terminals of the sender selector switches. Any other condition except low resistance ground on the test lead indicates that the sender is idle.

8.2 When a district selector starts to hunt for an idle sender, it first tests the sender on which its sender selector switch happens to be standing. If that is busy, the switch proceeds over the other senders of the group in rotation until it reaches an idle one. The sender selector stops on the first sender which has not a low resistance ground on its test lead.

8.3 When the sender selector stops on the first idle sender, it connects ground to the test lead to prevent any other sender selector from seizing it. It holds this condition on the test lead until talking selection is completed.

Relay T operates from the ground on the test lead and grounds the off normal lead operating relays TMS, SB, and AC also biasing (L) on its back contact with Fig. AF. Ground on the off normal lead also seizes the TT converter, when Option EB is provided. Relay SR also operates from a contact of relay T thru contacts on relays CR and SCL.

8.4 Battery over the "SC" lead operates the SC relay through the "T" and "S" windings to ground. The 1500 ohm circuit is for the purpose of maintaining a nonoperate current value through relay D in the district. Relay SC operates relay SCI which opens the operating circuit of relay SR. Leads "T" and "R" (from the calling subscriber) are connected at the same time as lead "SC"; with "EA" option, relay L in this circuit operates directly over leads "T" and "R"; with "EB" option the connection of leads "T" and "R" operates PB converter L relay, which operates relay L in this circuit. In either case relay L operated

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in this circuit provides another circuit to hold SR operated and at the same time operate relay CR through a make contact on relay SC1. Relay CR locks directly to ground on the armature of relay SB and closes the pulsing lead thru relay SR. This prevents dialing from being effective if the SC lead is open.

8.5 The operation of relay TMS moves the time measure switch Rl off normal.

The operation of SB connects battery and ground to SG relay but SG does not operate at this time since it is short-circuited by the ground on the test lead. Relay AC in operating, connects the A dial register relays to the dial pulse relay contacts and partially closes the dial tone circuit.

9. SENDER BUSY CONDITIONS

9.1 The sender is held busy to other district selectors, while a call is in progress by the ground held on the test lead by the district selector circuit until talking selections are completed.

9.2 When the district completes talking selections it removes the ground from the test lead which shunts the SG relay during the call. The SG relay operates and locks disconnecting the T relay from the test lead. This places ground through the low resistance windings of the SG relay of Figure C or D on the test lead.

9.3 When it is desired to take a sender out of service it is made busy by inserting in the MB jack at sender make busy frame a plug with ring and sleeve shortcircuited. This operates make busy relay MB, which disconnects the T relay from the test lead and grounds the test lead to the sender selectors.

9.4 The sender tests busy under the following special conditions:

9.41 Selection switch TR lead grounded, or PCI switch displaced from normal while sender is not in use, operating relay SB.

9.42 Sender frame driving motor stopped, operating relay MB.

9.43 A talking cord plug inserted in P jack to release a stuck sender, and inadvertently left there, operating relay MT which in turn operates relay MB.

9.5 While either SB or MB is operated a ground is connected to terminal SB which is provided for connection, when desired, of a sender holding time recorder

9.6 While either SB or MB is operated, it opens a normally grounded lead to an all senders busy register-circuit, or sender load register circuit. When all the senders of the group are busy simultaneously, the register operates. While MB relay is operated or while a make busy plug is in the MB jack the (SDR) lamp at the monitor position or the (SS) lamp at the sender make busy frame lamp is lighted.

10. REGISTERING CLASS OF SERVICE

10.1 The sender may be arranged to serve from one to four classes of subscribers.

10.2 When the sender is seized by a district it immediately registers the class of subscriber which that group of district serves, provided the sender serves more than one class. The equipment for three or four classes of subscribers consists of relays FT and FR. The equipment for only two classes consists of relay FT or FR.

10.3 The several groups of districts serving different classes of subscribers are arranged to connect direct ground or nothing to the FT lead, and direct ground or nothing to the FR lead when in the position where they seize a sender.

10.4 Relay FT operates to direct ground on the FT lead, and relay FR to direct ground on the FR lead. These relays when operated, lock to off-normal ground until the R2 switch leaves position 3, when their operating battery is cut off. The operating lead to FR is cut off when R2 switch leaves position 1. The operating lead to FT is cut off when the decoder does its work and operates release relays RL and RL1 so that the FT lead will be free for use in fundamental selections.

10.5 With four classes, neither FT nor FR relay operated, indicates one class,
FT operated a second class, FR a third class, and both FT and FR a fourth class.

11. DIAL TONE

11.1 With Fig. AE

11.11 Rotary Dial Set - 1000 Ohm Range -Option EA

As soon as leads T and R are cut through to the calling line, line relay L operates, holding its auxiliary Ll and slow release relay SR and its auxiliary SRI and SR2 if used. The operation of SR2 or SR1, relay AC having already operated, provides a ground to complete the dial tone circuit through the secondary winding of L, and an induced tone is sent over the line by its primary winding. After the first digit is dialed and registered, relay AC releases and cuts off this circuit.

11.12 Rotary Dial Set - Option EB

Circuit operation resulting from rotary dial calls with the pushbutton set feature provided, is essentially the same as when only rotary dial sets are provided. However, there are differences as follows:

(a) Relay L in this circuit is operated and released over lead "R1" from the PB converter L relay, which is directly connected to the subscriber "T" and "R" leads (and thus, directly follows rotary dial set actions).

(b) Dial Tone, although under control of relays AC, SR2 or SR1 and RCO, and, when provided, subscriber sender recycle circuit and relay XC3 in this circuit, is impressed on the subscriber's line through a tone coil in the PB converter.

(c) The range is approximately 1500 ohms. This is determined by the PB converter L relay. See CD-21976-01.

(d) See Paragraph 95 for a description of the operation of this circuit on calls from pushbutton sets.

11.2 With Fig. AF

11.21 Rotary Dial Set - 1500 Ohm Range -Option EA

11.211 Polarized relay L operates when the "T" and "R" leads are cut through from the calling line to it, and it remains operated except for a momentary release on each break of the dial until the sender is disconnected, unless the subscriber previously hangs up to abandon the call. (L) operates whenever its primary winding finds a circuit to ground over the "R" and "T" leads through the calling subscriber's switchhook and dial or through special bypass circuits when the "T" and "R" leads are being used for conversation with the monitor. Its secondary winding which is in series with a condenser, re-enforces the primary winding and makes its operation and release quicker and more energetic. Its tertiary winding biases it and tends to keep its armature on the back contact. Jack L affords a means to patch the primary and secondary windings to a relay test set, disconnecting battery from the primary winding.

11.212 Relays Ll and L2 operate and release with (L) serving to provide additional contacts.

11.213 Relays SR and SR1 operate or hold on the first operation of L, and release when the call is completed or abandoned, definitely releasing L. They hold up continuously between those times, regardless of the momentary release of L due to dial breaks. 11.214 Relay RA operates through a back contact of Ll on the first dial break of each digit dialed, and remains op-

preak 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 for one digit. RAI operates and releases in reverse to RA, and provides additional contacts.

11.215 One winding of tone repeating coil TN is in the T lead, another in the

ring lead, and the other winding is grounded at one end and connected through a condenser to the source of dial tone at the other from the time relay SRI operates until relay AC releases. This sends an induced tone to the calling subscriber until the first digit has been registered.

11.22 Rotary Dial Set - Option EB

Circuit operation resulting from rotary dial calls with the touch-tone set feature provided, is essentially the same as when only rotary dial sets are provided. However, there are differences as follows:

(a) Relay L in this circuit is operated and released over lead "Rl" from the TT converter L relay, which is directly connected to the subscriber "T" and "R" leads (and thus, directly follows rotary dial set actions).

(b) Dial Tone although under control of relays AC, SR2 or SR1 and RCO, and, when provided, subscriber sender recycle circuit and relay XC3 in this circuit, is impressed on the subscriber's line through a tone coil in the TT converter.

(c) See Paragraph 95 for a description of the operation of this circuit on calls from touch-tone sets.

12. RECEIVING DIAL PULSES - FIG. AE

12.1 When the subscriber dials, relay L releases momentarily on each pulse, under direct control of the dial with Option EA, or under control of the TT converter with Option EB. Between successive dialed digits, and after the last dialed digit, L remains steadily operated, until the district opens the T and R leads while advancing to make talking selections or the call is abandoned.

12.2 When L releases on the first pulse of

a digit, Ll also releases. As Ll is not very fast operate it may not follow all the operations of L, but will stay released or buzz slightly during the return of the dial. After the last pulse of each digit, however, when L stays steadily operated for an appreciable time, Ll also operates.

12.3 SR does not follow the pulses, being slow release, but remains operated until L and Ll finally release when the district selector advances for talking selections or the call is abandoned. SR holds through a front contact of L and a back contact of Ll when Ll does not operate with L, and through a front contact of Ll when it does. SRI and SR2 operate and release with SR.

12.4 On the first dial pulse of each digit, which releases L and Ll, register advance relay RA operates through a back contact of Ll. Being slow release, it holds up through the pulses of each digit, though Ll may intermittently break its operating path; but after the last pulse of each digit, when Ll operates and stays up until the first pulse of the next digit, RA releases. RAl operates when RA releases and locks to a make contact on L. This is to prevent any vibration of RA on its release from being followed by RAL.

13. COUNTING DIAL PULSES

13.1 The pulses of each digit are counted on the pairs of pulse relays Pl and Pl' to Pó and Pó'. Each dial pulse, directly from rotary dial sets, or indirectly from TT sets, by releasing and reoperating L, sends a pulse of current from the back contact of L into these relays, with the effect of operating first a counter and then its prime relays. See Par. 95 for operation with TT sets.

13.2 This pair of pulse relays lock in series to a break contact of RA1 until a later pulse operates the next or the second next pair, which opens the locking circuit of the former pair and releases them.

13.3 If the maximum of ten pulses come from the dial the pulse relays are locked up at the close of several pulses in accordance with the following table:

Pulse	1 relays	P1-P1 *
. 11	2 "	P2-P2+
11	3 "	P2-P21-P3-P31
11	4 n	P4-P4
11	5 "	P5-P5-P6
18 L	6 "	P1-P1 -P5-P51-P6
48	7	P2-P21-P61P61
н	8 1	P2-P21-P3-P31-P6-P61
H	a 🕛	P4-P41-P6-P61
" i	ó "	P5-P51-P0-P61

13.4 At the close of a string of pulses, whatever their number, the relays which are locked up at that time are released by the operation of RA1, after which they are ready to be operated again by the pulses of the next digit. A back contact of L1 Figure AE or L2 Figure AF serves to re-establish the locking circuit immediately on the receipt of the first dial pulse, without waiting for the release of RA1. Figure O provides an added make contact on the P2* relay which shunts the normal contacts of the P5 relay and prevents false pulses during the release of that relay.

14. RECISTERING FIRST DIGIT

14.1 The first digit dialed is recorded on the A register which consists of cut-in relay AC, lock relay AL and record-ing relays AZ (A zero), Al, A2, A4 and A5, the last four relays being shown in Figures A and B. Figure A is used when the sender is to function with 3-digit office codes only. Figure B is used when the sender will be required to function initially with 2-digit codes only, during an intermediate period with both 2 and 3 digit codes and ultimately with 3-digit codes only. Except as stated otherwise the following description of registering the first digit, absorbing any preliminary pulses and registering successive digits applies for both cases.

14.2 AC operates immediately after T, and connects the operating windings of the (A) recording relays to contacts on the prime pulse relays. As the pulses of the first digit proceed, the recording relays operate and release with the prime pulse relays, their locking circuit being open at this time.

14.3 If the maximum of ten pulses come from the dial, recording relays are operated at the close of the several pulses in accordance with the following table:

Pulse	14	relays	Al
- 11	2		A2
- 11	3	- 11	A1-A2
18	4	·	A4
15	5	19	A5
. 11	6		A1-A5
- 41	7	11	A2-A5
	8	ų	A1-A2-A5
	9	. 98	A4-A5
- :11 - ,	1Ő,	- 11	AZ

14.4 At the close of the string of pulses,

whatever their number, the relays which are operated at the time are locked up by the operation of RAL. The locking path effective immediately upon the operation of RA1 is through the locking winding of the recording relay, or two or three of them in parallel, through the winding of AL, through back contacts on the cut-in relays of all succeeding registers except the hundreds register, where the back contact is on relay RCO Figure AG only instead of relay HC, a front contact on RA1 and a front contact on SR2 Figure AG or SR Figure AH. AL operates and connects a permanent locking ground to its own winding in series with those of the operated recording relays.

15. PRELIMINARY PULSE OR TOLL DIRECTING CODE

15.1 Preliminary Pulse Absorbed - Fig. AL

15.11 In case 1 is dialed for the first digit or in case an accidental pulse is sent by the subscriber switchhook before the first dialed digit, the RA relay operates and releases as for any regular dialed digit. But the digit 1 is not recorded by the A register nor is the registering process advanced so as to register on the B registen nor is the dial tone immediately cut off. This is because if RA relay releases while the Al relay alone of the recording relays is operated there is no locking path closed and the AL relay does not operate, so everything is left as before the false pulse is received. If digit 3, 6 or 8 is dialed the locking path for the AL relay is closed through a front contact on the A2 or A5 relays.

15.12 Any number of preliminary pulses will be absorbed in the same way provided they come far enough apart to allow the RA relay to release between them. Otherwise they will register as a 2 or higher number.

15.13 If on associated decoder circuit is arranged to work with prefix 11 code and this circuit is not so arranged, Option "BJ" is provided. This option consists of a grounded "LA" lead which serves as a local area signal to the decoder circuit.

15.2 Toll Directing Code Fig. AM

15.21 Code Prefix 11

When a code preceded by the prefix 11 is used the first No. 1 operates the XC and XC1 relays. The second No. 1 operates the XC2 and XC3 relays. The XC3 relay ground the EA lead to signal the decoder that an extended area code was dialed. Responding to the EA lead signal the decoder will use an extra area translator or will route all extra area calls to tandem or to toll, with distinction between extra area and local area traffic.

The Pl' relay operates at the close of the first No. 1 dialed. Relays PO' AL and AL1 will not have operated. When the RA relay releases the combination of Pl' relay operated, PO, AL1 and XC1 relays normal will close the circuit for operating the XC relay. When the RA1 relay operates in its turn the Pl' relay releases and the XC1 relay operates: At the close of the second No. 1 dialed the Pl' relay operates and with the XC1 relay operated the XC2 relay is operated followed by the XC3 relay.

Option "BI" is provided to prevent false seizure of the auxiliary sender circuit when prefix ll code is followed by a DDD code. When relay (XC3) operates, the operate path of relays (ASC) and (AS1) in Fig. CF is opened to prevent seizure of the auxiliary sender circuit.

15.22 Preliminary Pulse Absorbed

If only one No. 1 is registered the XC and XCl relays operate but have no effect upon a call if a regular code is dialed. This is because the first digit other than 1 which is dialed will operate the AL and ALl relays and the XC2 and XC3 relays will remain normal. If one prelimimary pulse is registered and the call is then abandoned the XC2 and XC3 relays may operate but the sender will release without connection to a decoder.

16. REGISTERING SUCCESSIVE DIGITS

16.1 Three Digit Office Codes Only Used -Fig. A Equipped

16.11 The operation of AL upon registration of the first digit releases AC and operates BC, transferring the leads from contacts on the prime pulse relays from the recording relays of the A register to those of the B register. The back contact on BC opens the parallel connection between the windings of AL and BL, so that the latter will be clear of ground after RA1 releases until it operates again.

16.12 The second digit is registered in the same way as the first digit, and BL operated. But in this case if 1 is dialed it is registered, not absorbed.

16.13 All the digits dialed are registered in the same way, there being in all eight registers, A, B and C for the office code, TH, H, T and U for the called number, and ST for the stations letter for fifth digit of the called number if any.

16.14 Register cut-off relay RCO in Fig. AQ operates with HC but does not release with it, holding up to the end of the connection. RCO breaks the operating lead to THL and earlier lock relays and closes a

locking ground to HL and later lock relays. Its purpose is to divide the registers into two separate parts so far as their locking is concerned, because the locking current for all eight registers is too heavy to break on any one relay contact. See Paragraph 53.3 for operation with Fig. AH.

16.2 Two Digit Office Codes Used - Fig. B Equipped

16.21 If both 2 and 3 digit office codes are used, when the first code digit is dialed and the recording relays have operated, a ground is connected to a particular one of the cross-connecting terminals; TD2 to TD9, depending on the first digit dialed.

For example, if a 2 is dialed ground is con-nected to TD2 terminal, if a 3 is dialed ground is connected to TD3, etc. The circuit for this ground may be traced from the contact of the SB relay through the contacts of the Al, A4, TDI and TD2 relays. The TDI and TD2 relays are operated respectively by the A2 and A5 relays.

16.22 The TD1 terminal is strapped to such of these terminals TD2 to TD9 as correspond in number to the first digit of one of the 2-digit office codes. Thus the TD relay is operated each time the first digit of 2-digit office code is dialed.

16.23 The operation of the TD relay opens the lead from the AL relay contact to the BC relay and connects this contact to the winding of the CC relay, thus operating the CC relay instead of the BC and causing the second code digit to be registered on the C register after which the succeeding digits are registered on the TH, H, T, U and ST registers in the usual way.

16.24 The TD1 terminal is always strapped to whichever of the terminals TD2 to TD9 correspond in number to the first digit of the last two digit code to be converter to a three digit code. Terminals TD2 to TD9 are strapped together in a certain order depending upon the order in which it is desired to convert the two digit office codes to three digit office codes. For example assume that the two digit office codes beginning with 7 are first to be changed to 3-digit office codes followed in order by those beginning with 6, 5, 4, 2, 3, 8 and 9 respectively. Then, beginning at terminal TD7 the strapping is looped successively to terminals TD6, TD5, TD4, TD2, TD3, TD8, TD9 and TD1. By arranging the strapping in this manner the conversion to 3-digit office codes is effected by cutting a single strap each time a group of two digit office codes are converted to 3-digit office codes.

16.25 During the period when only 2-digit office codes are being used the B reg-ister relays BC, BL, BZ, B1, B2, B4 and B5 and the TD, TD1, and TD2 relays may be omitted. In this case leads TD at the TD relay are connected, together thus operating the CC relay directly from the contact of the AL relay on all calls during this period regardless of the first digit dialed.

16.3 Two Digit Converter Into 3-Digit Office Code - Fig. AT

Fig. AT provides for the reuse of the A register relays of Fig. B when an office is converted from 2 to 3 digits and avoids the need of changing these relays to agree with Fig. A codes.

17. CONNECTION WITH DECODER

17.1 When three digits have been dialed,

as shown by the operation of relay CL; or when zero is dialed for the first digit, as shown by the operation of relay AZ, or when permanent signal relay PS op-erates with the sender off normal start relay ST operates and when selection switch reaches position 2 it connects battery over lead ST to the decoder connector.

17.2 As soon as the connector and a de-coder are free to serve this sender, the sender is connected to the decoder by all the leads shown as going to the con-nector except leads ST and CBS.

17.3 The sender immediately transfers the office code and the class of service to the decoder by grounding a selection of the 17 leads, A1, A2, A4, A5, B1, B2, B4, B5, C1, C2, C4, C5, PS, KS, D1, D2, and D3, to operate corresponding relays in the decoder. In case the decoder is not arranged for its maximum of eight classes of service, one or more of leads D1, D2, and D3 may not be connected in the decoder and so need not be connected in the sender. Leads CK1 and CK2 are employed in connection with a check. of the above 17 leads.

17.4 The decoder then translates the office code and class of service and returns instructions to the sender by grounding a selection of the 32 leads CL1, CL2, CL3, CL4, DB1, DB2, DB3, TS, TS1, OB1, OB2, OB4, OB5, SD, SD1, DG1, DG2, DG4, DG5, TW, CR1, CR2, CR3, CR4, CR5, OG1, OG2, OG4, OG5, SO, ZCl and ZC2 to operate corresponding relays in the selection register of the sender. In some cases one or more of relays TS1, TW, ZC1 and ZC2 may be omitted from the sender and the corresponding leads left disconnected as the decoder will never ground them.

17.5 No relay is provided in the sender to be operated by a ground over lead CL4, that lead being used to indicate a free code and cancel the coin test in coin senders. Under certain conditions, however, the de-coder may ground the CL4 lead when connected to a noncoin sender, and in that case the sender must be prepared to connect battery to the lead to satisfy the decoder. For this purpose the (U) resistance, is provided to take the place of the missing (CL4) relay. The conditions requiring this resistance are that the sender shall work together with coin senders into a common group of decoders, and shall serve one or more of the first four classes of service in the decoder, those first four classes including any coin classes there may be.

17.6 After a brief interval to allow the selection register relays in the

sender to operate, the decoder grounds lead RL. This operates release relay RL, which locks and operates RL1. RL1 breaks the start lead ST and the decoder connector thereupon releases and breaks all connections between sender and decoder. RL1 also locks the selection register relays and connects the FT lead through to start districts brush selection.

17.7 Lead TRL, the remaining one of the 53 connecting sender to decoder, is used only in case the decoder fails to release the sender in the regular way as just described. Its use will be described later.

18. SENDING INFORMATION TO DECODER

18.1 On the first trial which a sender makes on every call to obtain a translation from a decoder, it must ground at least temporarily every one of the 17 sending leads A1, A2, A4, A5, B1, B2, B4, B5, C1, C2, C4, C5, PS, KS, D1, D2, and D3, except any of the last three which may be disconnected at both ends. A steady ground is connected to operate and hold a relay in the decoder, a temporary ground is connected to operate a relay in the decoder temporarily for checking purposes only. The temporary ground originates in the decoder and comes to the sender over leads CK1 and CK2.

18.11 The first 13 sending leads, for the office code, are connected to transfer springs on relays of the same designation. If a relay is operated it connects steady ground to its lead if it is not operated it connects its lead to lead CK1, or to lead CK2. The office code for dial zero or permanent signal is 0-0-0, and in addition lead PS is grounded on a permanent signal call.

18.12 Lead KS is permanently connected to lead CKl in this sender. It is connected to steady ground in a keyset "A" sender only, as its purpose is to notify the decoder whether its dealing with a subscriber sender or a keyset "A" sender.

18.13 The decoder may be arranged for a maximum of eight classes of service, and it is notified as to which class it is dealing with on a particular call by steady ground on a selection of leads D1, D2 and D3. If a group of senders serves only one class of service each of the D leads is permanently connected to lead CKl for a temporary ground or lead D5 for a steady Iſ ground, according to the class served. a group of senders serves two, three or four classes, some of the D leads are permanently connected to lead CK1 or lead D5, and the other D leads are connected to leads CK3 or CK4 and so to transfer springs on relay FT or FR. In this case the leads connected to FT or FR are connected to lead CK1 or to steady ground on each call according to the class of service as registered by the

link circuit on relays FT and FR. The proper cross-connections for D leads will be furnished by the Telephone Company.

18.14 When all relays in the decoder con-

nected to the sending leads operate, some by steady ground and some by the ground furnished by the decoder over leads CKl and CK2, a chain circuit in the decoder is closed, with the effect of removing the ground from leads CKl and CK2, and so releasing all decoder register relays except those which are operated by steady ground in the sender. The effect of first operating all the relays in the decoder and then releasing such as are not wanted, is to check all the connecting leads for continuity and for freedom from grounds and crosses.

18.2 If the decoder fails to send a regular release signal to the sender on the first trial, the sender releases the decoder connector and then makes a second trial.

19. SELECTION REGISTER GENERAL

19.1 The decoder records in the selection register full information for reaching the distant office and charging for the call. When the information for setting up the district and office selections has been utilized, the relays recording it are released. Then in case of a full selector call they are set up again directly from the numerical part of the dial register to guide the incoming and final selectors.

19.2 The following sections outline the functions of the several parts of the selection register as set up from the decoder and as set up from the dial register.
The relays are arranged in six parts.

20. SELECTION REGISTER, FIRST PART

20.1 This consists of relays CL1, CL2, CL3 and CLA. The first three are operated from the decoder only, and locked until the sender is released. CLA operates with any of the first three relays. The following combinations of the first three relays indicated the class of call:

None	Full selector class.
CLL	Operator class, restricted code.
CL2	CI tandem class.
CL1-CL2	CI direct class.
CL3	Operator class, special or official.
CL3	3-digit code, or permanent
CL2-CL3	CI tandem class, official 3-digit code to operator.
21. SELECTION R	EGISTER, SECOND PART
21.1 This consi DB3, IS, T	sts of relays DB1, DB2, S, TS1, ZC1, ZC2, ZC3,

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and ZC4.

21.2 DB1, DB2 and DB3 are set up first from the decoder to indicate the district brush, and are locked until the district group selection has been completed as shown by the advance of the selection switch. The following combinations indicate the district brush required.

District Brush O

· · ·

-11

2

3

. 11

. 11

None

DB1

DB1-DB3

DB2-DB3

DB2

21.3 IS (incoming selection) DB1, DB2, and DB3 are then set up in the same combination as relays TH1, TH2, TH4, and TH5 in the dial register, to indicate the incoming brush and assist in indicating the incoming group on full mechanical calls. Thousands transfer relay THT operates in the trunk test position of the selection switch after thousands has been dialed, provided relay CLA has not been operated, connecting the windings of the selection register relays to the contacts of the dial register relays. The following combinations indicate the thousands digit dialed and the incoming brush required,

None Thousands O) IS "1)	Incoming	brush O
DB1 IS-DB1 "2}	Incoming	brush l
DB2 DB3	Incoming	brush 2
IS-DB3 DB1-DB3 " 6) " 7)	Incoming	brush 3
IS-DB1-DB3 DB2-DB3 " 8) " 9)	Incoming	brush 4

All of the above combinations having either IS or DB3 operated, but not both, indicate odd thousands. Those with neither or both operated indicate even thousands. This helps to indicate the incoming group required.

21.4 TS, TS1, ZC1 and ZC2 are set up from the decoder only. The following combinations indicate the talking selection position to which the district is to be set, and whether or not the sensitive and marginal relays in zone registration districts are to be operated. TSl is furnished only when flat rate lines are equipped with meters to register calls to A-B toll points, or when zone registration districts are used. When TSl is not furnished, the wiring may be connected so that TS operated sets the district in the no charge position, or connected so as to set it in the charge position, as specified. ZCl, ZC2, ZC3, and ZC4 are furnished only when zone registration is used, and then sometimes not ZC2. With all relays furnished the combinations are as follows:

Relays Up.	Talking Selection District Relays Up	Zone
None TS TS-TS1 TS-ZC1 TS-TS1-ZC1 TS-ZC2 TS-TS1-ZC2	OperatorNoneNo chargeNoneChargeNoneNo chargeSensitiveChargeSensitiveNo chargeSensitive & MarginalChargeSensitive & MarginalChargeSensitive & Marginal	0 1 2 3 4 5

ZC3 and ZC4 are checking relays whose use will be described later.

22. SELECTION REGISTER, THIRD PART

22.1 This consists of relays OB, OB2, OB4, OB5, SD, SD1, and OT2.

22.2 OB1, OB2 and OB4 are set up first from the decoder to indicate the office brush, and are locked until the trunk test has been completed. The following combinations indicate the office brush required, the zero combination being used in case the call is not routed through the office frames:

None	Office brush 0
0B2 0B1-0B2	" " <u>1</u> " " <u>7</u>
0B5 0B1-0B5 0B2-0B5	
0B4-0B2-0B5 0B4-0B5	" " B "G"

The (DG5) relay is operated locally for pulses 5 to 9 incl., "G" option.

22.3 OBL, OB2 and OB4 are then set in the same combination as relays Bl, B2, B4 in the dial register to indicate the final brush, in the case of full selector calls only. Hundred transfer relay HT operates in the position preceding incoming group selection, provided relay CLA is not operated and after hundreds has been dialed, and connects the windings of the selection register relay to the contacts of the dial register relays. The following combinations indicate the final brush required.

None	Hundreds	0	or	56	Final	brush "	0
OB2	11	Ż	or	7		1 11	ŝ
0B1-0B2	11	3	or	8		11	3
OB4	11	4	or	9	0	- 11	4

By adding the numerical designations of the relays which are operated, the number of the final brush selected is obtained.

22.4 SD and SD1 are set up from the decoder only. SD is operated on all calls except those to manual offices having party lines with station letters, or with "add five" incoming group sel. SD1 is operated on all calls except those to manual offices having lines with 5-digit numbers.

22.5 OT2 operates when the first two numerical digits dialed are 1 and 0. In conjunction with SD and SD1 it serves to cancel the stations delay of the time measure switch when the kind of equipment of the terminating office, or the first two digits of the number, show that there is no occasion to wait for a stations letter or a fifth numerical digit, at the same time placing the synchronizing from trunk test under control of the UL relay so that trunk test may proceed without awaiting the advance of the time measure switch out of position 11. These relays in conjunction with the OT relay also serve to change the order of sending digits by RCI impulser when the called line has a 5-digit number. The purpose of the OTI relay is to prevent the operation of the OT2 relay should a 3, 6 or 8 be dialed as the thousands digit and a zero as the hundreds digit.

23. SELECTION REGISTER, FOURTH PART

23.1 This consists of relays (DGl), (DG2), (DG4), (DG5) and (TW).

23.1 DG1, DG2, DG4 and DG5 are set up first from the decoder to indicate the district group, and are locked until that selection has been completed. The following combinations show the district group required:

None	District	Group O
DG1	11	
DG1-DG2	11	11 7
DG4	и	" 4
DG5	1 I H-	. 5
DG1-DG5	- D - H	" 0
DG2-DG5		" (
DG4-DG5	1	" 9

By adding the numerical designations of the relays which are operated the number of the district group selected is obtained.

23.3 DGl and DG2 are then set up in a combination indicating the incoming

group. DGl operates if H5 in the dial register is locked up, through a contact on HT provided HT operates as it does on a full selector call only. DG2 operates if either DB1 or DB3 is operated alone, but not if both or neither are operated. The following combinations indicate the incoming group required:

None DG1 DG2 DG1-DG2	Thousands " "	even even odd odd		Hundreds " "	0-4 5-9 0-4 5-9		Incoming "	Group 0 " 1 " 2 " 3
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By adding the numerical designations of the relays which are operated, the num-. ber of the incoming group selected is obtained.

23.4 DG1, DG2, DG4 and DG5 are set up a third time on full selector calls, in the same combination as relays U1, U2, U4 and U5 in the dial register. This is done by units transfer relay UT, which operates in the position preceding final units selection provided relay CLA is not operated, and when units has been dialed, and indicates the final units selection. The combinations are the same as for the district

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group selection which have already been given. As before the numerical designations add up to indicate the final units selected.

23.5 TW is furnished in an office where some calls are routed through a distant office selector ADCI, crossbar tandem or sender tandem equipment. It is operated from the decoder on such a call, and serves to extend the interval which the time measure circuit allows for the sender to release before giving the monitor a stuck sender signal. It also delays the release of the sender in case a CI call is abandoned while awaiting assignment of the trunk by the operator.

24. SELECTION, FIFTH PART

24.1 This consists of relays CR1, CR2, CR3, CR4 and CR5. They are operated from the decoder only.

24.2 CR1, CR2, CR3 and CR4 fix the compensating resistance in the fundamental circuit during the office test and office selections, and also fix it at the same or a smaller value during the trunk test and later periods. The several combinations and the resulting resistances are as follows:

None	Office	Test	900	Trunk	Test	0
CR1	11	н I.	600			0
CR2	11	11	300	·	•	0
CR1-CR2	, O	1 1	0			. 0
CR3	11	n	900	1		300
CR1-CR3	# • • • •	. 11	600	· . · ·		300
CR2-CR3	11	11	300	100	· · · •	300
CR4	19	- 11	900			600
CR1-CR4	17	11	600	and particular in		600
CR3-CR4	18	ir i	900	,		'900

24.3 CR5 is operated on all mechanical

class calls over short trunks (trunk loops 1300 ohms or less). Its effect is to substitute the MTG relay for the TG relay in the fundamental circuit during office and trunk tests. The MTG relay will not operate should the trunk test be made while the fundamental is connected to one of the incoming selectors which has 24 volt battery on the incoming trunk conductors while it is returning to normal. When the incoming selector reaches normal 48 volt battery is connected to the incoming trunk conductors and the MTG relay will then operate.

25. SELECTION REGISTER, SIXTH PART

25.1 This consists of relays OG1, OG2, OG4, OG5 and SO.

25.2 OG1, OG2, OG4 and OG5 are set up first from the decoder to indicate the office group, and are locked until trunk test has been completed. The following combinations show the office group required, the zero combination being used in case the call is not routed through the office frames:

None			Of	tice g	roup	0
0G1				a	, - R	1 .
0G2	• • .	•		11	tt	2
061-062	•			H	11	3
OG4		· . ·		- (t	11	4
005		4.55	·	, 19	tt -	5
001-005	.1 .			11	88	6
062-065				11	.11	7
0G1-0G2-	065			11		. 8
064-065		1. J. M.	5	. 11		9

By adding the numerical designations of the relays which are operated the number of the office group selected is obtained.

25.3 OG1, OG2, OG4 and OG5 are then set up on full mechanical calls in the same combination as relays T1, T2, T4 and T5 in the dial register. This is done by tens transfer relay TT which operates in the position preceding final tens selection provided CLA is not operated, and when tens has been dialed, and indicates the final tens selection. The combinations are the same as for office group selection as given in the preceding paragraph. As before the numerical designations add up to indicate the final tens selected.

25.4 SO is operated from the decoder on skip office calls, that is, on calls not routed through the office frames. It serves to pass the selection switch through the office test, office brush and office group positions and permits the operation of FO3 immediately upon release of FO1 to close the fundamental for trunk test with "AA" wiring.

26. TIME MEASURE SWITCH

26.1 The time measure sequence switch R1 makes one revolution each time the sender is used starting from the normal position 1 when the sender is seized, advancing as different parts of the dialing are completed and returning to normal when the sender is released. If the dialing or the release is delayed, the switch is advanced by power driven interrupter to one of several positions where disposition is made of the call

26.2 The eighteen positions of the switch are used as follows:

1	Normal
2	Pass-by
3	Awaiting first digit
4	Awaiting first digit
5	Permanent Signal
ð	Awaiting Units digit
7	Amaiting Units digit
Å	Pantial dialing signal
· • ·	TOTATOT OTGATUP DEPINE
9	Stations delay
10	Stations delay
11	Stations delay
12 .	Stations delay
13	Passeby
īμ	Passehv
15	Awaiting Release
16	Awaiting Release
17	Awaiting Release
18	Stuck sender signal

27. STARTING TIME MEASURE SWITCH

27.1 When the sender is seized, the offnormal ground operates relay TMS which operates TM1. The latter advances the switch to position 3. TM1 releases as the switch leaves position 2, but TMS locks to off-normal ground. If the sender is seized before the time measure switch has restored to normal from the preceding call, TMS will not operate until it has done so.

28. TIMING FOR FIRST DIGIT

28.1 An interval of 30 to 60 seconds is measured by interrupter TMA in positions 3 and 4 for the registration of the first digit.

28.2 On the first closure of the interrupter after the switch reaches position 3, relay TM operates. Then when the interrupter breaks, TM1 operates in series with TM, and advances the switch to 4. As it leaves 3, TM and TM1 release.

28.3 On the second cycle of the interrupter, TM and TMl operate in the same way and advances the switch to 5, where they release. In this position permanent signal relay PS operates and a connection is established from the calling line to a permanent signal trunk, as will be described later.

28.4 If the first digit is dialed and registered before the second closure of the interrupter, the switch being in position 3 or 4, the operation of relay AL in the dial register operates relay TML alone. This advances the switch through to position 6, and holds open the operating lead to relay PS so the latter cannot operate while the switch passes through 5. As the switch leaves position 5 relay TML releases.

28.41 With Option X, the TMA interrupter will advance the Rl sequence switch out of position 5 in case the sender does not restore after the PS relay functions.

29. TIMING FOR UNITS DIGIT

29.1 The first digit having been dialed and registered in the time allowed, an interval of 30 to 60 seconds is measured by interrupter TMA in position 6 and 7 for the dialing of the other digits up to and including the units digit provided the class of call is one which requires the dialing of a number.

29.2 On the first closure of the interrupter after the switch reaches 6,
TM operates. When the interrupter breaks
TMI operates and advances the switch to 7.
TM and TMI operate again on the second cycle and advance the switch to 8.

29.21 Sender Monitor, Figure AN

In position 8 the SEL interrupter flashes the SDR lamp at the sender monitor position, with relays TMl and MS normal. Also an auxiliary signal is provided through the Kl cam. The flashing signal indicates partial dialing or failure to release on permanent signal or failure to release for other reasons. A steady lamp indicates a sender make-busy.

29.22 Automatic Priming After Time Out, Figure AO or AU

Instead of signaling at a sender monitor position, a circuit is closed in position 8 with the TMI relay normal to operate the MS relay. This operates the MT relay and in turn the PR relay. The sender is automatically primed the same as if a monitor performed the priming function. The SS lamp at the sender makebusy frame will light with Figure AO and the TA lead will be grounded to produce an audible alarm if the sender does not restore promptly. Option DI permits the SC lead to be grounded from the MB jack to facilitate the use of the stuck connection finder circuit.

29.3 If the units digit is dialed before the second closure of the interrupter, the switch being in position 6 or 7, or if it is dialed while the switch is in 8 but before the monitor plugs into the test jack, the operation of relay UL in the dial register operates relay TMl alone. This advances the switch through the position 9, and holds open the leads to the monitor's lamps and auxiliary signal circuit.

29.4 In the case of a zero or 3-digit official code call or a permanent signal, no units digit will be dialed and it is necessary to pass the switch to position 9 without measuring time. On a call of this kind the decoder will operate relay CL3 in the selection register. A ground through a front contact of CL3 operates TM1 and advances the switch to 9.

30. TIMING FOR STATIONS DIGIT

30.1 The units digit having been dialed and registered in the time allowed then if there is any reason to expect that a stations or a fifth numerical digit may be dialed, an interval of about four seconds is measured by interrupter SEL in positions 9 to 12.

30.2 The operation of advancing the switch through these positions is the same as above described. There is no alarm position following 12, but on reaching 13 the circuit proceeds to count the final interval, for the sender to release and the sender as a whole proceeds without waiting longer for another digit to be dialed.

30.3 If another digit is dialed and registered before the switch gets into

position 12, the operation of relay STL in the dial register operates relay TM1 alone, which moves the switch through to position 13 at once. Should dialing of the fifth numerical or stations digit start while the switch is in position 12 the release of (L-1) and the operation of the (RA) both connect ground to the TM relay winding thus preventing the operation of TM1 on the opening of the interrupter contact. When the (RA1) relay reoperates after the completion of the dial pulse the switch will move to position 13 by the operation of relay STL and TM1.

30.4 With certain combinations of relays SD, SDl and OT2 on the selection register, and T5 in the dial register, the dialing of another digit is possible and time is measured as above described. With other combinations it is not to be expected and TMl is operated as soon as the switch through to 13, thus cancelling the stations delay. These latter combinations are as follows:

30.41 Both SD and SD1 operated or SD1 operated and CLA normal, shows the terminating office has neither station letters nor 5-digit numbers.

30.42 SD operated but neither SD1 nor OT2 shows that there are no station letters, and that, while there are 5-digit numbers, the called number is not one of them because it does not begin with 10.

30.43 OT2 and T5 operated but SD1 not operated shows that there are 5-digit numbers and that the called number begins with 105 to 109. Usually it cannot be a 5-digit numbers, which are all in the series 10000 to 10499. Neither can they have a stations digit, because in an office with 5-digit numbers no station letters are assigned to numbers in the series 1000 to 1099. In certain localities there may be manual offices with numbers from 10500 to 10999. There an alternative wiring is used, bridging around the contacts on T5, and the stations delay is not cancelled on any number beginning with 10.

31. PASS-BY POSITIONS

31.1 The switch is advanced at once past positions 2, 13 and 14 by a ground on cam F1.

32. TIMING FOR RELEASE

32.1 Dialing having been completed an interval is measured by interrupter TMA for the sender to complete its work and be released. For any call routed through a 2-wire office selector of full selector tandem equipment, the interval is measured in positions 15, 16 and 17 and varies from 60 to 90 seconds. For any other call, the interval is from 30 to 60 seconds, position 17 being passed by without timing except that on an P.C.I. call if position 17 is not reached before trunk test is completed the switch must be timed thru position 17. This allows an extra 30 seconds for the operator to assign the trunk.

32.2 On the first cycle of the interrupter after the switch reaches 15, TM and TM1 operate and advance the switch to 16. On the second cycle they advance the switch to 17. If relays Cl and TW are both released, a ground through their back contacts operates relay TM1 and advances the switch to 18. If either of them is operated TM and TM1 operate on the third cycle of the interrupter and advance the switch to 18.

32.3 If the sender is released and the other switches restored to normal at any time, this switch being in any position except normal, ground through a back contact on relay TMS operates relay TM1, which advances the switch through to normal position 1.

33. SELECTION SWITCH

33.1 The selection sequence switch R2 makes one revolution each time the sender is used, starting from normal position 1 upon the operation of relay AL; or PS, and advancing step-by-step as the several selections are made.

33.2 The eighteen positions of the switch, are used as follows:

1 Normal District brush selection 2 District group selection 4 Office test 5 Office brush selection 6 Office group selection
7 Trunk Test -7 Trunk Test -8 Incoming brush selection 9 Awtg. Reg. 10 Incoming group selection 11 Cable discharge 12 Final brush selection 13 Awtg. Reg. 14 Final tens selection 15 Awtg. Reg. or C.I. Impulses 16 Final units selection Incoming advance 17 18 Talking selection

33.3 On a full selection call through an office selector the switch stops in each position while the appropriate function is performed, and then advance to the next position; except the cable discharge position, which it passes through without stopping. On skip office calls positions 4 to 6 are passed by without stopping.

33.4 On a Cl call the switch stops and advances as on a full selector call,

except as follows. It passes through position 8 to 14 without stopping. The Cl pulsing may start while the switch is passing these positions, if the trunk is assigned soon enough. Position 15 is used to complete the pulsing, after which the switch is advanced to 18 for talking selections.

33.5 On an operator class call the switch stops and advances as on a full selector call, except that it passes through positions 8 to 18 without stopping.

34. COUNTING RELAYS

34.1 The counting relay circuit, for counting revertive pulses on selections, consists of ten counter relays 0, to 9, eleven prime relays B0, F0 and 1^s to 9^s relays F01, F02 and F03 and the contact of the stepping relay STP. The winding of B0 and F0 are connected in parallel, and together they constitute the zero prime relay, two being furnished merely to provide the requisite number of contacts.

34.2 As the stepping relay operates and releases in response to the revertive pulses, it in turn sends pulses into the counting relays, through contacts of relays in the selection register. The direction of the current flow through the contact of STP is reversed after about half of the selections of a call have been made, to give longer life to the contact.

34.3 Each pulse from the contact of STP operates one counter when the pulse starts and the prime when the pulse ends. These relays lock and the prime steers the next pulse into the next lower numbered pair. So one pair after another is locked up, until finally 0, B0 and F0 operate and lock, which stops the revertive pulses. The number of pulses permitted is predetermined by the setting of the selection register, which steers the first pulse into a particular pair of relays.

34.4 On office group selection the contact of STP is connected through the selection switch to the transfer spring of OG1, and according to the setting of OG1, OG2 and OG4, it is connected thence to the transfer spring of 4:, 3:, 2: or 1: or to the front contact of 1:. If it is connected to 4:, the first pulse operates 4 and 4:, leaving them locked up, the second pulse operate 3 and 3:, the third 2 and 2:, the fourth 1 and 1:, and provided OG4 is not operated, the fifth pulse operates 0, BO and FO, and the pulses cease. If, however, the pulses are sent into the transfer spring of 3: first, instead of 4:, the fourth pulse operates, O, BO and FO and stops the pulsing, and so on. If OG5 is operated, five pulses in addition to those determined by the setting of OG1, OG2 and OG4 will be received between the pulse which operates 1 and 1', and the last pulse which operates O, BO and FO. These five additional pulses operate 9 and 9', 8 and 8', 7 and 7', 6 and 6' and 5 and 5'. Therefore according to the combined setting of OG1, OG2, OG4 and OG5, any number of pulses from one to ten will be received before their flow is terminated.

34.5 The operation of BO breaks the fundamental circuit and thereby stops the selector which is generating the revertive pulses.

34.6 After certain selections (office brush and group and final units) FO oper-ates FOl and FO2 in turn and FO2 releases F03, which is otherwise operated whenever, the selection switch is off-normal. FOI and F03 unlock the counting relays and they all release. FOI does not release at this time, however, as it locks, and FO3 being released maintains the break in the fundamental circuit after BO has released. The release of RO, with FOI locked up, advances the selection switch, and as it leaves the position it has been in, FOl and FO2 release and FO3 operates. The counting relay circuit is now ready for the next selection: The slow action introduced by FO1, FO2 and FO3 is for the purpose of preventing selectors from getting out of step with the sender.

34.7 After district brush and group selections and before talking selections on all calls and with "AA" wiring before trunk test on skip office calls where less time is required F03 operates thru the bottom break contact of F01 without waiting for F02 to release.

34.8 After all other selections where sufficient time is provided by a sequence switch position intervening before the following selection, FOI and FO2 are not operated, nor FO3 released. The operation of FO starts the sequence switch at once, and as it advances it unlocks the counting relays. The fundamental is closed by the release of BO and the advance of the switch to the second position beyond.

35. DISTRICT BRUSH SELECTION

35.1 The operation of relay RLL to release the decoder closes the fundamental tip to ground through the winding of STP, the operating winding of overflow OF shunted by its noninductive winding and a 1000 ohm resistance, all in series. The fundamental ring is open. Any false battery on the FR lead such as might cause an overcharge will operate relay ZC3, in case the sender is equipped for zone charging, and so prevent the closure of the fundamental tip to ground.

35.2 This closure of the fundamental tip to ground starts the district elevator,

and as that rises it sends pulses over the fundamental tip, STP follows the pulses, but OF does not because it is polarized in the other direction.

35.3 STP sends from one to five pulses through the contacts of the DB relays in the selection register to the counting relays. The last pulse breaks the fundamental, stopping the district elevator in position to trip the desired brush, release the counting relays, and advances the selection switch to position 3.

36. DISTRICT GROUP SELECTION

36.1 With the switch in 3 and BO and FO1 released and FO3 operated the fundamental tip is again closed to ground through the same circuit as before. The district elevator starts again and sends more pulses to STP.

36.2 STP sends from one to ten pulses through the contacts of the DG relays to the counting relays. The last pulse breaks the fundamental stopping the district elevator with its tripped brush on the first trunk of the desired group, releases the counting relays, and advances the switch to position 4.

36.3 Where the (R2) switch enters position 3 the "T" winding of SC relay - 1000 ohm - is shorted decreasing the resistance in "SC" lead to 500 ohms for the purpose of operating a relay in the district selector circuit.

37. ZONE REGISTRATION IN DISTRICT SELECTOR

37.1 Part of the information for zone registration is registered in the district by setting its switch in the nocharge or the charge talking selection position. The rest of the information is registered by operating a sensitive relay by high resistance battery from the sender, or the sensitive relay and also a marginal relay by low resistance battery from the sender. The battery is sent over the FR lead during the time district group selection is being made.

37.2 To send high resistance battery to the district, relay ZCl is operated by the decoder while the selection switch is in 2, and locked until the switch leaves 3. 580 ohms battery is then connected to the FR lead. To send low resistance (52.5 ohms) battery to the district, ZC2 is operated instead of ZCl.

37.3 As soon as district group selection is completed, the release of relay FO2 breaks the battery connection from the FR lead to avoid operating a relay in a tandem district or a call indicator trunk, on a skip office call. 37.4 The path for moving the selection switch out of position 1 is taken through break contacts in series on TS1, ZC1 and ZC2. This is to insure sticking the sender in preference to making an overcharge in case one of these relays is operated by a cross of its locking winding to ground or off-normal ground. If the locking contact of one of these relays is crossed, the relay will operate in position 1 of the switch by a circuit from an off-normal ground through cam E2.

38. OFFICE TEST

38.1 Assuming that the call is routed through the office frames, the switch stops in 4 and relay (OFT) operates while the district elevator hunts for an idle office selector. The fundamental is closed as a metallic circuit from fundamental tip to fundamental ring through the winding of trunk guard relay TG or MTG, the operating winding of overflow relay OF not shunted, the compensating resistance and a trunk guard resistance D of 14500 ohms, all in series. The value of the compensating resistance for office test if 0, 300, 600 or 900 ohms according to the setting of relays CR1 and CR2 in the selection register. The MTG relay or the TG relay is used according to the setting of relay CR5. The MTG relay is used on full selector calls where the maximum trunk resistance for trunk test does not exceed 1300 ohms.

38.2 The district elevator having hunted over the trunks of the group, stops on the first idle trunk, sending battery over the fundamental to operate TG or MTG but not OF.

38.3 TG when used, operates TGl and TG2 in turn, while MTG operates TG2 directly. TG2 advances the switch to 5. As the switch leaves 4 it breaks the fundamental and TG, TGl and TG2 or MTG and TG2 release, also OFT.

38,4 The purpose of resistance D, 14500 ohms is to prevent the line relay in the office selector from operating until the switch has passed to the next position.

In order to close the fundamental 38.5 for office test it is necessary to operate relay ZC2, and if it fails to operate the sender will stick. First relay ZC4 operates, and that connects oper-ating winding of ZC3 through break contacts of ZC1 and ZC2 to 1000 ohm battery, and also to the transfer springs of relays FT and FR. If either of the latter are operated at this time the 1000 ohm battery is short-circuited and ZC3 does not oper-This test proves two things--first ate. that ZC3 is operated and has a clear circuit to operate from false battery on the FR lead, to block district selections, and secondaly that sticky relay FT and FR

is operated falsely. This test is repeated in trunk test position 7.

39. OFFICE BRUSH SELECTION

In position 5 the fundamental is 39.1 closed as a metallic circuit through the operating windings of STP and OF, and the same compensating resistance as was used for office test, but without the high resistance D. The operating winding of OF is again shunted by the noninductive winding.

39.2 Closure of the fundamental through this circuit starts the office elevator, which sends from one to five pulses in reaching position to trip the desired brush.

39.3 STP pulses through the contacts of the OB relays, the selection is finished and the switch is advanced to 6 except that the fundamental closure is further delayed awaiting the release of FO2.

40. OFFICE GROUP SELECTION

In position 6 the fundamental is 40.1 closed again as in 5. The office elevator starts again and sends from one to ten pulses. The selection is made and the switch advanced to position 7, except that STP pulses go through contacts of the OG relays instead of the DG relays, and the fundamental closure is delayed for the release of FO2.

41. SKIP OFFICE SELECTION

In the case of a call which is not 41.1 routed through the office frames, the decoder will operate relay SO in the. selection register.

41.2 When the switch leaves position 3 after district group selection FOl does not release as usual, because it is locked by SO through positions 3 to 6.

41.3 A contact of SO passes the switch through positions 4, and FOl passes it through 5 and 6. The switch therefore passes through to 7 without stopping, while

F03 being released hold the fundamental open,

42. TRUNK TEST, FULL SELECTOR CALL

42.1 The switch stops in position 7 and relay OFT operates while the office selector, of the district in case office selection was skipped, hunts for an idle trunk. From here on the operations differ according to the class of call. The trunk test and remaining operations for a full selector call will be described first. For this class none of relays CL1 to CL3 in the selection register are operated and CLA is therefore not operated.

42.2 The fundamental circuit is the same as for office test except that the compensating resistance is now fixed by the setting of relays CR3 and CR4. The fundamental is closed between FT and FR through the winding of TG or MTG, the oper-ating winding of OF not shunted, a compensating resistance of 0, 300, 600 or 900 ohms, and a trunk guard resistance D of 14500 ohms.

The fundamental is not closed as soon 42.3 as the switch reaches position because FOI is held locked and FOJ re

released until the dialing has progressed far enough to permit incoming brush selection to proceed.

42.4 The office or district elevator

having hunted over the group of trunks, stops on the first idle one, and the trunk sends battery over the fundamental operating TG, when used. TG operates TG1 and TG2 in turn, and switch passes from 7 the fundamental is broken on the switch and TG, TG1, TG2 and OFT release. SO also releases at this time. The purpose of the D resistance is to prevent the line relay in . the incoming selector from operating until the switch has passed to position 8. Whithe MTG relay is used for this test the When operations above described in this para-graph are the same except that the TG1 relay does not operate, the MTG operating the TG2 directly. In this case should the incoming selector be returning to normal the MTG will not operate until it has reached normal and is ready to make selections. The (MTG) relay is used on panel FS calls where the maximum trunk conductor res. does not exceed 1300 ohms.

43. INCOMING BRUSH SELECTION

In position 8 the fundamental is 43.1 closed through the winding of STP and the shunted operating winding of OF, and the same compensating resistance as was used for trunk test.

Closure of the fundamental starts 43.2 the incoming elevator on brush selection, and it sends from one to five pulses.

43.3 STP pulses through the contacts of relays IS, DB1, DB2 and DB3, which have been set up in a new order for the incoming brush selection, as described before. The selection is made exactly as for district brush. The switch is advanced to position 9 on the operation of FO, as described before.

AWAITING REGISTER AFTER INCOMING BRUSH 44. SELECTION

44.1 If the hundreds digit has already been dialed, relay HT operates who been dialed, relay HT operates when the switch reaches 9, and it carries the switch through to 10 at once. Otherwise it will wait in 9 until relay HL is operated by the dialing of the hundreds digit.

45. INCOMING GROUP SELECTION - FIG. BD AND "F"

45.1 In position 10 the fundamental is closed through the same circuit as for incoming brush selection. The incoming elevator starts and sends from one to four pulses. STP pulses through the contacts of DG1, DG2 and DG4. The selection is made as for district group selection and the switch is advanced to 11 on the operation of F0.

. 45.2 "Add Five" Incoming Group Selection

To provide for routing calls to two full selector terminating crossbar units over a common trunk group. Fig. Z and "E" apparatus are added to permit adding 5 to the incoming group selection. When the dialed code indicates a need for this distinction, the decoder does not operate the (SD) relay for a full selector code. Ground from the normal contact of relay (SD) through relay (HT) reoperates relay (DG5) thus adding 5 to the incoming group selection. The former function of advancing the time measure switch on this class of full selector calls is now accomplished by the normal contacts of the (CLA) relay, Fig. Z, which is never operated for a full selector call.

46. CABLE DISCHARGE AFTER INCOMING GROUP SELECTION

46.1 The switch is advanced through to 12 without stopping in 11, and the cable is discharged while passing through 11 to prevent false operation of STP when it is connected for the next selection, the D resistance of 14500 ohms in series with the C resistance of 1000 ohms being bridged across the fundamental for this purpose. The high resistance prevents the premature operation of the incoming or final line relay. In this position it is never necessary to hold the switch, since the progress of dialing required for incoming group selection is sufficient for final brush selection also.

47. FINAL BRUSH SELECTION

47.1 In position 12 the fundamental is closed through the same circuit as for the incoming selections.

47.2 On the completion of incoming group selection the incoming selector starts hunting for an idle final selector. When one is found and the fundamental is closed in the sender, the final elevator starts and sends from one to five pulses.

47.3 STP pulses through the contacts of relays OB1, OB2 and OB4. The selection is made as for office brush. The switch is advance to 13 on the operation of FO. 48. AWAITING REGISTER AFTER FINAL BRUSH SELECTION

48.1 If the tens digit has not been dialed, the switch stops in 13 until it is dialed, when relays TL and TT operate.

49. FINAL TENS SELECTION

49.1 In position 14 the fundamental is closed as before. The final selector sends from one to ten pulses, and STP pulses through the contacts of relays OG1, OG2, OG4 and OG5. The selection is made as for office group. The switch is advanced to 15 on the operation of FO.

50. AWAITING REGISTER AFTER FINAL TENS SELECTION

50.1 If the units digit has not been dialed the switch stops in 15 until units is dialed. When both relays UL and UT are operated a path is closed to advance the switch out of position 15.

51. FINAL UNITS SELECTION

51.1 In position 16 the fundamental is closed as before. The final selector sends from one to ten pulses, which STP relays through the contacts of relays DGL, DG2, DG4 and DG5. The selection is made as for district group, but the switch is advanced to 17 when FO releases with FO1 locked up.

52. INCOMING ADVANCE

52.1 In position 17 the fundamental is closed as before. On the completion of the final selections the incoming advances and connects reversed battery to the fundamental; then when it finds the fundamental closed in the sender it advances further and cuts off the reversed battery.

52.2 The effect on the sender is that relays STP and OF receive a single long pulse of current in the reverse direction from usual. STP operates and releases, while OF operates and locks, OF operates incoming advance relay IA.

52.3 STP sends a pulse through a make contact of IA into the zero counting relay 0. B0 and F0 operate when STP releases. The fundamental is broken, F01 and F02 operated, F03 and the counting relays released, and the switch advanced to position 18, all as in district brush or group selection with the following exception. When F0 operates, instead of operating F01 directly it operates relay AV, AV operates AV1 and AV1 operatesF01.

52.4 When the switch advances, FO1, FO2, OF and IA release and FO3 reoperates, but AV and AV1 remain operated, being locked to off-normal ground. The RCO relay operates in parallel with the AV1 relay.

53. DISTRICT ADVANCE

53.1 The operation of AV1 opens the short circuit which up to this time has been about the high resistance primary winding of relay SC. This reduces the current in the SC lead and causes the district to advance to a position where it is ready for the talking selection to be made. While advancing to this position the T and R leads are opened by the district: (a) causing the L relay to release directly with EA option or (b), with EB option, causing the release of the TT converter L relay, which releases relay L in this circuit. For either option, release of relay L in this circuit release relays L1, L2, SR, SR1 and SR2.

53.2 In this position the district opens lead SC, with the effect of releasing relays SC and SC1. These operations start while the selection switch is in 17, and may be completed there or after it reaches 18.

53.3 A false ground on the dial pulse register leads is checked by failure of these leads to clear from ground when relay RCO relay operates and releases. If a ground remains upon those leads it will be held on the off-normal ground lead, after RCO and T release holding the sender busy and providing a stuck sender signal.

54. TALKING SELECTION

54.1 In position 18, after SCI has released showing that the district is ready for talking selection, the fundamental tip is closed to ground through the windings of STP and OF and a 1000 ohm resistance, the same as it was for district brush and group selections.

54.2 This closure of the fundamental tip to ground starts the district to advancing through its talking positions sending pulses over the fundamental tip as it does so.

54.3 STP pulses the counting relays through the contacts of relays TS and

TS1 in the section register, and these by their setting allow from one to three pulses before operating 0, BO, and FO. BO breaks the fundamental.

55. RELEASE OF SENDER

55.1 When the district completes talking selection, relay T releases and returns the selection switch to normal, provided SR1 has released. The circuit for returning the selection switch to normal, is wired through the back contact of SR1 to insure that the sender cannot be seized before the relays in the slow release chain SR, SR1 and SR2 (if used) have released and unlocked any dial pulse relays which may be operated. The off-normal ground lead is now no longer grounded. TMS releases and returns the time measure switch to normal, and all locked up relays release. Removal of ground from the off-normal ground lead releases all operated PB converter relays.

55.2 To prevent another district circuit

selecting a sender after the ground has been removed by the district and before the sender has returned to normal a protecting ground is held on the test lead as follows: - Relay SB places battery and ground on the 80 ohm winding of relay SG but as long as there is ground on the test lead this active winding will be shunted preventing the operation of the relay. Upon the removal of the ground from the test lead by the district SG will operate opening the test lead from the T relay which releases. Battery from relay SB will now hold SG operated until the selection switch returns to normal. If there is a district hunting on the terminal when the SB relay released, the battery from the hunting relay in the district through the 80 ohm winding of SG relay will hold relays operated. As the district advances by the terminal, relay SG will release. If the sender test lead were not protected in this way the hunting relay in the district might be released just as the sender selector was leaving the terminal which would cause it to stop on the next sender regardless of whether it was idle or busy. The 500 ohm winding of the SG relay, Figure C is for the purpose of decreasing the surge which tends to release the district hunting relay when the ground is removed from the test lead by the district.

55.3 This completes the operation of the sender on a full selector call.

56. PCI IMPULSER SWITCH

The 20-position PCI impulser sequence 56.1 switch R3 makes two revolutions on each call of the tandem or direct CI classes. Position 1 is the normal position and the switch is left there on all calls except those of the CI classes. Position 5 is the starting position for tandem CI calls and Position 17 is the starting position for the direct CI calls. The switch is advanced to the proper position as soon as the setting of the selection register determines The cuttings of the B3 cam allow the class. the switch to stop only in positions 1, 5, or 17.

56.2 When pulsing is started the switch starts from position 5 or 17, completes the first revolution, continues without pause to a second revolution, and stops on reaching position 1. If it starts from 5 it sends out pulses for the office code in running to 17. In running from 17 on the first revolution to 17 on the second it sends out pulses for the number and station. In running from 17 on the second revolution to the end at 1 it completes the pulsing operation, including the generation of a heavy positive pulse if the wiring is so connected.

57. SETTING PCI IMPULSER AT STARTING POSITION

57.1 On a direct CI call, the decoder locks up relays CL1 and CL2, and they operate CLA. The switch moves out of 1 when RL operates and passes by 5, stopping in 17. As it passes 11 the final pulse relays FP and FP1 operate by a path which remains closed until the selection switch leaves trunk test position 7.

57.2 On a tandem call, the decoder locks up relay CL2, and that operates CLA. Tandem relay TAN operates when RL operates, and it operates FP and FP1. TAN also moves the switch out of 1, and it stops in 5.

58. TRUNK TEST, CI CALL

58.1 The connections for trunk test on a CI call of either class differ from those for a full selector call because CLA is operated. The trunk test is made in position 7 of the selection switch.

58.2 The fundamental circuit is the same as for a full selector call except that the D resistance of 14500 ohms is omitted. The fundamental is closed between FT and FR through the winding of TG, the operating winding of OF not shunted, and the compensating resistance.

58.3 The fundamental is not closed as soon as the selection switch reaches position 7, because FOL is held locked from the previous selection by a ground through cam Al until either the time measure switch has passed position 12 or the UL relay has operated, depending on the stations delay condition set up by the decoder and by a ground through cam G3 until the impulser switch has reached its starting position 5 or 17. "HM" wiring eliminates a possible race condition when the (R1) switch slips, and wrong CI pulsing is prevented and stuck sender time outs on 7-digit MF calls are This is to delay further opereliminated. ations until dialing has been completed and the sender is ready to send out CI pulses. In the case of a CI tandem call by 3-digit official code no number will be dialed. For this class of call relay CL3 is locked up by the decoder as well as CL2. This serves to pass the time measure switch by the positions awaiting until registration. Otherwise this class of call is like a regular CI tandem call. Zeros are transmitted for the number and station except that if the first digit of the official code corresponds to the first digit of two digit office codes the first dialed digit will be sent as the tandem hundreds digit, a zero will be transmitted for the tandem tens digit, the second dialed digit will be

sent as the tandem units digit and the third digit, having been registered on the TH dial register relays it will be transmitted as registered. If a two digit office code is dialed the first dialed digit is transmitted as the tandem hundreds digit, a zero is transmitted for the tandem tens digit and the second dialed digit recorded on the C dial register is transmitted as the tandem units digit. When a 3-digit office code is dialed it is transmitted as recorded.

58.4 The office or district hunts over the group of trunks, stops on the first idle one and sends battery over the fundamental. TG, TGl and TG2 operate, but not OF.

58.5 TG2 operates call indicator relay CI, which locks to off-normal ground and advances the selection switch to 15. Until the switch leaves 7, relays OFT and TG2 are both held operated by ground from SS2-J2. This insures that CI shall have time to operate and lock in case TG is released very shortly after operating, by a quick While the switch is moving assignment. through 8 to 15 and after it stops in 15 relays TG2 and OFT are both held operated by ground from contact of relay TGL until the operator by assigning the trunk releases TC and TC1. The fundamental is held closed through the winding of TG by a circuit through front contacts of CI and TG2. This circuit also goes through a front contact of OFT and the operating winding of OF until the switch reaches 8, so that OF may respond to a true overflow condition, but then OF is shunted out by a lead from SS4-L2 so that it cannot respond to a momentary false overflow condition which may occur at that time due to the trunk being disconnected from its previous connection after it has been seized for this connection.

59. ROTATION OF PCI IMPULSER TO SEND PULSES

59.1 The sender is ready at any time after the switch leaves 7 to send pulses when the trunk is assigned at the incoming end. When a CI control circuit or a tandem sender is connected at the incoming end of the selector trunk, it replaces the battery and ground which operated TG, by a metallic relay circuit designed to receive CI pulses. This causes TG to release, followed by TGl and TG2. The condenser and resistance bridged around TG prevents the discharge of the TG from causing a false CI pulse.

59.2 The release of TG2, CI being locked up, connects leads FT and FR to the impulser with only the compensating resistance in series. It also operates start pulse relay SP, one purpose of which is to introduce the slight delay of its operating time between the closing of the fundamental and starting the impulser. Otherwise, if the switch were started at once on the release of TG2, the first pulse starting from the center of the cam cutting, might be abbreviated. SP also closes the circuit of the low resistance pulsing battery, which if normally closed would sometimes drain to ground through the units dial register and cams I3, P3 and Y3 from the time units is dialed until the trunk is assigned.

59.3 The operation of SP starts the switch rotating, a direct connection from the contact of SP to cam B3 carrying the switch through every position but 1. It is carried through 1 to start on its second revolution by a connection from the contact of SP, through a front contact of FP1, to cam C3. TAN, if operated, releases when the switch leaves 17 on the first revolution, and FP and FP1 releases when it leaves 10 on the second revolution. FP1 being down when the switch reaches 1 at the end of the second revolution, it stops there.

60. GENERATION OF CALL INDICATOR PULSES

60.1 As the impulser rotates, one pulse is generated in passing each position, and each pulse lasts one full position of 18 degrees of rotation, 9 degrees each side of the center. The pulses generated in the even-numbered positions are either light negative or heavy negative, and those in the odd-numbered positions are either light positive or blank, according to the setting of the dial register.

60.2 As the switch passes an even-numbered position, cam Y3 grounds lead FT, and cam F3 connects lead FR to battery through high 40 type resistance B. Unless this condition is modified by a connection in the dial register, a light negative pulse is generated. The high resistance is 6500 ohms.

60.3 In passing an even-numbered position the high resistance battery lead is also connected to some part of the dial register, through contacts of TAN and OT, and cam U3, K3, I3 or J3. In the dial register, according to its setting, there is either no connection, or a connection through cam P3 to battery through low 44 type resistance A. In the latter case the high resistance is shunted by the low resistance and a heavy negative pulse is generated.

60.4 As the switch passes an odd numbered position, cam Y3 grounds lead FR and lead FT is connected through contacts of TAN and OT, and through cam V3, L3, M3, N2 or O3 to some part of the dial register.

60.5 To generate a light positive pulse, the FT lead is connected in the register to a lead through cam R3 and high 40 type resistance A to battery. This resistance is also 6500 ohms to agree with resistance B in the FR leads. 60.6 To generate a blank pulse, the FT lead is connected in the register to a lead through cam S3 or T3 to ground for such a period as to extend the grounded condition of FT from the previous even numbered position through the first quarter of this odd numbered position. Then cam S3 or T3 opens this lead. The result is that both FR and FT are grounded for one quarter of the position, or 4-1/2 degrees, to discharge the cable, and then the FT lead is open for the remaining 13-1/2 degrees, to give the blank pulse. In the starting positions, 5 and 17, both leads are grounded 1/2 the position, instead of 1/4, in case the switch should start from a little past the center of the position.

60.7 The feeder ground to cam Y3 is taken through the top make contact of SP in normal position of the switch, in order to avoid a current drain when the sender is idle in case the switch should stop slightly off its normal position, as it may, due to the absence of an "A" cam.

61. CONNECTION OF IMPULSER TO DIAL REGISTER

61.1 If the impulser starts from position 5 with TAN operated, for a tandem call, high resistance B and the fundamental tip are connected through cams U3 and V3 respectively to the A, B and C registers in turn, while the switch moves through 16 positions to send out the office code. When Fig. "B" is used the high resistance B is also connected thru cams E3 and W3 and contact of TAN to the A register while the switch moves thru positions 5 to 9 of the first revolution only.

61.2 After sending the office code and releasing TAN, or from the start in 17 on a direct call, the leads are connected through cams I3, J3, L3 and M3 to the ST, TH, H, T and U registers in turn, provided relay OT is not operated; or through cams K3, N3 and O3 to the TH, H, T, U and ST registers in that order if OT is operated. OT is the over ten relay and is operated, except as explained hereafter, only when the called number is in the series 10,000 to 10,499. This fact is indicated by the following combination of conditions, all of which must exist:

61.21 OT2 operated and T5 not operated, showing that the number is in either the series 10,000 to 10,499 or the series 1000 to 1049. In certain areas where numbers from 10,500 to 10,999 are assigned, the wiring is so connected that it is sufficient for OT2 to be operated and is immaterial whether T5 is operated or not.

61.22 SD1 not operated showing that the called office has 5-digit numbers.

61.23 STL operated, showing that five digits were dialed.

62. CALL INDICATOR CODES

62.1 The dial register relays for all digits are set up in one code, as follows.

Number Relays Number Relays -Dialed Operated Dialed Operated 0 0 5 6 1 1 1-5 23 78 2 2-5 1-2 2-5 í4 4 9 4-5

It should be noted that by adding the numerical designations of the relays which are operated, the digit which was dialed will be obtained.

62.2 The CI pulses are sent out in three

different codes accordingly to the registers at the incoming end of the trunk. One code is for stations, another for thousands, and the third or regular code is for the office code and the four numerical digits. These three codes are as follows, N meaning Heavy negative, pulse, n light negative p light positive and - blank pulse:

Regular	Thousands Sta	tions
0 - n - n 1 p n - n 2 - N - n 3 p N - n	0 - n - n 1 - n - N 2 p n - n 3 p n - N	n' - n n - n
4 - n p n 5 - n - N 6 p n - N 7 - N - N 8 p N - N	$\begin{array}{c} 4 - N - n \\ 5 - N - N 5 (J) - n p h \\ 6 p N - n 6 (M) - N - N \\ 7 p N - N 7 (R) p N - n \\ 8 - n p n \end{array}$	
9 - n p N	9 - n p N 9 (W) - N - n	•

62.3 For a 4-digit number OT is not operated and the pulses are sent from the registers in accordance with the above codes. After the office code, if sent, stations is sent first, then thousands and the other numericals in order. If stations was not dialed, or if anything was dialed for stations except J, M, R or W, zero is sent.

62.4 For a 5-digit number OT is operated and pulses from the thousands register are sent first, after the office code, then the other numericals in order and pulses from the stations register last.

62.41 The registration on the TH register

is always 1 for a 5-digit number. This is to be received on the stations register at the incoming end of the trunk and therefore must be sent in the stations code, which is p n - n rather than the thousands code, which is - n - N. The first pulse is made positive by carrying the tip lead from the register through a transfer contact on OT. Normally, it connects with lead 0 to cam S3 and gives a blank pulse, but with OT operated it connects with lead M to cam R3 and gives a light positive pulse. The last pulse is not changed in the register from a light to a heavy negative, because the lead from low resistance A is not carried into the thousands register in position 20 where the pulse is sent.

62.42 The registration on the H register is always 0 for a 5-digit number. This is to be received on the thousands register at the incoming end of the trunk but as 0 is the same in all codes no special translation is required. 62.43 The registrations on the T and U registers are sent out in the regular code and received on the hundreds and tens registers at the incoming end.

62.44 The registration on the ST register may be anything from 0 to 9 and is to be received on the units register at the incoming end. It must be sent therefore in the regular code instead of the stations code. This is done by using a separate set of contacts on the ST register relays.

62.5 Unless this circuit is arranged for direct distance dialing, zero is never used for the second or third digit of a published office code, so if zero is dialed it is presumably in error for letter 0. Therefore if relay BZ or CZ in the dial register is locked up, the same CI connections are made as when BI and B5, or Cl and C5, are locked up, these being the combinations for number 5, which occupies the same dial hole as letter 0. However, in case this sender is also used by operators employing codes with zero for the second or third digit, it will be necessary to transmit zeros when dialed. For this case a modification is made in the wiring at relays BZ and CZ.

63. FINAL HEAVY POSITIVE PULSE

63.1 The last pulse of the last digit is generated as the impulser passes position 16 on its second revolution. In passing 17 a blank pulse is sent, consisting like any other, of a ground of FT and FR leads from 1/4 position and an open for 3/4 position. In passing 18 a heavy positive pulse is sent if a wiring is connected, or the fundamental is open if B wiring is connected. In passing 19 and 20 the fundamental is open.

64. FINISH OF CALL INDICATOR CONNECTION

64.1 As the impulser reaches position 18 3/4 with S wiring, or 17 with T wiring, FPI being released, advance relay AV operates and locks to off-normal ground. AV advances the selection switch from 15 to 17, where AVI operates, followed by FOI, FOI advances the selection switch to 18 and releases.

64.2 The sender is now in the same condition as at the end of incoming advance on a full selector call. District advance, talking selection and release take place.

65. TRUNK TEST, OPERATOR CALL

65.1 There are two classes of calls for operators over direct trunks. One class, is for a call which was made for an unassigned or restricted code and which the decoder rerouted to an operator. For this class the decoder locks up relay CL1, the only affect of which is to operate CLA, since CL2 is not operated. The other class is for a zero, official 3-digit or permanent signal call. For this class the decoder locks up relay CL3, which also operates CLA.

65.2 Relay CLA being operated for either class of operator call, as it is for any class of CI call, the fundamental circuit is the same as for an CI call.

65.3 On the first class of operator call it is to be expected that the subscriber will dial a number, and it is necessary to delay the trunk test until he has done so, to prevent the dial pulses from falsely releasing the supervisory relay in the district selector. This is done as in a CI call. However, if desired the CL3 relay may be operated by decoder on the unassigned code calls, to pass the time measure switch by the positions awaiting units registration.

65.4 On the second class of operator call no number will be dialed. Relay CL3 being operated passes the time measure switch by the positions awaiting units registration and the trunk test is not delayed.

65.5 The office or district hunts over the group of trunks, stops on the first idle one and sends battery over the fundamental. TG, TGl and TG2 operate but not OF, just as on a full selector or CI call.

66. FINISH OF OPERATOR CONNECTION

66.1 TG2 operates the operator relay OP; which locks to off-normal ground. OP advances the selection switch to position 10, operating AV as the switch passes 9-3/4. AV locks to off-normal ground and advances the selection switch to position 17, where AVI operates followed by FOL. FOL advances the switch to 18 and releases.

66.2 The sender is now in the same condition as at the end of incoming advance on a full selector call. District advance, talking selection and release take place.

OVERFLOW AND TELL-TALE CONDITION

67. TELL-TALE BY DISTRICT SELECTOR

67.1 If the district elevator goes to telltale in making brush or group selection, the selector becomes stuck and holds the sender until released manually.

68. OVERFLOW ON OFFICE TEST

68.1 If the district elevator goes to the overflow terminal in hunting for an office selector, it will advance to the position where it sends overflow tone to the subscriber and will open the "TR" lead releasing the T relay and restoring sender and TT converter (with EB option) to normal.

69. TELL-TALE BY OFFICE SELECTOR

69.1 If the office elevator goes to telltale in making brush or group selection, and if it is of the type which does not return reversed battery to the sender in that condition, the sender sticks and calls in the sender monitor.

69.2 If the office selector sends reversed current over the fundamental, STP and OF operate. OF operates IA and OF1. OF1 locks to off-normal ground and advances the switch to position 10.

69.3 While the switch is moving from 5 to 6-1/4 the fundamental is held closed through STP by a front contact of OF1. Then the fundamental opens and STP releases. The operation and release of STP sends a pulse through a front contact of IA to the zero counting relays, operating 0, B0 and F0. F0 operates relay AV, which locks to offnormal ground, permanently breaks the metallic fundamental circuit, and advances the switch to 17.

69.4 "AE" option. When dialing has been completed and the time measure switch advances to 13, (AVI) relay operates. "AF" option. With the (AV) relay operated and the selection switch (R2) in position 17 relay (AVI) operates. With (AVI) relay operated (FOI) and (FO2) relays operate and (FO3) relay releases, releasing the counting relays and advancing the selection switch (R2) to position 18, where relays (FOI), (FO2), (OF) and (IA) release, leaving relays (OFI), (AV), (AVI) and (FO3) operated.

59.5 District advance, talking selection and release now take place as usual.
However, on account of OFI being locked up, the contact of STP is connected to counting relay 3' instead of the one previously determined by the setting of TS and TS1.
Therefore four pulses are received from the district on talking selection, and the district is set in the overflow position.

70. OVERFLOW ON TRUNK TEST

70.1 If the office or district elevator goes to the overflow terminal in hunting for a trunk, reversed current will be sent over the fundamental.

70.2 On a full selector call the reversed current operates (TG) and possible (OF), and the switch is advanced to incoming brush position 8 by TG2. In 8 the reversed current operates STP and OF, if not already operated. OF operates IA and OF1, and OF1 advances the switch to 10.

70.3 On a CI or operator call the reversed current operates TG and OF together in position 7, the trunk guard resistance not being in circuit. OF operates IA and OFI, and OFI advances the switch to 10. The operation of TG, followed by TGI and TG2, have no real effect on the operations, and they release when the switch leaves 7. On a CI call TG2 may operate CI momentarily, but it cannot hold after OFI operates. On an operator call TG2 operates GP, but this has no effect since its normal functions are in this case anticipated.

70.4 After OFl operates and while the switch is moving to and through position 8-3/4 the fundamental is held closed through STP by a front contact of OFl. When the fundamental opens the STP releases.

70.5 The continuous closure of the fundamental while the switch passes to and through 8-3/4 besides functioning with STP, has the further purpose of allowing the reversed current to flow long enough for the relays in a 2 wire office selector to function.

71. TELL-TALE BY INCOMING SELECTOR

71.1 If the incoming selector goes to telltale in making brush or group selection, it will send reversed current over the fundamental, operating STP and OF, followed by IA and OF1.

71.2 In the case of tell-tale in brush selection, position 8, the ensuing operations will be the same as in overflow on trunk test, full selector call, after the switch reaches 8.

71.3 In case of tell-tale in group selections, position 10, the switch will

remain in that position until the incoming selector advances and cuts off the reversed battery, which it does by itself without assistance from the sender. (STP) relay then releases and the pulses generated by (STP) relay operates relays (0), (BO) and (FO) which operates relay (AV) advancing the selection switch (R2) to position 17 With "AE" option, when dialing is completed and the time measure switch (R1) advances to position 13 relay (AVI) operates. With "AF" option relay (AVI) operates as soon as the selection switch reaches position 17. The operation of relay (AVI) is followed by the operation of relays (FOI) and (FO2) the release of relay (FO3) and the counting relays, the advance of the selection switch to position 18 and the district advance. In position 18 talking selection takes place, advancing the district to overflow on account relay (OF1) being locked up, and release occurs as usual.

71.4 Certain incoming selectors, in going to tell-tale and advancing, may cut off the reversed current so quickly that while OF has time to operate and lock, STP does not remain operated long enough to op-erate counting relay 0 after the operation of IA. To care for this contingency and insure that FO shall operate nevertheless, there is a make contact on IA which grounds the front contact of relay 0. The construction of the relay is such that this contact does not close until after the adjacent make contact which connects the contact of STP to the winding of O. Normally the latter contact operates 0 but short circuits BO and FO until STP releases. In case of the failure of O to operate from STP, however, O, BO and FO will operate together through the special ground contact of IA.

72. OVERFLOW BY INCOMING SELECTOR

72.1 If the incoming selector goes to the overflow terminal in hunting for a final selector, it will send reversed current over the fundamental. This operates STP and OF, followed by IA and OF1.

72.2 The selection switch will remain in position 12 until the incoming selector advances and cuts off the reversed battery, when the operation will be completed as in the case of tell-tale in incoming group selection.

73. TELL-TALE BY FINAL SELECTOR

73.1 If the final selector goes to telltale in making any selection, the incoming selector is advanced to send reversed current and then cut it off, just as after a successful final units selection.

73.2 District advance, talking selection and release take place as usual, but

as the reversed battery operates OF before, the selection switch leaves position 16, OF1 operates and modifies the talking selection as in the other overflow and tell-tale conditions.

74. ABANDONED CALLS, RELEASE OF CALLING LINE

74.1 When the subscriber hangs up before the connection has been so far completed as to operate relay AVL, and with EA option, relays L, Ll, L2, SR, SRL, and SR2 release; with EB option, the TT converter L relay releases and, in turn, releases relay L in this circuit. The release of SR2, Fig. AG or SRL, Fig. AH advances the time measure switch to position 15, which indicates that dialing has been completed, if it has not already reached or passed that position.

74.2 Line release relay LR operates through cam H1, make contact of TMS and break contact of AV1, SR1, L and LR1. LR cannot operate while the time measure switch is normal or returning to normal from the preceding call. It locks to off-normal ground and operates LR1. LR1 opens ground from the armature spring of L to prevent the reoperation of SR in case the receiver is again removed from the hook before the dialing leads are broken. A second contact on LR1 operates RL to release the decoder if it is connected at this time. A third contact of LR1 advances the selection switch out of any positions 9, 11, 13 and 15.

74.3 LR short circuits the secondary winding of SC, grounding lead SC.

Reducing the resistance in the SC lead releases the D relay in the district which starts to disconnect the calling line. This relay also advances the district to a position depending upon whether or not district group selection has been completed. The further operations differ according to this condition, and if the group selection has been completed, then they differ according to the class of call as well.

75. ANY CALL ABANDONED BEFORE COMPLETION OF DISTRICT GROUP SELECTION

75.1 If the district has not yet completed group selection when the call is abandoned and its D relay released it advances to normal. In doing so it opens the test lead releasing relay T which restores the sender to normal.

76. FS CALL ABANDONED AFTER DISTRICT GROUP SELECTION BUT BEFORE OPERATION OF AV1

76.1 If the district has completed group selection when a full selector call is abandoned and its D relay released, it advances only to the trunk hunting position.

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If it has already reached or passed that position, it advances no further at this time.

76.2 The sender proceeds to complete any uncompleted part of office test, office brush and group selections, and trunk test, just as if the call had not been abandoned. If the selection switch is in any of the positions 9, 11, 13 or 15 it is advanced to the next selection position. Trunk test is not delayed since the time measure switch was advanced to position 15 by the release of SR2 or SR1.

76.3 The sender next attempts incoming brush selection, or if that was completed before the call was abandoned, it attempts incoming group or whatever final selection is next in order. Since relay LR has been operated and it opens the lead from contact of STP on all incoming and final selections, therefore the counting relays cannot be satisfied on this attempted selection, and the selector will run to tell-tale.

76.4 On running to tell-tale the selector returns reversed current to the sender and the district is advanced and disconnect effected as described for the several telltale conditions, with these exceptions: First, since the time measure switch had advanced to 15, AVI operates after AV without waiting for dialing to be completed. Secondly, on account of the D relay having been released, in the district, the latter when it is advanced runs all the way to normal, and the talking selection function is skipped, the release of T relay restoring sender and TT converter (with EB option) to normal.

76.5 If the call is abandoned just after the completion of the final selections, the incoming advances in the regular manner, AB and ABl operate, and the operations are finished as in the preceding paragraph.

77. CI CALL ABANDONED AFTER DISTRICT GROUP SELECTION BUT BEFORE TRUNK IS ASSIGNED

77.1 If the district has completed group selection but the trunk if selected has not yet been assigned at the incoming end when a CI call is abandoned, the sender proceeds to complete as much as remains to be done of office test, office brush, and group selections, and trunk test, the same as in the case of a full selector call abandoned after district group selection. The sender is then in the condition of awaiting trunk assignment, with TG2 and CI operated and the selection switch advancing from position 7 to 15 or waiting in 15.

77.2 If there is no distant office selector, ADCI crossbar tandem or panel tandem equipment in the train, AV operates through make contact of TG2, cam G2, and

break contacts of TW and SR2 or SR1, when the selection switch is in 9 or beyond. It is operated as soon as possible to break the fundamental and 'extinguish the trunk lamp at | the distant office, but its operating path cannot be closed before the switch is in 9 without danger of operating it on an abandoned full selector call. AV locks to off normal ground and advances the switch 17, where AV1 operates through cams N2 and I1. The delay of at least two positions before allowing AV1 to operate is to insure time for the release of the (D) relay in the dis-trict. AVI advances the switch to 18 and also advances the district as usual but on account of the (D) relay being released the district advances all the way to normal. The sender is released as on a call abandoned before completion of district group selection.

If there is a distant office selector, 77.3 ADCI, crossbar tandem or panel tandem equipment in the train, relay (TW) will be locked up. For Figures "P" and "E" or "F" this breaks the above path for the operation of AV. The sender will continue to await assignment until the time measure switch reaches position 18. If the trunk happens to be assigned in the meantime, TG2 will release and the sender will transmit CI impulses for zeros as if the call had not been abandoned until after the assignment, as described in the following section. Τf the trunk is not assigned the sender will be stuck, and during the long delay the office selector, tandem equipment will time out and be released. For Figures "R" and "S" or "T" when the time measure switch enters position 18, (TW) relay operated, the (AV) relay. operates.

78. CALL INDICATOR CALL ABANDONED AFTER TRUNK IS ASSIGNED, BUT BEFORE OPERATION OF AV1

78.1 If a CI call is abandoned after the trunk has been assigned the sender transmits CI pulses; or completes them if already started, but instead of sending numbers as registered, it sends zeros for all digits after LR and LR1 operate.

78.2 The substitution of zeros is accomplished as follows: LR opens the low resistance battery lead to the dial register, preventing any of the even numbered pulses from being changed to heavy negative, LRI opens the high resistance battery lead to the register, preventing any of the oddnumbered pulses from being made light positive. LR connects the fundamental tip to lead 0 to cam S3, to supply the onequarter position ground required at the beginning of all blank pulses, which would not be supplied by the register if set to give a light positive pulse. 78.3 The final heavy positive pulse is sent if the wiring is connected to send it on a completed call. AV and AVI are operated as on a completed CI call, and the remaining operations will be same as for a CI call abandoned after district group selection is completed but before the trunk is assigned.

79. OPERATOR CALL ABANDONED AFTER DISTRICT GROUP SELECTION BUT BEFORE OPERATION OF AV1

79.1 If the district has completed group selection when an operator call is abandoned, the sender proceeds to complete as much as remains to be done of office test, office brush and group selections and trunk test, the same as in the case of a full selector call abandoned after district group selection.

79.2 The operation of TG2 on trunk test operates relay OP, which advances the selection switch to position 10 and operates AV. The remaining operations will be as for a CI call abandoned after district group selection is completed but before the trunk is assigned, except that the TW relay is always normal on this class of call.

80. ANY CALL ABANDONED AFTER OPERATION OF AV1

80.1 If any call is abandoned after it has progressed so far as to operate AVI in the regular way, L, Ll, SR and SRl and SR2 release if they have not already done so, but it is not longer possible to oper-" ate LR, since its operating circuit runs through a back contact of AVI.

80.2 In advancing, the district assumes control of the calling line and when the receiver is hung up the line is disconnected and the district advances to normal opening the test lead, releasing the (T) where relay and causing sender to restore to normal.

81. PERMANENT SIGNAL

81.1 If the first digit is not dialed in 30 to 60 seconds after the sender is seized, the time measure switch stops in position 5 with relay TM1 not operated. Permanent signal relay PS operates and locks, operates ST and moves selection switch to 2 thereby connecting battery to lead ST to obtain connection with a decoder and grounds leads PS to notify it of the permanent signal condition. Relays PS and ST operated, advance the time measure switch out of position 5. The CL3 relay provides the circuit for advancing the Rl switch to position 9. If the sender becomes stuck, the Rl switch reaches position 18. 81.2 The decoder sets the selection register for the same class as a dial zero call, and for the proper district brush and group selections to obtain the group of permanent signal trunks, which always appear on the district frame. The sender then makes the district selections and trunk test.

81.3 On trunk test reversed battery is sent to the sender, whether the district finds an idle trunk or runs to overflow. The subsequent operations so far as they effect the sender are identical with those following overflow on trunk test on any operator class call.

81.4 If an idle permanent signal trunk is found, the operations following trunk test affect the district differently from those if the district runs to overflow. In either case the sender requires and gets four pulses on talking selection. On an overflow, the four pulses are sent while the district is advancing to the talking to operator position, and then it advances by itself to the overflow position. In case connection is made to a permanent signal trunk, the sleeve of the latter becomes grounded and holds the district in the talking selection position.

82. PARTIAL DIALING

82.1 If the class of call requires the dialing of a number, and the units digit is not dialed in the 30 to 60 seconds after the first digit, the time measure switch stops in position 8 with relay TM1 not operated. Under this condition the individual sender lamp before the monitor flashes and the auxiliary signal circuit is energized.

82.2 If the units digit is then dialed, before the monitor answers the lamp, by plugging a talking cord into talking jack T, the lamp will go out and the sender will proceed with the connection.

83. STUCK SENDER

83.1 If the sender is not released in the time allowed, which is either 30 to
60 or 60 to 90 seconds after the completion of dialing, the time measure switch stops in position 18 with relay TM1 not operated.

83.11 Sender Monitor Operation, Figure AN

In position 18 with relays TMl and MS normal the SEL interrupter will flash the SDR lamp at the sender monitor position. AN auxiliary signal is closed through the El cam. Upon observing a lamp signal the sender monitor will plug a talking cord into the T jack. This operates the MS relay, directly for a 34 ohm sleeve, or by means of DJ option the MS relay will be operated when a 350 ohm sleeve circuit is needed. The MS

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relay retires the lamp signal, holds the dialing circuit to prevent further registration and prevents line release. The monitor talking circuit to the subscriber line is closed and cord supervision will inform the monitor when the subscriber abandons the call.

83.111 With Fig. AN and DN option, the AS relay operates in position 18, with the TM1 relay normal. The AS relay operated provides interrupted ground from the TMA interrupter which is applied to the SC lead through the operated AV1 relay. This feature tends to release subscriber lines, advance district selectors, and release the sender under double connection stuck sender conditions, which otherwise would require manual release by maintenance.

83.12 Priming the Sender

When the sender monitor does not succeed in clearing the connection the monitor can cause a release by removing the cord from the T jack and inserting it momentarily in the P jack. Ground over the tip of the P jack then operates the monitor tip MT If the ST relay has not operated, relay. ground from a contact of the MT relay will operate the PS relay. The calling line will be connected to a permanent signal trunk. If relay ST has been operated the PR relay instead of the PS relay will operate. The PR relay operates the LR relay, the LR1 and RL relays are operated and the decoder is released. The PR relay also grounds the SC lead to release the D relay in the district selected as in an abandoned call. This releases the calling line which seizes another sender for connection to the permanent signal trunk. The PR relay advances the R2 switch to position 18 and the AV1 relay operates. The district is advanced either by the release of its D relay or by the operation of the AVI relay. The district will release the T relay and the sender and TT converter (with EB option) will restore to normal.

83.13 If the attempt to release a stuck sender fails, the lamp at the monitor position will resume flashing. The sender is guarded as long as the MT relay is operated by the 80 ohm winding of the SG relay.

84. AUTOMATIC PRIMING AFTER TIME OUT

84.1 Figure AO

With the Rl switch in position 8 or 18 the sender automatically operates the PR relay to accomplish the priming function. The MS and MT relays operate in turnoperating the PR relay. The SS lamp of the sender make-busy frame is lighted and if the sender does not restore under the priming action the TA lead being grounded will produce an audible alarm. With EA option the CTR key of the sender make-busy frame is connected

in the path from the PR relay which advances the R2 sequence switch and operates the AV relay. By means of the CTR key stuck senders may be traced. A resistance ground on the SC lead from the make-busy jack with DI option will facilitate the use of the stuck connection finder circuit in locating districts involved in double connections. The resistance ground is high enough not to release the district D relay and low enough so that the test relay of the stuck connection finder circuit will operate. A value of 100 ohms is a suitable compromise value for this resistance. See par. 95 for CTR key operation with Option EB.

84.2 Figure AU

This figure is an improvement over Figure AO particularly to avoid incomings which are left off-normal due to the priming function. The following advantages are gained:

(a) Partial dial calls after the ST relay is operated are treated as abandoned calls. This avoids incomings left offnormal.

(b) The stuck sender audible alarm is produced only on stuck senders having the AV relay operated.

(c) The SS lamp at the sender make-busy frame flashes on a stuck sender having the AV relay operated and is lighted steady, otherwise, on a stuck sender:

(d) The CTR key is in the PR relay operate circuit, placing the entire priming function under key control.

(e) The SS lamp lights steady if the sender make-busy, or sender frame make-busy or motor stop features are in effect (Option "BK").

The R1 switch in position 8 or 18 with the TM1 relay normal will operate the MS relay through the Fl cam. If the ST relay is normal as for permanent signal stuck senders or partial dial of less than three digits the PS relay will operate to route the call to a permanent signal holding trunk. If three or more digits have been dialed, the ST relay being operated, the LR relay oper-ates over the Hl cam and this causes the sender to function as for an abandoned call For a stuck sender the Rl switch in position 18 operates the MT relay and will oper-ate the PR relay under control of the CTR key, Option EA; see par. 95 for operation with Option EB. | The PR relay advances the R^2 switch, operates the AV relay and grounds the SC lead. The grounded SC lead advances the district and should cause the release of the sender. If the AV relays already were operated the sender will wait about 27 seconds for the next closure of the TMA interrupter and this closure will ground

the SC lead. The AV2 relay operates from the AV. It transfers the SS lamp from steady to flashing and also closes the TA lead to limit the audible alarm to senders which fail to release on priming. The audible alarm will be sounded if the sender waits for the TMA interrupter, but most cases will not require this wait. For tracing double connections a 100 chm ground circuit over the tip of the make-busy jack is connected to the SC lead. In most cases this resistance will hold the district D relay and also allow the stuck connection finder circuit to locate stuck senders.

85. TROUBLE RELEASE OF DECODER AND SECOND TRIAL

85.1 In case the decoder fails to operate release relays RL and RL1 to break the start lead ST and release the decoder connector, this failure will be indicated by the nonrelease of the decoder. The latter will count time and ground trouble release lead TRL.

85.2 Grounding lead TRL operates relay TR, which breaks the start lead and releases the decoder connector. When connection with the decoder is broken lead TRL is broken and relay TRl operates in series with relay TR. This closes the start lead again and the sender is connected to another decoder.

85.3 The second decoder will ground lead RL in the usual way, relays RL and RL1 will operate, and the connection will proceed. But if the second decoder also fails to cause a normal release, it also will count time and ground lead TRL. Relay TR will then release but TRI will remain locked to off-normal battery. The start lead will be broken and the decoder connector released but as the RL1 has not been operated the district selections cannot proceed and the sender will be stuck. With TR normal and TRI operated a circuit is closed to advance the time measure switch by position 15 to 17 into 18 thus lighting the stuck sender lamp after all dialing has been completed.

86. SENDER MAKE-BUSY

86.1 With Figure AN when sender monitor inserts a plug in the P jack the SS lamp at the sender make-busy frame will light. Responding to this lamp a plug inserted in the MB jack at the sender make-busy frame will light the SDR lamp at the sender monitor position as an indication that the sender was made busy. A plug in the MB jack operates the MB relay when the SB relay is released. The MB relay therefore cannot be operated while the sender is completing a call. The MB relay is locked to prevent unguarding the sender if the SB relay operates during testing. The MB relay places a ground on the TR lead and opens the circuit to the T and SG relays.

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86.2 Automatic Priming After Time Out

With Figure AO or AU a make-busy plug inserted in the MB jack operates the MBP relay which in turn operates the MB relay when the SB relay is normal. The MBP relay opens the TA lead to stop the stuck sender audible alarm. The MB relay grounds the TR lead for sender busy and opens the circuit to the T and SG relay. It also opens the lead to the sender load indicating circuit or to the group busy register circuit. The MB relay locks when operated to avoid unguarding the sender in case the SB relay is operated during testing.

87. AUXILIARY MAKE-BUSY

With senders equipped with Figure AN for sender monitor operation a circuit from the tip of the MB jack is provided for operating the MT relay without operating the MB relay, by means of a plug having the tip and ring crossed. This operation of the MT relay operates the SG relay and the 80 ohm ground is connected to the test lead as a severe hunting condition when sender selectors are under observation for hunting.

This feature is dispensed with when Figure AO or AU is equipped, wherein the tip of the MB jack is used to ground the, SC lead to expedite location of districts involved in double connection.

88. CONTACT PROTECTION

Condenser A "W" option and one half of resistance A, 19-EY, absorbs the discharge of the L relay and protects the multiple bank, cable insulation and the dial contacts. With "V" option varistor A performs the same function with the L24 relay.

Condenser B and the resistance B, 18-BH, are used to protect the stepping relay contacts against the discharge of the counting relays.

Condenser C and the second winding of L relay or tone coil are used to induce dial tone on to the ring side of the line.

Condensers D and Dl or J and E resistance, 19-BM or 18-BH are used to protect the contacts of L relay against the discharge of the L-1 relay and the dial pulse relays Pl to P5, inclusive with Fig. AE.

Condenser E and one half of K resistance, 19-BM or Rl condenser and resistance are used to protect the A cam, and A cam pring of the Rl sequence switch against the discharge of the Rl magnet.

Condenser El and one half of K resistance, 19-BM or R2 condenser and resistance are used to protect the A cam and A cam spring of the R2 sequence switch against the discharge of R2 magnet.

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Condenser F and one half of resistance F, 19-EY, are used to protect the contacts of the FOl relay and of the F2 cam against the discharge of the odd-numbered counting relays.

Condenser Fl and one half of resistance F, 19-EY are used to protect the contacts of the F03 relay and of the J2 cam against the discharge of the even-numbered counting relays.

Condenser G and one half of resistance G, 19-DY, are used to protect the contacts of the SB relay against the discharge of the A, B, C and TH dial register relays.

Condenser Gl and one half of resistance G, 19-DY, are used to protect the contact of the RCO relay against the discharge of the H, T, U and STA dial register relays.

Condenser H and primary winding of resistance C, 40-AT, are used to absorb the discharge of the TG relay and thus prevent false CI pulsing.

The Ll condenser and resistance Fig. AE protect the contacts of the Ll relay.

The Ll condenser and resistance protect contacts of the L relay, Fig. AF.

The J condenser and E resistance protect contacts of the L relay, Figures AE and AF.

The A condenser and resistance, absorb surge, Figures AE and AF.

The D condenser and E resistance protect contacts of Ll relay, Figures AE and AF.

The PH condenser is for improved L relay operations, Fig. AF.

(P-) relay protection units.

Unit (PA) protects contacts 3-4T (P2) relay.

Unit (PB) protects contacts 3-4T (P4*) relay.

Unit (PC) protects contacts 4-6T or 4-5T relay (P5'). Unit (PD) protects contacts 1-2T, 1-2B

(RAI) relay.

The units which protect two combinations are always in circuit when either or both of the combinations are released. The (PA), (PB) or (PC) unit also protects the 1-2T, 1-2B contacts of the (RA1) relay when either of the combinations connected with these units is operated at the end of a digit.

Unit (PE) protects contacts 1-2B of relays Pl' and P3'. Unit (PF) protects contacts 1-2T or relay P2'. Unit (PG) protects contacts 1-2T of relay P4*. Unit (PH) protects contacts 1B or 3B of

relay P5¹. The R1, R2, and R3 units protect the contacts operating the R1 and R2 sequence

Two networks AV and FO1 protect #1 contact FO relay.

The K condenser and RA resistance [Pig. AG) protect contacts of Li relay, Figs. AE and AF.

The K condenser and one half A resistance (Fig. AH) protect contacts L1 relays, Figs. AE and AF.

The (SCl) network, Option DK, protects the SC relay contact.

The (0')-(9') networks, Option "ED" or "EE" in Figure AS, protects the 1 and 2 contacts of the prime counting relays.

89. SAFEGUARDS

switches.

89.1 Check of Chain Circuit Through Back Contacts of Pl' to P5' Relays, Inclusive (Fig. X)

When relay SR releases it connects ground through winding of relay CK to battery on relay Pl if the chain circuit through the back contacts of relay Pl to P5', inclusive, used in setting the register relays in response to dial pulses, is properly closed. If the CK relay fails to operate in this case relay SB will be locked to its own front contact. This will prevent the sender resetting to normal, holding the test lead open, and cause the display of the sender monitors signal. The sender in this condition cannot be "Primed" Out" by the monitor.

89.2 Grounded TR Lead, Grounded ON Lead or Open SC Lead, or District Stuck in Pos. 1

Under these conditions, the TMS relay will move the Rl switch to pos. 3, but the R2 switch will remain normal. The Rl switch times from pos. 3 to pos. 5, the PS relay operates advancing the Rl switch to pos. 6. It will time to pos. 8 where the stuck sender signal is established.

An open SC lead will be detected when the sender is seized, as the T relay operates grounding the ON lead.

89.3 Prevention of False Registration

To prevent false registration due to the failure of relays, wiring crosses, grounds or open circuits, when the sender is arranged for "Zone Registration," certain precautions have been taken. The following description of these safeguards lists the wires, apparatus and cam cuttings involved and outlines the troubles guarded against together with the resultant circuit reactions.

89.031 Circuit from battery thru the R2 magnet, contact spring 4-C2 cam,
contacts 4T-3T ZC2, 4T-3T ZCI Fig. J,
4T-3T TS1 Fig. H, through SC1, AL and SB relays operated to ground, advancing the R2 switch from position 1.

If either the ZC2, AC1 or TS1 relay fails to release or reoperates from a trouble condition, an overcharge might result. However, the R2 switch cannot advance from position 1 and the call will block.

89.4 The OF relay must be type 231-GA or 239-FU or 280-G.

89.5 The ground on 3B RCO relay in Fig. AH is designated "AM" option and the 3B RCO relay is connected to off-normal ground on 1B RCO relay to prevent a mutual lockup of PS, ST, RL, RL1 and CL3 relays on partial dialed calls routed to permanent signal holding trunk.

89.6 STP coil reduces the peak transient current which occurs on reclosure of the STP relay contacts, thereby improving the release performance. There is a gain in permissible resistance in the commutator circuit for revertive pulses.

90. DIVERSION OF RESTRICTED PBX TRAFFIC ON EXTRA CHARGE CALLS

90.1 The diversion feature makes use of relays TDC, TDR, and TDS in Figure CC. When diversion of restricted PBX traffic on extra charge calls may be required as a re-sult of route or zone the decoder operates relay TDR by grounding lead TDV through the winding of one of its own relays. Relay TDR locks operated under control of relay TDS and opens the operating paths for relays TMI and AVI. Upon completion of dialing, as signaled by the time measure switch reaching position 13 (passby after stations delay), relay TDC operates to ground from the Fl cam. Relay TDC, in operating, con-nects relay TDS to the subscribers loop, with Option EA, removes relay L from this loop (or with Option EB, removes the PB converter E relay from this loop), and closes the operating circuit for relay TML. Relay E in this circuit is released, either. directly or under control of the TT converter. Relay TDS operates and replaces the ground removed by the release of relay L, thus maintaining supervision of the line. This prevents the transfer of the loop away from relay L from being interpreted as a subscriber disconnect when relay L releases. Relay TDS also releases relay TDR. Relay TDR releasing closes a contact in parallel with that on relay TDC for the operating

Page 39.

circuit of relay TMl and prepares the operating circuit for relay AVL. The sender then completes its outpulsing and releases in the normal manner unless the calling line is a PBX line with the toll diversion feature.

90.2 When relay TDS is connected to the line the battery and ground applied to the tip and ring are reversed with respect to the way they are connected through the L relay. This reversed polarity operates a polar relay in the PBX line. The subscriber's line is then transferred to the FBX operator and the sender receives a disconnect signal. This releases relay TDS and allows relays L1, L2, SR, SRI and SR2 to release. The sender, recognizing a line release condition, then restores to normal, restoring the PB converter to normal.

90.3 The reversed polarity on the subscriber's loop has no effect in the handling of a call from other than a PBX subscriber with the diversion feature in the line circuit. Local calls are unaffected by this feature regardless of the type of calling subscriber because the decoder does not ground the TDV lead.

90.4 In order to insure that the subscriber's loop has received the reversal, the operating path for relay AV1 is broken by the operation of relay TDR and restored only after release of relay TDR as a result of the operation of relay TDS. In case of a subscriber disconnect, the TDR relay is released when the (LR1) relay operates.

90.5 Where diversion of restricted PBX traffic extra charge calls is not provided Figure CD is used. If the decoder is arranged for diversion and this sender is not so arranged, Option "BL" is used. This puts a 500 ohm resistance on the TDV lead to satisfy the decoder lead integrity test.

91. AUXILIARY SENDER OPERATION - FIG. CF

When auxiliary senders are furnished, the subscriber sender is arranged to complete 10-digit DDD calls and 7-digit MF calls via the auxiliary sender. The sender recognizes a 10-digit call by the second digit, 0 or 1, dialed by the subscriber and prepares a circuit for completing the call via an auxiliary sender. A 7-digit call which is to be MF outpulsed is recognized by the decoder and is indicated by the operation of class relay 7DG. The 7DG relay operated prepares the circuit for completing the call via the auxiliary sender.

In addition to the class relays required for a regular tandem C.I. call and the 7DG relay, the decoder controls the operation of class relays SK2 and SK3 to provide class indications to the auxiliary sender as follows:

SK2 operated, skip 2 digits on outpulsing.

SK3 operated, skip 3 digits on outpulsing.

SK2 and SK3 normal, no skip, outpulse all digits.

The condition on the class lead to the auxiliary sender which is 1711 ohm ground with SK2 and SK3 normal is changed to direct ground or 317 ohm ground by the operation of the SK3 or SK2 relay respectively. SK2 will not be operated on a ten digit call.

The function of the auxiliary sender is to register the final 2 digits dialed by the subscriber on a ten digit call, to establish a connection through the switch train to the incoming trunk in the remote office, and having received by C.I. pulses the digits recorded on the subscriber register relays, to send the called number information forward to the terminating end on a multifrequency pulsing basis. When the auxiliary sender completes its functions it signals the subscriber sender to switch the fundamental back into the sender and to proceed with talking selections and release.

91.1 Ten Digit DDD Call

91.11 Recognizing 10 Digit Call

On a ten digit call, the arca code office code, TH and H digits are recorded on the A, B, C, TH, H, T, U and ST register relays, respectively, in the sender. The T and U digits are registered directly in the auxiliary sender. The circuit for de-tecting a 10 digit call is through normal contacts of the B2, B4 and B5 relays and cams M, N, O, and P of the R1 switch cut in positions 1/7. When the subscriber has dialed the fourth digit, the THL relay operates, closing ground through the detecting circuit to operate the ASC and ASI relays. When the subscriber has dialed the fourth digit, the (THL) relay operates, closing ground through the detecting circuit and through the (ASC) and (AS1) resistorthermistor networks to operate the (ASC) and (AS1) relays. These networks tend to slow up the operation of the (ASC) and (AS1) relays in order to prevent false operation of these relays due to transient grounds that originate from the (R3) switch while the switch sets in position "5" or "17" as explained in paragraph 58.3. The (AS) varis-tor in the operate path of relay (HC) pre-vents false operation of this relay due to these came transient grounds from the (R3) these same transient grounds from the (R3) switch.

The (ASC) and (AS1) relays, operated prepare the circuit for calling in the auxiliary sender and transferring the connections required for auxiliary sender operation.

91.12 Connection to Auxiliary Sender

The ASC relay operated, partially closes a path for grounding the ST lead to the auxiliary sender link circuit, and operating the AS2 relay, prepares the circuit for operating the DPT relay and opens ground from the Flicam to prevent the Rl Switch from advancing on dial completion until the DC lead is grounded by the auxiliary sender.

When the subscriber has dialed the seventh digit the auxiliary sender is called in. The UL relay operated, closes ground to the ST lead through operated contacts of the ASC relay to start the auxillary sender link circuit hunting for an auxiliary sender. The AS2 relay is also operated at this time, closing a path to hold the ASC relay operated on the secondary winding and making additional changes required for auxiliary sender operation. When an auxiliary sender is seized, ground is closed to the subscriber sender SA lead, operating the SA relay. A 317 ohm ground, or direct ground if the SK3 is operated, is on the CL lead at this time giving a class indication to the auxiliary sender.

91.13 Registration of Final Two Digits in Auxiliary Sender

When the 8th digit is dialed, the STL relay operates, closing ground through operated contacts of the ASI and ASC relays to operate the DPT relay. The DPT relay operated, locks under control of the STL and ASI relays and transfers the pulsing lead. Pl, to the auxiliary sender so that the next digit dialed by the subscriber will be pulsed into the auxiliary sender.

On the first pulse of the 9th digit (received directly from the rotary dial, EA option, or with EB option, from the TT converter on rotary dial or PB set calls), the release of the L, Ll and RA1 relays closes ground through operated contacts of the DPT relay to contacts of the SA relay. If the SA relay is normal at this time, the OF1 relay will operate. This is to insure that the call will be sent to overflow if an auxiliary sender is not attached and ready to receive pulses when the subscriber starts. to dial the 9th digit. A message register will be operated, as later described, to record the number of times this condition occurs. If an auxiliary sender is attached, the SA relay is operated, preventing the operation of the OF1 relay at this time. The SA relay operated, also prepares a path for operating the SWF relay in position 7 of the selector switch.

When the final 2 digits have been dialed, the auxiliary sender signals the subscriber sender by connecting ground to the DC lead. The timing switch which has advanced in the normal manner for an 8 digit call up to position 13, times through positions 13 and 14 waiting for the dialing completion signal. Ground on the Fl cam which is used to advance the timing switch through passby positions 13/14 on a normal call is held open by operating contacts of the ASC relay. An interval of 30 to 60 seconds is measured in positions 13 and 14 by the timing switch. This timing period is canceled when ground is connected to the DC lead by the auxiliary sender advancing the Rl switch to position 15.

The Ql cam is cut in positions 5/14 to provide a path from ground on normal contacts of the 7DG relay, through operated contacts of the ASI relay to hold the FOI relay operated after office selections until the Rl switch has advanced from position 14. This is to insure that the trunk test loop is not closed until the dialing completion signal is received from the auxiliary sender.

91.14 Switch Fundamental and TG Loop to Auxiliary Sender

Selections take place in the sub-scriber sender in the normal manner until the R2 switch advances into trunk test posi-To insure that the TG loop will not tion 7. be closed to the fundamental in position giving a false indication to the terminating equipment, the FT lead to the district is held open from the TG relay path by contacts of the AS2 relay. In position 7, the SWF relay operates to ground through cams K2 and 12 and operated contacts of the SA re-lay. The operation of the SWF relay splits the fundamental circuit, connecting the FT and FR leads of the District to the FTO and FRO leads of the auxiliary sender and presenting the PCI trunk test loop of the sender circuit over leads FTI and FRI to the auxiliary sender. The C.I. trunk test loop is held open in position 7 until the F03 relay has reoperated. The FO3 relay is released when the FOl and FO2 relays operate after office selections and does not reoperate until the R1 switch has advanced from position 14, releasing the FO1 and FO2 relays. The SWF relay operated also closes the AVL lead to the winding of the AV relay.

91.15 Trunk Test By Auxiliary Sender

The splitting of the fundamental circuit by the operation of the SWF relay leaves the subscriber sender looking at the auxiliary sender with its call indicator trunk guard bridge and leaves the auxiliary sender looking at the remote incoming trunk through the switch train.

The auxiliary sender can function to make trunk test over the FTO and FRO leads to the remote trunk and cause the trunk to engage a sender prepared to receive MF pulsing. The auxiliary sender also can function to complete C.I. trunk test in the subscriber sender over the FTI and FRI leads, and by producing the assignment signal, cause the subscriber sender to transmit C.I. pulses into the auxiliary sender. The trunk test will not be made until the ·C.I. MF trunk test is satisfied, so that if the overflow signal is received on MF trunk test, the auxiliary sender will relay the overflow signal to the subscriber sender on the C.I. trunk test. Assuming that the remote trunk is normal, the TG, TGl and TG2 relays operate to the termination in the auxiliary sender and the OF relay remains normal. Relay TG2 operates call indicator relay CI which locks to off normal ground and advances the selection switch to "15." Until the switch leaves "7", relays OFT and TG2 are both held operated by ground from SS2-J2. This insures that CI shall have time to operate and lock in case TG is released very shortly after operating, by a quick assignment. While the switch is mov-ing through "8" to "15" and after it stops in "15," relays TG2 and OFT are both held operated by ground from contact of relay TGl until the auxiliary sender, by assigning the trunk, releases TG and TG1. The, fundamental is held closed through the winding of TG by a circuit through front contacts of CI and TG2. The circuit also goes through a front contact of OFT and the operating winding of OF until the switch reaches ∂ , so that OF may respond to a true overflow condition. The OF relay is then shunted out by a lead from SS4-L2.

91,16 Rotation of Impulser

When the trunk at the remote office has a sender attached it sends a momentary reversal of polarity over the pulsing tip and ring to the auxiliary sender. The auxiliary sender simultaneously assigns the call indicator loop back to the subscriber sender by transferring it from battery and ground to the dry call indicator relay loop. This has the same effect as the connection of a CI control circuit or a tandem sender to the incoming end of the selected trunk on a normal call. The TG relay releases, followed by the release of the TG1 and TG2 relays. The release of the TG2 relay closes the FTI and FRI leads to the impulser and rotation of the impulser proceeds as on a regular tandem C.I. call.

91.17 Connection of Impulser to Dial Register

In order that the 8 digits recorded on the dial register of the subscriber sender may be PCI pulsed into the auxiliary sender in the order in which they were received, the connection of the impulser to the dial register relays is changed as follows: Connection of the TH register relays is switched from J3 cam to I3 cam, connection of the H register relays is switched from SS3-J3 to SS2-J3, connection to the T and U register relays is switched from the I3 cam to the K3 cam and the OT relay is operated. These changes in the PCI impulser were effected by the operation of the AS1, AS2 and SA relays.

For a call requiring completion by the auxiliary sender the impulser switch has been set in position "5" as for a 3-digit tandem C.I. call. The impulser starts from position "5" with TAN operated. High resistance B and the fundamental tip are connected through cams U3 and V3, respectively, to the A, B and C registers in turn while the switch moves through 12 positions. After the first 3 digits are sent, relay TAN releases and high resistance B and the fundamental tip are connected through operated contacts of the OT relay through cams O3, I3, N3, J3 and K3 to the TH, H, T, U and ST registers in that order. The C.I. pulses are sent out in two different codes which are described earlier under "C.I. codes." The digits registered on the A, B, codes." and C registers are sent out in office or regular code, the digits registered on the TH register in TH code and the remaining digits, H, T, U and ST in regular code, the operation of the AS1, AS2 and SA relays having made the necessary changes in the CI circuit. The final heavy positive pulse which is sent in position 18 to indicate completion of pulses on a regular tandem C.I. call has no significance when C.I. pulsing into the auxiliary sender. The R3 switch advances to position 1 and remains normal.

The path which is used to operate the AV relay in position 17 or 18-3/4 of the R3 switch on a regular P.C.I. call is held open by contacts of the SWF relay.

91.18 Finish of DDD Connection

The auxiliary sender functions to MF pulse the digits forward to the terminating end as soon as it receives the first two digits PCI pulsed from the subscriber sender. When all digits and a start pulse signal have been transmitted to the terminating end, the auxiliary sender grounds the AVI lead to the subscriber sender. Ground on the AVI lead operates the AV relay which locks to off normal ground. AV operated opens the trunk loop toward the distant end and advances the selection switch from "15" to "17", where AVI operates, followed by FOL. FOI advances the selection switch leaves position "17," the SWF relay releases, transferring the fundamental tip and ring from the auxiliary sender back into the subscriber sender. The sender is now in the same condition as at the end of incoming advance on a full selector call. District advance, talking selection and release take place just as described for that class of call.

The operation of the RCO relay after the selection switch has reached position 17 and the HD relay is operated, removes ground from the ST lead releasing the link crosspoints in the auxiliary sender link and causing the link and auxiliary sender to return to normal.

91.2 Seven Digit MF Call

On a seven digit call, the decoder has operated the 7 DG relay in addition to the relays required for a regular tandem C.I. call. The digits dialed by the subscriber are recorded on the dial register relays as on a regular call. The 7 DG relay which is operated by the decoder operates the ASC and AS1 relays. These relays prepare the circuit for calling in the auxiliary sender and transferring the connections required for auxiliary sender operation. With the 7DG relay operated, the advance of the RL Switch through passby positions 13/14 is not affected by the operation of the AS relay. The RI Switch advances as on a regular 7 digit call. Connection to an auxiliary sender takes place as described for 10 digit operation except that the SK2 relay may be operated changing the indication on the class lead to 317 ohm ground.

If the subscriber dials an 8th digit, ground is connected to the DC lead indicating to the auxiliary sender that an 8th digit is to be MF pulsed forward to the terminating equipment. The DPT relay has no function on a 7 digit call.

Switching of the fundamental and TG loop to the auxiliary sender, trunk test, rotation of the impulser, connection of impulser to dial register and finish of connection are the same as described for 10 digit operation.

91.3 Overflow

91.31 Ten Digit Call

On a ten digit call, if an auxiliary sender is not attached when the subscriber dials the ninth digit, the sender is sent. to overflow. On the first pulse of the ninth digit, a path is closed through normal contacts of the LA and RA1 relays, operated contacts of the DPT relay and normal con-tacts of the SA relay to operate the OF1 The OF1 relay operated, locks to off relay. normal ground and releases the ASC relay, thereby removing ground from the start lead to the auxiliary sender link. The release of the ASC relay closes ground to advance the Rl switch into timing for release. If the selection switch has not reached position 5 district selections and office test take place. When the switch advances into position 5, the OF relay operates and Locks

under control of the M2 cam in position 5/17. The R2 switch is advanced to position 10 under control of the OFI relay. The IA relay operates in positions 5/17, operating the FO and BO relays in positions 5/6 and 8/17 through normal contacts of the AV1 and LR relays. The AV relay, operated under control of the IA and FO relays operated, locks to off normal ground and advances the selection switch from position 10 to 17. From this point, overflow operations continue as described for "Overflow on Office Test."

Overflow on office test or trunk test are as described for a regular 7 digit call. The operation of the OFI relay, releases the ASC relay, thereby removing ground from the ST lead and releasing the auxiliary sender and auxiliary sender link.

91.32 7 Digit MF Call

On a 7 digit call, if no auxiliary sender is available when requested, the call is not sent to overflow. The subscriber sender will complete the call when an auxiliary sender becomes available, providing the call is not interrupted by overall timing for release.

If the sender is primed automatically after time out and the CTR key is not operated, the selections switch will not advance from the trunk test position. The sender will be released when an auxiliary sender becomes available. The auxiliary sender will encounter an open loop on trunk test toward the district and will signal the subscriber sender for trouble release.

If an 8th digit has been dialed and the DPT relay is operated, the release of the L relay on prime out will close a path through contacts of the DPT relay operated and the SA relay normal to operate the OF1 relay. The sender will advance and release as on overflow.

Overflow on office test and trunk test is as described for a regular 7 digit call. The operation of the OFI relay releases the ASC relay, removing ground from the ST lead and releasing the auxiliary sender and auxiliary sender link.

91.4 Abandoned Calls

On calls abandoned before an auxiliary sender is summoned, the sender operation is as previously described for abandoned calls. If the call is abandoned after the auxiliary sender is summoned, the operation of the LR1 relay in the subscriber sender grounds the LR lead to the auxiliary sender as a signal to stop outpulsing the called number. If assignment has not yet been made, the auxiliary sender opens the trunk loop toward the terminating end causing the remote trunk to cancel the bid for an incoming sender and operates the OF relay in the

subscriber sender on TG test. The sender releases as an overflow. If the call is abandoned after assignment the sender and auxiliary sender complete their functions as on a regular call but no digits are outpulsed by the auxiliary sender. The connection is wiped out by the release of the district and sender.

91.5 Partial Dial

A partial dial occurring before the auxiliary sender is summoned is handled as previously described for a 7 digit call. On a 10 digit call, if a partial dial occurs after the 7th digit has been dialed and an auxiliary sender has been summoned the path for advancing the Rl switch through passby positions 12/14 is open awaiting a dial completion signal from the auxiliary sender. The auxiliary sender will time through an interval of six to twelve seconds waiting for the ninth or tenth digit and then signal the subscriber sender for trouble release.

91.6 Trouble Release from Auxiliary Sender

The auxiliary sender signals the subscriber sender for trouble release by grounding the AVI lead and reversing the polarity of the FTI and FRI leads. If the trouble occurs before the dialing completion signal has been received on a ten digit call, the DC lead is grounded by the auxiliary sender to permit closure of the trunk test loop in the subscriber sender. When the TG loop is bridged across the FTI and FRI leads, the reversal operates the OF relay causing the sender to go to overflow.

Once the R2 switch has advanced from position 7 the subscriber sender cannot differentiate between an advance signal from the auxiliary sender (ground on the AVI lead) and trouble release from the auxiliary sender (ground on the AVI lead and reversal on the FTI and FRI leads). If a trouble release signal is received after the switch has advanced from position 7, the subscriber sender will advance and make talking selection. If MF pulsing has not been completed, the terminating equipment will return overflow signal to the subscriber.

92. INTERSENDER TIMING

92.1 Intersender Timing Control -Figs. CH & CJ

When approximately ninety per cent of the senders in an office are busy, lead "IT" is grounded by the misc. circuit for the subscriber sender frame.

With cam V2 in position 2/18, battery is extended to the inner end of relay (IT). When trunk test is made, relay (TG2) of Fig. CH operates. Relay (TG2) operated, extends the ground on lead "IT" to operate relay (IT) which locks through relays (SP) and (FO) normal.

92.2 Intersender Timing Cycle - Fig. CI

The operation of relay (IT) starts the intersender timing cycle of 3 to 6 seconds. Ground on lead "IT" is extended through relay (IT) operated to the back contact of the (IT) interrupter in the misc. interrupter circuit, through relay (IT2) normal to operate relay (IT1). Relay (IT1) locks to lead "IT" through relay (IT2) normal. Approximately 3 seconds later the interrupter makes on its front contact to operate relay (IT2) via the "IT" lead. Relay (IT2) locks to off normal ground. Relay (IT2) operated operates relay (OF1) to send the call to overflow.

With relays (IT1) and (IT2) operated, lead "ITR" to the misc. register circuit is grounded to operate a register in that circuit. When relay (IT2) operates, relay (IT1) releases to remove the ground from lead "ITR". The removal of this ground causes the register to release and score. This register scores the number of calls sent to overflow due to intersender timing.

If the call is a CI call and assignment is made before the timing cycle is completed, relay (TG2) releases to operate start pulse relay (SP). Relay (SP) operated releases relay (IT) to cancel the intersender timing cycle. If the call is a full selector call, relay (FO) operates when incoming brush selection is made. Relay (FO) operated releases relay (IT) to cancel the intersender timing cycle.

93. SIX DIGIT TRANSLATION (SENDER RECYCLE) FIGURE CL

93.1 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 registra-tion of these three dialed digits is complete, as indicated by an operated (CCA) relay. An idle connector in a code compressor connector brought in by the operated start relay connects the recycle circuit and code leads which normally carry this registered information to the decoder, to an available code compressor circuit. Tf 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 2/5 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.

93.2 If the code is one requiring compression and after this is accomplished

by the compressor circuit, as described, the subscriber sender is recycled to release the A, B and C register to permit a subsequently dialed local code to be registered on the A, B, C registers as on a local call with the numericals following registered in their usual TH, H etc., slots. When registration of the local code is complete, the decoder 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.

93.3 Handling of an auxiliary sender call is similar to that described in paragraph 91, except that with recycle the auxiliary sender start signal is derived from the 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.

93.4 After processing each type code; of the three circuits used by the sender in the six-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 relased for use by other senders in the group.

93.5 If the processing of a code compressed call cannot be completed in the interdigital interval, before the (CCB) relay operates, the subscriber sender recycle circuit returns an overflow indication to the subscriber sender. Now when dialing is completed, the call will receive an overflow signal.

94. DOUBLE CONNECTION RELEASE - FIGURE CM

When the line finder and district circuit seizes a sender and has advanced to position 2, battery through the 1200 ohm primary winding of the district (L) relay is closed through to the sender over the "FT" lead with the (RL1) relay normal, the "FT" lead is connected to a wheatstone bridge type circuit with resistors (DCA) and (DCB) and noninductive secondary winding of relay (DCT1) as the other branches and polar relay (DCT) across the center of the bridge. With one district selector circuit connected, the wheatstone bridge circuit is in a near balanced condition and current flow through relay (DCT) is insufficient for it to operate. If the sender has been simultaneously selzed by two district selectors circuits then two district (L) relays would be connected to the "FT" lead causing a substantial unbalance in the bridge circuit in the direction to operate relay (DCT). Relay (DCT) in turn operates relay (DCT1). Relay (DCT1) operated connects ground to lead "DCR" for scoring a register and operates relay (LR). With relay (LR) operated the sender functions as for an abandoned call advancing

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the districts which in turn release the sender.

95. OPERATION WITH TOUCH-TONE SETS -OPTIONS EB AND EC

95.1 General

Touch-tone sets send multifrequency (MF) signals, two frequencies for each digit, in response to subscriber operation of the set buttons. When this circuit is seized, both for rotary dial and touchtone set calls, the touch-tone calling signal to dial pulse converter circuit (TT converter) is seized over lead ON (from off normal ground from relay T operated). Subscriber line leads T and R connect di-rectly to a dial pulse receiving circuit in the TT converter, from which circuit a multiple connection (on leads T and R) is made to the touch-tone calling receiving circuit (TT receiver). As described in paragraphs 11.12 and 11.22 for rotary dialed calls Option EB, the TT converter L relay (of the dial pulse receiving circuit) follows dial pulses and repeats these pulses by operating relay L in this circuit over lead Rl. For TT calls, MF digit signals are detected in the TT receiver from which they are sent as dc signals to the TT converter. In the TT converter these digits are translated, registered and then dc outpulsed (at 20 PPS) over lead Rl to relay L in this circuit. Connection to the dial tone generator and connection of tone to the subscriber's line are made in the TT converter; however, control of dial tone connection is in this circuit over lead DT through relays AC and SR2 or SR1 and RCO (and also XC3, and the sender recycle circuit, when provided) to ground.

95.2 Subscriber T and R Lead Connections

The T and R leads are connected to the TT converter such that the diversion of restricted PBX traffic feature is not disturbed; minor changes of this feature resulting from adding the TT feature are described in paragraph 90.

The R lead is connected to TT converter -48 volt battery through a dial coil winding and the L relay operate winding (both in the TT converter); the T lead is connected through the presently used contact on relay (LR1) in this circuit, then to TT converter ground, through a second winding of the tone coil and a resistance lamp (both in the TT converter).

Since the dial tone coil is located in the TT converter, and in order to delete unnecessary resistance in the T and R leads, in this circuit coil (TN) and resistance in the T lead are removed and connection to dial tone supply is removed on Option EB. This affects the main figure and Figs. U and V, Sheet -0203, Fig. AF, Sheet -0204and Fig. CL, Sheet -0210.

95.3 Trouble Conditions

When troubles are detected on TT calls by the TT converter, Option EB, that circuit either prevents the start of or causes the stoppage of dc outpulsing, causing a permanent signal or partial dial time out in this circuit; for "mutilated digit" troubles the TT converter scores a plant register. In addition, with Option EC, for senders arranged for automatic priming, on all troubles overflow tone is connected to the subscriber's line by the TT converter; and for "mutilated digit" troubles the TT converter also causes this circuit to stick over lead "MTD", subject to control of the CTR key in the misc. circuit for sender make busy frame.

In order to stick this circuit on TT converter detected "mutilated digit" troubles under CTR key control, the automatic priming feature is modified and lead "MTD". is added. Without the TT feature, Op-tion EA on stuck sender time outs the misc. circuit for sender make busy frame CTR key; circuit for sender make busy frame CTR key; (a) when in the "IN" position, connects lead "CPI" to lead "CP2", both from this circuit, to automatically release this sender; (b) when in the "OUT" position, opens leads "CPI" and "CP2", causing this circuit to stick (see paragraph 84). With the TT feature. Options EB and EC, the CTR the TT feature, Options EB and EC, the CTR key is rearranged to control a TT converter relay and the "CP1" and "CP2" leads from this circuit are directly connected to the TT converter. With this arrangement the CTR key: (a) when in the "IN" position causes the TT converter relay to be released and lead "CP1" is connected to lead "CP2" through a break contact on the TT converter relay; (b) when in the "OUT" position, operates the TT converter relay which (1) opens leads "CP1" and "CP2" and (2) grounds lead "MTD" to this circuit. Ground on lead "MTD" holds relay SRI operated, forcing this circuit to stick. Also, with Option EC, leads "CP1" and "CP2" to the alarm transfer circuit are deleted, since the alarm transfer circuit will control the TT converter relay to take over the function of these leads.

96. PREFIX "O," PREFIX "1" AND 11X CALLS

96.1 Prefix registration and control features are built into this sender to provide additional toll calling facilities. A dialed prefix predetermines a proper routing for the call whether it will be special service or DDD.

Dialing of two successive ones causes their registration on the (A) and (B) registers, dialing of any third digit completes a llX code. The decoder recognizes these codes and routes them as determined from the prefix mark furnished by the sender.

96.2 Prefix "O" Call

A prefix "O" timer delays calling a decoder immediately, as the call may be either a zero operator or special service call. It would be a special service call provided dialing of additional digits is immediate or before a 3 second timing interval is expired, as determined in the sender by the prefix time. Under these conditions added functions in the sender are made available to provide the necessary signals for handling the call in the auxiliary sender and decoder. When the senders are equipped with recycle, the prefix "O" control facilities provide for canceling the recycle features and substituting instead a sender decoder operated sender delay signal for starting an auxiliary sender.

When the customer dials zero operator, this is sufficient to complete the call when the prefix timing interval is expired. As before, the sender receives and records the zero digit on a provided prefix zero register. Since this type of call requires no additional digits to be dialed, the prefix zero timing feature connects ground under control of the operated prefix zero register relay and operates the zero relay (AZ) in the (A) register. Two class signals, "LA" and "PF" lead grounds, are sent to the decoder and routes the call to zero operator.

Prefix "O" relay (PFO) over its 3M operated, (4-5B) of (AL1) normal, (1-2T) of (RA) normal starts the prefix timer, Fig. DW from ground. In 3-6 seconds ground from the timer through 4-5B normal contact on relay (IT) of Fig. DX or the "2," "AZ1" leads of Fig. CZ, if intersender timing is not furnished, 4M on relay (PFO) operates relay (AZ). Relay (PFO) operated also grounds the "PF" lead toward the decoder.

Sender recycle is cancelled on all prefix "O" calls, since they are destined for auxiliary sender handling on all classes of call. The compressor start circuit is opened by (2B) of (PFO) and its (1M) furnishes a ground signal to the auxiliary sender for converting the M.F. start signal of this circuit to indicate to a distant sender that the call is a special service toll call.

96.3 Prefix "1" Call

Dialing of the access code, prefix "1" will signal the decoder that the call is a prefix call and must be routed such that it will be detailed billed. Essentially this preliminary dialing of one would result in its absorption in the (A) register. With the added prefix controls, the sender registers the one in a new first prefix one register. The following digit, other than a zero or one, is registered in the usual manner on the (A) register. Subsequently

dialing of the fourth digit, the decoder may be called and the routing determined from the prefix and code informations. With sender recycle the procedure would essentially be the same as described, except a decoder start would be delayed until after dialing of the seventh digit.

Prefix "1" registration is made on relays (FPF) and (FPF1), and is functionally a two step operation. The first relay is operated from the dial register circuit and the second relay is operated during the interdigital interval. Relay (FPF) grounds the "PFO" lead which becomes the "PL" lead in Fig. CV and connects the "CK1" lead to the "LA" lead to the decoder. The decoder determines the routing from the ("PF") signal and code from the (A), (B) and (C) registers.

96.4 Service Codes 11X

Addition of a Second Prefix registration feature, Fig. CU to the First Prefix registration circuit, Fig. CT, permits dialing of a new series of codes defined as llX. Operation of relays (SPF) and (SPF1) is similar to the First Prefix. Fig. CU, relay operation. When registration of the second prefix is complete, both the lst and 2nd prefix registrations are transferred to the (A1) and (B1) registers. Under this condition the 3rd dialed digit is now directed in the normal manner to the (C) register.

Dialing of the second prefix "1" digit is directed as always to the (A1) register. Ordinarily dialing of one's into the register would merely operate it, and since no hold was provided, it would subsequently release. The second prefix feature provides a locking circuit for the (A1) register at (5-6T) of (SPF). When registration of the second digit is complete on the relay (SPF1), ground from (1-2B) of (SPF1) connected to the "B1" lead and the (B1) register is operated. The remaining register operations are the same as for any digit dialed into the (B-) register.

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