CROSSBAR SYSTEMS
NO. 1
SUBSCRIBER SENDER LINK
AND CONTROLLER CIRCUIT

CHANGES

D. Description of Changes

D.1 The TTLL lead in Fig. 9 is made part of ZU and ZX options on a D no-record basis.

D.2 Options YJ and YK are added to provide a means of distinguishing between rotary dial and TOUCH-TONE® leads, on a D no-record basis.

D.3 Options YA, YJ, YK, ZY, and ZZ are added to the "TOUCH-TONE calling initially" section of Circuit Note 114, on a D no-record basis.

D.4 Option YN is added to light a lamp in the maintenance center when all TOUCH-TONE senders in a partially converted sender subgroup are busy and another lamp to light when all rotary dial senders in the same group are busy.

F. Changes in CD Section

F.1 In SECTION II, 28. SENDER GROUP BUSY REGISTRATION, FIG. 9, change 28.02 to read:

28.02 When all rotary dial and overflow senders in a subgroup are busy, relay SGB operates through a series cross-connection over lead MB (see Note 212). The operation of relay SGB lights a busy lamp at the make-busy frame over lead BL, YN option. When all TOUCH-TONE and overflow senders in the subgroup are busy, relay TTGB operates through a series cross-connection over lead TMB, (see Note 212). The operation of relay TTGB lights a busy lamp at the make-busy frame over lead TTBL, YN option. The operated SGB and TTGB relays operate the associated GB- relays of Fig. 6 and the TGB- relays of Fig. 25, respectively. The operated SGB or TTGB relay also causes the operation of individual registers over leads CG and TCG, respectively.

F.2 Add the following as title for 28.03:

C. YM Option - Mfr Disc

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5615-DWW-RBC-JR

CROSSBAR SYSTEMS
NO.1
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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont) PAGE

TABLE OF CONTENTS (Cont) PAGE

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 The purpose of this circuit is to provide means for connecting any of 100 district junctors to any of 100 subscriber senders, to provide means for controlling the establishment of these connections one at a time and, with automatic message accounting operation, to close through the line link frame identification leads to the associated sender. With the aid of a line link and controller circuit subscriber lines, subscriber district junctors, and senders can be connected together. Dialing type district junctors can be connected to senders without the aid of the line link.

1.02 When TOUCH-TONE® calling is provided on a partially converted basis only a portion of the subscriber senders are equipped to handle TOUCH-TONE traffic. The senders associated with each sender subgroup can be split into a two- or three-section arrangement, intended for offices with low CCS to sender ratio, provides a section of rotary dial senders not converted for TOUCH-TONE and a section of senders converted for TOUCH-TONE that handle TOUCH-TONE calls only. The three-section arrangement consists of a section of unconverted senders to handle only rotary dial calls, a second section made up of converted senders to handle only TOUCH-TONE calls, and a third section made up of converted senders to handle overflow from the other two sections.

1.03 On each call an indication is given this circuit as to the type of sender required. This circuit will then function to connect the call to the proper type sender.

2. GENERAL DESCRIPTION OF OPERATION

2.01 None.

SECTION II - DETAILED DESCRIPTION

1. LINK DISTRIBUTION PLAN

1.01 There are ten primary switches and five secondary switches associated with a subscriber sender link and controller circuit. The primary switches accommodate 100 district junctor circuits while the secondary switches provide means for connecting to 100 subscriber sender circuits. The district junctors are divided into ten groups of ten district junctors each and these ten groups are subdivided into pairs, the two groups of a pair being those two groups that are served by the switches which have access to the same group of 10 sender links. Hence, there are five district groups each served by 10 sender links with each group consisting of 20 districts. The sender circuits are divided into 10 subgroups of 10 senders each. There are five secondary switches, each of which accommodates two subgroups of senders. Five sender links connecting to each sender subgroup have access to each district group, one link serving each of the five groups of 20 district junctions. The secondary switches shall always be connected to senders even though there may be less than 100 senders in the office in order to provide sufficient sender links to accommodate the traffic demands of the districts. In the offices where there are less than 100 senders, one or more sender groups will be connected to more than one secondary switch of the same sender link and controller circuit. Of course, from the standpoint of wear, it is desirable that each subgroup of 10 senders shall have as many appearances on secondary sender link switches as every other sender subgroup. In no case shall a sender subgroup contain less than five senders in order that the associated sender links may be used efficiently.

2. DISTRICT GROUP INDICATIONS TOWARD THE LINE LINK AND CONTROLLER CIRCUITS

A. ZP Option Available Path

2.01 Fig. 4 is arranged so that when all relays are normal, ground is connected from the off-normal contacts of the D holding magnets of Fig. 2 through the normal contacts of the GB- relays of Fig. 6 to the TA, TB, RA, and RB leads of the line link and controller circuits. It should be observed that the "path available" ground over lead PA from Fig. 6 indicates that there is at least one path or idle sender link available from the group of 20 districts to a sender group having at least one idle sender.

B. ZQ Option Available Path

2.02 A ground is connected from the off-normal contacts of the D holding magnets of Fig. 2 through the normal contacts of the GB- relays of Fig. 6 (PA leads) to the RDA lead of the line link and controller circuit. A ground on the RDA lead is an indication to the line link and controller circuit that there is at least one path or idle sender link available from the group of 20 districts to a sender group having at least one idle rotary dial or overflow sender. Ground is also connected from off-normal contacts of the D holding magnets of Fig. 2 (TPA leads) through the normal contacts of the TGB- relays of Fig. 25 to the TDA lead of the line link and controller circuit. A ground on this lead is an indication to that circuit of at least one path or idle sender link available from the group of 20 districts to a sender group having at least one idle TOUCH-TONE or overflow sender.

3. DISTRICTS AVAILABLE

3.01 When ground is connected to the TA or TB lead for a group of 10 districts through the normal contacts of the associated CA or CB relays it indicates that there are two or more idle district junctors in the group. As will be described later the CA and CB relays of a group of 20 districts are operated by the controller circuit of Fig. 8 each time a call is being served by the associated district group thus priming the group testing relays for determining whether there is one, or more than one, district still available in the group of 10 districts that served the call. If there is only one district available in a group of 10 districts after the previous call has been served, the associated CA or CB relay will remain locked operated. Relays A and B are marginal relays and operate only if there are two idle districts available while relays RA and RB are sensitive and operate if there is at least one idle district available in a group of 10 districts. An idle district junctor circuit connects battery through a resistance to its associated BT lead of Fig. 4 through contacts of the CA or CB relay to a D- resistance and, thence, to the RA and R or RB and B relays to ground. If there is only one idle district available in a group of 10 districts, relay RA or RB will connect ground to the associated RA or RB leads and ground will not be connected to the TA or TB leads. The ground is subject to the master control of the DP relay which operates each time the controller circuit of Fig. 8 serves a

call regardless of which group of 20 districts is serving the call. The operation of the DP relay removes ground from the TA, TB, RA, RB, and DA leads thus making the district group test busy to all associated line link and controller circuits.

4. CALL STARTS - DISTRICT GROUP SELECTION

4.01 When ground is connected to the TA, TB, RA, and RB leads, the line link and controller circuit proceeds to select the district junctor group in which it prefers to place a call. When this is accomplished, the line link and controller circuit connects ground to a GP lead of Fig. 5 corresponding to the desired district group, thus causing the associated GP- relay of Fig. 8 to operate if relay CK is released. One or all relays GP0 to GP4 may attempt to operate simultaneously depending upon the number of line link and controller circuits that may be trying to serve calls at the same instant. Only one GP- relay, the lowest-numbered one, will remain operated if more than one has operated after relay CK operates from battery on one of the operated GP- relays. The battery for locking the GP- relay operated is in a chain circuit starting at relay GP0 thus permitting only the lowest-numbered one to remain operated. Relay GP- in operating:

(a) operates the G relay of the associated Fig. 4;

(b) connects the sender group preference battery from resistance J to contact 4B of an SG- relay; and

(c) operates relay CK.

4.02 The operation of the G relay of Fig. 4:

(a) connects ground to lead 0G thus causing relay ON to operate;

(b) short-circuits the RA and A relays and the RB and B relays to prevent excessive nonoperate current flow through the D0 to D9 relays later in the circuit operation;

(c) ZP option - closes leads GT0 to GT9 from the off-normal contacts of their respective C holding magnets of Fig. 2 through the contacts of the GB- relays of Fig. 6 and through Fig. 5 or 23 to the SG0 to SG9 relays of Fig. 8 in preparation for sender group selection; ZQ option, on rotary dial calls closes the GT0 to GT9 leads from their respective C holding magnets of Fig. 2, through the normal contacts of the GB- relays of Fig. 6, through operated contacts of the RD relay of Fig. 25, and through Fig. 5 or 23 to the SG0-9 relays of Fig. 8, on TOUCH-TONE calls closes the GT0 to GT9 leads from their respective C holding magnets of Fig. 2 to the TGT0 to TGT9 leads of Fig. 25, through the contacts of the TGB- and TTD relays and through Fig. 5 or 23 to the SG0-9 relays of Fig. 8. In either case the SG- relays will operate provided there is an idle link available to a subgroup of senders having at least one of the proper type sender idle;

(d) ZP option - connects ground from the PA lead to lead SL of the line link and controller circuit indicating the call will be served by some district of the associated group of 20 district junctor circuits; ZQ option - on rotary-dial calls connects ground from the PA lead through a break contact of the TD1 relay and the RD diode to the SL lead of the line link and controller circuit, on TOUCH-TONE calls connects ground from the TPA lead through a break contact of the RD1 relay and the TD diode to the SL lead of the line link and controller circuit. In either case the ground indicates the call will be served by some district of the associated group of 20 district junctor circuits which has access to the proper type sender;

(e) closes a number of other leads which are not used at this time; and

(f) ZQ option (AMA not provided) closes the ID lead from the line link and controller circuit to the series connected RDA and TDA polar relays of Fig. 25.

4.03 A ground on TOUCH-TONE calls, or -48 volt battery on rotary dial calls, placed on the ID lead at the line link and controller circuit will operate the TDA or RDA relay, respectively. The operated TDA relay operates the TTD relay which, in turn, operates the TD1 relay. The operated RDA relay operates the RD relay which, in turn, operates the RD1 relay.

4.04 Where the AMA feature is provided, the IDA lead performs the function of the ID lead as described in 31.07.

4.05 Relay CK in operating operates relay RS. The operation of relay RS operates relay DE and relay TS to start the timing relays.

4.06 Relay ON operated:

(a) opens the original operating circuit of the GP0 to GP4 relay so that none of these relays can be reoperated until relays ON and CK release at the completion of the call;

(b) furnishes ground for later operating and holding relays DO to D9 inclusively;

(c) prepares the operating circuit for relay SL;

(d) operates relay ON1; and

(e) connects battery to the secondary winding of relay DC.

4.07 Relay ON1 operated:

(a) connects ground to the GB lead of each Fig. 4 thus operating the DP relay of each Fig. 4;

(b) locks to the off-normal ground lead; and

(c) prepares the operate circuit for relays DS and TM.

4.08 The operation of the DP relays of each Fig. 4 removes ground from the TA, TB, RA, RB, and DA leads thus causing all five of the associated district groups to test busy and directs other originating line link and controller circuits to wait or to place their calls with other available subscriber sender link and controller circuits. The operation of relay DP of Fig. 4, which is being servied also, short-circuits the A and B relay windings in order to prevent false operation of the A or B relays.

5. DISTRICT JUNCTOR SELECTION

5.01 When ground is connected to an SL lead of Fig. 4, as described in 7., it causes the preferred line link and controller circuit to hold or lock to the sender link and controller circuit and at the same time causes it to connect ground to an A or a B lead of Fig. 4 corresponding to the group of 10 districts in which it has decided to place its call. Ground on the selected A or B lead causes the corresponding BA or BB relay of Fig. 4 to operate which, in turn:

(a) operates relay DA or DB; and

(b) connects the 10 busy test BT lead of the associated group of 10 districts through the operated DE relay contacts to the district junctor selecting relays DO to D9 inclusive of Fig. 8.

5.02 Relay DA or DB operated, prepares the circuit for operating the A and B magnets of Fig. 1. When a district junctor is idle it connects battery to the BT lead of Fig. 4 so that the corresponding D-relay of Fig. 8 will operate for the idle district condition, ground being furnished from the ON relay contacts.

5.03 When any of the DO to D9 relays operate, they will lock to ground furnished by relay ON. When any DO to D9 relays operate, a circuit is closed for operating relay DS which:

(a) operates relays CA and CB of Fig. 4, corresponding to the group of 20 district junctors which is serving the call;

(b) releases relay RS which is slow to release; and

(c) closes the circuit for operating relays R1 and R2 of Fig. 3.

5.04 Relay TM operates and locks to relay ON1 if there are two or more DO-9 relays operated and will not operate if only one DO-9 relay operates. If only one DO-9 relay operates during the combined releasing times of relays RS and DE, the circuit assumes that the last idle district junctor circuit is being used to serve the call, in which case a circuit is closed later when relay SL operates, through the normal contacts of relay TM to lead TM for operating the traffic meter associated with the group of 20 district junctors that is serving the call. This indicates that the 10 districts being tested are busy but gives no indication of the condition of the other 10 districts of the group. If relay TM operates, it indicates that there are at least two idle districts available for serving the call and it opens the meter circuit to lead TM in addition to releasing relay DE immediately without waiting for the slow relay RS to release at this point, the district junctor selecting relays DO to D9 have chosen the district junctor to be used for the call since the preference circuit is established from ground which is closed:

(a) from relay GH through the DP lead cross-connections and the contacts of relay DO to D9 to one of the SHO to SH9 leads so that the secondary line switch magnet corresponding to the selected district junctor will be operated when relay GH operates; and

(b) from relay GH through relays OH and contact of relays DO to D9 to one of the AO to A9 leads so that the primary link switch hold magnets A and B corresponding to the selected district junctor will be operated when relay OH operates.

5.05 The DO-4 leads are grounded through cross-connections which can be shifted periodically to distribute wear over the districts and the link primary crosspoints. It should be noted also that the wiring in connection with leads A and B, Fig. 4, is

furnished in order to prevent trouble crosses on these leads or momentary ground due to relay operation, from energizing more than one DA or DB relay at a time and thereby causing double-connections. The A and B leads are controlled by relay G, so that only one of the five district groups can have its DA or DB relay operated at a time. Moreover, the operating ground for relay DS is obtained from break contacts of relays BA and BB in order to block the call if both these relays become operated. Relay DS locks operated from ground on its front contact.

6. REGULAR SENDER GROUP TEST

6.01 When the G relay of one Fig. 4 operates, it closes circuits from the operating windings of relays SG0 to SG9, inclusive, through normally closed contacts of ten GB relays, through off-normal break contacts of the C magnets of ten links, through contacts of relays R1 and R2 of Fig. 3 to the GT leads of ten sender selector circuits per Fig. 9. An idle sender circuit will not have ground connected to its associated SB- relays of Fig. A, B, or C will not be operated. When two or more SB- relays are normal, ground is connected to the GT leads which, in turn, are connected to the normal contacts of the R1 or R2 relays of all associated Fig. 3. Relays SG0 to SG9 will then operate provided, that in each case, there is an idle link available to the subgroup of ten senders having more than one idle sender in the subgroup.

6.02 If the reverse sender test feature (Fig. 3 and ZH option) is not provided, the G relay of Fig. 4 closes circuits from the operating windings of relays SG0 to SG9 inclusive through normally closed contacts of ten GB relays, through off-normal break contacts of the C magnets of ten links, and to ground through break contacts of the SGE relay. Under these conditions, relays SG0 to SG9 will operate provided that in each case there is an idle link available to the subgroup of ten senders having at least one idle sender.

7. RESERVE SENDER GROUP TEST - (MFR DISC.)

7.01 If sender subgroup selection has not been made before relay DS operates, this selection will be made on a "reserve" basis since the operation of relay DS indicates that an interval has elapsed which would normally be sufficient to complete sender subgroup selection. The operation of relay DS causes relays R1 and R2 to operate which, in turn, disconnects the sender subgroup test relays SG0 to SG9 from the GT leads and connects them to the ten RT leads. The SG0 to SG9 relays can operate to ground on the RT lead provided the corresponding links are idle. The fact that the GB and SGE relays are normal is an indication that the sender subgroup is not made busy by the make-busy jack on the sender make-busy frame or not held busy by another controller circuit and that there is at least one idle sender in the subgroup. If there is no idle sender in the subgroup, relay SGB, of the associated Fig. 9, will operate from ground supplied through the series contacts of the SB- relays. Relay SGB operated:

(a) closes a traffic metering circuit for recording the number of times that all senders of the subgroup are busy;

(b) lights a lamp on the sender make-busy frame which is primarily intended as a guard signal;

(c) removes ground from the GT leads; and

(d) connects battery to the associated GB- relays of Fig. 6 to all sender link and controller circuits served by the sender subgroup. The operation of a GB- relay will prevent the corresponding SG- relay from operating.

8. SENDER GROUP SELECTION

8.01 With one or more SG- relays operated, a circuit is closed from battery at resistance J through GP- relay contacts to the selecting contacts of the SG- relay and from there to the associated LL relay of Fig. D, E, or F corresponding to the available sender subgroup nearest to the preferred sender subgroup. The LL relay is connected to ground and operates when battery is supplied by its associated SG- relay. Relay LL operated:

(a) prevents other sender link and controller circuits from subsequently seizing the sender subgroup, either by preventing the operation of other LL relays or by preventing other operated LL relays from operating their associated SS relay;

(b) closes the circuit for holding operated the SG- relay which has previously operated the LL relay;

(c) operates the SS relay; and

(d) starts the release of relays CH1 and CH2, the latter of which will not release if the C relay of the sender subgroup operates as described below.

8.02 When relay SS operates:

(a) it opens the operating circuits for relays SG0 to SG9;

(b) closes an auxiliary circuit to ground to the PA and SEL leads so that the line link and controller circuit will not be dismissed if the last available path is used to serve the call; and

(c) prepares the circuit for operating the OC relay.

8.03 Since the LL relay of only one sender subgroup has operated it follows that only one SG- relay will have a holding circuit after relay SS has operated. Hence, all SG- relays will release except the relay having the holding circuit. When this occurs, relay OC operates and, in turn, operates the corresponding C relay of Fig. 7 and the associated PS selecting magnets of Fig. 1 under control of the operated SG- relay.

9. SENDER SELECTION

9.01 When relay C operates as described in 8.01, it:

(a) connects ground (ZR option on regular and ZS option on auxiliary customer sender link frames) to the frame indicating leads F00 to F10 and F as an indication to be used later by the originating marker to identify the district link and connector frame on which the district serving the call is located;

(b) extends link control leads RL, ON, GS, and SL to the sender relays;

(c) closes the class-of-service leads CS0 to CS9 or SA to SE and S0 to S2 to the sender connecting relays;

(d) closes ground to lead CG of Fig. A for holding any of the relays S0 to S9 operated until the connection is completed;

(e) closes leads S0 to S9 to relays S0 to S9 of Fig. A, B, and C;

(f) holds relay CH2 of Fig. D operated; and

(g) operates relay SGE of Fig. 9.

9.02 Relay SGE opens the GT and RT leads to insure that when the sender subgroup is selected by one sender link frame the subgroup shall immediately test busy to other link frames without waiting for an individual sender to be selected. If relay SGE were not operated until the S- relay operated, failure of the controller to pick an individual sender in the selected subgroup, due to a trouble condition, could, by leaving relay SGE normal, cause dial tone delays and sender link alarms on other sender link frames attempting to seize the exposed sender subgroup. When a sender is idle, ground will not be connected to its associated SB lead so that the corresponding SB- relay will be normal. If one or more of the SB0 to SB9 relays of Fig. A, B, and C is normal, the ground that is connected from the operated G relay to one of the P0, P2, P4, P6, or P8 leads when relay C operates ZP option, will cause the corresponding S- relay to operate or the S- relay for the idle sender nearest in preference to the preferred sender. With ZQ option, the operated TD1 or RD1 relay described in 7. applies ground to the TTP or RDP leads, respectively. When C relay operates the leads are extended to the TTP or RDP punchings of Fig. A. These punchings will be cross-connected as shown in Note 212. Thus, for example, on a rotary-dial call ground on the RDP lead will cause the S- relay of the first preferred rotary dial sender to operate if the associated SB- relay is normal. Operated SB- relays associated with rotary dial senders extend the preference to the next preferred rotary dial sender. If all SB- relays associated with rotary dial senders are operated the preference is extended to the S- relay of an overflow sender. The TTP preference lead which is activated on TOUCH-TONE calls functions similarly to that described for the RDP lead. Cross-connections as shown in Note 212 allow for the charging of preference sequence to distribute wear over the various senders and secondary crosspoints.

9.03 The operated S- relays:

(a) locks to ground furnished by relay C over lead CG;

(b) selects the sender to be used to serve the call;

(c) prepares the circuit from ground at relay P to lead SC of the associated sender;

(d) grounds one of the S0 to S9 leads corresponding to the selected sender, operating the proper secondary selecting magnet SS- of Fig. 2;

(e) operates relay P which provides ground to hold the SS- magnet, connects ground to lead SC of the selected sender and connects lead GH to lead OH for operating the OH relay of Fig. 8; and

(f) provides a holding path for relay SGE.

9.04 When the sender, which has been selected, is made busy (during the process of establishing the connection from the calling line to the selected sender), it connects ground to its associated lead SB thus causing its corresponding SB- relay to operate. When any relay SB0 to SB9 operates, it:

(a) opens the test lead to its associated S- relay;

(b) connects lead AS to lead BS for controlling the ground which is to hold the established connection so that the connection will not be held by the sender unless its SB- relay is operated;

(c) with ZP option, closes its series contacts for the "group-busy" indication to the winding of relay SGB, with ZQ option, closes its series contacts for the proper group busy indication to the winding of either the SGB relay or TTGB relay; and

(d) removes its indication from the GT leads.

9.05 Subscriber sender subgroups with mixed rotary dial (dial pulse) and TOUCH-TONE calling are provided with a feature to force all senders in a preference chain. Rotary dial, or TOUCH-TONE, to be used before the first sender in the chain can be reused. This is accomplished by making the SB- relays self-latching, except the last one. Operation of the CTT relay in the TOUCH-TONE sender and the CRD relay in the rotary dial sender causes release of all preceding self-latched SB- relays in their respective chains that have idle associated senders. Diodes RD and TT are in the circuit to permit a ground on relay CRD upper to operate relay CRD and not operate relay CTT, to apply a ground to relay CTT upper to operate relay CTT and not operate relay CRD, and to permit a ground on lead TTRD to operate both relays CRD and CTT. Diodes SB- are in the circuit to isolate the latching grounds that appear on 8T of relays SB- from the traffic usage recorder on lead SB.

9.06 The preference leads P0, P2, P4, P6, and P8 are arranged to distribute wear over the various senders and the link secondary crosspoints in accordance with the district group being served V option, or by flexible cross-connections W option.

9.07 Relays SB- are made slow to release to guard the subscriber sender against premature reseizure, while certain sender relays are in process of restoring.

10. OPERATION OF SELECTING MAGNETS

10.01 The PS- selecting magnets of the primary link switches of Fig. 1 are operated when the sender subgroup has been selected as described in 11. The SS- selecting magnet of the secondary link switch of Fig. 2 is operated at the completion of sender selection as described in 12. The line link and controller circuit controls the operation of the selecting magnets of its primary and secondary switches.

11. OPERATION OF CUSTOMER SENDER LINK HOLDING MAGNETS

11.01 When relay C of Fig. 7 has operated as described in 11. and one of the S- relays of Fig. 9 has operated as described in 9, a circuit is closed for operating the proper SS- selecting magnet of Fig. 2. If the PS- magnets of Fig. 1 have operated at this time a circuit is closed through the selecting magnet contacts and contact of relay P of Fig. 9 for operating relay OH.

11.02 Relay OH operates relay GH and the latter supplies the contacts of the former with local ground through cross-connectable punchings, supplied for wear distribution purposes, to one of the A0-9 leads corresponding to the selected district junctor circuit. This causes the associated A and B primary link holding magnets of Fig. 1 to operate. The operation of the A holding magnet extends ground over lead S to the C and D secondary link holding magnets of Fig. 2. When the C holding magnet of Fig. 2 operates, it connects ground to lead S of the selected sender circuit and this ground is then closed through certain relay contacts of the sender to lead SL of Fig. 7 which, in turn, causes relay SL of Fig. 8 to operate indicating that the

primary and secondary link holding magnets A and C have operated. As will be described later, the B and D holding magnets are checked operated over the T and R leads from the subscriber line through to the sender circuit.

12. OPERATION OF HOLDING MAGNETS OF LINE LINK AND CONTROLLER CIRCUIT

12.01 As described in 11., relay GH is operated by relay OH. Relay GH operated, locks under control of relay RL and connects the preference ground, described in 14., to one of the SH0-9 leads corresponding with the selected district junctor. This causes the secondary holding magnet of the line link and controller circuit to operate and lock to ground supplied to lead SC through the district junctor circuit by the off-normal contact of the A holding magnet of Fig. 1, which operates as described in 11. When the secondary holding magnet of the line link and controller circuit operates, it operates a relay in that circuit which, in turn, operates the holding magnet of the calling line. When the line holding magnet operates, the line relay of the calling line releases and, in turn, releases a relay in the associated controller circuit which connects ground to lead ON of Fig. 4, thus operating a relay in the sender circuit and indicating to the sender that the primary and secondary holding magnets of the line link and controller circuit have operated. When the GS lead is grounded, as will be later described, the sender circuit is informed that the primary and secondary holding magnets of the customer sender link and controller circuit have operated and also that the sender circuit should connect ground to the S lead of Fig. 2 for holding the established connection if it detects a line loop closure over the T and R conductors controlled by the contacts of the four holding magnets.

13. DOUBLE-CONNECTION TEST

13.01 Relay DC is used to detect double-connections; that is, any trouble condition which may have caused the call that is being established to be crossed with an already established connection at any of the switches of the sender link and controller circuits. Relay SL operates when ground is connected to lead SL as described in 14. Ground on lead SL energizes the biasing or secondary winding of relay DC to assist this relay in meeting its non-operate condition in the event that a double-connection is encountered. When relay SL operates, it:

(a) closes ground to lead TM and operates relay CD under control of relay TM as described in 5;

(b) connects ground to the off-normal ground lead;

(c) connects ground to relay SS to hold it operated in order to prevent false operation of the SG- relays when the operated GP- relay releases which will occur before the associated G relay of Fig. 4 releases;

(d) releases relay OH;

(e) prepares the double-connection test through the 60Ω winding of relay DC;

(f) provides a holding path for the G relay of Fig. 4 under control of the primary and secondary selecting magnets;

(g) prepares the circuit for operating relay DR;

(h) provides a local locking path for itself in series with relay DC; and

(i) provides ground for holding the sender link holding magnets over the SL lead to the sender.

13.02 Relay CD performs no useful function with Fig. 4, but is used with Fig. 15 as described in 16. Relay OH is moderately slow to release to prevent opening the holding circuit of the sender link holding magnets before holding ground is closed through the 60 winding of relay DC in case of excessive vibration of the continuity contacts of relay SL. When relay OH releases, it opens the ground that it previously supplied over one of the A0 to A9 leads inclusive, for operating the proper set of A and B holding magnets of Fig. 1. The previously operated A, B, C, and D holding magnets now hold over lead S to lead SL of Fig. 8 in series with the winding of relay DC to ground supplied by the SL relay. The ground supplied through the winding of relay DC is used to hold the established connection and, at the same time, this holding current is sufficient to operate relay DC. Relay DC will not operate if the sleeve of the established connection is crossed with the holding ground of another busy connection since the operating winding of relay DC is shunted under this condition. The biasing or secondary winding of relay DC is energized and opposes the primary winding so that this relay will not operate even if lead resistance is encountered in the sleeve circuit

of the busy connection. If relay DC does not operate, then the timing relays W, Z, WA, and ZA, TA, AR, TB, and AL function to operate an alarm to indicate that a trouble condition has occurred. For this condition, lamp DC will light (provided that a plug has previously been inserted in the HD jack) as an indication that a double-connection has been encountered although this indication is not absolute since other trouble conditions, such as an open DR relay winding, will cause the same reaction. If relay DC operates, it will normally operate relay DR which:

(a) prepares the circuit for operating relay FS;

(b) locks under control of relay SL to battery furnished by the operated CK relay;

(c) connects ground to lead GS as an indication to the sender that it should connect ground to the sleeve for holding the established connection;

(d) prepares the circuit for operating relay AB; and

(e) opens the circuit to lamp DC so that this lamp will not light for circuit failures that may occur beyond this point. This double-connection test will not detect double-connections between two idle sender links and is not capable of detecting double-connections on the B and D switches of Fig. 1 and 2 unless corresponding double-connections with a busy sender link occur on the A and C switches.

14. SLEEVE CONTINUITY CHECK

14.01 As described in 11., the continuity of the sleeve from the A holding magnet of Fig. 1 through the crosspoints of the C holding magnet of Fig. 2 and through the selected sender circuit over lead SL to Fig. 8 is checked when relay SL operates. If relay SL fails to operate due to failure in this continuity check of the sleeve circuit through Fig. 1 and 2 and through the sender circuit then, after timing relays W, Z, WA, and ZA, TA, TB, AR, and AL have functioned, an alarm will be operated. If a plug is in the HD jack, relays HL and HD will also be operated thus closing a circuit for lighting lamp CF indicating that a sleeve continuity failure has occurred. The sleeve circuit through the holding magnets of the line link and controller circuit is checked at the time that relay RL operates. This occurs after the sender connects ground to the sleeve as the result of the ground signals which it has received over lead GS when relay DR operates as described in 13. When the sender has received the ground signal on lead GS, it connects ground to the RL lead of Fig. 7 provided that the tip and ring conductors are closed through from the calling customer station and also provided that the sender has received the "frame indication" and the "class-of-service" signal. Relay DC may release when the sleeve is grounded by the sender circuit operating relay AB locally but, if it does not release, ground on lead RL of Fig. 7 from the sender circuit will cause relay AB to operate. Relay AB operated locks under control of relay SL and G and operates relay RL, J option. With H option the ground for operating relay RL is furnished by the CTI relay or by the trouble indicator circuit if the CTI relay is operated.

14.02 Relay RL operated:

(a) releases relay OC which releases the C relay of Fig. 7 and the primary selecting magnets of Fig. 1;

(b) connects ground to hold relay ON1 operated;

(c) releases relay GH;

(d) opens ground from lead H; and

(e) locks to ground supplied by relay DR to lead GS.

When relay GH releases it opens the ground which it has previously supplied through one of the D0 to D9 relay contacts to one of the SH0 to SH9 leads and also connects the RL lead from the line link and controller circuit to lead H to that circuit. If the continuity of the sleeve through the line link and controller circuit is complete, then ground from lead SC of Fig. 1 corresponding to the selected district junctor circuit is returned through the sleeve contacts of the primary and secondary line link holding magnets to lead H thus causing the release relay of the line link circuit to operate and holding relay RL on its secondary winding. If the holding sleeve is not continuous, ground will not be returned over lead H and, hence, the RL lead will not be grounded when relay RL operates, thus, causing the timing relays TA, TB, AL, W, Z, WA, ZA, TR, OS, and AR

to function and operate an alarm. If the sleeve is continuous, both controller circuit will function to return to normal.

15. RETURN TO NORMAL

15.01 Relay RL is operated by relay AB, J option. With H option the ground for operating relay RL is furnished by the CTI relay or by the trouble indicator circuit if the CTI relay is operated. This occurs after the sender has connected ground to the sleeve for holding the established connection as described in 14. If the sleeve circuit through the holding magnets of the line link and controller circuit is continuous, ground will be present on lead H. Hence, when relay RL operates and releases relay GH, it will cause ground to be connected to lead RL of the line link and controller circuit. This causes the line link and controller circuit to function and return that circuit to normal, thus removing ground from the GP lead of Fig. 5 and also from the A or B leads of Fig. 4. When ground is removed from the GP lead of Fig. 5 which was previously used in establishing the connection, the associated GP- relay of Fig. 8 releases thus:

(a) releasing the previously used LL relay which, in turn, releases the associated SG- relay,

(b) opening the operate path of relay G which holds operated from relay DA or DB; and

(c) opening the operated path of relay CK.

15.02 Relay CK remains operated until the operated SG- relay releases thus preventing operation of a GP- relay on a new call from seizing the controller circuit until these relays are released; the release of relay CK releases relay DR, R1, and R2. When ground is removed from the A or B leads of Fig. 4, the corresponding BA or BB relay releases thus releasing relay DA or DB. When relay DA or DB has released, relay G releases thus:

(a) opens the operating circuit for relays CA and CB, which will remain locked to their own contacts until relays A and B operate;

(b) releases relays ON and AB if relay C is released; and

(c) with ZQ option causes the release of the TDA, TTD, and TD1 relays, or RDA, RD, and RD1 relays.

15.03 Relay ON released, releases the D0 to D9 relays which have been previously operated for the call and also releases relays SL and DC. The release of the D- relays releases relay DS. The SS-selecting magnet of Fig. 2 releases after relay C of Fig. 7 releases which occurs when relay OC releases as described in 17. When relay SL releases, it releases relays SS and CD and removes ground from the off-normal ground lead.

15.04 Relay RL releases when relays AB and DR release provided ground is removed from leads H and GS. When relay RL releases, it releases relay ON1 provided relays ON, DS, SL, and OC are released which releases all of the DP relays of Fig. 4 providing the respective Fig. 4 does not have the CA or CB relay operated and the RA and RB relays nonoperated. If this latter condition exists, the associated DP relay will remain locked operated to the same ground that is holding the CA and CB relays until an idle district of the group of 20 becomes available at which time the RA or RB relay of the group of 10 districts having the available idle district will operate thus releasing the associated DP relay. When the DP relay is released, the associated district group is made available to the line link and controller circuits. When relay ON1 releases, it releases relay TM if operated, and relay TS, which resets any of the timing relays W, Z, WA, ZA, TA, TB, AL, TR, and OS which may be operated at this time. The circuit is thus restored to normal and prepared to serve the next call.

16. OPERATION WITHOUT A LINE LINK - FOR DIALING TYPE DISTRICTS FROM "A" SWITCHBOARD OR DISTANT OFFICE - FIG. 14 AND 8

16.01 The operation, when Fig. 14 is used, is similar to that previously described in connection with Fig. 4, with the following exceptions. With ZP option the G relay connects -48 volt battery to the ID lead of Fig. 25 operating the RDA relay. The operated RDA relay will cause the call to be completed on a rotary dial basis. The operation of relay G operates relay DT, Fig. 11, U apparatus. Relay DT operates relay TST and together these relays close ground to the line vertical lead to provide a distinctive code (98888) to all calls through Fig. 14. Lead PA is grounded if the controller is normal and there is at least one idle link to a sender group having at least one idle sender. When one or more of the 20 associated districts are started off-normal, battery

is received on leads A or B or both. Relays AG and BG are so arranged that only one remains operated if both should operate simultaneously. As relay AG has a locking circuit it usually is preferred. Assuming relay AG has operated, ground is connected to the associated GP- relay of Fig. 8. Relay GP- operates operating relay G. Relay BA operates under control of relays G, AG, and GRL closing the operating circuit for relay DA. Lead SEL is closed when relay G operates locking in any districts which may have started calls in the group, the selection between them being made by the D- relays which operate over the BT- leads of idle districts. Relay DP operates and opens the PA lead when relay ON1 operates. District and sender selection takes place as described in 8. through 14., 16., and 17. except that relay CD of Fig. 8 operates when relay DA operates, locks independently of relay TM, and closes the circuit for operating relay TM as soon as any one of the D- relays operates, thereby canceling the delay of the RS relay release time before relay DE releases to operate relay OH.

16.02 The operation of the primary link holding magnets causes ground to be returned over lead HA operated relay H, which grounds the H and ON leads and closes the SEL lead independent of relay GRL. When relay AB operates (see 14.) relay RL operates, J option. With H option the ground for operating relay RL is furnished by relay CTI or by the trouble indicator if the CTI relay is operated. Since relay H is operated relay RL locks as soon as relay GH releases. Ground is now extended over lead RL to operate relay GRL. Relay GRL locks under control of relay AG and opens the circuit to relay BA which releases, releasing relay DA. Relay GRL also grounds lead GRL to the district. The associated district removes ground from lead HA releasing relay H. Relay H released opens lead SEL (SLA toward the district) forcing any districts other than that just served to momentarily open lead A releasing relay AG. Relays GP- and GRL release, releasing the controller circuit and relay G as described in 15. When the controller is completely restored, relay DP releases grounding lead PA to the remaining districts as an indication that calls can be handled.

17. FALSE START CALLS - FIG. 14

17.01 False starts which are long enough to close lead SEL are locked in and treated as described in 24. except that relay GH need not necessarily be operated at the time the disconnect is initiated.

18. CALLS WAITING ALARM - FIG. 14

18.01 While line links can place calls in more than one sender link no such facilities are available to dial type districts as these are selected without reference to available paths and are confined to one appearance. For this reason calls waiting in this group, Fig. 14, can temporarily divert all calls originating in line links not already locked to lead SEL from this sender link. When a call is waiting relay CW is operated. With a path available to serve the call, relay DPA operates, operating the DP relays in each Fig. 4 of the associated link frame. This opens the "paths available" leads, TA, TB, RA, and RB to all associated line links. Under this condition relay DP of Fig. 14 should operate and release as the controller handled calls until no more calls are waiting. If contact B of interrupter CW is closed when relay CW operates, relay CWA may operate, but will release if relay DP operates before the timing interval is completed. If relay DP does not operate within 5 to 12 seconds after relay CW operates, relay CWB will operate from contact F of interrupter CW. Both relays CWA and CWB lock to key R and a visual and audible alarm is given. If relay DP operates in the normal interval but remains operated for an abnormal interval relay CWB operates from contact B of interrupter CW and, approximately 5 seconds later, relay CWA operates from contact F. Both relays lock to key R and give a visual and audible alarm.

19. TEST CIRCUIT CALLS

19.01 When the district junctor test circuit desires to have a district junctor circuit connected to a subscriber sender for test purposes, it connects battery to one of the D0 to D9 leads of Fig. 8, ground to one of the G0 to G9 leads of Fig. 13, and battery to lead ST of Fig. 5. The ground on one of the G0 to G9 leads identifies the district group of 10 districts in which the district to be served is located while battery on one of the D0 to D9 leads indicates the district of the group of 10 which is to be served. If no regular call is being served at this time relays TS and GP0 to GP4 will be normal and the battery supplied to lead ST of Fig. 5 by the test circuit causes relay TL to operate. Relay TL operated:

(a) opens the operating circuit to relays GP0 to GP4;

(b) operates relay OS;

(c) prepares the operate circuit for relay TC;

(d) operates relay RS; and

(e) with ZQ option, connects -48 volt battery to the ID lead through Fig. 5 or 23 to Fig. 25 operating the RDA relay. The operated RDA relay will cause the call to be completed on a rotary dial basis.

19.02 Relay OS operated:

(a) opens the SEL lead toward the line link and controller circuits; and

(b) operates relay ON1. Relay ON1 operates the DP relays of all associated Fig. 4 and also operates relay TS. Relay TS starts the timing relays W and Z to count pulses and also operates relay TC.

19.03 Relay TC operated:

(a) connects the DA and DR relays of all associated Fig. 4 to the automatic test circuit; and

(b) connects ground to leads CS or S to fully or partially satisfy the sender for the "class-of-service" signal.

19.04 The test circuit connects ground to one of the 10 district group leads G0 to G9 which, in turn, causes a particular DA or DB relay of Fig. 4 to operate. When the DA or DB relay of a Fig. 4 operates, it operates its associated G relay. The G relay operated, in turn, prepares the circuit for operating the SG- relays for sender group selection and also operates relay ON by connecting ground to lead OG.

19.05 Relay ON operated:

(a) operates relay TD which operates relay TE and connects the D0 to D9 relays to the test circuit;

(b) prepares the holding circuit for the D- relay which will be operated by the test circuit, in accordance with the particular D0 to D9 lead that is connected to battery by the test circuit.

19.06 Relay TE operated:

(a) opens the circuit which is normally used for operating the traffic meter over lead TM for the district group being served to avoid undesirable operation of the district group traffic meters on test calls;

(b) connects ground to the H lead to be used later for the RL lead ground;

(c) prepares a locking circuit for itself;

(d) connects ground to lead CS3 for further class indication to the sender when required; and

(e) connects TRL and RL leads through to the test circuit.

19.07 Relay TD, in operating, also closes battery from resistance J through back contacts on relay GP0 to GP4 to punching SGT which is cross-connected to punching SG0 to SG9 to distribute test calls over the sender groups preferred on test calls, operating the preferred LL- relay. From this point on the circuit functions as previously described for a regular service call except for:

(a) the connection of ground to lead ON of the sender which occurs when relay GH operates; and

(b) cancellation of the sleeve continuity check through the line link and controller circuit which is not required for test calls that are therefore canceled by the group which relay TE has connected to lead H. The double-connection test is made as described in 16. and relays AB and RL are operated in the regular manner after the sender circuit has connected ground to the sleeve lead for holding the established connection.

19.08 When relay RL operates, it:

(a) connects ground to the RL lead of the automatic test circuit;

(b) releases relay OC which, in turn, releases the C relay of Fig. 7 and also the primary selecting magnets of Fig. 2; and

(c) locks to ground supplied by relay TE.

When the test circuit has recorded the release signal over its RL lead, it releases relay TL which, in turn, releases relays TC and TD. Relay TE releases when relay SL releases thus restoring the circuit to normal.

20. TIMING RELAYS

20.01 The principal function of relays TS, W, Z, WA, ZA, TA, TB, TR, OS, AR, and AL, is to time each call in order to dismiss the calling line link and controller circuit or the district junctor test circuit within a short interval if a trouble condition is encountered. These relays also serve to record the number of such trouble conditions and also operate an alarm each time that such a condition occurs. Relay TS operates when relay ON1 operates and:

(a) prepares the circuit for holding relay TA;

(b) short-circuits relay TL to prevent it from operating until the circuit has restored to normal for a service call;

(c) connects battery to relays W and Z; and

(d) connects battery to relays WA and ZA.

20.02 Ground is furnished intermittently by the interrupter frame circuit to lead A and when ground is closed to this lead after relay TS has operated, it causes relay W to operate and lock. When ground is removed from lead A relay Z operates. Relay Z in operating, operates relay WA. When ground is connected to lead A a second time, relay W is shunted and releases but relay Z holds operated to ground on lead A. When ground is removed from lead A a second time, relay Z releases, in turn, allowing relay ZA to operate. With ZP option relay ZA in operating operates relay TR for dismissing the call if sender group selection has not been made at this time. With ZQ option an additional check is made at this time before the TR relay is allowed to operate and dismiss the call (see 21.01). When relay TR operates it releases relay TL on test calls and also operates relay OS which dismisses service calls by opening the SEL lead. When ground is connected to lead A a third time relay W operates. When ground is removed from lead A a third time, relay Z operates, in turn, releasing relay WA. The release of relay WA, with relay ZA operated, operates relay TA, which locks under control of relay TS, opens one of the operating paths for relay ON1 and prepares an operating path for relay T1 if a trouble indicator is provided or relay AR if a trouble indicator is not provided. When ground is supplied to lead A for the fourth time, relay W releases. When ground is removed from lead A for the fourth time relay Z releases, in turn releasing relay ZA. When relay ZA releases it partially closes a circuit for operating relay FS for those calls where an open tip or ring condition is recognized at this time as described in 25. When ground is supplied to lead A for the fifth time relay W operates. When ground is removed from lead A for the fifth time, relay Z operates, in turn, operating relay WA. If a trouble indicator is provided, E wiring is used, and the operation of relay WA, with the trouble indicator idle and relay TA operated, closes a circuit to operate relay TI which functions as described in 29. to call in a trouble indicator and operate relay AR. If the trouble indicator is plugged busy relay TIB will be operated, relay TI normal, and relay AR will operate immediately after relay WA operates. If a trouble indicator is not provided K wiring is used and punching AL is connected to punching AL1. Then the operation of relay WA, with relay TA operated, causes the operation of relay AR.

20.03 Relay AR:

(a) locks to the AR key ZA option, or, when AB option is furnished, to ground from the alarm transfer circuit through the AR key;

(b) connects ground for operating audible and visual alarms; and

(c) operates relay TB. If the hold feature is not in use lead LA or T is grounded causing a minor alarm.

If the hold feature is not in use lead LA or T is grounded causing a minor alarm. If the hold feature is in use lead MA or DL is grounded causing a major alarm. Lead G provides an aisle pilot signal when the audible and visual alarm circuit is used.

20.04 Relay TB operated:

(a) lights lamp AL, and connects ground to lead AL to the miscellaneous circuit for the trouble indicator frame;

(b) operates relay AL by means of ground supplied by relay WA and at the same instant connects ground to lead TRL for operating the trouble meter of the line

link and controller circuit or for dismissing the automatic district junctor test circuit on a "trouble release" basis; and

(c) opens the operate path of relay AR if relay T is not operated.

20.05 The AL relay operated:

(a) operates the CA or CB relays of the Fig. 4 being served at this time if these relays have not been previously operated;

(b) operates a trouble register of the trouble register circuit;

(c) operates relay ON1 if not operated or locks to it if operated;

(d) connects ground to lead GS if relay SL is operated in order to permit connections to be established if relay DR fails to operate and also to operate a relay in the sender which will make the sender busy as long as its sleeve lead S remains grounded; and

(e) operates relay TR if the hold feature is not in use.

20.06 Relay TR operated, releases relay TL on test calls and operates relay OS which opens lead SEL toward the line link and controller circuit thus dismissing any service call which was being accommodated. The subscriber sender link and controller circuit, however, is held busy until relay WA releases to allow sufficient time for the line link and controller circuit that encountered the trouble condition to be routed to another subscriber sender link and controller circuit with the opportunity for the second circuit to select a different sender group on the "second trial". When lead A is grounded for the sixth time relay W releases. When ground is removed from lead A for the sixth time relay Z releases, in turn, operating relay ZA. When relay ZA operates relay TR releases. When ground is applied to lead A for the seventh time relay W operates. When ground is removed from lead A for the seventh time relay Z operates, in turn, releasing relay WA. When relay WA is shunted and released relays ON1 and AL release. The circuit will then restore to normal providing the line link and controller circuit has disconnected itself prior to this point and providing that the trouble condition which has been encountered does not prevent the AL relay from releasing.

20.07 The following are the overall times of the various alarm timing stages:

NOMINAL TIME INTERVALS IN SECONDS*		
	Min	Max
Pickup	0.0	0.5
Traffic Release	0.5	1.0
False Start	1.5	2.0
Sender Link Alarm	2.0	2.5

* Measured from seizure of circuit but disregarding relay operating times and interrupter variations.

20.08 Whenever the alarm stage is reached the sender link controller is guarded against reseizure for an additional interval of one second after dismissing the line link.

21. AUTOMATIC RELEASE DUE TO TRAFFIC DELAYS - ZR OPTION

21.01 If the cricuit is unduly delayed in sender group selection, it will automatically dismiss the calling line link and controller circuit or the automatic test circuit and restore to normal in order to prevent false trouble alarms due to traffic delays. It is expected that such dismissals will occur very rarely since the interval ordinarily required for sender group selection is very short. The automatic release is accomplished as described in 20. when with relay ZA operated relay WA releases. With ZP option this closes a circuit for operating relay TR providing no SG- relay is operated, indicating that sender group selection has not been made. With ZQ option an additional check is made to insure that the call will not be released automatically if the battery or ground signal used to indicate the type of sender required is not received on the ID or IDA leads. Since the SGO-9 relays cannot operate if this indication is not received the check prevents automatic release on an actual trouble condition. The check is accomplished via the IDK and IDK1 leads through Fig. 5 or 23 to the contacts of the TD1 and RD1 relays of Fig. 25. If either the TD1 or RD1 relay is operated when the ZA relay operates and no SG- relay is operated a path is closed to operate the TR relay. If neither the TD1 or RD1 relay is operated, relay TR will not operate and the circuit will continue to time and cause the trouble indicator or alarm circuit to function. When relay TR operates it releases relay TL on test calls

and operates relay OS, which closes a circuit for holding relay ON1 operated and also opens ground to lead SEL of Fig. 5 thus causing the line link and controller circuit to be dismissed on service calls. The dismissed service call may reenter the same sender link and controller circuit or it may select another circuit to serve it. The dismissed test call may immediately be served again by the link and controller circuit.

21.02 Relay SS1 and the control apparatus of Fig. 16 and 17, together with a contact on relay SGB of Fig. 9 are used in connection with the timing circuit to improve the operation of the traffic release feature. Relay SS1 is made operative only during periods of heavy-sender traffic, when interference with the traffic release path might be caused by repeated operations of relays SG0-9 on successive tests for idle sender subgroups. Since relay SGB and with ZQ option the TTGB relay of Fig. 9 operate when all associated senders of the subgroup become busy and, since sender traffic is fairly well distributed over the various subgroups, the operation of relay SGB or TTGB in any subgroup may be taken as an indication of a peak sender load. In order, therefore, to prevent interruption of the traffic release path in the various controllers, due to successive operations of relays SG0-9 under this condition, the control circuit of Fig. 16 comes into use to alter the traffic release feature of all sender link controllers.

21.03 The sender subgroups need not reach a point where all senders in any one group are busy before calls will be delayed sufficiently at the sender link and controller circuits to cause time-outs which needlessly call in the trouble indicator and give an alarm. To avoid this situation, the traffic release control feature is arranged to function when two or more sender link controllers simultaneously have timed past the point where relays TA or ZA are operated. When each sender link controller, Fig. 8, has either of these relays operated, it grounds lead SLT through a 1340Ω SLT resistance. The presence of two or more 1340Ω ground closures on lead SLT to Fig. 16 causes relay SLT to operate making the traffic release control feature to function as described below.

21.04 Relay SGL of Fig. 16 comes up following the operation of the SLT relay or from ground derived from the load register in the traffic register circuit and operates relays GS of Fig. 16, GS1 of Fig. 17, and GSA1 of Fig. 24. Relays GSA2-4 follow GSA1 in sequential operation. The operated GSA1-4 relays ground lead SLR to the line link and controller circuit. Relays GS and GS1 lock under control of relay LCR and ground individual CG leads to Fig. 8 of the various controllers. This ground on lead CG operates relay SS1 in series with relay SS, if sender group selection has not taken place by the time relay ZA operates to close the traffic release path. Relay SS1 then connects ground directly to the traffic release path, independent of the series chain through relays SG0-9. Relay SS1, when operating, always breaks the SG0-9 chain circuit which controls relay OC, in order that relay OC may not be operated falsely in case relay SS should operate in series with relay SS1. If sender group selection is completed within the allotted interval, relay SS1 remains shunted by direct ground on its winding.

21.05 The control feature of Fig. 16 remains effective during peak sender loads and automatically releases when the load subsides. The control circuit tests the busy condition of the sender subgroups during traffic lulls when relay SGL is restored, and as soon as a half-minute open interval is reached, the timing arrangement consisting of interrupter LT and relays TT and LRC functions to unlock relays GS and GS1 of Fig. 16 and GSA1-4 of Fig. 24.

21.06 As the load falls off, therefore, the traffic release path returns to its old route through the SG0-9 chain.

21.07 Option ZS, Fig. 17, provides for individual CG leads to controller circuits on auxiliary subscriber sender link frames. Relay GS2 operates when GS1 operates and the automatic release for auxiliary frames furnished as described above.

22. USE OF HOLD JACK TO INDICATE TROUBLE

22.01 This circuit is so designed to be of assistance to maintenance in tracing trouble conditions by holding the district group, the available idle district, the sender subgroup, and the selected sender depending, of course, upon the extent to which the call has progressed at the time that a trouble condition was encountered. This action is obtained when a trouble condition is encountered after a plug has been inserted in the HD jack of Fig. 8. Since this feature has a requirement that the controller circuit be out of

service during the interval that the trouble is being observed, it is important the the HD jack shall be used only under close maintenance supervision. As long as the circuit is held out of service by the HD jack at the time of trouble, the associated 100 district junctors and the selected group of 10 senders are also held out of service. In addition, all of the dialing districts or interoffice districts appearing on this frame are held out of service with no busy indications or other means for diverting the traffic. This may be as high as one-half of the total number as such districts. The following procedure for using the HD jack would appear to be satisfactory for maintenance purposes. During normal service, there should be no plug in the HD jack. The circuit will then function satisfactorily until a trouble condition is encountered at which time a trouble indicator record will be obtained, and relay AR will operate and lock through the AR key to sound a minor alarm. The circuit, however, will continue to attempt to serve succeeding calls. The trouble indicator record and the "locked-in" alarm will indicate the controller circuit involved in the trouble. The AR key should then be operated momentarily to silence the alarm. If the trouble occurs repeatedly, a plug may then be inserted in the HD jack. Under this condition relay HL operates and the circuit will function as before except that when the next trouble condition occurs after the plug is inserted in the jack, relay HD operates to hold the controller circuit off-normal and also causes the line link and controller circuit to time out and connect to its mate emergency controller circuit, thus indicating the line link and controller circuit involved on the connection. When relay HD operates, it holds the GP- relay operated (which was operated on the call) thus indicating the group of 20 districts and holding the controller circuit relays locked operated in the same manner as in service.

22.02 If a trouble condition occurs for a call originated by the district test circuit while the plug is in the HD jack, the test circuit will automatically disconnect after it receives a trouble release signal on the TRL lead thus releasing relays TL, TC, TD, TE, and the previously operated DA or DB relay. The group of 20 districts, however, will be indicated by an operated GP- relay which will operate when relay HD operates. Also, there will be no associated line link and controller circuit alarm.

22.03 Relay HD applies holding ground to relay OC to keep relays C, S, and SGE operated and so deny testing access to the sender subgroup.

23. USE OF HOLD FEATURE WITH COMMON HOLD JACK CIRCUIT

23.01 When the common hold jack feature is in use there will usually be no plug in the individual HD jack. If there is, the circuit will operate as in 22. and will be independent of the common hold jack until the plug is removed from the individual HD jack. Removal of the plug transfers the holding path of this circuit from the individual HD jack to the common holding plug. Under this condition the release of the circuit is accomplished by the operation of the HR key of Fig. 8. Ground on lead H from the common circuit operates and locks relay HL as soon as relay TS releases (if operated). If no trouble is encountered relay HL remains operated until ground is removed from this lead. This occurs when the plug is removed from the common hold jack or when another sender link and controller circuit is being held. If, however, relay AR is operated with relay HL operated, relay HD operates causing relay HL to hold over lead L and ground to be connected to lead OP to the common hold jack circuit which removes ground from lead H. Ground on lead OP causes the common hold jack circuit to function to release the operated HL relays of other sender link and controller circuits. The remainder of the functions of relay HD are similar to those described in 22.01. Ordinarily key AR will be operated to retire the alarm and key HR will be operated when the condition is to be released if the common hold jack feature is in use. Key HR will, however, restore the circuit and retire the alarm, if desired. This key, when provided, should be used to release the controller.

23.02 It should be noted that if dialing districts or interoffice districts are served by the office the use of the common hold jack circuit may block traffic on one-half of the dialing or interoffice district but if, in addition, an individual hold jack is used on one such frame and a common hold jack circuit is attached to the link frame serving the remainder of these districts all traffic of this type will be blocked.

24. FALSE STARTS - CALL IS ABANDONED BEFORE GH OPERATES

24.01 If the calling customer disconnects before relay GH is operated, the line link and controller circuit connects ground to lead ON which operates relay AB.

24.02 Relay AB operated:

(a) operates relay RL;

(b) operates the CA and CB relays of the Fig. 4 serving the call; and

(c) prepares the circuit for connecting ground to lead H when relay DS operates.

When relay DS operates, it connects ground to lead H so that with relay RL operated, the release relay of the line link and controller circuit operates and the circuit is restored to normal in the same manner as described in 15.

25. FALSE STARTS - CALL IS ABANDONED AFTER RELAY GH OPERATES

25.01 If the calling customer disconnects after relay GH operates, the abandoned call cannot be recognized until the sender circuit has progressed to the point of testing the dialing tip and ring leads for the line closure. This circuit is not capable of detecting the difference between a trouble condition, wherein the tip and ring conductors through the switches of the established connection are actually open and a normal "false start" call, wherein the tip and ring conductors are closed momentarily to start a call and then immediately opened by the calling customer. However, a meter is provided for recording all such conditions since it is expected that the vast majority of legitimate false starts will consist of closures longer than one second in duration so that a trouble meter record will furnish a fair indication of the existence of actual trouble conditions. The "false start" record is made on a meter over lead FS and by comparing meter readings for all sender link and controller circuits periodically, those meters which record a predominance of false starts will indicate the presence of actual trouble in the tip and ring conductors of the associated sender link and controller circuit.

25.02 The circuit for operating relay FS is closed only after relay DR has operated and provided that a sufficient time has elapsed to permit a normal call to be served for which the tip and ring closure has been recognzied by the sender. This occurs when the timing relays have reached the interval where the ZA relay is released and the TS and TA relays are operated. If the circuit has not released prior to this time, the circuit assumes that a "false start" has occurred although actually some trouble conditions may have caused the same reaction, such as an open lead in the sender which prevents the sender from connecting ground to the RL lead of Fig. 7. In any case, when relay FS operates, there will be very few possible trouble conditions other than an open tip and ring condition which can exist at this point in such a way that the circuit will be permitted to restore to normal without operating an audible alarm. When relay FS operates, it operates the meter which is connected to lead FS and also connects a potentiometer arrangement of battery and ground from resistance FS through relay FS1 to lead GS to the sender circuit. Relay FS1 will operate to battery or ground in the sender over lead GS unless some trouble condition exists to keep this lead open. With N option, Mfr Disc., the operation of relay FS1 operates relay AB which locks and provides ground for future connection to the RL lead. Relay AB operated, J option, operates relay RL. With H option the ground for operating relay RL is furnished by relay CTI or by the trouble indicator circuit if relay CTI is operated. The operation of relay RL releases relay GH. Relay GH, in releasing, connects the ground from relay FS1 operated through relays DS, AB, and RL operated to the RL lead which releases the line link and controller circuit thus causing this circuit to restore to normal as described in 15. With M option, standard, the operation of relay FS1 operates relays AR and RL and immediately grounds the RL lead which releases the line link and controller circuit thus causing this circuit to restore to normal as described in 15.

25.03 The potentiometer arrangement of relay FS1 and resistance FS is provided to prevent actual false start conditions from failing to operate relay FS1 thus registering as sender link alarms. Such conditions include the following:

(a) Flashing by the originating customer at such time as to delay the operation of the sender relay which operates over the customer line and the relay which it operates, thereby, allowing these relays to encroach upon the operating time of a sender off-normal relay which normally depends upon lead GS for its operating path and ground supplied by sender link relay DR. If the closure of the operating path of the sender off-normal relay is delayed too long, it may fail to operate and return ground over lead GS. Under this condition, relay FS1 will operate to battery through the sender off-normal relay.

(b) Plug fumbling on the part of a PBX attendant who originates a call. The effect is the same as described in (a) above.

26. MAKE-BUSY JACKS

26.01 A make-busy (MB) jack is furnished per Fig. 4 which may be used for removing a group of 20 districts from service or for adjusting any of the A, B, CA, CB, RA, or RB relays of the associated Fig. 4 as well as any of the A or B switches of the associated Fig. 1. A sender group make-busy jack is furnished per Fig. 9 for removing a group of 10 senders from service or for adjusting any of the relays of Fig. 9. This jack is shown on the miscellaneous circuits for sender make-busy frame.

27. EMERGENCY TRANSFER

27.01 To transfer from the regular to the emergency controller the regular transfer switches A and B of Fig. 5 should first be restored to normal and then the associated emergency transfer switches should be operated. This will cause the regular circuit operating leads from Fig. 2, 3, 4, 6, 7, 13, 14, D, E, and F and the associated line link controller circuits and district junctor test circuit to be transferred to the emergency Fig. 8 which will be common to a number of sender link and controller circuits. The operation of the emergency Fig. 8 is identical with the regular Fig. 8. Lamp EF of Fig. 10 will light at the frame using the emergency controller circuit. Leads 1 and 2 connect to a parallel lamp which will light at a central point to indicate the frame using the emergency controller is in use, lights on every frame when relay EC operates due to ground being connected to lead EL of any Fig. 10. The transfer is accomplished by inserting a 349A plug into the ET jack operating all ET- relays.

27.02 From this point circuit operation proceeds as in 27.01. To check that all the ET- relays have operated, ground is fed through an operated contact on each ET relay and is connected to lead EL. Failure of the EF and EM lamps to light indicates that all the ET relays did not operate.

28. SENDER GROUP BUSY REGISTRATION - FIG. 9

A. ZP Option

28.01 When all senders in the subgroup are busy relay SGB operates through the series chain circuit over lead MB or, when a sender subgroup is made busy, SGB operates from ground at the sender make-busy frame. The operation of relay SGB operates associated GB- relays in Fig. 6, lights a busy lamp at the make-busy frame over lead BL, and causes the operation of a register over lead CG.

B. ZQ Option

28.02 When all rotary dial and overflow senders in a subgroup are busy, relay SGB operates through a series cross-connection over lead MB (see note 212). When all TOUCH-TONE and overflow senders in the subgroup are busy, relay TTGB operates through a series cross-connection over lead TMB, (see note 212). The operated SGB and TTGB relays operate the associated GB- relays of Fig. 6 and the TGB- relays of Fig. 25, respectively. The operated SGB or TTGB relay also causes the operation of individual registers over leads CG and TCG, respectively.

28.03 If a sender subgroup is made busy ground is placed on the MB lead at the sender make-busy frame causing both the SGB and TTGB relays to operate through the GB and TGB diodes, respectively. With both the SGB and TTGB relays operated the busy lamp will light at the make-busy frame.

29. TROUBLE INDICATOR

29.01 The purpose of the trouble indicator is to supply data which will facilitate the location of trouble in that part of the originating equipment concerned with operation up to the point where the sender takes control. To do this the trouble indicator attaches itself to the sender link frame and to the controller at the end of the alarm interval and records, on relays and lamps, the various stages marking the progress of the call. The addition of the trouble indicator does not eliminate the hold jack and sender link alarm features, but the sender link alarm ordinarily remains

inoperative during normal functioning of the trouble indicator. The alarm becomes operative however, whenever the trouble indicator itself develops certain troubles or is plugged busy or when a plug is in the hold jack.

29.02 The trouble indicator is called in after a delay of 2 to 2-1/2 seconds by the timing relays. With relays TA and WA operated and TB and TIB normal relay TI operates as described in 23. Relay TI upon operating:

(a) grounds lead TIA to the miscellaneous circuit for trouble indicator frame to bring in a minor alarm;

(b) closes start battery over lead TIS to the trouble indicator;

(c) prepares the operating path for relays CIA to CID inclusive, by way of lead CIA;

(d) grounds lead DL to leave a relay and lamp record in the trouble indicator of the controller attempting the connection; and

(e) closes various other paths which will be mentioned in due course.

Battery on lead TIS operates a chain lockout relay in the trouble indicator circuit to exclude other sender link controllers and to cause the return of ground over lead CIA for operating connector relays CIA to CID inclusive.

29.03 Relays CIA to CID inclusive, upon operating, close a series ground over lead C to operate a trouble indicator relay which locks up and starts the trouble indicator timing. Relay CIA grounds lead TIC extending through the transfer switch to operate relay TIC of Fig. 13 and, thence, through Fig. 7 as lead SGC to operate relay SGC of Fig. 9, and closes several leads from the controller to the trouble indicator. Relays CIB to CID, inclusive, close numerous other leads to the trouble indicator. Relay TIC of Fig. 13:

(a) grounds lead SLF- to the indicator to show which sender link frame is connected;

(b) grounds lead LF extending through the district group connector equipment of Fig. 4 to the connected line link frame as lead TI; and

(c) connects leads DA and DB of the ten subgroups of 10 district junctors to leads DG0 to DG9, to the trouble indicator.

29.04 Relay SGB of Fig 9:

(a) grounds lead SGP to indicate the sender subgroup involved; and

(b) connects the indicating leads SG0-9 to the various SC leads of Fig. A, B, and C, to indicate the individual sender selected.

The line vertical number indication is extended on a 2-out-of-5 basis over 25 leads from the line link to the sender link and control circuit through the contacts of the operated TIR relay to the trouble indicator where they are recorded on register relays. These register relays may be used to check the line vertical number on every call through the controller and, thus, function as part of the controller circuit by inserting a plug in the associated ET jack of the trouble indicator circuit. Under this condition relays CTI and TIR, Fig. 22, operate and release under control of relay ON.

29.05 Lead LF, grounded by relay TIC of Fig. 13, reaches back to the connected line link frame and is extended from that point through relay contacts to the trouble indicator, where it serves to designate the line link frame concerned.

29.06 If the connection has originated through a dialing district instead of a regular district, no line link frame indication will appear in the trouble indicator display although the district group involved will be identified by the group circuit of Fig. 14. The line vertical number code (98888) will be recorded on the trouble indicator as a result of the operation of relays DT, U apparatus, and TST Fig. 11 when relay G operates. The line vertical leads are connected to the trouble indicator by the operation of relays CTI and TIR, Fig. 22.

29.07 Connection to the trouble indicator has now been completed and various locking relays in the latter circuit will proceed to make a record of the various frames and circuits used, as well as the stage reached by the connection at the instant the trouble indicator was called in. Following is a list of the indications provided.

Indications	Leads	Fig. No.
Line Link Frame	TI	4
Sender Link Frame	SLF0-SLF19	13

Indications	Leads	Fig. No.
Subgroup of 10	SGP0 SGP29	9
Individual Sender Used	S0-9	9
Group of 20 District Junctors	DG0-9	13
Subgroup of 10 District Junctors	DG0-9	13
D Relay Operated	D0-9	8
Rotary Dial Call	RD	8
TOUCH-TONE Call	TD	8
Call Progress Relays:		
0C Relay - Completion of Sender Group Selection	0C	8
DS Relay - Completion of District Selection	DS	8
OH Relay - Completion of Sender Selection and Operation of Select Magnets	OH	8
GH Relay - Circuit Closed to Operated Hold Magnets	GH	8
SL Relay - Crosspoints Closed from District to Sender	SL	8
DR Relay - Double Connection with Busy Link	DR	8
AB Relay - Release Stage Reached	AB	8
RL Relay - Release Stage Reached	RL	8
TC Relay - Failure on a Test Call	TC	8
ON Relay - Sender Link Controller Off-Normal	ON	8
SG Relays - Which One of 10 SG Relays is Operated	SG0-9	8
H Lead - Ground on Line Link Hold Magnet	H	8
LLH Lead - Line Link Hold Magnets Operated	LLH	8
Emergency Controller Using Trouble Indicator	EM	8

29.08 The trouble indicator allows time for its locking relays to record the various indications and then returns ground over lead RA to operate relay AL. Relay AL upon operating:

(a) locks itself to off-normal ground;

(b) operates relays TR and OS to dismiss the line link, using ground from a normal contact of relay ZA; and

(c) operates relay TB to cut off the trouble indicator.

Relay TI restores relays CIA to CID, inclusive. The release of relay CIA causes relays TIC, Fig. 13, and SGC, Fig. 9, to release. Connection to the trouble indicator has now been broken off and the sender link controller returns to normal in the regular way.

29.09 If the trouble indicator fails, altogether, to supply releasing ground on lead RA, the sender link controller times for an additional 1/2-second interval, gives an alarm, and disconnects. This is brought about by the back contact of relay Z which is wired through a contact on relay TI to the winding of relay TIB. The associated armature on relay Z is wired through a make contact of relay TI to ground J wiring, or through a make contact on relay TA and a make contact on relay ZA to ground, H wiring. This ground is used to operate relay TIB. Relay TI meanwhile keeps the armature of relay Z grounded, J and H wiring, in order to leave relays WA and ZA in their previous condition, namely; with relay WA operated and relay ZA normal. Thus, when relay TIB operates at the end of an additional half-second interval (relays W and Z released) the alarm (AR) relay is operated and locked to

bring in a sender link alarm. Relay AR operates relay TB, and the latter locks up relay AL. Relays TR and OS now operate to dismiss the line link, but the sender link is held busy until relay WA releases. During this time relay TI remains locked up to keep relay ZA normal, and so maintains ground on the off-normal ground lead through the locking contact of relay AL. When relay Z operates at the end of an additional half-second interval, relays TIB and TI are released. Relay ZA will operate when relay relay Z releases at the end of the next half-second interval, and relay WA will release when relay Z operates on the next half-second interval, restoring the circuit to normal.

29.10 In cases such as that just described, where the sender link controller is obliged to time itself out because of failure to release in the normal way on ground received over lead RA, the TIB relay, upon operating, sends a ground over lead RM to operate and lock the trouble indicator relay which ordinarily grounds the RA leads. This places the trouble indicator in an off-normal condition so as to save delays and prevent alarms on other sender link frames.

29.11 It will be noted that relay TI, with relay TIB operated, supplies direct ground to the lead which operates alarm relay AR. This arrangement insures that alarm relay AR will have ample time to operate. Otherwise, if relay TB continued in control of this operating path, a ground speedily applied to lead RA in the trouble indicator might cause relays AL and TB to open the operating circuit of relay AR before that relay could lock up.

29.12 The circuit is arranged so that the trouble indicator can be made busy to the sender link controller whenever a plug is inserted into a make-busy jack at the trouble indicator frame. This make-busy jack, one of which is furnished for each controller, operates relay TIB to bypass the trouble indicator start relay TI and to substitute alarm relay AR. Hence, whenever a time-out occurs, the trouble indicator record is omitted and a sender link alarm is brought in.

29.13 Lead TIA extending from Fig. 8 to the miscellaneous circuit for the subscriber sender trouble indicator frame serves to bring in a minor alarm whenever the trouble indicator is summoned. A holding lead for the alarm circuit, extending from the trouble indicator to the same miscellaneous frame circuit, is likewise grounded whenever one or both of the trouble indicator relays associated with leads DL and C become operated and locked. The minor alarm ordinarily continues from the instant the trouble indicator is first seized until the indicator is released by the maintenance force, but if a second controller attempts to summon the indicator the alarm changes from minor to major. This is brought about by the regrounding of the TIA lead at relay TI of the second controller.

29.14 The hold-jack feature is arranged to warn the maintenance force, by means of a sender link alarm, whenever the controller times out with a plug in the hold jack, regardless of whether the trouble indicator is in service or not. To insure this alarm, in connection with the trouble indicator, relay HL opens the operating path of relay AL controlled by the trouble indicator, thereby delaying the release for an extra half-second and forcing the sender link alarm to function as described in 21.

30. SENDER GROUP TROUBLE - FIG. 9, D, E, AND F

30.01 When no calls are being placed in a sender subgroup by a sender link controller circuit relays CH1 and CH2 are normally operated if the two contact chains on the LL relays are closed through. If either of these chains should be defective and incomplete, relay CH1 would release releasing relay CH2 or relay CH2 would release alone. Since no call is being placed in the subgroup, C relays associated with this subgroup are released thus permitting relay CH2 to release. Relay CH2, in releasing, operates relay CH3 which places ground through all the LL relays to the MB lead of Fig. 9 operating relay SGB and with ZQ option relay TTGB making the subgroup busy to all controllers and providing a signal to the miscellaneous circuit for the sender make-busy frame where a minor alarm is indicated.

30.02 If there should be no LL relay contact chain trouble but a trouble in the controller or subgroup circuit between the time the LL relay is operated and the C relay associated with the controller and subgroup operates, relay CH2 will release operating relay CH3. Since an LL relay is operated the MB lead is not grounded at this time. The controller will time out and call in the trouble indicator providing a record of the subgroup and controller involved in the call. When the trouble indicator has recorded the information or if the trouble indicator is busy, lead TIB

to Fig. 9 is grounded by the trouble indicator which operates relay SGB and, with ZQ option, relay TTGB of the subgroup circuit making it busy until the unserved line link circuit has had a chance to select another subgroup via another sender link circuit.

30.03 Relay SGB operating under either of these trouble conditions connects the ground on lead GT to lead LL to the miscellaneous circuit for the sender make-busy frame to aid in giving the proper indication at that point when the minor alarm is brought in, ZH option.

31. AUTOMATIC MESSAGE ACCOUNTING

31.01 Automatic message accounting through the use of common tape perforators requires the identification of the calling customer line in connection with each call. This identification is accomplished during the line link frame operation and the information is connected to leads for connection to the associated sender circuit. This is accomplished by the sender link circuit in the following manner.

A. District Group Circuit

31.02 When the district junctor group in which the call is to be placed is determined and relay G in the particular Fig. 4 is operated, as described in 4., the associated GR relay in Fig. 18 will operate thereby associating the common sender link code leads with those of the line link frame serving the particular call.

31.03 These leads are extended through to the trouble indicator register circuit to the operation of relays CTI and TIR, Fig. 22, under control of relay ON, Fig. 8, and the trouble indicator circuit.

B. Sender Group Connector

31.04 As described above, the code leads from the line link frame being served having been connected to this sender link circuit, means are provided for associating them with the available sender subgroup. This is accomplished by operation of relay CR in Fig. 19 under control of the C relay in the associated Fig. 7 thereby completing the code lead closure between the line link frame and the sender subgroup involved.

C. Test Call Code Connector

31.05 In connection with automatic message accounting operation means have been provided for the identification of test calls. This is accomplished by the provision of a connector relay shown as TST in Fig. 11, which is operated under control of relay TL in Fig. 8. The test call operation of the TL relay is more fully described in 19. Operation of relay TST closes ground connections to the common sender link code leads which are connected to the sender subgroup in use by operation of the CR relay as described in 31.04. This arrangement will provide for the identification of test calls by tape perforations indicating column 888, switch 8, and file 8 a combination of numbers not used for service calls. With the addition of U apparatus the test call code connector provides a means under control of relay G in Fig. 14 of supplying a distinctive code (988-8-8) for tape perforations of calls through dialing districts, interoffice districts, and combinations of dialing and interoffice districts.

D. Line Observing Operation

31.06 The operation of relays GR and CR previously described also provides connection of lead LO from the line link frame to the sender for the transmission of an indication that a complete record of the called number shall be provided on all calls originated from the line under observation.

E. TOUCH-TONE Calling - ZQ Option

31.07 The class signal used to indicate sender type on a particular call is extended to this circuit on the IDA lead via the call-identity indexer frame. An operated GR relay of Fig. 18 extends the signal from the line link and controller circuit to the windings of the series connected RDA and TDA polar relays.

32. SENDER PREFERENCE CANCELLATION DURING SENDER LOAD CONTROL (MFR DISC.)

32.01 If the originating office unit is arranged for sender load control, relay LC of Fig. 15 is provided and operates from the traffic register circuit when load control becomes effective. Relay LC, in operating, opens the SP leads from the different district group circuits each of which gives a different preference starting

point in the selected sender subgroup and grounds only the SPO lead to the sender subgroup. This insures that the first nine senders of the group will receive first preference since the last choice sender of the group under these conditions is arranged to automatically route calls to overflow and is therefore to be last preferred.

33. USE OF THIS CIRCUIT FOR ADDITIONS

33.01 This circuit may be used for additions in offices where similar circuits are installed in accordance with other drawings. This circuit may be considered as consisting of the following component equipment parts, which may be mounted in different locations, and provided in varying quantities:

(a) Sender link frame (Fig. 1, 2, 3, 4, 5, 6, 7, 8, 10, 13, 14, 15, 23, 25, and D, E, or F);

(b) Sender selector circuit (Fig. 9, A, B, C and G);

(c) Traffic release control circuit (Fig. 16 and 17);

(d) AMA connector circuit (Fig. 11, 18, 19, and 22);

(e) Emergency controller (Fig. 8 and 12); and

(f) Line link controller release circuit (Fig. 24).

33.02 Any of these components may be provided for additions, connecting to the same and other components installed in accordance with other circuit, with the exception that the emergency controller per Fig. 8 and 12 cannot be used with old-type circuits. Similarly designated leads are connected in all cases, as covered by circuit note 113, and, of course, when all leads are not shown on either circuit, the nonmatching leads are left unconnected.

33.03 When a "sender link frame" component of this circuit is required to function with an old-type emergency controller, the following should be borne in mind. If the old-type emergency controller has leads designated DG0-9, these leads will not connect to the Fig. 5 for emergency operation of the new sender link frame. These leads are used in the old circuit in conjunction with a TC relay in the controller for functioning the DA and DB relays of Fig. 4 and 14 from the district junctor test circuit. On the new sender link frame, the TC relay is a part of Fig. 13, which is not a part of the controller circuit and is not cut out of service when the transfer keys of Fig. 5 are used. Accordingly there is no need to carry these DG0-9 leads through Fig. 5. In this connection, the CS lead of the old controller, which is used with old-type sender link frames to provide a class-of-service indication to the sender on district junctor test calls, is used when connected to Fig. 5 of the new sender link frame for operating the TC relay of Fig. 13 which performs the same functions as the TC relay in the controller and also provides the class-of-service indication to the sender on test calls. Also, the TF lead of the old controller, which is used with old-type sender link frames for operating relays in the frame when a trouble indicator is called in to give an indication to the trouble indicator of the sender link frame, the sender and the line link frame involved in the call, is used when connected to Fig. 5 of the new sender link frame to operate relay TIC of Fig. 13 to perform the same functions. This TF lead will, of course, not be used if no trouble indicator is provided.

33.04 It should be noted that the CSA lead of the old controller need not be connected to Fig. 5, since this is used with old link frames to provide part of the class-of-service indication to the sender on test calls, whose function is performed by relay TC on the new frames. Also, lead CSC of the new Fig. 5 need not be connected to an old emergency controller, since this lead is used for class-of-service indications on senders requiring three leads to be grounded, and such senders will not be used in old offices.

33.05 When a "sender link frame" component of this circuit is added in such offices where other sender link frames have LL relays which differ from those shown in Fig. D, E and F, the old and new LL relays may be connected as shown in Fig. 151 and 152 for use in the same sender subgroup preference chain.

33.06 When a "sender selector circuit" component of this circuit is added in offices where all sender link frames do not have LL relays in accordance with Fig. D, E, or F, the sender preference chain alarm features of Fig. 9 are ineffective and, in such cases, relay CH2 of Fig. 9 is

blocked operated to prevent unnecessary current drain through relay CH3.

33.07 When this circuit is used in offices where the trouble indicator circuit for sender link and controller is not provided, punchings AL and AL1 are strapped and relay TI is blocked nonoperated. When the timing relays described in 20. reach the stage where relay TI would be operated to call in the trouble indicator, relay AR will operate immediately, instead of when relay TIB operates, and will function as described in 32.

33.08 Certain leads which normally connect to the miscellaneous circuit for the trouble indicator frame for sender link and controller will, under this condition, connect to the miscellaneous circuit for sender make-busy frame, as covered in circuit note 112. Also, a lamp per Fig. 20 will be provided per new sender link frame on the emergency frame lamp panel.

34. CONTACT PROTECTION

34.01 Contact protections in accordance with circuit notes 111 and 114 are provided to protect the contacts of the relays which operate and release the relays or magnets to which the contact protections are connected.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 None.

2. FUNCTIONAL DESIGNATIONS

2.01 None.

3. FUNCTIONS

3.01 To inform the line link and controller circuit which groups of district junctors (10 junctors per group) have more than one idle junctor with at least one idle path through the sender link primary and secondary switches to an idle sender.

3.02 To inform the line link and controller circuit which groups of district junctors (10 junctors per group) have at least one idle junctor with at least one idle path through the sender link primary and secondary switches to an idle sender.

3.03 To recognize that a line link and controller circuit requires service and which groups of 20 district junctors have been preferred by line link and controller circuits.

3.04 To select one of the group of 20 district junctors from among those which have been preferred when simultaneous calls are recognized, as the one which is to be served.

3.05 To notify the line link and controller circuit that the sender link and controller circuit will serve its call.

3.06 To notify unserved line link and controller circuits that they will not be permitted to place calls in the groups of 20 district junctors which have been preferred and to cause all 10 groups of 10 district junctors each to test busy to all associated line link and controller circuits after one line link and controller circuit has been selected to be served.

3.07 To release the line link and controller circuit and cause it to select another group of 20 district junctors if paths through the sender link switches to idle senders cease to be available after the line link and controller circuit has selected such a group of 20 junctors.

3.08 To recognize which group of 10 district junctors of the group of 20 junctors has been chosen by the line link and controller circuit.

3.09 To test the chosen group of 10 district junctors to determine which junctors are idle.

3.10 To allot district junctors in such a manner that the traffic is satisfactorily distributed over all district junctors, the allotment being made dependent upon cross-connections, periodically changed.

3.11 To test a maximum of 10 subgroups of senders (10 senders per subgroup) simultaneously to determine whether paths are available to sender subgroups which have more than one idle sender.

3.12 To retest the 10 sender subgroups simultaneously if the first test failed to find an accessible sender subgroup having more than one idle sender, the retest determining whether paths are available to subgroups of senders having only one idle sender.

3.13 To prefer one of the available subgroups of 10 senders, the preference depending on the subgroup of 20 district junctors in which the call has been placed.

3.14 To prevent other sender link and controller circuits from seizing the preferred subgroup of 10 senders.

3.15 To shift the preference to another subgroup of 10 senders if prevented by another sender link and controller circuit from selecting the preferred subgroup.

3.16 To remove the test from other subgroups of ten senders after seizing the preferred subgroup.

3.17 To cause the preferred subgroup of the ten senders to test busy to all sender link and controller circuits after it is seized.

3.18 To select one of the idle senders by means of a preference arrangement which is made dependent upon the group of 20 district junctors in which the call is being served.

3.19 To operate the proper selecting magnets of the primary switches of the sender link after selection of the sender subgroup is completed.

3.20 To operate the proper selecting magnet of the secondary switch of the sender link after selection of the sender circuit is completed.

3.21 To close through leads from the line link and controller circuit to the subgroup of 10 senders for transmitting to the sender information concerning the class of service of the calling customer.

3.22 To indicate to the subgroup of 10 senders which one, of a maximum of 20 sender link and controller circuits, is placing the call.

3.23 To furnish ground to the associated line link and controller circuit for operating holding magnets and closing the crosspoints of the primary and secondary switches of the line link and the sender link.

3.24 To test for the closure of the tip, ring, and sleeve from the customer line circuit to the sender circuit.

3.25 To test for continuity of the lead over which the ground for operating the hold magnets is furnished.

3.26 To test for false ground on the lead over which the ground for operating the primary hold magnets for the line link is furnished.

3.27 To test for false ground on the lead over which the release signal is given.

3.28 To test for a double-connection of the sender link with another busy call after the crosspoints are closed.

3.29 To test for an open tip and ring in the connection between the calling customer and the sender and, in case of an open circuit, to score on a register and give a release signal to the line link and controller circuit.

3.30 To test for the release of the customer line relay.

3.31 To release the line link and controller circuit immediately after the connection has been established and no trouble conditions have been detected.

3.32 To operate an alarm to cause the trouble indicator to function to score on a register and to revert the call to the line link and controller circuit if a trouble condition has been encountered.

3.33 To provide means for holding the sender link and controller circuit out of service if desired when any trouble condition is encountered.

3.34 To provide means for switching to an emergency controller circuit when desired.

3.35 To light the EF lamp at the frame where the emergency controller circuit is being used.

3.36 To light the EC lamp which is located at a central place with other EC lamps to indicate which frame is using the emergency controller circuit.

3.37 To light the EM lamp on every frame as an indication the emergency controller circuit is in use.

3.38 To provide lamp indications when a double-connection is encountered or when sleeve continuity failures are detected when a plug is in the holding jack HD.

3.39 To provide means for making any group or groups of 20 district junctor circuits busy.

3.40 To provide means for operating a district group traffic meter for recording the number of times that the last district junctor circuit of a group of 10 districts has been selected to serve a call.

3.41 To provide means for operating a sender group traffic meter each time all senders of the group are busy.

3.42 To provide means for connecting district junctor circuits to customer sender circuits under control of the automatic test circuit for district junctors.

3.43 To provide means for holding the controller circuit off-normal when trouble conditions are encountered to facilitate maintenance.

3.44 To provide means for immediate release for those calls where disconnection by the calling customer occurs before the circuit has progressed to the point where the holding magnets are operated.

3.45 To provide means for preventing trouble alarms from occurring in those cases where calls are excessively delayed in sender group selection due to traffic congestion.

3.46 To hold itself busy for a short interval after the sender link and controller circuit has reverted a call to its line link and controller circuit when a trouble condition has been encountered, in order to permit the line link and controller circuit to seize another sender link and controller circuit to serve the call.

3.47 To provide means for connecting dial type district junctors to senders without the use of a line link.

3.48 To provide a separate class-of-service indication for each ten junctors within a group of 20.

3.49 To prevent the serving of calls from a line link and controller circuit while an A switchboard or interoffice call is waiting.

3.50 To provide an alarm if A switchboard or interoffice calls are waiting and the controller circuit remains either busy or idle too long.

3.51 To provide an alarm if a contact chain or relay failure occurs in the preference chain for a sender subgroup.

3.52 To provide means for connecting the controller and the sender link frame to a trouble indicator.

3.53 When automatic message accounting operation is provided to close through leads from the line link and controller circuit to the subgroup of 10 senders for transmission to the sender of the "calling line identification information".

3.54 When automatic message accounting information is provided to close through leads to the subgroup of senders for transmission to the sender of a predetermined line identification code number for the identification of test calls to the accounting center.

3.55 To provide a distinctive code for all calls originated through an operator dialing district interoffice district or combination of both.

3.56 To provide means for identifying the calling line equipment number in the associated trouble indicator.

3.57 To provide an indication of customer senders load to the line link and controller circuit.

3.58 To provide means for identifying the type sender required on a particular call, when TOUCH-TONE calling is provided on a partially converted basis.

3.59 To provide means for flexible splitting of the associated senders within a particular select circuit among TOUCH-TONE and rotary dial.

3.60 To provide for connecting to the proper type sender when the indication described in 3.58 is received.

3.61 To extend the preference chain to the overflow sender or senders if all senders of the type required on a particular call are busy.

3.62 To provide means for operating a traffic meter for each type of sender, (rotary dial and TOUCH-TONE) within a select circuit, when the associated type senders are busy.

3.63 To provide a rotary dial indication on calls from operator or interoffice dialing districts and on test calls from the district junctor test frame.

3.64 To indicate to the selected sender which one of a possible ten district link frames will be used to complete the call.

3.65 To provide for various frame indications when this circuit is used on an auxiliary customer sender link frame.

3.66 To provide for the release of controller circuits on auxiliary customer sender link frames.

3.67 To provide TOUCH-TONE calling on a partially converted basis.

3.68 To provide for controlling the traffic release control feature of the customer sender link controller from the load register circuit.

3.69 To provide a feature for forcing all senders in a preference chain, DP or TT, to be used before the first sender in the chain can be reused.

4. CONNECTING CIRCUITS

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

(a) Subscriber Line, Line Link, and Controller Circuit - SD-25553-01.

(b) District Junctor Circuit, Noncoin - SD-25620-01 or SD-25620-02.

(c) District Junctor Circuit, Coin - SD-25210-01.

(d) Dialing District Junctor Circuit from Switchboard No. 13C, 13D, 15C, or 15D - SD-25481-01.

(e) Subscriber Sender Circuit - SD-25562-01 or SD-25612-01.

(f) District Junctor Automatic Test Circuit - SD-25158-01 or SD-25622-01.

(g) Floor Alarm Frame Fuse and Time Alarm Circuit - SD-25046-01.

(h) Traffic Register Circuit - SD-25317-01.

(i) Interrupter Frame Circuit - SD-25062-01.

(j) Common Hold Jack Circuit - SD-25522-01.

(k) Miscellaneous Circuits for Sender Make-Busy Frame - SD-25076-01.

(l) Originating Sender Test Circuit - SD-25221-01.

(m) Trouble Indicator for Subscriber Sender Link and Controller Circuit - SD-25452-01.

(n) Miscellaneous Circuit for Trouble Indicator - SD-25453-01.

5. ALARM INFORMATION

5.01 When an alarm sounds, the sender link frame involved is determined by observing the lighted white aisle pilot and the frame alarm (AL) lamp.

A. Alarm Retired by Momentary Operation of the AR Key

5.02 If alarms occur on two or more sender link frames within approximately five seconds of each other, it may be assumed that the trouble is in a line link frame rather than the sender link frames. This is because an alarm condition at a sender link frame causes the sender link frame to hold itself busy while the line link frame selects another sender link frame to handle the call. If the trouble is caused by the line link frame, the second sender link frame will also time out and bring in an alarm. Eventually the line link frame times out and brings in an alarm.

5.03 Since this circuit times out under trouble conditions and leaves no record of the equipment involved, an HD jack is provided. A 349A plug in this jack holds the circuit the next time the trouble occurs.

5.04 When the trouble recurs with a plug in the HD jack, the major alarm is sounded instead of the minor alarm.

5.05 When the circuit is held in this manner, the equipment involved in the call is determined as follows. The operated BA0 to BA4 or BB0 to BB4 relay indicates the district junctor subgroup. These relays must be observed before the line link circuit times out in 6 to 13 seconds. The operated G0 to G4 relay indicates the district junctor group. The operated D0 to D9 relays indicate the idle district junctors. The operated SG0 to SG9 relay indicates the sender subgroup. The operated secondary select magnet indicates the sender.

5.06 If analysis indicates that the trouble is confined to the control circuit, the plug in the HD jack is removed and the emergency controller substituted for the regular controller as described in 6.06. If the trouble is external to the control circuit, the sender link frame is made busy as described in 6.02.

5.07 The hold feature results in a sender link control circuit, 100 district

junctors, and, in some cases, a customer line being out of service during the interval that the trouble is being held for observation. Therefore, it is important that this hold feature be used under close maintenance supervision.

B. Alarm With the CF (Continuity Failure) Lamp Lighted

5.08 The CF lamp being lighted indicates that the call progressed far enough to operate the OH relay which closes the operate circuit to the hold magnets, but the sleeve lead may not be continuous from the sender link, through the sender and back to the sender link.

5.09 When the line link times out, the primary and secondary sender link hold magnets release, but the equipment involved in the call can be located in accordance with 5.05.

5.10 The SC1 relay in the sender being normal indicates a continuity failure of the SC lead from the sender selection relays to the sender.

C. Alarm With the DC (Double-Connection) Lamp Lighted

5.11 Observe which district group (primary switches) have select magnets operated. Locate the primary A hold magnet involved by examining the crosspoints closed on the level corresponding to the operated select magnets on the switch containing the A hold magnets. Observe other crosspoints on this hold magnet for two crosspoints being operated. If two crosspoints are closed, observe if two select magnets are operated. If two crosspoints are not closed on the primary switch observe the secondary switches and C magnets for double-connections using the same procedure as for the primary switches. Observe if two secondary select magnets are operated.

5.12 In the event of double-connections on either primary or secondary switches, a handset (D-156219) is inserted into the jack at the bottom of the vertical unit of the primary A hold magnet involved in the connection and the customer is challenged and advised to hang up. After the customer disconnects, the off-normal spring of the primary A hold magnet will be opened momentarily and the handset will be disconnected.

D. Alarm With the CF or DC Lamps Not Lighted

5.14 The condition of the following relays and magnets indicates the stages which have been reached in the progress of the call. Various troubles are listed which could possibly cause the following conditions of these relays. The various relays and switches should be checked in the order given so as to quickly determine the progress of the call.

Relay or Magnets	Possible causes of Failure
Secondary select magnets not operated.	DP lead continuity failure from the line link to the sender selection relays. Secondary select magnet operating path continuity failure from sender selection relays to the secondary select magnets.
OH relay sender link not operated.	OH relay operating path continuity failure from G relay through both primary and secondary select magnet contacts to OH relay. The DS relay non-operated may indicate an A or B lead continuity failure between the line link and the sender link.
ON1 relay (sender) not operated. The sender involved is determined by the operated secondary select magnets.	ON lead continuity failure from the line link to the sender. CS lead continuity failure from the line link to the sender. Crossed CS leads. The condition of the open or crossed CS leads can be checked by observing if no CS relay or more than one CS

Relays or Magnets	Possible causes of Failure
	relay in the sender is operated.
	Frame lead continuity failure from the sender link to the sender.
	Cross-frame leads from the sender link to the sender. The condition of open or crossed frame leads can be checked by observing if no frame relays or select magnets or more than one frame relay or select magnet in the sender is operated.
	Crossed leads such as F0 and F1 may also prevent the closing of the select magnet off-normal contacts, by energizing opposite sides of the select magnet.
	SH lead continuity failure from the sender link to the line link. An SH magnet failing to operate prevents the closure of the ON lead by failing to operate the T relay in the line link and subsequent operation of the customer line hold magnet and release of the L and RE relays in the line link.
	H-lead continuity failure between the sender link and the line link. The results are the same as an open SH lead.
ON2 relay (sender) nonoperated.	ON1 relay (sender) operating failure. GS lead continuity failure from the sender link to the sender.
AB relay (sender link) not operated.	REL lead continuity failure between the sender and the sender link. A second path for operating the AB relay is through the DC relay normal which may release when the sleeve is grounded by the sender, although it is not required to release.
RL relay (sender link) is operated.	RL lead continuity failure between the sender link and the line link.

5.15 If primary hold magnets associated with the operated select magnets are operated, the plug should be removed from the HD jack just as soon as the probable cause of the trouble is determined. This is necessary in order to free the customer line.

E. Conditions Not Associated With Sender Link Frame Alarms

5.16 A high registration (compared to other sender links) on the PC false start register associated with a particular sender link indicates a tip or ring lead continuity failure between a primary line link switch and the sender.

5.17 A cross between any two of the DP0 to DP4, SH0 to SH9, A0 to A9, or P0 to P4 leads results in two district junctors being connected to one customer, and when the customer dials, the district junctor F relays operate. This results in an originating trouble indicator record. The location of the F relays is determined from the trouble indicator lamps.

5.18 The required record of these alarms should be entered on the proper form.

F. False Sender Group Busy Alarm

5.19 With option ZU or ZV provided, a false ground condition occurring at some point along the MB lead or among the connecting network of sender-busy relay contacts is detected by an alarm. The occurrence of a false ground causes the SGB or TTGB relay to operate before all the senders are in use. With the condition where the TTGB or SGB relay operates, but not all sender busy relays operate, ground is provided to the coil of the FB relay via the operated contacts of relay TTGB or SGB, the GT lead, operated contacts of sender busy relays, and the normal contacts of the unoperated sender busy relay. The operation of the FB relay provides ground through FB relay contacts to the LL lead going to the miscellaneous circuit for sender made-busy frame. Ground on the LL lead operates the CA relay in that circuit which lights the CA lamp.

5.20 Option ZU is provided for partial TOUCH-TONE senders subgroups. Option ZV is provided for an all TOUCH-TONE sender subgroups or all rotary dial sender subgroups.

6. TAKING EQUIPMENT OUT OF SERVICE

A. General

6.01 When it is necessary to remove a sender link frame from service to work on the apparatus, it should be done during periods of light traffic.

B. Customer Sender Link Frame

6.02 The customer sender link frame is taken out of service by making all of its associated district junctors busy. This is accomplished by inserting 349A plugs into all MB- jacks on the sender link frame. Whenever this is done, other junctors of the type made busy must still be available to traffic.

C. Primary Switch and District Group Circuit

6.03 Two primary switches and a district group circuit are removed from service by making the 20 associated district junctors busy. This is accomplished by inserting a 349A plug into the associated MB- jack on the sender link frame. No new calls can then be placed in this group.

D. Secondary Hold Magnets

6.04 Individual secondary hold magnets can be removed from service by the insertion of a 351C plug into the switch vertical unit. This must not be done while the hold magnet is in service, and the hold magnet must not engage a select finger when operated in this manner.

E. Primary Hold Magnet

6.05 Individual primary hold magnets can be removed from service as described in 5.15. The associated district junctor must be made busy by the insertion of a 349A plug into the junctor MB jack at the district junctor frame.

F. Controller Circuit

6.06 The controller circuit is removed from service by substituting the emergency controller. A 349A plug in the ET jack on the sender link frame will transfer the leads from the regular to the emergency controller.

6.07 On frames equipped with transfer switches, the transfer to the emergency controller is accomplished by the operation of transfer switches A and B to the OFF position followed by the operation of transfer switches A-EM and B-EM to the ON position. The regular controller is restored to service by the operation of the transfer switches A-EM and B-EM to the OFF position followed by the operation of the transfer switches A and B to the ON position.

6.08 The sender link frame is made busy as in 6.02 while the transfer is being made. Only one sender link frame may be connected to the emergency controller at a time. If several controller circuits must be removed from service, one sender link frame is connected to the emergency controller and the other link frames are made busy.

Note: When a transfer to the emergency controller circuit is made during periods of light load, on a sender link frame whose EF lamp is equipped with a red lamp cap, the regular controller circuit should be restored to service as soon as the trouble is cleared. This precaution is needed because sender group preference strapping (G-SG) on the

emergency controller circuit agrees only with regular controller circuits whose EF lamps are equipped with white lamp caps. It is therefore possible, when using the emergency controller, that the change in the sender group preference chain will cause the customer to pick the same sender on successive calls, and if the sender is in trouble without testing busy, the call will not be completed.

G. TIR, R1, and R2 Relays

6.09 Care must be exercised when working on the TIR, R1, and R2 relays as some of the leads are multipled to other sender link frames in the office.

SECTION IV - REASONS FOR REISSUE

D. Description of Change

D.1 This change provides features to improve circuit operation and customer service.

(a) The sender subgroup preference circuit is changed to provide a more even distribution of sender usage in subgroups containing both TOUCH-TONE and rotary-dial-type senders. This is accomplished by making all SB- relays, Fig. A, B, C, (except Fig. C in the TOUCH-TONE and in the rotary dial preference chains) self-latching. The operation of the last SB- relay releases the preceeding self-latched SB- relays that have idle senders. Diodes SB-, Fig. 26, are used to isolate the grounds on 8T of the relays SB- from the traffic usage recorder over the SB leads. Diodes RD and TT are used to permit operation of both relay CRD and CTT over the TTRD lead or individual operation of either relay CRD or CTT by applying ground over leads CRD or CTT respectively.

(b) Provisions have been made to eliminate operation of the intersender timing in relatively light traffic in the larger offices. This is accomplished by extending the present range of from 1 to 6, to from 1 to 15, the number of sender subgroups busy that can be selected to initiate intersender timing. This consists of changing the values of the CG and TCG resistors, Fig. 9, from 1200Ω to 3200Ω to provide the required resistance to work into a new load register in the Traffic Register Circuit. This makes possible the extension of this range.

(c) Operation of the traffic release control in light traffic has been eliminated by changing its trigger source to the load register control. This is accomplished by changing the SGL lead in Fig. 16 from ground through contacts on either the SGB or TTGB relays to obtain a ground from the load register, in the Traffic Register Circuit.

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DEPT 5615-DWW-DAJ-PH