STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A or 35E97
INCOMING TRUNK CIRCUIT
E, M AND N OR E AND M LEADS SUPERVISION

CHANGES

A. Changed and Added Functions

A.1 To provide an off-hook signal of approximately 150 msec on initial seizure to establish trunk integrity when this trunk is associated with a No. 4 type toll crossbar office arranged for trunk integrity check on the far end.

B. Changes in Apparatus

B.1 ADDED:

ZG Apparatus

CPS D4

910A Conn OH

B.2

SUPERSEDED	SUPERSEDED BY
Fig. D	Fig. H
ZI Apparatus	ZJ Apparatus
18F Res A	KS-8512, L2A Res A, 150 ohms
ZK Apparatus	ZL Apparatus
18AJ Res P	KS-8512, L2A Res P, 400 ohms

D. Description of Changes

D.1 Fig. D is rated Mfr Disc and replaced by Fig. H;and ZG, ZH, ZI, ZJ, ZK, and ZL options are added.

D.2 Circuit Note 102 is changed to show Fig. H and the application of ZG and ZH options.

D.3 Circuit Note 105 is added.

D.4 Equipment Note 204 is added.

D.5 Connecting information changed to permit connection to a 4-wire terminating circuit.

F. Changes in Description of Operation

F.1 Under 3. FUNCTIONS add:

3.9 To provide a timed off-hook signal as a trunk integrity check when this trunk is associated with a No. 4A or 4M toll crossbar distant office.

F.2 Under 4. CONNECTING CIRCUITS add:

4.7 Four-Wire Terminating Circuit - SD-96463-01.

4.8 Circuit Pack Schematic (Timer) - SD-99355-01.

F.3 Under 5. SEIZURE add:

5.3 Fig. H and ZH Option with ZG Apparatus

When Fig. H and ZH option is used, this circuit provides a timed off-hook signal on seizure to the incoming sender in a distant No. 4A or 4M toll crossbar office. This is used as an integrity check before connections are established. When this circuit is seized as described in 5.1 or 5.2, ground from the B relay is applied to terminal 3 of the circuit pack timer. The timer connects this ground through a resistance to terminal 1 for an interval of approximately 150 msec. This operates and releases the BY relay which applies battery then ground to the M lead, signaling the distant office.

F.4 Under 7. SUPERVISION change 7.2 to read:

7.2 When Fig. H Is Provided

Operation when Fig. H is provided, etc.

F.5 Under 9. MISCELLANEOUS change the twelfth sentence to read:

The D network provides contact protection for the busy flash interrupter relays.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 2363-TPS-RJJ

STEP BY STEP SYSTEMS
NO. 1, 350A, 355A, OR 35E97
INCOMING TRUNK CIRCUIT
E, M AND N OR E AND M LEADS SUPERVISION

CHANGES

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED, OR REMOVED APPARATUS

C.1 Test Notes 6 and 1, CR Tables Page 2 and 3 respectively, changed to limit the number of instances that pulse repeating requirements must be applied. In addition, means for zeroing the per cent break meter when applying pulse repeating requirements is added.

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Circuit Note 102 changed to clarify the conditions for which Figure A, Figure B, or Option "V" are used and the condition when the circuit is required to repeat pulses to a step-by-step office.

D.2 Connecting information changed to permit connection to a test distributor circuit and connection to a repeating coil circuit.

D.3 The title of this circuit is changed to include installation in a 35E97 Office and to clarify the types of connecting equipment that can be used.

D.4 This circuit is rated A&M Only for use in a 35E97 Office.

All other headings, no change.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 2315-RJS-RCD-PM

STEP-BY-STEP SYSTEMS
NO. 1, 350A, OR 355A
INCOMING TRUNK CIRCUIT
FOR USE WITH TYPE "B" COMPOSITE SIGNALING OR SIMPLEX SIGNALING

CHANGES

A. CHANGED AND ADDED FUNCTIONS

A.1 To provide loop pulsing into some crossbar offices.

A.2 To provide improved battery-ground pulsing over short loops by adding resistance compensation in the pulsing circuit.

A.3 To provide improved pulse repeating.

A.4 To automatically insert or remove the pulse compensating resistances in the outgoing loop as the call progresses.

B. CHANGES IN APPARATUS

B.1 Added

18AJ res. (N)
18AJ res. (P)
18CN res. (M)
KS-8680, 5000W Pot. (A)
19YM res. (R)
280BW rel. (P)
UA57 rel. (P1)
U462 rel. (P2)
284 type jack (PT)

B.2

Removed	Replaced by
2.08 - 2.24 M.F. Cond. (B)	2.62 - 2.79 M.F. Cond. (B)

C. CHANGES IN CIRCUIT REQUIREMENTS OTHER THAN THOSE APPLYING TO ADDED OR REMOVED APPARATUS

C.1 Timing Requirements were added for relay (C).

D. DESCRIPTION OF CIRCUIT CHANGES

D.1 Fig. E was part of Fig. 1 and is replaced by Fig. G when battery-ground pulsing is required and the call may be completed over pulsing loops which may be short for the first few digits and long for the remaining digits. This Fig. G provides a means of automatically inserting resistance in the pulsing loop when the loop is short and removing this resistance on long loop.

D.2 "ZC" and "ZD" options provides a means of removing battery and ground from the pulsing circuit and arranging the circuit for loop pulsing.

D.3 "ZE" and "ZF" option provides for paralleling the winding of relay (C) with a potentiometer which is required for applying timing tests to the (C) relay. Timing requirements on the (C) relay are required to limit the max. releasing time of relay (C) to provide sufficient inter-digital time for relay (P) to operate on short pulsing loops.

D.4 In Fig. 1 "ZA" option is rated Mfr. Disc. and "ZB" added to provide compensating resistance in the pulsing ckt. for pulsing over short loops.

D.5 Fig. F is provided when all outgoing loops exceed 1200W.

D.6 Resistance (M) "ZB" option in Fig. A is provided to limit the current thru the A relay to improve pulse repeating. The 2.08 M.F. Cond. (B) option "ZA" is changed to 2.62 M.F. option "ZB" to compensate for the reduced current thru the (A) relay and provide the required percent break output.

D.7 The Option Table in Note 102 was expanded to include information for pulse repeating, similar to information shown on other battery-ground pulse repeating circuits.

All other headings under Changes, no change.

1. PURPOSE OF CIRCUIT

1.1 This circuit is used with incoming composite signaling trunk circuits to convert the CX dialing to loop or battery-ground pulsing, to transmit reverse battery supervision as CX signals over the trunk, when Fig. D is provided, to transmit signals received over the "F" lead as CX signals over the trunk, when Fig. E is provided, to automatically provide compensation in the supervisory circuit for short loops and remove this compensation on long loop, for loop pulsing, and when Fig. G is used to automatically provide compensation in both the supervisory and pulsing loops when short loops are encountered and remove all the compensation on long loops.

2. WORKING LIMITS

2.1 Maximum outgoing external circuit loop to 45-52 volts, 2480 ohms.

2.2 Minimum insulation resistance 30,000 ohms.

2.3 On outgoing trunks to AB toll transmission selector circuits over 1200 ohms conductor loop, it is necessary to use a compensating trunk circuit to compensate the conductor loop between 1900 ohms and 2000 ohms.

3. FUNCTIONS

3.1 To repeat composite signaling supervisory and dialing pulses on a loop basis to succeeding switches.

3.2 To increase the current during pulsing towards the succeeding switches by connecting battery to the tip and ground to the ring through the contacts of the (C) relay.

3.21 Where Fig. B is used to correct the percentage break of the pulses received as they are repeated to the succeeding switches.

3.3 To repeat the reverse battery supervision as composite signals to the composite signaling trunk.

3.4 To repeat the signals received over the "F" lead as composite signals to the composite signaling trunk.

3.5 To hold the succeeding switches operated when calls are completed to a distant office without an outgoing repeater.

3.6 To operate a traffic register when all the trunks of a group are busy.

3.7 When associated with directly connected telephone repeaters to provide a termination for the repeater when the circuit is normal.

3.8 To automatically insert resistance compensation in short outgoing pulsing loops and remove these resistances on long loops when Fig. G is used, or provide or remove the shunt resistance for relay (D), when required, only in the supervisory bridge when Fig. E is used.

4. CONNECTING CIRCUITS

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

4.1 Line and Balancing CX set and Repeating Coil Circuit - SD-95004-01.

4.2 Composite Signaling Circuit - SD-95032-01.

4.3 AB Toll Preceding Selector Circuit - SD-30869-01.

4.4 AB Toll Transmission Selector Circuit - SD-31746-01.

4.5 Incoming Local Selector Circuit - SD-30972-01.

4.6 Traffic Register Circuit - SD-31976-01.

DESCRIPTION OF OPERATION

5. SEIZURE

5.1 Figs. 1 and A

When the circuit is seized at the distant end, ground is connected to the "E" lead operating the (A) relay which in turn operates the (B) relay. The (A) and (B) relays operated, close the tip and ring, supplying a loop circuit for the (A) relay of the incoming selector. The (B) relay operated also removes its ground from the "BR" lead to the traffic register circuit so that when all of the trunks in a group are busy the lead will be ungrounded, ("V" wiring) connects ground to the "S" lead to hold succeeding switches operated in case the call is routed to a distant office without an outgoing repeater circuit and energizes the rear winding of the (D) relay but this relay does not operate at this time as the current flow in the front and rear windings is opposing. The (B) relay operated, also removes the termination for the telephone repeater which consists of the (C) condenser and (C) resistance.

5.2 Figs. 1 and B

The operation is the same using these figures as described above in paragraph 5.1 except that the tip and ring loop circuit to the incoming selector is not carried through contacts of the (A) relay and the (F) relay operates from ground from the (B) relay.

6. PULSING

6.1 Figs. 1, A and E or F

The (A) relay follows the pulses received from the trunk or the signaling circuit over lead "E" repeating these pulses to the succeeding equipment. The (B) relay, which is slow to release, remains operated during the dialing of the digit. The (A) relay released, supplies ground to operate relay (C) which is slow to release and remains operated during the dialing of the digit. The (C) relay

operated, applies a short-circuit to the supervisory bridge circuit including the repeating coil, condenser (A), and supervisory relay (D). This prevents false operation of relay (D) due to surges or line discharges at the start or end of a digit. With "ZC" option relay (C) operating transfers the outgoing tip and ring from the supervisory bridge to a closed circuit across the tip and ring for loop pulsing. With "ZD" option relay (C) operating transfers the tip and ring from the supervisory bridge to battery through the (F) resistance to the tip and ground thru the (A) resistance to the ring to increase the line current during pulsing thereby aiding the pulsing of the succeeding switches. With "F" option; when the (CX) relay in the composite signaling circuit releases, ground is connected over the (N) lead operating the (C) relay before the (A) relay has released. With "R" or "X" option; relay (C) operating operates relay (G) opening the circuit for the (A) condenser and short-circuits one winding of the repeating coil. At the end of the digit the (C) relay releasing applies a short-circuit to the winding of the (G) relay which releases and reestablishes the circuit through the repeating coil and reconnects the (A) condenser in the talking circuit.

Figure F is used when this circuit is connected directly to trunks with 1200 ohms minimum resistance.

Figure E and option "Y" is specified when this circuit is connected in loops with less than 1200 ohms.

Figure E with option "K" is specified when it is required to pulse into some loops less than 1200 ohms and others 1200 ohms or more on a loop basis. As described above, relay (C) is released during the interdigital time and connects the (P) and (O) relays across the tip and ring. If the loops are short enough to allow sufficient current to flow, relay (P) operates and connects the shunt resistance (D) in parallel with the operating winding of relay (D) to prevent a false operation of this supervisory (D) relay.

6.2 Figures 1, A, and G

Figure G is specified where battery and ground pulsing ("ZD" option) is required when some of the outgoing pulsing loops are 1200 ohms or more, for example, when this circuit is connected over a short loop to a selector arranged with some levels wired to equipment on short loops (under 1200 ohms) and other levels connected to outgoing trunks not equipped with repeaters to distant offices over loops 1200 ohms or more.

The operation of the equipment in Figures 1 and A are the same as described in paragraph 6.1 except that as soon as relay (A) operates operating relay (B) and the loop to the succeeding circuit is closed over a short loop relay (P) operates operating relay (P1) on its primary winding. When relay (A) releases the ground which is supplied to relay (C) also holds relay (P1) on its secondary winding, as relay (P) releases due to the opening of the loop at the (A) relay contacts. Relay (P1) is slow enough in releasing so that the ground from the back contacts of relay (A) is applied to the (P1) secondary winding before the (P1) releases as the loop is opened at the make contacts of relay (A). The slow release feature of the (P1) is due to the relay releasing in parallel with the secondary noninductive winding on relay (P2). With this arrangement relay (P1) is slow to release but fast to operate in order to apply the (D) resistance shunt to the (D) relay operating winding before that relay can operate. Relay (C) operating operates relay (P2). Relay (P1) operating connects shunt resistance (D) across the operating windings of the (D) relay to limit the current through this winding thereby preventing a false operation of relay (D) due to a heavy reverse current. Relay (P2) operating removes the short-circuit across the compensating resistances (N) and (P) to limit the current to the pulsing relay of the succeeding circuit thereby improving pulsing on short loops. Relay (P2) operating transfers the holding circuit through the (P1) secondary winding from the winding of relay (C) to ground through make contacts on the (C) relay to hold these (P1) and (P2) operated during the pulsing of a digit and also to prevent any effect on the releasing time of relay (C). Relay (C) releasing during the interdigital time releases relays (P1) and (P2) and reconnects relay (P) across the outgoing tip and ring to test the loop and determine if the compensating resistances (N) and (P) are required. At the end of the first digit relay (C) releases, the succeeding selector (A) relay is connected across the tip and ring on a short loop as the switch hunts for an idle trunk. When an idle trunk is reached the cut through relay operates transferring the loop from the (A) relay to the trunk by means of transfer contacts which momentarily opens the loop circuit releasing relay (P). If the loop through the trunk is short enough to permit sufficient current through the primary winding to operate relay (P), the (P) and (P1) relays operate as before and during the next digit the compensating resistances (N) and (P) are in the circuit, but insufficient current will not operate relay (P) and the compensating resistances will be removed

from the pulsing loop during the next digit. In order to provide sufficient time for the (P) relay to operate on short loops "ZF" option is specified. "ZF" option provides a potentiometer (A) to apply a timing adjustment to relay (C) thereby limiting its maximum releasing time to provide the necessary time to operate relay (P) if its operation is required.

6.3 Figs. 1, B and E or F

When a pulse is received from the composite signaling circuit (CX) relay, the (E) relay operates in series with the (A) relay which holds. The (E) relay operated, opens the original operating circuit for the (A) relay, short-circuits the break contacts of the (J) relay through which the tip and ring are carried, operates the (H) relay, supplies a ground for operating the (C) relay which also receives ground from the break contacts of the (CX) relay in the composite signaling circuit when "F" option is used, opens the circuit to the (F) relay and operates the (K) relay. The (K) relay operated, places a short circuit across the break contacts of the (J) relay through which the tip and ring are carried, and removes the (H) resistance from in parallel with the (E) relay winding. The (H) resistance is used to insure that the (A) relay holds when the (E) relay operates and also to prevent the (E) relay from operating on momentary opening of the (CX) relay contact. The (G) resistance in series with the (A) relay when it is operated is used to reduce the current drain, this relay being operated during conversation. The (H) relay operated, operates the (J) and (H1) relays. The (J) relay operated supplies a ground for holding the (C) relay operated and opens the tip and ring circuit through its break contacts which, however, as stated above, are short-circuited by contacts on the (E) and (K) relays. The (C) relay performs the same function as described in paragraphs 6.1 and 6.2. When ground was removed from the winding of the (F) relay by the operation of the (E) relay the (F) relay releases but it is somewhat slow in releasing due to the (J) resistance in parallel with its winding. The (F) relay released, releases the (A) and (E) relays. If the (CX) relay of the composite signaling circuit has reoperated the (A) relay immediately reoperates or if it is slower to release than the (E) relay it may hold. Otherwise, the (A) relay remains released until the (CX) relay does reoperate. The (E) relay released, reestablishes the circuit for reoperating the (A) relay, removes its short circuits from the break contacts of the (J) relay but these contacts remain short-circuited by the contacts of the operated (K) relay. The (E) relay released also removes ground from the winding of the (H) relay, removes its ground for operating the (C) relay and releases the (K) relay. The (K) relay released, removes its short circuits from the break contacts of the operated (J) relay which begins the open period of the pulse to the succeeding switches. The (K) relay released, also reoperates the (F) relay. This resets the condition preparatory to receiving another pulse. If the speed at which the pulses are received is comparatively slow or this is the last or only pulse of the digit the (H) relay after an interval releases in turn releasing the (H1) relay. The (H) relay released with the (A) relay operated, releases the (J) relay which recloses the tip and ring to the succeeding selector terminating the open period of the pulse transmitted. If the rate at which the pulses are received is high the (E) relay will reoperate on the next pulse reconnecting ground to the (H) relay winding before the (H1) relay has had time to release, thus maintaining the circuit for holding the (J) relay operated. The (A) relay operated, in this case, closes the tip and ring, terminating the open period of the pulse transmitted to the succeeding switches. The operation of the (K) and (F) relays on this and subsequent pulses is the same as described for the first pulse. From the above, it will be seen that at slow rates of pulsing or the last or only pulse of a digit, the open period of pulses is the same length of time and is determined by the releasing time of the (H) and (H1) relays plus the releasing time of the (J) relay minus the releasing time of the (K) relay. This time is established by adjusting the spring tension on the (H) and (H1) relays to give the required percentage break-meter reading when the circuit receives pulses from the pulsing test set at the low speed. At high rates of pulsing the closed period of all pulses is a constant length of time and is determined by the release time of the (F) relay plus the release time of the (E) relay plus the release time of the (K) relay. This time is established by adjusting the spring tension on the (F) relay to give the required percentage break-meter reading when the circuit is receiving pulses from the pulsing test set at the normal speed of 12 pulses per second. At the end of the last pulse of a digit the (A) relay remains operated and upon the release of the (J) relay the circuit for the (C) relay is opened and after its slow to release interval it removes the battery through the (F) resistance from the tip and ground through the (A) resistance from the ring reestablishing the bridge circuit through the repeating coil and (D) relay winding circuit. Where "X" wiring and

apparatus is used, the release of the (C) relay short-circuits the winding of the (G) relay which releases. The (G) relay released removes the short circuit from the winding of the repeating coil and reestablishes the talking circuit through the (A) condenser.

6.4 Figs. 1, B and G

The operation is the same using these figures as described in paragraph 6.2 except that the loop circuit to the succeeding equipment is not carried thru contacts on the (A) relay and ground is supplied to the (C) relay thru make contacts on the (J) and (E) relays in place of the back contact of relay (A). The loop is opened thru break contacts on the (J) relay as described in paragraph 6.3.

7. SUPERVISION

7.1 When Fig. C is Provided

Supervision is received by this circuit as a reversal of the line current which then makes the front and rear windings of the (D) relay aiding and this relay operates. The (D) relay operated, removes ground from the "M" lead to the composite signaling circuit substituting battery through the (B) lamp which is a supervisory indication to the originating end. The (D) relay operated, also opens the circuit to the (C) relay. This is for the purpose of preventing the (C) relay from operating if pulses are received when a reversal condition exists since this would cause battery to be connected to battery and ground to ground releasing the associated switches. The (A) or (J) relay of Fig. A or B under such a condition will open the front winding circuit of the (D) relay but this relay remains operated on its rear winding. The (D) resistance is used to prevent too great a current flowing through the front winding of the (D) relay in the nonoperate direction, thus overpowering the rear winding and falsely operating the relay.

7.2 When Fig. D is Provided

Operation when Figure D is provided is the same as described in paragraph 7.1 except that the (BY) relay may operate under control of the "F" lead on operator originated calls over local type switching trains. When the (BY) relay operates, battery is connected to the "M" lead whether or not the (D) relay has previously operated. The ground on the "F" lead may be either busy flash or supervision from free service lines depending on the progress of the call to succeeding switches. The (BY) relay operated also opens the operating path of the (C) relay.

8. DISCONNECT

8.1 Figs. 1 and A

When the originating end disconnects, ground is removed from the "E" lead, releasing the (A) relay which opens the tip and ring circuits to the succeeding switches and opens the circuit to the slow release (B) relay. The (B) relay released, removes ground from the sleeve, releasing the succeeding switches, reconnects its ground to the "BR" lead to the traffic register circuit indicating that at least one trunk of the group is idle and deenergizes the rear winding of the (D) relay which releases if operated. The release of the (B) relay also deenergizes the second winding of rel. P when Fig. G is used.

8.2 Figs. 1 and B

When the originating end disconnects, ground is removed from the "E" lead operating the (E) relay. The circuit then progresses the same as described under pulsing up to the point where the (J) relay has operated and locks through the contact of the (A) relay and the (E) and (K) relays released open the tip and ring to the succeeding circuit. The continued release of the (A) relay releases the slow to release (B) relay which performs the same functions as described above in paragraph 8.1 and in addition releases the (F) and (J) relays.

9. MISCELLANEOUS

The (B) resistance and condenser is used to protect the contacts of the (CX) signaling relay in the composite signaling circuit and to regulate the percent break of the (A) relay, when using Fig. A. The (A) and (F) resistances are used to limit the current flow through the contacts of the (C) relay when the tip and ring are momentarily connected together during the operate and release of the (C) relay. As referred to above the (C) condenser and (C) resistance are used when this trunk is associated with a directly connected telephone repeater to provide a termination with the circuit idle. Also, as described above, the (D) resistance prevents the (D) relay from operating falsely on short loops due to the front winding receiving sufficient current to overpower the rear winding. The (E) resistance is used in parallel with the winding of the (C) relay to accomplish its slow to release function. The potentiometer (A) is used in parallel with the winding of the (C) relay in place of the (E) resistance when timing requirements are applied to the (C) relay. The (M) resistance in Fig. (A) is used to limit the current thru the (A) relay and

improves repeating pulses from the (CX) circuit. As described above the (G) resistance is used to reduce the current drain after the (A) relay is operated but by being short-circuited decreases the operate time of the (A) relay. The (H) resistance also as described above, is used to insure that the (A) relay holds when the (E) relay operates and also to prevent the (E) relay from operating on momentary opening of the (CS) relay contact. The (J) and (K) resistances are used to make the (F) and (H) relays somewhat slow in releasing. The (T) and (P) jacks are used for adjusting the (F) and (H) relays to the desired release time through the use of the pulsing test set and percentage break-meter. The (E) network provides contact protection for the busy flash interrupter relays. The (E) network provides contact protection for the (E) relay and the CX signaling relay. The (F) network provides contact protection for the (F) relay. The (G) network provides contact protection for the (H) and (H1) relays. The (PT) jack is used for adjusting the (P) relay in Fig. G. This (PT) jack is arranged so that if a plug is inserted into the jack in error while the circuit is in use, the busy call will not be interrupted.

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DEPT. 2313-ASD-RLL-FR