CROSSBAR SYSTEMS
NO. 3
INTERRUPTER CIRCUIT
60 OR 120 IPM

CHANGES

B. Changes in Apparatus

B.1 Added

CW2 - 177A Network, Fig. 7, Option X

B.2

Removed	Replaced By
AL - 2Y Lamp - Fig. 3	AL - M1 Lamp - Fig. 3

D. Description of Changes

D.1 FS2, 4, and 5 have been revised to clarify the connections between figures. Corresponding changes are also shown in the respective App Fig.

D.2 FS7 has been revised to show the addition of X option.

D.3 Circuit Notes 101, 102, 104, and 105 have been revised.

D.4 Circuit Note 109 is added.

D.5 Equipment Note 205 is rated Mfr Disc. and is replaced by Equipment Note 208.

D.6 CADs 1, 2, and 3 have been revised.

D.7 CAD 4 is added.

F. Changes in CD SECTION II

F.1 Change first sentence of 4.01 to read:

The start circuit FS2 is provided three per office and are operated by ground over a start lead common to all circuits connected to the associated secondary.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-GFC

WE DEPT 25820-RET-GWC-BT

CROSSBAR SYSTEMS
NO. 3
INTERRUPTER CIRCUIT
60 OR 120 IPM

CHANGES

D. Description of Changes

D.1 The CAD 2 changed to reflect the addition of OFT leads required for the auxiliary line circuit for call-waiting service.

D.2 The FS5, succeeding and preceding notations are added for the B and F leads.

F. Changes in CD Sections

F.01 In SECTION I, 2.03, change the reference to "same cam contact", to read "same relay contact."

F.02 In SECTION I, 2.04, change the reference to "line link trunk and register circuits", to read "line link, trunk, and register circuits."

F.03 In SECTION II, 1.02, change the reference to "60 IPM for line-busy tone for locked out lines", to read "60 IPM for line-busy tone."

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-HNS

WE DEPT-355-RET-KLF-JCM

5

CROSSBAR SYSTEMS
NO. 3
INTERRUPTER CIRCUIT
60 OR 120 IPM

TABLE OF CONTENTS

SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit is a source of ground interruptions and interrupted low tone and precise low tone. It provides tone and ground interruptions at 60 and 120 IPM to trunk and register circuits for use as busy or overflow signals. The ground interruptions are also supplied to incoming trunk test line circuits for synchronizing automatic tests with the test circuits in the originating office.

1.02 This is a repeating relay circuit which uses a ringing and tone power plant circuit as the prime source of interruptions.

2. GENERAL DESCRIPTION OF OPERATION

2.01 The basic circuit required for each interruption rate includes a primary relay, a secondary relay and associated start relay, and an alarm circuit.

2.02 Two primary relays are included in each primary circuit, FS1. One relay of each pair continuously pulses. The second relay remains idle and is available to replace the relay in service if necessary because of failure or for testing. The primary figures are provided for each frequency as necessary to control the secondary relays.

2.03 The primary relays used for 60 and 120 IPM are directly operated and released by relays in the ringing and tone power plant circuit. All of these primaries of the same interruption rate are operated in parallel from the same cam contact.

2.04 The secondary relays, FS4, 5, and 6, interrupt ground and/or tone for the line link trunk, and register circuits requiring these signals. Secondary circuits are provided as necessary for the numbers of connecting circuits and types of interruptions required.

2.05 To extend relay life, a secondary relay is pulsed only when a circuit connecting to it requests tone or flash. One of the start relays, FS2, is associated with each secondary circuit. Each start relay can be operated by any of the circuits connecting to the associated secondary circuit and will cause a secondary relay to follow the operations of a primary relay. The secondary relay continues to supply flashing ground or interrupted tone until the start relay is released by the connecting circuit.

Printed in U.S.A.

2.06 An alarm circuit, FS3, is provided for each interruption rate. Slow-release relays in these circuits check the operated and released intervals of all secondary relays. If a failure occurs, relays of an alarm circuit provide automatic transfer to the alternate primary relays of that IPM and bring in an alarm.

SECTION II - DETAILED DESCRIPTION

1. SECONDARY CIRCUITS

1.01 The 60- and 120-IPM ground and tone supplied by the secondary circuits is used as a busy or overflow signal. The 60- and 120-IPM ground is also used by incoming trunk test lines for synchronizing tests with the test circuits in the originating office.

1.02 The FS4 may be connected to a 60- or 120-IPM primary relay and provides ground interruptions only. The TS- switch of this figure removes ground from the FL- leads to permit testing the FC- secondary relays. Switch TS- operated also lights the AL alarm lamp shown in FS4 and causes an alarm. This is to assure this switch is returned to the normal position after testing.

1.03 The FS5 provides low tone interrupted at 60 or 120 IPM. Battery is connected to the TN- leads when the T relay is normal. This prevents crosstalk between the TN- leads for 60- and 120-IPM tone by holding the leads at AC ground when tone is not transmitted. The TN- leads are not connected to direct ground because the low tone is imposed on battery.

1.04 The FS6 provides low tone interrupted at 60 IPM for line-busy tone for locked out lines and 120 IPM for overflow tone on trunk switches. Battery is connected to the LBT- or OFT- leads when the relays are normal. This prevents crosstalk between the LBT- or the OFT- by holding the leads at AC ground when tone is not transmitted. The LBT- and OFT- leads are not connected to direct ground because the low tone is imposed on battery.

1.05 The FS7 provides 10-IPM interrupted battery pulse for calls-waiting service. A ground signal over lead CWS from the auxiliary line circuit operates the CWS relay. Relay CWS operated closes the path through a make-contact to operate the CWI relay. The CWI relay follows the ground pulse from the power ringing and tone distributing circuit over lead PU, battery is then supplied to the auxiliary line circuit at the same pulse rate as the ground supplied through the PU lead.

2. ALARM CIRCUITS

2.01 A separate alarm circuit is required for each interruption rate. These circuits check the operated release intervals of the secondary relays. The 60- and 120-IPM alarm circuit FS3 also tests for a trouble ground on the lead from the ringing and tone power plant circuit which controls the primary relays of each frequency.

2.02 One FS3 alarm circuit is provided for all secondary circuits of 60 IPM, and a second FS3 is provided for all secondary circuits of 120 IPM.

2.03 The B relay of FS3 is slow-release because of an RC timing circuit described below, and is used to check the operated intervals of the secondary relays. If all secondary units are idle, relay B is held operated from battery over lead B through a series circuit of a break-contact of each associated secondary relay. When one or more secondary relays are in use, this operate path is opened each cycle; however, the B relay will hold over a normal open interval.

2.04 If the series circuit of break-contacts remains open a nominal 0.7 second for 60 IPM or 0.5 second for the 120-IPM secondary relays, relay B releases and operates relay AL. Relay AL operates relay AL1 and connects resistance battery to the alarm circuit MJ lead to cause a major alarm and lights the AL lamp.

2.05 Relay AL1 locks under control of the alarm release (AR) key and the alarm sending circuit if the latter is provided. Relay AL operated also transfers the ringing and tone power plant circuit ground pulses to the alternate primary relays. This automatic transfer will make the circuit operational again after a failure caused by a primary relay or primary relay contact.

2.06 The AL relay operate path includes break-contacts of the RA- and RB- relays to prevent operation of the AL relay

during a closure interval. Otherwise the RA- or RB- relays could be released and re-operated during transfer of the AL relay contacts.

2.07 Relay F functions identically to relay B to check the released intervals of the active secondary relays. The F relay operate path is a series circuit of a make-contact of each associated secondary relay. Each make-contact is paralleled by a break-contact of the associated start relay to maintain the continuity of the chain when the secondary relays are not in use.

2.08 Relay R is connected to the lead 60 IPM or 120 IPM and continuously follows the ground pulses from the ringing and tone power plant relay contact. A break-contact of relay R pulses the GP relay, which is made slow-release by a timing circuit similar to that for relays B and F, and remains operated when the circuit is functioning normally.

2.09 A trouble ground on the 60 IPM or 120 IPM lead will hold relay R operated causing the GP relay to release in approximately 0.75 second. Relay GP released removes battery from the coils of the primary relays, releasing all of the primary relays which are in use. This feature prevents secondary relays remaining operated because of a trouble ground on one of the leads from the ringing and tone power plant circuit. This is to avoid a false charge condition in trunk circuits which return off-hook during the grounded interval of the flashing supplied to them. If the primary relays are released as above, an alarm will be sounded when the first start relay is operated by a connecting circuit, as the chain of secondary relay make-contacts will be opened by a break-contact of the start relay. Operation of the R relay is checked by connecting an R relay make in series with the F relay contact chain.

2.10 The RC timing circuits which are used to slow the release of relays B, F, and GP of FS3 are all similar except for the release times of the relays. The B relay circuit is typical and functions as follows.

2.11 When the secondary relay contact chain is closed, battery over lead B holds relay B operated and charges capacitor B through diode V2. This capacitor charges to approximately 48 volts as terminal two of the diode is very close to ground potential when the diode is conducting. When the contact chain opens, battery is removed from lead B. The voltage of capacitor B and the D battery in series now to maintain a holding current through relay B and timing resistor R. As the IR drops across the B relay coil is initially less than the voltage of capacitor B, the diode is back-biased and does not conduct.

2.12 Relay B is thus held during the discharge of the B capacitor until the capacitor voltage reduces to a point at which the diode is again forward-biased. When this occurs, the diode conducts and shunts down the B relay. Resistor U limits the initial current surge to protect the diode when capacitor B is charged. Capacitor V2 limits the voltage from the inductive kick of the B relay coil which occurs when battery is removed from lead B.

2.13 Each alarm circuit provides a switch designated TBF or TGP which is used to isolate the slow-release relay timing circuits for testing. In addition, a TR switch allows manual transfer of the ringing and tone power plant circuit pulses to the alternate primary relays of each frequency.

3. ALARM RELEASE

3.01 The AR key provides manual release of locked alarm relays of each alarm circuit. These relays may also be released under control of the alarm sending circuit.

4. START CIRCUIT

4.01 The start circuit FS2 is provided one per two secondary figure and is operated by ground over a start lead common to all circuits connected to the associated secondary. Make-contacts of the start relays connect interrupted ground and battery pulses from the primary relay contacts to the secondary relay coils.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 None.

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designations	Meaning
AL	Alarm
ALl	Auxiliary Alarm

Designations	Meaning
B	
F	
FC	Flash
GP	
LBT	Line-Busy Tone
OFT	Overflow Tone
R	Ringing
RA	Primary A
RB	Primary B
STA	Start A
STB	Start B
T	Tone

3. FUNCTIONS

3.01 Provides ground and tone supply for a busy or overflow signal.

3.02 Provides switches for testing the slow-release timing circuits.

3.03 Provides switches for testing the secondary relay circuit for supplying ground.

3.04 Provides a key for manual transfer of primary relays.

3.05 Provides an alarm lamp and an alarm release key.

3.06 Provides 10-IPM battery pulse for calls-waiting service.

4. CONNECTING CIRCUITS

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

(a) Power, Ringing, and Tone Distribution Circuit - SD-26414-01.

(b) Voice Alarm and Control Circuit - SD-26390-01.

(c) Trunk Switch and Connector Circuit - SD-26383-01.

(d) Originating Register Circuit - SD-26385-01.

(e) Permanent Signal Holding Trunk Circuit - SD-26134-05.

(f) Alarm Sending Circuit - SD-26442-05.

(g) Station Ringer Test Circuit - SD-26109-01.

(h) Incoming Trunk Test Line Circuit - SD-26413-01.

(i) Test Circuit on Test and Recorder Frame - SD-26411-01.

(j) Line, Line Switch, and Connector Circuit - SD-26382-01.

(k) Ringing and Tone Power Plant Circuit - SD-26457-01.

(l) Alarm Circuit - SD-26393-01.

(m) Miscellaneous Circuit - SD-26406-01.

(n) Outgoing Trunk Circuit - SD-26421-01 (Typical).

(o) Revertive Call Trunk Circuit - SD-26415-01 (Typical).

(p) Incoming Trunk Circuit - SD-26417-01.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 This interrupter equipment shall be capable of meeting all the requirements of the Circuit Requirements Table.

6. ALARM INFORMATION

6.01 A major alarm will sound under any of the following conditions:

(a) Failure of a primary relay.

(b) Failure of a secondary relay.

(c) An open lead from the ringing and tone power plant circuit.

(d) A trouble ground on a lead from the ringing and tone power plant circuit. (60 and 120 IPM only).

6.02 When an alarm occurs, one of the AL lamps on the interrupter unit is lighted and indicates which of the interruption circuits has failed, eg, the 60-IPM circuit. The frame line-up lamp in the test frame for the frame line-up in which the interrupter unit is located is also lighted. The alarm remains locked in until released by an alarm release key on the interrupter circuit or from a distant office if the alarms have been transferred.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 Relays RA and RB - Both RA and RB relays of the same frequency should not be removed from service at the same time. To remove a primary relay from service, the associated transfer (TR) key is operated to place the alternate primary in service. The AL relay of the associated alarm figure should be blocked nonoperated as an incidental operation of one of these relays could reverse the primary relay choice made with the transfer key.

7.02 Relay STA, STB - Jumper the G and N leads around the make-contacts of the STA and STB relays so the associated secondary relays will pulse continuously.

7.03 Relay T, FC, OFT, or LBT - Make busy the circuits connecting to the tone or flash leads of the secondary relay to be tested or replaced. Also connect the F leads of the secondary figure together and connect the B leads together. This is to maintain continuity of the series contact chains.

7.04 Relay GP - Before removing the GP relay from service, bridge contacts 6-6M and 4-4M to maintain the battery supply for the primary relays. The GP relay should be returned to service as soon as possible to restore the false ground detection feature.

7.05 Relay R - Before removing the R relay from service, bridge contacts 4-4M in order to maintain the operating circuit for the F relay. Also, block GP operated as it would otherwise release and remove battery from the primary relays.

7.06 Relay AL, AL1 - Before removing the AL relay, connect the L(RA) or L(RB) lead to battery (depending on which set of primaries is in use) and the U(RA) or U(RB) lead to the lead from the ringing and tone power plant circuit, eg, the 60-IPM lead. This maintains the operate path of the primary relays. Remove the leads to the coils before removing the contact leads. Return the relay to service as soon as practicable to restore the automatic transfer feature and the alarm feature.

7.07 Relay B or F - Remove the leads to the contacts of these relays before removing the coil leads. This is to avoid operating the alarm relay.

7.08 Relay CWS - Before removing the CWS relay from service bridge contacts 5-5M so the CWI relay will pulse continuously.

7.09 Relay CWI - Make busy the circuits connecting to the interrupted battery supply leads before removing the relay. Return the relay to service as soon as possible to restore the calls-waiting service.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-LCB

WE DEPT 355-RET-KLF-DM