

**TROUBLE RECORDER CARD ANALYSIS  
AND  
TROUBLE LOCATION  
NO. 5 CROSSBAR OFFICES**

	PAGE		PAGE
1. GENERAL . . . . .	2	Sender Called Number Check Circuit of Completing Marker . . . . .	5
2. MATERIAL AND METHODS USED IN ANALYZING AND LOCATING TROUBLES . . . . .	3	3. Trouble Recording . . . . .	7
A. Equipment . . . . .	3	4. Single-Sided Trouble Recorder Card E-3638—Typical Example . . . . .	11
B. Indications of Trouble . . . . .	3	5. Double-Sided Trouble Recorder Card E-4393—Typical Example . . . . .	12
C. Tracing Circuit Continuity . . . . .	3	6. Double-Sided Trouble Recorder Card E-5254—Typical Example . . . . .	13
D. Taking Equipment Out of Service . . . . .	4	7. Double-Sided Trouble Recorder Card E-5488 —Typical Example . . . . .	14
E. Alarms . . . . .	4	8. Typical Trouble Recorder Card and Associated Sequence Chart for Dial Tone Connection— Single-Sided Card . . . . .	15
3. TROUBLE RECORDING . . . . .	6	9. Typical Trouble Recorder Card and Associated Sequence Chart for Outgoing Trunk Connection—Single-Sided Card . . . . .	16
A. General . . . . .	6	10. Typical Trouble Recorder Card and Associated Sequence Chart for Incoming Trunk Connection—Front of Double-Sided Card . . . . .	17
4. TROUBLE RECORDER CARD ANALYSIS . . . . .	9	11. Typical Trouble Recorder Card and Associated Sequence Chart for Intraoffice Trunk Connection—Front of Double-Sided Card . . . . .	18
A. Card Description . . . . .	9		
B. Basic Steps in Analyzing Trouble Recorder Card . . . . .	9		
C. Use of Sequence Charts . . . . .	10		
D. Analysis of Typical Trouble Recorder Cards . . . . .	10		
 <b>FIGURES</b>			
1. Modification of a Low Resistance Test Receiver for Use as a High Resistance Test Set . . . . .	3		
2. Long Chain of Make and Break Contacts—Typical Example in an Outgoing			

## SECTION 218-105-301

### 1. GENERAL

**1.01** This section describes trouble recorder card analysis and trouble location in No. 5 crossbar offices with the use of the master test frame trouble recorder control and test circuit, KS-13834 trouble recorder perforator, and trouble recorder card.

**1.02** This section is reissued to update trouble record card punches and to add information about the automatic progression trunk test frame, remote office test line, translator test and administration circuit, and line verification circuit.

**1.03** The trouble recorder control and test circuit with associated keys and lamps provides facilities for controlling the operation and testing of the trouble recorder perforator.

**1.04** The trouble recorder perforator is a fast, intricate mechanical device which provides facilities for automatically recording information on punched trouble recorder cards as a result of circuit or traffic failures on service calls, monitored calls, or test calls.

**1.05** Perforations on the trouble recorder cards furnish certain basic types of information aiding in the analysis and location of troubles such as the following:

- (a) Equipment involved in establishing a call connection
- (b) The type of call connection being established
- (c) Progress of the various circuit operations at the time the trouble occurred
- (d) The specific test which has indicated trouble
- (e) Identification of the calling line, called line, trunk, and channel through which the connection was established
- (f) The time the trouble occurred, if AMA facilities are provided.

Arrangements have been made to use a spare position on the trouble recorder card for recording or trapping selected traffic conditions (reorder, vacant code, failure to match, particular channel selection, etc) during the progress of a call. By means of appropriate cross-connections in the marker, these traffic conditions may be recorded with the aid of the trouble recorder under key control at the master test frame.

**1.06** When an office is unattended, the trouble recording facilities operate automatically to produce trouble recorder cards. These cards are stored in the trouble recorder perforator until the next attended period, at which time the master test frame testing facilities may be used to locate and correct any troubles that still exist.

**1.07** Trouble recording facilities are an essential part of testing and maintenance. The various conditions and circuits involved on a service call indicated on a trouble recorder card can be simulated by setting keys and switches on the master test control circuit. Usually, any trouble encountered on a test call also results in a trouble recorder card, thereby assisting in pinpointing the malfunction by indicating the progress of the test call. The trouble recording facilities may also be used to make permanent records of satisfactory test conditions such as an O.K. check of cross-connections associated with a customer line.

**1.08** Audible and visual alarms occur at the master test frame when serious traffic delays or irregularities are encountered. These alarms may be transferred to other offices through the use of alarm sending facilities when the office is unattended.

**1.09** The amount of maintenance required in an office can be reduced by eliminating, as much as possible, certain sources of trouble such as cross-connection errors, solder crosses, broken wires, and dirty contacts. When a broken wire is replaced or repaired, the maintenance personnel should be careful not to introduce additional trouble such as crosses caused by wire clippings or dropped

solder. Dust in the air or dirt stirred up by repair work may cause contact failure at a future date.

## 2. MATERIAL AND METHODS USED IN ANALYZING AND LOCATING TROUBLES

### A. Equipment

**2.01** The analysis and location of trouble is based on the use of the information given on the SD drawings. On detached contact schematics, this information is in the form of functional schematics and sequence charts. The sequence charts and circuit description indicate the order of operation of the relays and other equipment in the circuit; the functional schematics give the circuit electrical operating paths. On attached contact schematics, the circuit description supplies information regarding the order of operation of relays in the circuit. Further information necessary for the analysis and location of trouble may be obtained from sequence charts, operational sketches, and reference material tabulated by the local company.

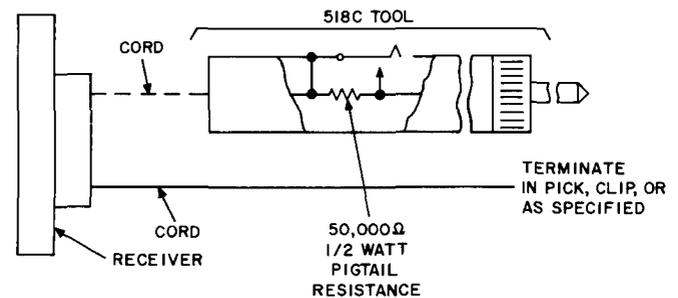
**2.02** The master test frame should be used whenever possible to make trouble location tests. These tests are made to reproduce the conditions under which the trouble became apparent. Use of the master test frame results in faster and more accurate analysis and location of trouble. When the master test frame is used for locating trouble, a 32A remote control test set and either a test receiver or a test meter may be required.

**2.03** A test receiver, such as the 716C receiver, modified for use as a high resistance test set as shown in Fig. 1 should be used. The modification consists of a 518C tool in which a 1/2-watt, 50,000-ohm resistor is connected in series with the receiver. The 518C tool is equipped with a nonlocking switch, which when depressed, shunts the 50,000-ohm resistor out of the circuit.

**2.04** The KS-14510 meter test set, or equivalent, is a self-contained, portable, volt-ohm-milliammeter provided with test leads terminating in either test picks or alligator clips. This test set is used for general testing purposes in the telephone plant.

### B. Indications of Trouble

**2.05** Irregular operating conditions occasionally occur; therefore, it is necessary to determine



**Fig. 1—Modification of Low-Resistance Test Receiver for Use as High-Resistance Test Set**

the cause of the irregularity and to decide if the condition resulted from a trouble in the equipment or an overload condition. Trouble conditions must be analyzed and remedied by the maintenance personnel.

**2.06** The first indication of trouble is usually given by audible and visual alarms. When the trouble recorder control and test circuit is seized, an alarm sounds and the aisle pilot lamp lights at the master test frame.

**2.07** Indications that trouble exists may also be obtained from the following reports: (1) customer, (2) testboard, (3) operator, (4) routine testing, and (5) distant office.

**2.08** Usage lamps for nearly all of the major circuits in the office are provided at the master test frame. Analyzing the lamp displays aids the maintenance personnel in determining the course of action to take to prevent traffic delays and to control the effect of equipment overloads. When the lamps associated with particular groups of circuits are lighted at infrequent intervals, either a light traffic load exists or certain types of traffic are not being served. The latter condition is determined by observing that the lamp associated with a particular circuit does not remain extinguished for a long period of time. A listing and usage of these lamps are given in SD-25762-01 circuit notes (master test frame jack, lamp, and key circuit).

### C. Tracing Circuit Continuity

**2.09** The two main sources of circuit trouble are wiring and dirty contacts. Observation of

proper maintenance procedures will reduce troubles caused by these sources.

**2.10** Trouble affecting the continuity of a circuit should be located with a test receiver. Trouble requiring voltage, current, and resistance measurements should be located with an appropriate test meter. Reference should be made to Section 032-173-301 for procedures to be followed when working on circuits containing diodes, varistors, or transistors.

**2.11** Trouble in a long chain of make or break contacts (Fig. 2) generally can be located more quickly if testing is started in the middle of the chain. This procedure normally reduces the average number of trials necessary to locate the source of trouble. However, use of such a procedure depends upon the physical location of the equipment. When using a test receiver to locate the source of a trouble in which a relay is missing an operating ground, one side of the receiver should be connected to battery and the missing ground traced out. This procedure prevents false relay operation. When the opposite condition exists, one side of the receiver should be grounded and the missing battery traced.

**2.12** When checking for battery, a low resistance test receiver may be used in conjunction with the high resistance ground (HRG) terminal on the various frames. This terminal has a 12,000-ohm resistor connected to ground and will limit the current sufficiently to make practical the use of a low resistance test receiver. There is no high resistance battery terminal available to check for ground with a low resistance test receiver; therefore, it is advisable that a high resistance test receiver be used when checking for continuity, ground, or battery. Battery or ground should not be used directly through a low resistance test receiver. The current may burn out the dirt on contacts and thereby remove the possible source of trouble before it is located. Trouble accidentally cleared in this manner provides no indication as to the original cause or the possibility of recurrence.

#### **D. Taking Equipment Out of Service**

**2.13** The trouble recorder circuit may be taken out of service by inserting 322A (make-busy) plugs into the TRMB- jacks at the master test frame. Use of these plugs makes the trouble recorder control and test circuit appear busy to all

circuits having access to it. Therefore, the master test frame connector circuit and consequently the trouble recorder circuit cannot be seized because the TRST lead in each of these circuits will be opened during any bid for a trouble record.

**2.14** If a circuit indicates a failure affecting a large number of calls, it is essential to rapidly remove the circuit from service until the trouble is located and cleared. When a failure is affecting a large number of calls and the defect is not evident, a rapid check may be made by removing certain suspected circuits from service for short periods of time. Removal of circuits from service should be done with extreme caution and under close supervision.

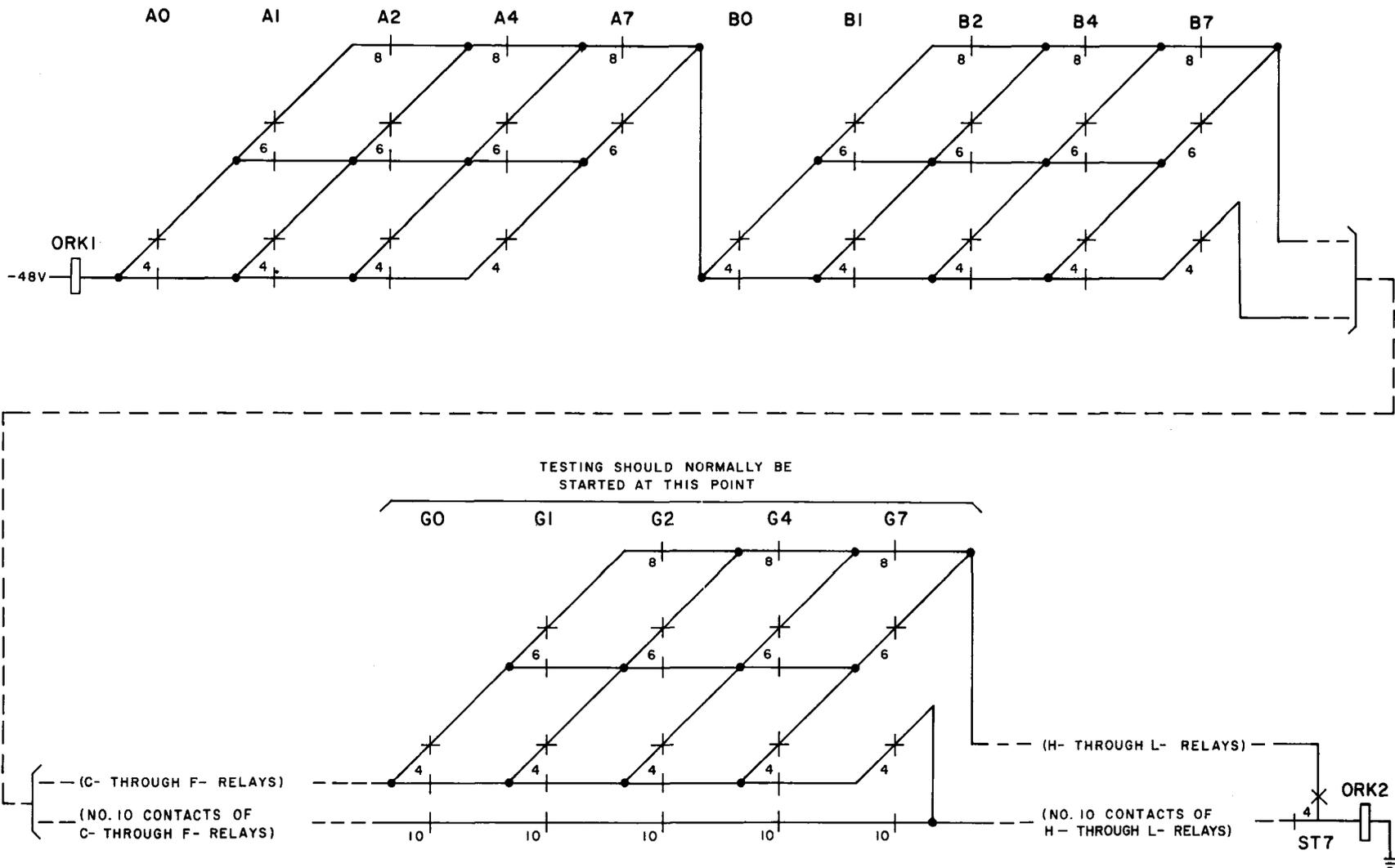
**2.15** Make-busy jacks are furnished for making busy markers, transverters, AMA translators, pretranslators, AMA recorders, registers, senders, master timing circuits, connectors, and outgoing trunks. A circuit may be removed from service by inserting a make-busy plug into the make-busy jack associated with the circuit. Use of the make-busy plug prevents a circuit in trouble from causing service failures. Removal of the make-busy plug restores the circuit to service.

**2.16** Trouble should be cleared and circuits restored to service as quickly as possible to prevent a backup of traffic that will extend to and affect other offices.

#### **E. Alarms**

**2.17** An alarm sounds each time the trouble recorder control and test circuit is seized. The alarm may be either major or minor depending upon the conditions under which the circuit was seized. In general, a minor alarm indicates a first trial failure and a major alarm indicates a second trial failure.

**2.18** When the trouble recorder control and test circuit is seized, an alarm sounds, the aisle pilot lamp lights at the master test frame, and the trouble recorder request lamp (TRR) lights at the trouble recorder control panel. While the trouble recorder card is being punched, the recorder off-normal (RON) and the trouble recorder busy (TRMB) lamps light at the trouble recorder control panel. After the card has been punched, the RON and TRMB lamps extinguish. However, the TRR



**Fig. 2—Long Chain of Make and Break Contacts—Typical Example in an Outgoing Sender Called Number Check Circuit of Completing Marker**

lamp remains lighted and the alarm continues. This indicates that a trouble recorder card was punched.

**2.19** When the trouble recorder control and test circuit is busy or has been taken out of service, a requesting circuit brings in an alarm and lights the TRR and display lost (DL-) lamps at the master test frame.

**2.20** The alarm resulting from a trouble record or a display lost indication may be silenced and the TRR and/or DL- lamp extinguished by operation of the trouble recorder request-alarm release (TRR-AR) key at the master test frame. In some offices, the alarm may also be silenced at points remote to the master test frame through use of the remote control facilities.

**2.21** When the trouble recorder control and test circuit is requested to serve more than a predetermined maximum number of trouble records within a timed interval of approximately 1/2 to 2 minutes, the temporarily out-of-service (TOS) lamp lights. If a circuit attempts to seize the trouble recorder control and test circuit while the TOS lamp is lighted, an alarm will sound and the DL-lamp will light. The TOS timing may be canceled by operation of the cancel temporarily out-of-service (CTOS) key.

**2.22** If the trouble recorder control and test circuit remains off-normal for more than 2 to 4 seconds, a major alarm sounds and the TRMB and RON lamps light. Operation of the AR key silences the alarm; operation of the motor cut-off release (MCOR) key extinguishes the TRMB and RON lamps and restores the circuit to normal unless there is a trouble condition which prevents restoration.

**2.23** If trouble develops in the master test frame connector circuit, requesting circuits cannot seize the trouble recording facilities and the following action takes place.

- (1) Markers, transverters, and pretranslators time out, release, and bring in their own major alarm and trouble recorder timing (TRT) lamp at the respective frames.
- (2) The master timing circuit times out, brings in a major alarm, and lights time alarm lamp (TAO) or (TAE) at the master test frame.

- (3) The automatic monitor, register and sender test circuit brings in a minor alarm and lights the TRR and DL- lamps. The monitor releases unless the hold (HLD) key is operated, in which case both the monitor and register are held.

- (4) The AMA recorder brings in a minor or major alarm and lights the TRR lamp. If the recorder fails to release, it may be identified at the master test frame by its lighted in-use (R-) lamp.

**2.24** When the trouble recorder card bin is almost empty, a minor alarm sounds and a warning (WAR) lamp lights at the trouble recorder control panel. Each succeeding trouble record will cause the same alarm to sound until the card bin has been refilled. This alarm may be silenced by operating the alarm release (AR) key at the trouble recorder control panel. When the bin is empty, a major alarm sounds, the WAR and TRMB lamps light, and the trouble recorder is made busy. This alarm may be silenced by operation of the AR key. When the bin is refilled, the trouble recorder control and test circuit may be restored by operating the motor cut-off release (MCOR) key.

**2.25** If a trouble recorder card becomes disengaged or jammed in the card moving mechanism, the procedure is similar to that described in 2.24, except that the WAR lamp does not light.

### **3. TROUBLE RECORDING**

#### **A. General**

**3.01** Most service irregularities are indicated on trouble recorder cards. These cards are punched as a result of circuit or traffic failures on service calls, monitored calls, or test calls.

**3.02** Requests for trouble recorder cards originate from the following sources (Fig. 3):

- (a) Markers
- (b) Pretranslators
- (c) Automatic monitor, register and sender test circuit
- (d) Line insulation test circuit

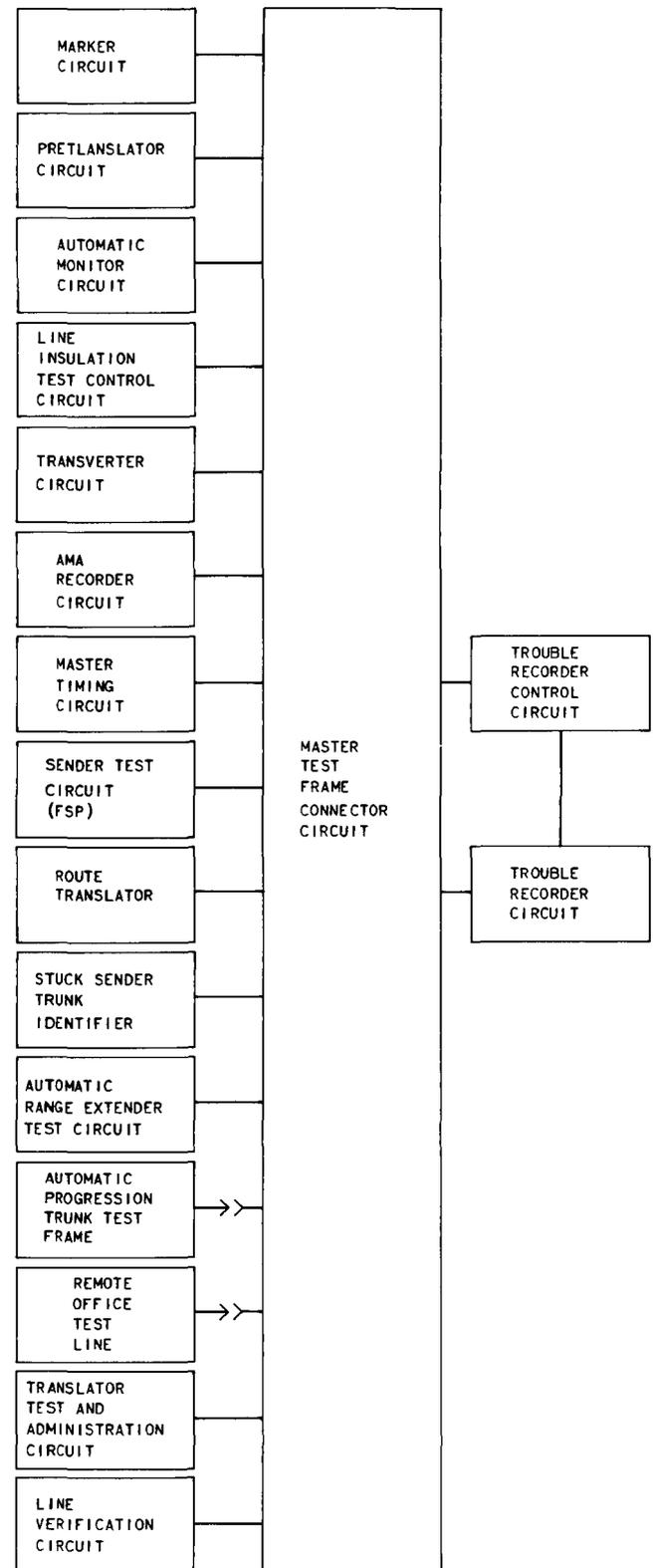
- (e) Transverters
- (f) AMA recorders
- (g) Master timing circuit
- (h) Sender test circuit (FSP)
- (i) Route translator
- (j) Stuck sender trunk identifier
- (k) Automatic range extender test circuit
- (l) Automatic progression trunk test frame
- (m) Remote office test line
- (n) Translator test and administration circuit
- (o) Line verification circuit.

**3.03** The master test control circuit is used for establishing a majority of the test connections. Except for test circuits in use, all keys and switches should be restored to normal. This practice prevents interference which may be caused by keys and switches which have access to the points under test.

**3.04** Operation of the master test control circuit start (ST) key causes that circuit to signal and seize the other test circuits and the master test frame connector circuit. These circuits in turn signal, select, and seize the required central office service circuits to establish the test connections.

**3.05** Operation of the release (RL) key extinguishes the lamps and releases the control circuit relays, thereby restoring all of the connected common control circuits to normal. Trunk supervision can often be held for purposes of extending the call. A repeat test is made by reoperating the ST key.

**3.06** With the exception of line tests, the start and release control can be extended to all equipment frames through the RC jack multiple. By using a 32A test set plugged into an RC jack, test calls can be started and released from any equipment location. The operation of the test call can then be observed at these locations.



**Fig. 3—Trouble Recording**

## SECTION 218-105-301

- 3.07** When testing on a remote control basis, the trouble recorder may be made busy to the particular marker or transverter used on the test to prevent the punching of cards.
- 3.08** The operation of the master test control circuit repeat (REP) key causes the tests of registers and senders to be repeated on the same register or sender after each successful completion.
- 3.09** On register tests, after a test call is started, the ST key may be used on a local or remote control basis to control digit pulsing with the operation of the digit step-by-step (DSS) key. Each operation of the ST key provides for the pulsing of only one digit at a time until all digits have been pulsed.
- 3.10** The master test control circuit record (REC) key causes the marker, transverter, or automatic monitor, register and sender test circuit to summon the trouble recorder and make a record of the connection set up before they release.
- 3.11** Markers or transverters are seized by the master test control circuit by use of the master test frame connector circuit. As indicated by operated keys and switches, the markers or transverters go through call cycles. The progress of the test call is shown on the test frame marker and transverter lamps. If no trouble is encountered, the markers or transverters release when the end of the operation cycle is reached. If the REC key is operated, the release is delayed until a recorder card is punched to show in detail the operations gone through on the test call. If trouble is encountered, a recorder card is punched regardless of the REC key in order to indicate the trouble, unless the trouble recorder is made busy to that circuit.
- 3.12** After the marker or transverter releases, the test frame control relays and indicating lamps remain operated under control of the RL key. If the test is not a register, sender, or trunk test, no other equipment is held.
- 3.13** If a trunk, originating register, or outgoing sender test is made, the marker sets up the connection to the respective test circuit. This test connection is held under control of the RL key. To complete the testing cycles, some of the trunk tests require operation of keys in response to trunk test lamp signals. After the marker releases, the test proceeds under control of the test circuit and the performance of the test is indicated on lamps and by audible tone signals.
- 3.14** Trouble recorder cards are punched for pulsing troubles encountered on register and sender tests from the automatic monitor, register and sender test circuit.
- 3.15** Incoming trunk tests require patching a test cord between the common trunk frame test jack and the test jack of a particular trunk. A marker is used on incoming trunk tests to obtain the line number from the keys and switches operated in the master test frame. It then establishes the connection to this line.
- 3.16** Incoming registers are seized through test access verticals on the incoming register links. When register tests are made with the use of the automatic monitor, register and sender test circuit, the markers connect to the master test frame and pass back to the test circuit the number registered under pulsing test conditions. Incoming register tests may also be made with the use of the portable register and CAMA sender test set in conjunction with the incoming register test circuit, the trouble recorder, a telephone set, and the pulse generating test set. When making incoming register tests with the portable test set, use of a 20-conductor test cord and appropriate 20-conductor jacks on the master test frame control bay and on the incoming register frames is necessary.
- 3.17** On some types of test calls which are not specific tests of marker or transverter features and which may be controlled at points remote from the master test frame, strict observance of the marker and transverter lamps is not required.
- 3.18** The master timer circuit is arranged to recognize start signals from the even or odd master timing circuit for trouble records. When the even or odd master timing circuit encounters trouble, it connects battery to the corresponding TRST lead to this circuit. If an AMA recorder is attached for a test or special pattern call, the timing circuit, rather than the recorder, calls for the trouble record regardless of the location of the trouble. Connection of battery to the TRST lead causes the TPE relay for the even circuit or the TPO relay for the odd circuit to operate, lock, and connect ground to the CO lead to the master

timing circuit subject to various preference conditions. This causes the master timing circuit to remove its standing test and to return ground on the CI lead, thereby operating the MTE or MTO relay.

**3.19** When a trouble occurs during the handling of a call, a circuit which has access to the trouble recorder control and test circuit puts in a bid for the preparation of a trouble recorder card. The cam switch of the trouble recorder perforator indicates to the circuit whether the trouble recorder is busy or idle. If the trouble recorder is idle, it is seized by the circuit requesting the trouble record and made busy until the trouble record has been completed. During this period, other circuits encountering troubles will not be able to connect to the trouble recorder and will be released without a record.

**3.20** In general, the troubles are recorded in the order of occurrence but a preference circuit is provided so that in case of two simultaneous troubles the master test frame connector circuit will give preference to one of the requesting circuits and will exclude all others except for AMA recorder test and special pattern calls. When some unusual condition causes a number of troubles to appear in rapid sequence, all calls requesting the recorder while any one call has the recorder busy will be released without a record. However, since a complete recording operation including the punching of the card and recycling of the perforator to the normal position requires only slightly over a second, most troubles are recorded.

**3.21** The circuit in trouble is connected to the trouble recorder perforator through nine sets of scanning relays associated with the trouble recorder circuit. These relays have 30 contacts each and are operated four at a time by the cam switch of the perforator. In addition, there are nine wire-spring relays operated along with these relays to close a total of 124 leads. The trouble recorder card is advanced by the card feed mechanism as each successive set of scanning relays is operated. Thus, the 124 contacts of each set of scanning relays successively close circuits to the 124 punch-selector magnets of the perforator during each of the nine steps of the trouble recording cycle. This permits the operation, during each step of the cycle, of those punches required to record on the card the conditions existing in the circuit.

#### 4. TROUBLE RECORDER CARD ANALYSIS

##### A. Card Description

**4.01** Four types of cards (E-3638, Fig. 4; E-4393, Fig. 5; E-5254, Fig. 6; E-5488, Fig. 7) are available for use in No. 5 crossbar offices. The type of card (single-sided or double-sided) used in the office depends on the wiring used.

**4.02** Each lettered numeral (S8, S7, R8, etc) on the side of the card corresponds to the designation of a scanning relay in the master test frame connector, and each scanning relay controls the perforation of a particular row of punches on the card. The lettered numerals are also used to designate the row number of the punch when referring to the coordinates of the punch. The numerals (numerals or letters on double-sided card) at the top of the card correspond to the contact numbers of the scanning relay and are also used to designate punch position in each row. The row numbers, together with the punch positions, constitute the card coordinates of the punches. For example, S8 0 indicates punch position 0 in row S8 on the single-sided card, or S8 00 indicates punch position 00 in row S8 on the double-sided card.

**4.03** The schematic drawings and circuit descriptions for the master test frame connector circuit contain lists of all trouble recorder card punches with functional designations for both the single-sided and double-sided trouble recorder cards. See SD-25805-01 for cards E-3638, E-4393, and E-5254. See SD-27718-01 for card E-5488.

##### B. Basic Steps in Analyzing Trouble Recorder Card

**4.04** In analyzing a trouble recorder card, it is essential that the information punched be scanned quickly and systematically in order to arrive at a final conclusion without unnecessary research. Therefore, the steps listed below should be followed when analyzing a card:

- (1) **TURN OVER Punch:** If the card is double-sided, the presence or absence of this punch indicates which side of the card to read.
- (2) **Trouble Indication (TI) Punch:** If this punch indication is not perforated, a trouble was not encountered on the connection. If the

punch indication was perforated, the test class and monitoring punch indications should be checked to determine if the card records a trouble encountered on either a test connection or a service call.

(a) The test class punch indications identify the various tests performed by the master test frame, route translator, ARET, LIT, etc, which may produce a trouble card. These indications include the marker-transverter-pretranslator-subscriber line test (MTPT), automatic trunk test (ATKT), sender-register test (SRT), trunk test (TKT), marker line verification (MLV), transverter line verification (TLV), line verification failure (LVF), and line verification match (LVM).

(b) The type of monitoring being performed at the time that the trouble record is taken is determined by monitored originating register (MOR), monitored incoming register (MIR), or monitored outgoing sender (MOS) indication.

(3) **Source of Call Punches:** The equipment that has seized the trouble recorder is identified by pretranslator (PRT), marker (MKR), transverter (TV), recorder (REC), master timing circuit (TMG), automatic monitor (MIR, MOR, or MOS), line insulation test frame (LIT), sender test circuit (FSP), route translator (RT), stuck sender trunk identifier (SSTI), or automatic range extender test circuit (ARET).

(4) **Cross Detecting and Special Record Punches:**

It should be determined that the following punch indications are not perforated before proceeding with a detailed analysis of the card: transfer start (TRS), ground test (GT5), trunk guard test (TGT), permanent signal record (PSR), false cross and ground (FCG), sequence advance (SQA), link release (LR), and cross-connection punch indications such as cross class (XCL), cross code route (XCR), etc. In most cases, these punches indicate the trouble, but are frequently overlooked. In addition many other indications, such as omitted input A, B, C, etc; 2/5 FT, FU, etc; standing XS; excess information; and 3/5, etc, should be checked.

(5) **Type-of-Call Punches:** The perforation of punch indications such as intraoffice (ITR), revertive (RV), etc, indicate the type of connection or call that caused the seizure of the trouble indicator.

(6) **Marker Progress Punches:** When the source of trouble has not been identified by cross or special record punches, the progress punches are to be analyzed. If a marker encounters a trouble while establishing a connection, the MKR punch indication on a trouble card is perforated and indicates that a marker seized the trouble recorder. The particular marker in the group is identified by the display registered (DR0-9) and in most cases display registered tens (DTR0, 1) punch indication perforations.

(7) **EX Punch:** To assist in the analysis of a particular trouble, temporary wiring may be connected to terminals EXB and EXG on terminal strips. This punch indicates the presence of battery or ground at particular circuit points.

#### C. Use of Sequence Charts

4.05 The primary function of sequence charts is to show the operation and release of relays, switches, and other devices as they perform their various functions in a circuit. Sequence charts also show the punches to be expected on the trouble recorder card. Although sequence charts are presented on a circuit basis, related operations of connecting circuits are included when necessary to show continuity of operation of a call. Therefore, use of sequence charts and the tables in CD-25805-01 and CD-27718-01 are necessary for analyzing trouble recorder cards.

#### D. Analysis of Typical Trouble Recorder Cards

- (1) Dial tone connection (Fig. 8)
- (2) Outgoing trunk connection (Fig. 9)
- (3) Incoming trunk connection (Fig. 10)
- (4) Intraoffice trunk connection (Fig. 11).

NO.5 CROSSBAR SYSTEM  
TROUBLE RECORDER CARD

SCANNING RELAY CONTACT NUMBERS

0										5										10										15										20										25										29										30										35										40										45										50										55										59																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
TI										MLV										SST										PRT										DR										CWF										JXP										OR										OR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
D										LIT										MOR										MOS										MOS										MOS										MOS										MOS										MOS										MOS										MOS										MOS										MOS										MOS										MOS																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
FR										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN										CN																																																																																																																																																																																																																																																																																																																																																																																																																																			
LT										PHC										OR										TAN										INC										RO										FAC										LTI										TOBS										TOBIFG										FG										TF										TF										LL										LL										LL										LL																																																																																																																																																																																																																																																																																																																																																																																																																																																							
PS										PK										CR										SCR										MAN										ZP										OBS										NOB										CNR										CM										A										B										C										SD										PCK										PRL										RLK										PTR										XX										TST										M										SPL										NC										NT										NTT										MPT										NH										NN																																																																																																																																																																																																																																																																																																																																									
FR										FR										CN										S										LST										LSD										4DG										SDG										SC										TVT										OBS										NOB										AMA										RO																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
OSG										OSG										SSA										SSB										OS										OS										OSE										OSK										TSR										OST2										RSC										RNT2										RNK										SLK1										SLK2										AVKI										ITR										G										7										8										9										13										14																																																																																																																																																																																																																																																																																																																																																																																											
A										A										B										C										D										E										F										G										H										I										J										K										L										M										N										O										P										Q										R										S										T										U										V										W										X										Y										Z																																																																																																																																																																																																																																																																																																																																																			
A'										A'										B'										C'										D'										E'										F'										G'										H'										I'										J'										K'										L'										M'										N'										O'										P'										Q'										R'										S'										T'										U'										V'										W'										X'										Y'										Z'																																																																																																																																																																																																																																																																																																																																																			
G										G										H										I										J										K										L										M										N										O										P										Q										R										S										T										U										V										W										X										Y										Z																																																																																																																																																																																																																																																																																																																																																																																																															
G'										G'										H'										I'										J'										K'										L'										M'										N'										O'										P'										Q'										R'										S'										T'										U'										V'										W'										X'										Y'										Z'																																																																																																																																																																																																																																																																																																																																																																																																															
CP										CP										MB										RN										DL										CL										MII										I										2										3										4										5										6										7										8										9										10										11										12										13										14																																																																																																																																																																																																																																																																																																																																																																																																															
NGCU										TH										HN										HN										OA										OB										SNG										NGK										UK										HTUK										TNK										PTK										NGK										PBX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
T										U										U										SLCK										CKO										CKR										A										AK										SAE										EG										RNG										AN										PRC																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
PN										TN										PTN										PBN										FNA										FNB										OV										BY										OFH										PUL										LCH										TCH										LIN										TIN										BN										RI										TBI										TBH										RSK										LI										TCKI										EN										SRK										RCK2										RCK3										AR																																																																																																																																																																																																																																																																																																																																																													
FT										FU										VG										VU										HG										SW										VF										CT										CT										TGT										PSR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
FT										SWT										FU										SW										VG										HG										VF										CU										CU										SEE										CD-25805-01										FOR										DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
0										1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59									

TROUBLE INDICATION

TROUBLE LOCATION

TROUBLE FOUND OR ACTION TAKEN

CLEARED BY

TIME RECD

DATE

CLASS REPORT

TRBL CODE

TICKET NO

SEE CD-25805-01 FOR DESCRIPTION

SCANNING RELAY DESIGNATIONS

Fig. 4—Single-Sided Trouble Recorder Card E-3638—Typical Example

58 00 LOCATES PUNCH TT

SCANNING RELAY CONTACT NUMBERS

00 04 10 14 20 24 30 34 40 44 50 54 A										B 00 04 10 14 20 24 30 34 40 44 50 54									
NO. 5 XBR SYS TBL RCDR CARD										NO. 5 CROSSBAR SYSTEM TROUBLE RECORDER CARD									
TROUBLE INDICATION										TROUBLE INDICATION									
TROUBLE LOCATION 2TR										TROUBLE LOCATION 2TR									
TROUBLE FOUND OR ACTION TAKEN										TROUBLE FOUND OR ACTION TAKEN									
CLEARED BY TIME RECD DATE										CLEARED BY TIME RECD DATE									
CLASS REPORT TROUBLE CODE										CLASS REPORT TROUBLE CODE									
TICKET NO.										TICKET NO.									
SEE CD-25805-01 FOR DESCRIPTION										SEE CD-25805-01 FOR DESCRIPTION									

SCANNING RELAY DESIGNATIONS

SCANNING RELAY DESIGNATIONS

RA OB LOCATES PUNCH AG2

A-FRONT SIDE

00 04 10 14 20 24 30 34 40 44 50 54										00 04 10 14 20 24 30 34 40 44 50 54									
NO. 5 CROSSBAR SYSTEM TROUBLE RECORDER CARD										NO. 5 CROSSBAR SYSTEM TROUBLE RECORDER CARD									
TROUBLE INDICATION										TROUBLE INDICATION									
TROUBLE LOCATION 2TR										TROUBLE LOCATION 2TR									
TROUBLE FOUND OR ACTION TAKEN										TROUBLE FOUND OR ACTION TAKEN									
CLEARED BY TIME RECD DATE										CLEARED BY TIME RECD DATE									
CLASS REPORT TROUBLE CODE										CLASS REPORT TROUBLE CODE									
TICKET NO.										TICKET NO.									
SEE CD-25805-01 FOR DESCRIPTION										SEE CD-25805-01 FOR DESCRIPTION									

SCANNING RELAY DESIGNATIONS

SCANNING RELAY DESIGNATIONS

B-REAR SIDE

Fig. 5—Double-Sided Trouble Recorder Card E-4393—Typical Example

SCANNING RELAY CONTACT NUMBERS

<p>NO. 5 XBR SYS TBL RCDR CARD</p> <p>TROUBLE INDICATION</p> <p>TROUBLE LOCATION 2TR</p> <p>TROUBLE FOUND OR ACTION TAKEN</p> <p>CLEARED BY TIME RECD DATE</p> <p>CLASS REPORT TROUBLE CODE</p> <p>TICKET NO.</p> <p>SEE CD-25805-01 FOR DESCRIPTION</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>00</td><td>04</td><td>10</td><td>14</td><td>20</td><td>24</td><td>30</td><td>34</td><td>40</td><td>44</td><td>50</td><td>54</td> </tr> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td> </tr> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td> </tr> <tr> <td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td> </tr> <tr> <td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td> </tr> <tr> <td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> <tr> <td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td> </tr> <tr> <td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td> </tr> <tr> <td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td> </tr> <tr> <td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td> </tr> </table>	00	04	10	14	20	24	30	34	40	44	50	54	0	1	2	3	4	5	6	7	8	9	0	1	1	2	3	4	5	6	7	8	9	0	1	2	2	3	4	5	6	7	8	9	0	1	2	3	3	4	5	6	7	8	9	0	1	2	3	4	4	5	6	7	8	9	0	1	2	3	4	5	5	6	7	8	9	0	1	2	3	4	5	6	6	7	8	9	0	1	2	3	4	5	6	7	7	8	9	0	1	2	3	4	5	6	7	8	8	9	0	1	2	3	4	5	6	7	8	9	9	0	1	2	3	4	5	6	7	8	9	0
00	04	10	14	20	24	30	34	40	44	50	54																																																																																																																										
0	1	2	3	4	5	6	7	8	9	0	1																																																																																																																										
1	2	3	4	5	6	7	8	9	0	1	2																																																																																																																										
2	3	4	5	6	7	8	9	0	1	2	3																																																																																																																										
3	4	5	6	7	8	9	0	1	2	3	4																																																																																																																										
4	5	6	7	8	9	0	1	2	3	4	5																																																																																																																										
5	6	7	8	9	0	1	2	3	4	5	6																																																																																																																										
6	7	8	9	0	1	2	3	4	5	6	7																																																																																																																										
7	8	9	0	1	2	3	4	5	6	7	8																																																																																																																										
8	9	0	1	2	3	4	5	6	7	8	9																																																																																																																										
9	0	1	2	3	4	5	6	7	8	9	0																																																																																																																										

A - FRONT SIDE

SCANNING RELAY CONTACT NUMBERS

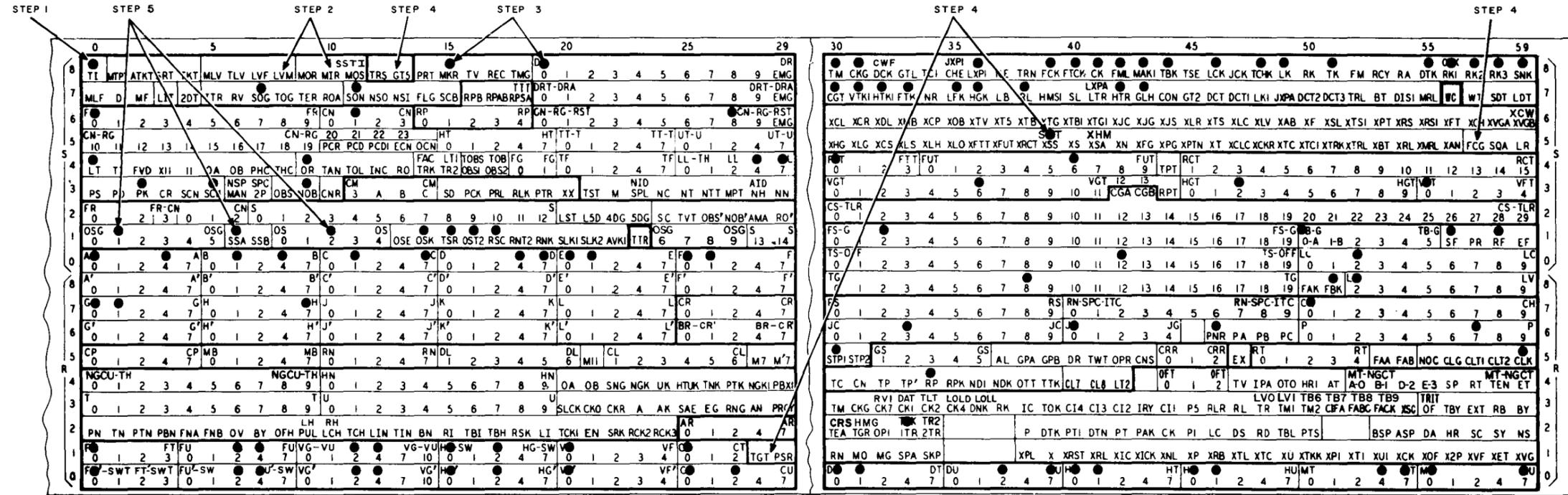
<p>NO. 5 XBR SYS TBL RCDR CARD</p> <p>TROUBLE INDICATION</p> <p>TROUBLE LOCATION 2TR</p> <p>TROUBLE FOUND OR ACTION TAKEN</p> <p>CLEARED BY TIME RECD DATE</p> <p>CLASS REPORT TROUBLE CODE</p> <p>TICKET NO.</p> <p>SEE CD-25805-01 FOR DESCRIPTION</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>00</td><td>04</td><td>10</td><td>14</td><td>20</td><td>24</td><td>30</td><td>34</td><td>40</td><td>44</td><td>50</td><td>54</td> </tr> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td> </tr> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td> </tr> <tr> <td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td> </tr> <tr> <td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td> </tr> <tr> <td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td> </tr> <tr> <td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> <tr> <td>6</td><td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td> </tr> <tr> <td>7</td><td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td> </tr> <tr> <td>8</td><td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td> </tr> <tr> <td>9</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>0</td> </tr> </table>	00	04	10	14	20	24	30	34	40	44	50	54	0	1	2	3	4	5	6	7	8	9	0	1	1	2	3	4	5	6	7	8	9	0	1	2	2	3	4	5	6	7	8	9	0	1	2	3	3	4	5	6	7	8	9	0	1	2	3	4	4	5	6	7	8	9	0	1	2	3	4	5	5	6	7	8	9	0	1	2	3	4	5	6	6	7	8	9	0	1	2	3	4	5	6	7	7	8	9	0	1	2	3	4	5	6	7	8	8	9	0	1	2	3	4	5	6	7	8	9	9	0	1	2	3	4	5	6	7	8	9	0
00	04	10	14	20	24	30	34	40	44	50	54																																																																																																																										
0	1	2	3	4	5	6	7	8	9	0	1																																																																																																																										
1	2	3	4	5	6	7	8	9	0	1	2																																																																																																																										
2	3	4	5	6	7	8	9	0	1	2	3																																																																																																																										
3	4	5	6	7	8	9	0	1	2	3	4																																																																																																																										
4	5	6	7	8	9	0	1	2	3	4	5																																																																																																																										
5	6	7	8	9	0	1	2	3	4	5	6																																																																																																																										
6	7	8	9	0	1	2	3	4	5	6	7																																																																																																																										
7	8	9	0	1	2	3	4	5	6	7	8																																																																																																																										
8	9	0	1	2	3	4	5	6	7	8	9																																																																																																																										
9	0	1	2	3	4	5	6	7	8	9	0																																																																																																																										

B - REAR SIDE

Fig. 6—Double-Sided Trouble Recorder Card E-5254—Typical Example







Follow the procedures below when analyzing this card:

- | STEP | ACTION  |
|------|---|
| 1    | Check TI punch. The presence of this punch indicates that trouble was encountered in attempting to establish the connection.  |
| 2    | The absence of the test class and monitor class punches indicates that trouble was encountered on a service connection and that the call was not being monitored when the trouble recorder was seized.  |
| 3    | Check punches to determine what equipment seized the trouble recorder. The presence of DR0 and MKR punches indicates that marker 0 seized the trouble recorder.   |
| 4    | Check cross-detecting (XCL, XCR, XSS, etc) and special record (TRS, GT5, TGT, PSR) punches. The presence of the XSS punch indicates that marker 0 seized the trouble recorder when it encountered crossed sender selection leads from the outgoing sender link through the trunk link frame.                      |
| 5    | Investigate associated sequence chart (SOG) from completing marker circuit. This sequence chart shows that the XSS punch is perforated when at least two cross-connections occur on the sender selection leads. Check equipment punches. Punches OSG1, SSA, and OS2 indicate particular outgoing sender selected. |

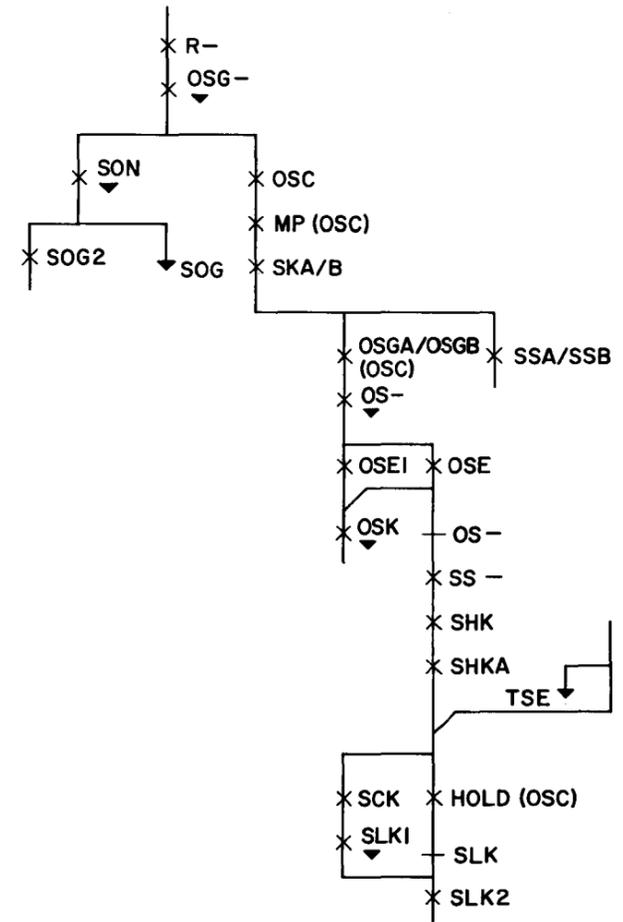


Fig. 9—Typical Trouble Recorder Card and Associated Sequence Chart for Outgoing Trunk Connection—Single-Sided Card

NO. 5 XBR SYS  
TBL RCDR CARD

TRouble INDICATION

TRouble LOCATION

TRouble FOUND OR ACTION TAKEN

CLRD BY TIME RECD DATE

TIME CLRD DATE

CLASS REPORT TROUBLE CODE

TICKET NO.

SEE CD-25805-01 FOR DESCRIPTION

SA

RA

Follow the procedures below when analyzing this card:

STEP

ACTION

- 1 Check TURN OVER punch. The absence of this punch indicates this side of card should be read.
- 2 Check TI punch. The presence of this punch indicates that trouble was encountered in attempting to establish the connection.
- 3 The absence of the test class and monitor class punches indicates that trouble was encountered on a service connection and that the call was not being monitored when the trouble recorder was seized.
- 4 Check punches to determine which equipment seized the trouble recorder. The presence of DR0 and MKR punches indicates that marker 0 seized the trouble recorder.
- 5 Check cross-detecting (XCL, XCR, etc) and special record (TRS, GT5, TGT, PSR, etc) punches.
- 6 Since none of the cross-detecting or special record punches are perforated, determine the type of connection that the marker was in the process of establishing when the trouble recorder was seized.
- 7 Check progress punches (TM, CKG, etc). The presence of the TK and WT progress punches indicates that the marker timed out and seized the trouble recorder after the test check was made on the connection.
- 8 Investigate the completing marker sequence chart for a terminating incoming trunk call. The portion of the sequence chart that is associated with channel selection and hold magnet operation shows that the J and T hold magnets are operated in parallel over the same path and that the J hold magnet has operated as proved by the presence of the JXP1 punch on the trouble indication card; therefore, all of the path must be good up to a common point.
- 9 The trouble could be (1) failure of the T hold magnet to operate, (2) a broken wire, or (3) open winding of the T hold magnet.
- 10 The trouble could also be failure of the SL relay to operate. It could *not* be failure of the SLA relay to operate as its path is in the marker.

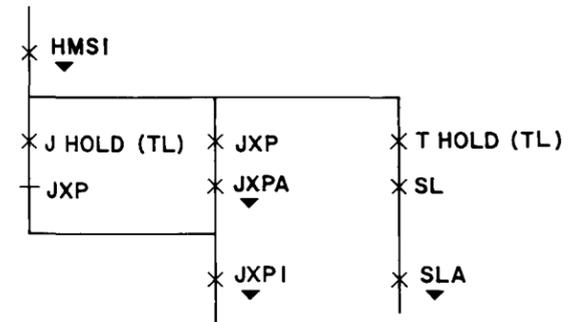


Fig. 10—Typical Trouble Recorder Card and Associated Sequence Chart for Incoming Trunk Connection—Front of Double-Sided Card

