CIRCUIT DESCRIPTION

CD-25572-01
ISSUE 3D
APPENDIX 14B
DWG ISSUE 22B
DISTN CODE 1C99

32

CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

D. Description of Changes

D.01 The ROS and ROS1 leads to the interface circuit for program controlled data acquisition for No. 5 crossbar are being reversed for proper operation. This change should be applied on a D no-record basis.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-HRWB-DAJ-KAP

Printed in U.S.A.

CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

B. Changes in Apparatus

B.01 Added - App Fig. 10

CTO,1,2,3,4 Relays - 286M

CTO,1,2,3,4 Networks - 180A

BGFA, BGRA Connectors - KS-13895 L1

BW0A, BW20A Connectors - KS-13895 L1

BW40A, BW60A Connectors - KS-13895 L1

BW80A, BW100A Connectors - KS-13895 L1

BGFB, BGRB Connectors - KS-13875 L1

BW0B, BW20B Connectors - KS-13875 L1

BW40B, BW60B Connectors - KS-13875 L1

BW80B, BW100B Connectors - KS-13875 L1

D. Description of Changes

D.01 A change is made to provide isolation to prevent mutilation of trouble recorder cards when Automatic Trouble Analysis (ATA) is provided.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-WJR-DAJ-GLW

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CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL AND TEST CIRCUIT

CHANGES

D. Description of Changes

D.01 A change is made to clarify cabling and multiple provisions concerning the alarm sending circuit and the interface and control circuit, (No. 5 crossbar).

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-WJR-DAJ-PJH

CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL AND TEST CIRCUIT

CHANGES

A. Changed and Added Features

A.01 Provide information to the interface and control circuit for TASC in crossbar tandem offices.

D. Description of Changes

D.01 A change is made to provide the RON, LOC and HCV leads requested for crossbar tandem interface and control circuit for TASC.

F. Changes in CD Section III

F.01 Under 4. CONNECTING CIRCUITS, add the following:

4.16 Interface And Control Circuit For TASC (Crossbar Tandem) - SD-28121-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-WJR-DAJ-PJH

CIRCUIT DESCRIPTION

CD-25572-01
ISSUE 3D
APPENDIX 10B
DWG ISSUE 18B
DISTN CODE 1C99

28

CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

A. Changed and Added Functions

A.1 Provide parallel operation between alarm sending and interface and control circuit.

D. Description of Changes

D.1 This circuit is changed to facilitate parallel operation between alarm sending circuits and the interface and control circuit.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-SHVD-DAJ-JAY

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CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL AND TEST CIRCUIT

CHANGES

A. Changed and Added Functions

A.1 Provide information to the interface circuit for program controlled data acquisition when program control data acquisition interface features are added.

D. Description of Changes

D.1 Provision is made to provide program control data acquisition interface features in a No. 5 crossbar office when the interface circuit for program controlled data acquisition is provided.

F. Changes in CD Section III

F.1 Add the following to 4. CONNECTING CIRCUITS:

4.15 Interface Circuit for Program Controlled Data Acquisition - SD-27165-01

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-SHVD-DAJ-JAY

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CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

D. Description of Changes

D.1 The circuit is changed to provide automatic trouble analysis features in No. 5 crossbar offices to include connection to the Maintenance Data Transmitter Circuit - SD-28111-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-SHVD-DAJ-VK

CROSSBAR SYSTEMS
NO. 5 AND TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

A. Changed and Added Functions

A.1 Provide information to the computerized maintenance and adminstration support III facility.

B. Changes in Apparatus

B.1 Code Change

Capacitors	Old Code	New Code	
MCT1	KS-13366,L3	KS-13365,L34	
NR1	KS-13366,L3	KS-13365,L34	
NR2	KS-13366,L3	KS-13365,L34	Fig. 1
NRT2	KS-13366,L3	KS-13365,L34	
TM1	KS-13366,L3	KS-13365,L34	

Resistors	Old Code	New Code	
L	221A	KS-20810,L1A	
N	221A	KS-20810,L1A	
P	221A	KS-20810,L1A	Fig. 1
R	221A	KS-20810,L1A	

D. Description of Changes

D.01 Capacitor and resistor codes are changed as listed in B.01.

D.02 Provision is made to provide computerized maintenance for adminstration support III for crossbar tandem offices.

F. Changes in CD Section III

F.01 Add the following to 4. CONNECTING CIRCUITS:

4.14 Application Schematic for Computerized Maintenance and Administration Support III - SD-28104-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-SHVD-DAJ-JCM

CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

D. Description of Changes

D.1 Miscellaneous corrections are made to make this circuit agree with Western Electric T- drawings.

D.2 Provisions have been made in this circuit to work with the Centralized Status, Alarm and Control System (CSACS).

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-SHVD-DAJ-DM

Printed in U.S.A.

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CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

D. Description of Changes

D.1 This circuit schematic has been reissued in detached contact-type schematic format. All sheets have been replaced or redrafted.

D.2 Time of day circuit for non-AMA offices, SD-27983-01, has been replaced by Common Systems, Calendar and Clock Circuit - SD-68591-01.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5242-JIS-DAJ-PKM

CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

D. Description of Changes

D.1 Equipment arrangement for master test frame control bay expansion has been changed.

D.2 Provision is made to use this circuit in ACD offices equipped with the new automatic call distribution test frame.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5142-JIS-DAJ-PKM

CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

D. Description of Changes

D.1 The provision is made to permit connection of the trouble recorder control and test circuit to the new time of day circuit for non-AMA offices.

(a) Leads TML and TMS are required for the time of day circuit for non-AMA offices.

D.2 Ground for lead MJR is changed to minimize wiring by agreement with WECo on a "D" no-record basis.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5141-DLK-RBC-PK

CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Added

MJR Lamp 2Y (Red), Option F

B.2

Superseded	Superseded By
L Resistor - 145C - 1.87 MΩ ± 5%Ω, Option G	L Resistor - 221A - 1.78 MΩ ± 1%Ω, Option H

D. Description of Changes

D.1 A modification is made to prevent a possible synchronization failure in the Master Timer, SD-25633-01, when the trouble recorder motor fails. Option H changes the TM timer limits to 1.9 - 4.9 seconds to prevent an extended ground of 6 seconds duration on the TML lead to the master timer.

D.2 Option F provides for lamp MJR which indicates a major alarm condition within the trouble recorder whenever the MCO relay is operated.

D.3 Option E provides for the transfer of a major alarm to a remote alarm center whenever the trouble recorder fails and its office is unattended.

D.4 Circuit Note 107 is changed to agree with connecting circuit information specified by the tandem trouble recorder connector circuit.

F. Changes in CD SECTION III

F.1 Change 3.233 to read:

3.233 Provides a TM timing interval of 1.9 to 6.9 seconds (1.9 - 4.9 seconds with option H) at which time the TM relay operates unless the TM timing interval has been recycled.

F.2 Add the following statement to the end of the first paragraph in 5.1.

. . . If option H is provided to prevent a possible synchronization failure in the master timer circuit, the TM timing limits will be 1.9 to 4.9 seconds.

F.3 Change the second paragraph in 5.1 to read:

. . . If both the STR-2 and ON relays release before the 1.9 to 6.9 seconds (1.9 to 4.9 seconds with option H) have elapsed, the TM condenser will be discharged and the time-out TM timer recycled without operating the TM relax.

F.4 Add the following statement to the end of the third paragraph in 5.4.

. . . However, where a major alarm is required for a remote alarm center, a provision is made to strap wire across the TOS relay contacts associated with the MJ lead.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5611-DLK-RBC-DK

CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

CHANGES

B. Changes in Apparatus

B.1 Added

TM - 185A Network, Opt J

C. Changes in Circuit Requirements Other Than Those Caused by Changes in Apparatus

C.1 When testing the TM relay, the contact to be insulated is changed from "3B of the ACO" to "1T of the TM".

C.2 Due to the insulation of contact 1T of the TM relay, the TM primary and secondary winding "test" current values are increased to 110 percent of their readjust values. The new values are 15.0 mA and 11.8 mA, respectively.

C.3 The TM relay secondary winding "readjust" current value was inadvertently omitted, and is therefore added. The value is 10.7 mA.

D. Description of Changes

D.1 Minor wiring changes are made, and a 185A contact protection network, designated TM, is added. The wiring changes prevent starting the trouble recorder perforator when it is in the off-normal position.

D.11 The new wiring and the network are assigned "after-date Standard" option J, and the existing wiring is assigned option K, which is rated "Mfr Disc.".

D.2 A minor CAD change is made to correct a duplication of terminal assignments, on a "D no-record" basis per agreement with the Western Electric Company.

F. Changes in CD Sections

F.1 Under SECTION III, change 3.234 to read:

3.234 Provides for holding operated the TM relay when the CN or the STR2 relay is operated.

F.2 Under SECTION III, change 3.2407 to read:

3.2407 Provides for holding operated the MCO relay.

F.3 Under SECTION III, 5.1, change first sentence of third paragraph to read:

If the TM relay operates, it in turn operates the MCO relay which locks under control of the MCOR key, and can only be released by the MCOR key (operated) when the perforator is in the home position, and a card is properly engaged.

F.4 Under SECTION III, remove existing 5.5 and replace with the following:

5.5 Perforator Motor Cutoff Release

The MCO relay may be released by operating the MCOR key only when the perforator is in the "home position" and a card is properly engaged.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5011-KWH-MFF-SN

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CROSSBAR SYSTEMS
NO. 5 OR TANDEM
TROUBLE RECORDER CONTROL
AND TEST CIRCUIT

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.1 This circuit provides means for adapting the KS-13834 perforator as a trouble recorder in the No. 5 Crossbar System and in the Crossbar Tandem System. Means are also provided to test the KS-13834 perforator and that part of the trouble recorder control and test circuit associated with a service trouble record.

SECTION II - DETAILED DESCRIPTION

1. TROUBLE RECORDING OPERATION

1.1 Starting a Trouble Record

When the trouble recorder perforator is available for perforating a trouble record card it indicates this to the master test frame or trouble recorder connector circuit by the absence of ground on the "ROS", "RTOS", "ON" and "TRC" leads. The master test frame connector or the marker test circuit will initiate the start of a trouble record by grounding the "STR" lead or the "STRA" lead to this circuit. The "STR" lead will be grounded when it is desired to perforate a service trouble record and the "STRA" lead will be grounded when it is desired to perforate either a trouble record from the automatic monitor circuit or a trouble record during the process of a test call being initiated at the master test frame. The grounding of the "STRA" lead will operate the STR-2 relay while the grounding of the "STR" lead will operate the STR-1 relay which in turn will operate the STR-2 relay. The operation of the STR-1 relay will be an indication to this circuit that a service trouble record is being perforated and that certain additional functions should be performed.

The operation of the STR-2 relay will operate the MC relay which in turn will operate the MCR contactor relay. The operation of the MCR contactor relay will supply power to the perforator motor to start this motor.

The operation of the STR-2 relay or the operation of the STR-1 and STR-2 relays will extend the ground on the "STR" or "STRA" lead over the "ST" lead to the MO cam contacts in the perforator. When the perforator MO cam contacts close, the ground on the "ST" lead is extended to operate the ST relay. The MO cam contacts close only for a short time in each revolution of the M shaft, to insure that each record starts at the proper point with reference to the cycle of the punches which are controlled by the M shaft. The ST relay locks operated to ground on the "ST" lead. To insure the ejection of the associated trouble recorder card and the bringing a new card into the first recording position if the ground on the "STR" or "STRA" lead is removed prematurely, the ST relay is also locked operated when the TRC relay is released.

In crossbar tandem offices with provision for outgoing trunk identification the "ST" lead is held open by the DLY relay. This relay is controlled by the trunk identifier circuit and is added to provide a start delay. Once the DLY relay is released the start will proceed in the normal manner.

The RON lamp lights when the STR-2 relay operates and remains lighted as a trouble recorder off-normal signal until the ON relay releases and the perforator is ready to perforate another record.

1.2 Perforating Cycles

With the KS-13834 perforator in its normal position a card will be in the first recording position, which is with the bottom or first row (designated RO on the card margin) of 60 punching positions under the front row of 60 punches and with the tenth row (designated SO) of 60 punching positions under the rear row of 60 punches. With the ST relay operated the closure of the M4 cam contact extends ground through a break contact of the INT clutch contacts and over the "SO" lead to the master test frame or trouble recorder connector circuit to operate the RO and SO multicontact scanning relays in the master test frame or trouble recorder connector circuit. A lead designated "BW-O/119" from each of the 120 interposer magnets (10 to I119) associated with the front and rear rows of punches will be extended, with the RO and SO relays operated, to leads associated with the marker, transverter, AMA recorder, or any other circuit which is associated with the trouble recorder. The IO-59 interposer magnets are associated with the front row of punches which will perforate the lower half of the trouble record card while the I60-119 interposer magnets are associated with the rear row of punches which will perforate the upper half of the card. The IO-59 interposer magnets are associated with the RO-8 lines on the trouble recorder card while the I60-119 interposer magnets are associated with the SO-8 lines as designated in the margin of the trouble recorder card. If it is desired to perforate a position on the trouble recorder card the associated interposer magnet lead will be grounded by the marker, transverter, AMA recorder, or other circuit which is associated with the trouble recorder circuit.

Interposer magnets I10-119 which have associated leads grounded will operate. When the shuttle bars of the perforator move in, they engage and mechanically lock-in those interposers corresponding to the operated interposer magnets. After the interposers have been locked mechanically, the M4 cam contact will open to release the RO and SO scanning relays in the master test frame or trouble recorder connector circuit. The shuttle bars continue "in" and during their "in position" period cams force punches corresponding to engaged interposers through the card. When the shuttle bars move to their "out-position" the punches are withdrawn and the interposer magnet mechanisms are free to release.

Having perforated the desired information on the RO row and the SO row on the trouble recorder card, the perforator is now ready to advance the position of the trouble recorder card under the punches so that, on the next punching cycle, the desired information will be perforated on the second row which is designated R1 and on the eleventh row which is designated S1 on the trouble recorder card. To advance the position of the trouble recorder card the closure of the M3 cam contact will operate the latch LCH magnet, which in turn will operate the intermittent clutch INT magnet. With the ST relay operated, ground will be extended over the "LCH" lead to the perforator where the closure of the M3 cam contact will extend ground over the "M3" lead to the trouble recorder circuit. With the PA-1 relay nonoperated ground on the "M3" lead will be extended over the "LW" lead to operate the latch LCH magnet in the perforator. The LCH magnet will lock operated with the ST relay operated or with the INT magnet operated. The operation of the LCH magnet will operate the intermittent clutch INT magnet. The operation of the intermittent clutch magnet will cause the engagement of the intermittent clutch through which the trouble recorder card will be advanced to the second step position for punching the R1 and S1 rows on the trouble recorder card. The continued operation will result in the trouble recorder card being advanced step-by-step to each position for punching the third to ninth rows which are designated R2-8 and the twelfth to eighteenth rows which are designated S2-8 on the trouble recorder card.

At about the time the shuttle bars restore to the "out position" and after the LCH and INT magnets have operated, the second revolution of the M shaft will again cause the ground closure of the M4 cam contacts. The "SCN" lead to the perforator has been grounded by the operation of the ST relay with the TST-3 and PA-1 relays nonoperated. With the closure of the M4 cam contacts the ground on the "SCN" lead has been extended through the operated intermittent clutch INT magnet contacts and the closed K1 cam contacts to place ground on the "S1" lead to the master test frame or trouble recorder connector circuit. Ground on the "S1" lead will operate the R1 and S1 scanning relays in the master test frame or trouble recorder connector circuit for the second step. The operation of the R1 and S1 scanning relays will extend a different group of leads associated with the marker, transverter, AMA recorder or other circuits associated with the trouble recorder to the interposer magnets I0 to I119 associated with the punches. Grounds on the leads associated with the interposer magnets will operate the interposer magnets. As during the first step, when the shuttle bars move in the operated interposers are locked mechanically and when the shuttle bars reach their "in-position" the punches will perforate the trouble recorder card. When the M4 cam contact opens the R1 and S1 scanning relays are released.

The cycle of advancing the trouble recorder card to a new position and then punching is repeated until 18 rows have been punched two rows at a time starting at the RO and SO rows of the card and ending at the R8 and S8 rows. At each step taken the K cam shaft of the perforator will be rotated to close the correct K-1/8 cam contact to operate the one R-0/8 relay and the one S-0/8 relay associated with the cycle or step.

Interposer magnets IX0-3 shown in Fig. 101 are used when the KS-13834 perforator is provided as a trouble recorder in a No. 5 crossbar office arranged for 4-wire or PPCS-LAMA. Interposer magnets IX2,3 are used when the KS-13834 perforator is provided as a trouble recorder in a crossbar tandem office arranged for person-to-person and coin. The perforating cycle is the same except now an additional relay designated AB-0/8 in No. 5 and X8 in tandem operates in multiple with S-0/8 and R-0/8 scanning relays. Leads designated "BWX0-3"

from interposer magnets IXO-3 in No. 5 and leads designated "BW2,3" from interposer magnets IX2,3 in tandem are extended, with the additional relay operated, to circuits requiring their use in order to provide a trouble record.

1.3 Trouble Record Completed and Perforator Restored to "Home"

At about the time that the interposers have been mechanically locked for the R8 and S8 rows to be punched, the closure of the L2 cam contact has grounded the "TRC" lead which results in the operation of the trouble record complete TRC relay. The TRC relay will lock operated with the ON or ST relays operated. The operation of the TRC relay with the TST-1 relay nonoperated will place ground on the "TRC" lead to the master test frame or trouble recorder connector circuit as an indication that the trouble record has been completed. Ground on the "TRC" lead will operate relays in the master test frame or trouble recorder connector circuit which will remove the start ground on either the "STR" or "STRA" lead and will inform the circuit, such as a marker or transverter, which has requested the trouble record that the trouble record is complete and the marker or transverter should disconnect from the master test frame or trouble recorder connector circuit.

When the TRC relay operates and the start ground on the "STR" or "STRA" lead is removed the ST and STR-2 relays and if operated the STR-1 relay are held operated by the closure of the M1 cam contacts grounding the "STH" lead. A short period of time after the TRC relay operates the M1 cam contacts will open thereby releasing the ST and STR-2 relays and the STR-1 relay if operated. The release of the ST relay with the M2 cam contacts open will release the intermittent clutch INT magnet which in turn will operate the continuous clutch CONT magnet when the I4 cam contacts are closed.

The continuous clutch engages the L shaft with a fast continuous drive which causes the card to be moved rapidly to the used card bin and a new card to be moved into the first recording position for the new trouble record. As the continuous clutch drives the perforator to the "home" position, the L4 cam contact opens to release the continuous clutch CONT magnet thereby allowing the perforator to coast to the "home" or normal position at which point the perforator is stopped by a brake and stop mechanism.

As the perforator comes into the "home" position the L1 cam contact opens thereby releasing the ON relay which in turn releases the TRC relay. The release of the TRC relay removes the ground from the "TRC" lead to the master test frame or trouble recorder connector circuit as an indication that the trouble recorder control and test circuit is ready to accept a new trouble record start.

1.4 Miscellaneous Control Operations

1.41 Perforator Motor Control Timing

The motor control timing feature reduces recording time in case several records are required within a short period of time by having the motor running at full speed when the service records are initiated within a brief interval of time after the preceding records. When an initial record is initiated the perforator motor is started by the operation of the MCR relay. The operation of the STR-2 relay with the MCC key nonoperated will operate the MC relay which will lock operated with the motor control timing MCT relay nonoperated. The operation of the MC relay with the MCO relay nonoperated will operate the MCR relay which will energize the perforator motor. After the trouble record has been completed the MC relay will be held operated by the nonoperated condition of the MCT relay. Therefore the MCR relay will be held operated and the perforator motor energized until the motor control timing circuit has timed-out and operated the MCT relay.

When the STR-2 relay releases after a trouble record has been perforated and with the MC relay operated the short circuit across the charging condenser MCT will be removed and a charging path for this condenser is provided. The charging path for the MCT condenser will be from the +135 volts, through the B resistance to one side of the MCT condenser and from the other side of the MCT condenser with the STR-2 relay nonoperated and the MC relay operated through the A resistance and winding of the MCT relay to ground. The charge potential on the MCT condenser is impressed on the control anode of the MCT vacuum tube through the D resistance. The STR-2 relay nonoperated and the MC relay operated maintains this charging condition on the MCT condenser. If the trouble recorder is not seized and the STR-2 relay not operated for a time interval of 4.7 to 16.5 seconds, the potential of the control anode will have increased to the breakdown voltage of the control gap causing the main tube gap to

break down thereby operating the MCT relay. The operation of the MCT relay will release the MC relay which will in turn release the MCR relay and stop the perforator motor. However, if the trouble recorder is seized and the STR-2 relay operated before the time interval has elapsed the operation of the STR-2 relay will open the operating path for the MCT relay thereby preventing its operation. The operation of the STR-2 relay will also connect the C resistance across the MCT condenser to discharge the condenser and recycle the MCT timer circuit.

Successive trouble records which result in the reoperation of the STR-2 relay before the 4.7 to 16.5 second time interval elapses prevent the MCT relay from operating. An operation of the STR-2 relay discharges the MCT condenser and recycles the motor control timing. This resets the motor control timing feature each time the trouble recorder is seized for the perforation of a trouble record card so that the perforator motor continues to run until an interval of 4.7 to 16.5 seconds after the last trouble recorder seizure is released.

1.42 Limiting the Number of Trouble Records

The trouble recorder control and test circuit has a feature whereby the number of service trouble records within an interval of time which the trouble recorder control and test circuit will accept is limited. After the trouble recorder has accepted the specified maximum number of service records within the interval of time the trouble recorder will be made temporarily busy. By cross-connections the specified maximum number of service records may be selected as 5, 10, or 20 records.

All types of trouble records which are initiated by the grounding of the "STRA" lead from the master test frame connector or marker test circuit are eliminated from the counting of the number of trouble records for the purpose of limiting the number of trouble records. Thus the master test frame test call trouble records and automatic monitor circuit trouble records are ignored for the purpose of counting the number of records.

1.43 Number of Record Timing

The operation of the STR-1 relay with the NRS-1 and NRT relays and the CTOS key nonoperated will operate the number of records start NRS relay. The NRS relay will lock operated with the NRT relay and the CTOS key nonoperated. The operation of the NRS relay will initiate the number of records timing by removing the short circuit across the charging condenser NRT and providing a charging path for the condenser. The charging path for the NRT condenser will be from the +135 volts, through the E resistance to one side of the NRT condenser and from the other side of the NRT condenser with the NRS relay operated through the H resistance and the winding of the NRT relay to ground. The charge potential on the NRT condenser is impressed on the control anode of the NRT vacuum tube through the G resistance.

After a time interval of 24.0 to 84 seconds the potential of the control anode will have increased to the breakdown voltage of the control gap causing the main tube gap to break down thereby operating the NRT relay. The operation of the NRT relay will release the NRS relay thereby completely recycling the number of record timing.

1.44 Counting Number of Records

By cross-connecting the NR cross-connection punching to one of the NR-5, NR-10, or NR-20 cross-connection punchings it is possible to limit the maximum number of trouble records within the time interval to 5, 10, or 20 records. The operation of the NRS relay will remove the -48 volt potential applied to the nongrounded side of the NR charging condenser through the T resistance. However, the NR condenser will not be charged until both the STR-1 and ON relays are operated during the perforation of the trouble record. The time interval during which both the STR-1 and ON relays are operated for the perforation of one trouble record is not long enough to charge the NR condenser to a voltage high enough to break down the control anode of the NR vacuum tube. However, each successive trouble recording will reoperate the STR-1 and ON relays, increase the charge on the NR condenser and increase the potential impressed on the control anode of the NR vacuum tube.

If the number of records timer NRT times out, as described in 5.43, before the