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CROSSBAR SYSTEMS NO. 3 SUBSCRIBER MESSAGE REGISTER CIRCUIT FOR INDIVIDUAL OR 2-PARTY LINES

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 This circuit comprises a register circuit and associated 60-cycle ac power supply for operating customers registers over the line sleeve. It also incorporates a no-voltage alarm and a cross-detecting alarm on each of the power supply sources. Registers are operated in series with cold cathode electron tubes and provide substantially infinite shunting impedance to the sleeve circuit.

2. GENERAL DESCRIPTION OF OPERATION

2.01 Customer message registration for single, 2-party lines and message unit repetition to a PBX is provided over a single sleeve lead. The registers operate directly in series with the tube and by means of a phased relationship of the alternating wave voltage and a rectified portion of this voltage, selective operation of either a tip or ring party register, or 2-party customer lines is obtained. The PBX message unit registration is controlled by an additional make-contact on the message register in the control office. Resistance battery is supplied through the make-contact to the PBX station message register pulse circuit.

SECTION II - DETAILED DESCRIPTION

1. REGISTER OPERATION

1.01 Any register may be connected to any line by connecting the S lead to the line sleeve. The register operates in series with a cold cathode gas-filled tube which requires the application of a high breakdown voltage in order to become conducting, thus making the register circuit essentially infinite impedance to normal sleeve voltage.

1.02 Registers are ordered in groups of 16. All of one group may be assigned either tip or ring registration depending upon the cross-connection used. These cross-connections determine the polarity of the 60-cycle ac component of the voltage which is applied to the cathodes of the tubes. Actual selection of the tip or ring register is accomplished by the TP relay in the trunk circuit. In the normal position this relay connects a voltage to the sleeve which will cause the ring register to operate. In the operated position it applies

a voltage which will cause the tip register to operate. Two power supply sources are combined to produce register operation. The MRS-T and MRS-TP sources are used for tip register operation and the MRS-R and MRS-RP sources for ring register operation. The MRS-T and MRS-R sources each consist of an ac component of 75 volts RMS superimposed upon -48 volts direct current and are permanently connected to the cathodes of the tubes in series with the registers. The polarity of the ac component connected to the tip tube is, at each instant, opposite to that of the ac component connected to the ring tube.

1.03 Two sources of positive, half-wave, rectified pulses of 60-cycle voltage are available to the trunk circuit, these being MRS-TP and MRS-RP. The pulses from the two sources occur on alternate half-cycles; that on the MRS-TP occurring while the alternating current on the MRS-T lead is negative and that on the MRS-RP occurring while the alternating current on the MRS-R lead is negative. These positive pulses are applied over the sleeve lead (one source at a time) to both message registers. The tube on which the sleeve and cathode voltages are of opposite polarity will break down and cause the register to operate. The difference of voltages on the tube having like polarity on the sleeve and cathode will not receive sufficient voltage for breakdown and the register will receive no current. The register selected for operation receives pulses of current at the rate of 60 per second. A copper sleeve on the register averages these pulses and provides positive operation without chatter.

1.04 The positive pulsating voltages are obtained by connecting diodes in series with a 117V RMS source of alternating current, obtained from transformer T. Rectifier J delivers the pulse to the MRS-TP lead and rectifier T to the MRS-RP lead. Rectifiers N and R are not used in register operation but serve to maintain the sleeve at ground potential during the alternate half-cycles when the high pulsating voltages are absent. During these half-cycles the hold magnets are held operated in series with these rectifiers and sufficient ac voltage (5.5 volts peak) is applied in series with the rectifiers and magnets to compensate for the voltage drop in the rectifiers. These compensating voltages are obtained from transformer taps No. 10 and 12.

1.05 The magnitude and relative polarity of the voltages from the four power sources, existing with nominal input voltage, are shown in the following table wherein the 'odd', half-cycle arbitrarily refers to the half-cycle during which the positive pulse appears on the MRS-RP lead:

		Nominal Peak Volts on Power Supply Leads (With respect to ground						Nominal Peak Volts Across Tube*	
				MRS-R		MRS-T			
Half-Cycle	Trunk TP Relay	MRS-RP	MRS-TP	ac	dc	ac	dc	Ring Tube	Tip Tube
			For Ring Register Operation						
Odd	Norm	+165	Open	-106	-48	+106	-48	+319	+107
Even	Norm	0	Open	+106	-48	-106	-48	-58	+154
			For Tip Register Operation						
Odd	Opr	Open	0	-106	-48	+106	-48	+154	-58
Even	Opr	Open	+165	+106	-48	-106	-48	+107	+319

*The tube breakdown limits are 190 to 255 volts. The plus (+) sign in these two columns indicates that the voltage polarity is with positive on the anode which is the conducting direction. The minus (-) sign indicates nonconducting direction. (Voltages shown negelect all losses.)

2. LINE-BUSY AND LINE-IDLE CONDITIONS

2.01 Under the "line-busy" condition the sleeve will be at ground potential and the potential across each tube will alternate between 154-volt peak in the conducting direction and 58-volt peak in the nonconducting direction.

2.02 Under the "line-idle" condition both the anode and cathode are at -48 volt dc potential. The superimposed alternating voltage on the cathodes will subject the tubes to a potential of 106-volt peak alternately in the conducting and nonconducting directions. Since the minimum breakdown voltage in the forward direction is 190 volts, neither tube breaks down either under the "line-idle" or "line-busy" condition.

3. NO-VOLTAGE ALARM

3.01 No-voltage alarms are provided on all four power sources. The TP relay is held normally operated by the half-wave rectified pulses on the MRS-TP lead. It is a slow-release relay in order that it may remain operated between pulses. A series resistance C limits the current drain to the amount actually required for relay operation. In case the voltage fails the TP relay releases, and

(a) Connects battery through 800 ohms to the MJ lead to bring in an alarm.

(b) Lights the no-voltage alarm (NVA) lamp.

(c) Supplies a ground for operating and locking the CO relay when the alarm cutoff (ACO) key is operated.

(d) Opens the MRS-T supply.

3.02 The RP relay operates similarly from the MRS-RP supply. Its functions are similar to those of the TP relay except that it opens the MRS-R supply when it releases.

3.03 The TS relay is held operated by the ac component of voltage from the MRS-T supply. It operates on full-wave rectified pulses supplied from diodes A to D. A series capacitor TS prevents any dc current flow from the superimposing 48-volt battery. The parallel resistors FA and FB limits the ac current drain and prevents excessive peak voltages being applied to the diodes. The TS jack provides access to the winding of the TS relay for making current flow adjustments, isolates the winding from the diode bridge, and short-circuits the load terminals on the varistor bridge to prevent varistor damage due to excessive voltage when the relay is removed from the circuit.

3.04 The TS relay will release if there is no 60-cycle ac component present on the MRS-T lead and will release the TP relay. The TP relay in releasing performs the functions already described. Opening of the MRS-T lead when the TS relay is released prevents a possible false charge due to failure of the 60-cycle component of voltage on this lead. If this voltage were absent at the time the positive pulses were applied to the sleeve and if the MRS-T lead were left connected to -48 volt battery, both register circuits would receive identical voltage applications of 215-volt peak in the conducting direction, which would be sufficient to cause both registers to operate if the tubes had low breakdown voltages. Opening of the MRS-T lead has no useful function when only the TP relay releases due to failure of MRS-TP supply.

3.05 The RS relay and associated circuit perform similar functions with respect to the MRS-R supply.

3.06 When the power is restored to a released alarm relay the relay will reoperate and restore the alarm.

ALARM CUTOFF

3.07 Any no-voltage alarm may be cut off by operation of the alarm cutoff (ACO) key. This operates the CO relay which:

(a) Restores the alarm.

(b) Lights a guard lamp (NVG).

(c) Extinguishes the NVA lamp.

(d) Locks to ground under control of the TP or RP relay.

If the trouble should disappear while the CO relay is operated, the locking ground for the CO relay will be removed when the alarm relay reoperates and the circuit will restore to normal.

4. CROSS-DETECTING ALARM CIRCUIT - FS8

4.01 A means is provided by FS8 for detecting a cross between the MRS-TP and MRS-RP supply leads when both these leads are required. A cross to ground on either lead will operate either the trunk fuse if the trouble is in the trunk or the main fuse in FS2 if between the trunk frames and the power supply. However, a short between the leads will not blow any

fuse since, as previously described, the positive peaks are out of phase and the diodes prevent reverse current to ground at the midpoint of the transformer.

4.02 The CA tube in series with the CD relay is connected in parallel with the J diode. Under normal conditions this results in a peak nonoperate voltage of 165 volts across the tube. The nonoperate voltages appearing across the tube occur when terminals No. 1 of the shunting diodes are positive. On alternate half-cycles when these terminals are negative, the diode resistance is very low and the voltage impressed across the tube in inverse direction is negligible.

4.03 If the MRS-TP and MRS-RP leads become shorted a peak operating voltage of 335 volts is impressed across the tube and CD relay thus causing the tube to ionize on alternate half-cycles and the relay to operate.

4.04 Relay CA operates from CD and locks to ground on the AR key in the alarm sending circuit. Relay CA opens the tube circuit and opens the MRS-TP and MRS-RP supplies to the trunk circuits preventing the cross from operating the wrong message register. The CA lamp lights.

4.05 The MRS-TP and MRS-RP supplies are also opened from the no-voltage alarm relays TP and RP releasing them, lighting the NVA lamp, and bringing in a major alarm.

4.06 The AR key is used to release the locked-in cross-detecting alarm and no-voltage alarm.

4.07 The C-TST key is for use in testing the CA tube for breakdown using circuit voltages. When operated, the key transfers the CD relay from the MRS-TP to the MRS-RP lead causing the tube to fire and the CA lamp to light. With relay CA blocked nonoperated, the test does not interfere with the operation of the message register circuits. With the CA relay not blocked nonoperated, the alarm circuit as a whole can be tested but will prevent register operations. The C-TST key should not be held operated after the CA lamp lights.

5. FUSE AND FUSE ALARM RELAY CIRCUIT

5.01 When the MRS-R or MRS-T TST-T or TST-R or MRS-R1 (FS4) fuse operates, the M relay operates lighting the FA lamp of FS5 and applies resistance battery through the MJ lead causing the alarm circuit to give visual and audible indications.

5.02 The copper sleeve on the M relay retards the changes in flux sufficiently for the relay to operate and hold on the 48-volt dc component despite the 75-volt, 60-cycle component of the MRS-R or MRS-T supply. The M resistance reduces the current drain, especially if both a MRS-R and MRS-T or TST-R and TST-T fuse are blown at the same time.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 None.

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designation	Meaning
CA	Cross Alarm
CD	Cross Detector
CO	Cutoff for Alarms
M	Fuse Alarm
RP	Ring Party, No-Voltage Alarm
RS	60-Cycle Component for Ring Party
TP	Tip Party, No-Voltage Alarm
TS	60-Cycle Component for Tip Party

3. FUNCTIONS

3.01 Provides a message register circuit for individual or 2-party lines.

3.02 Provides the proper voltage polarity for functioning either the tip or ring register as determined by the trunk circuit.

3.03 Provides for operating the registers over the sleeve of the line circuit.

3.04 Provides a nonoperate circuit condition for the unwanted register.

3.05 Provides a no-voltage alarm on each of the four power supply leads.

3.06 Provides a major alarm when any power source fails.

3.07 Provides a no-voltage alarm lamp in the no-voltage alarm circuit.

3.08 Provides an alarm cutoff feature.

3.09 Provides a no-voltage guard lamp.

3.10 Provides for opening the MRS-T or MRS-R supply when the 60-cycle component of power fails on the associated lead.

3.11 Provides rectifiers in the trunk supply leads MRS-RP and MRS-TP to furnish a pulsating positive voltage on these leads.

3.12 Provides a low-voltage positive pulse to the sleeve between high-positive pulses in order to maintain the sleeve near ground potential.

3.13 Provides a cross-detecting alarm on the MRS-TP and MRS-RP leads which locks under control of AR key and alarm sending circuit, FS8.

3.14 When a cross exists between the MRS-TP and MRS-RP leads to light the CA lamp, open both supplies from the trunks thus causing a no-voltage alarm and a major alarm, and opening the MRS-T and MRS-R supplies to the register circuit tubes.

3.15 Provides a resistance battery signal to simultaneously operate a station message register located in a PBX. (App Fig. 4).

4. CONNECTING CIRCUITS

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

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

(b) Outgoing Trunk Circuits (Typical) - SD-26421-01.

(c) Intraoffice Trunk Circuit - SD-26415-01 (Typical).

(d) PBX Systems Station Message Register Pulse Circuit - SD-66915-01.

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

(f) Alarm Sending Circuit - SD-26442-01.

(g) Two-Way CO Trunk Circuit - SD-66870-01.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 The message register equipment shall be capable of meeting all the requirements of the Circuit Requirements Table.

6. ALARM INFORMATION

NO-VOLTAGE ALARMS

6.01 If in response to a major alarm the NVA lamp is found lighted on the no-voltage alarm unit it indicates that the trouble is in the power supply to these circuits.

6.02 Operate the ACO key to silence the alarm. Observe that the associated NVG lamps light.

6.03 When the trouble is cleared, the NVG lamp is extinguished and no further action is required.

6.04 Observe the RP, TP, RS, and TS relays and proceed as follows:

(a) If the RP, TP, RS, and TS relays are released it indicates an operated cartridge (120-volt ac 3-amp) fuse located on the same unit. Replace the fuse.

(b) If the RP or TP relay is released it indicates an operated MRS-RP or MTS-TP fuse located on the same unit. Replace the MRS-RP or MRS-TP fuse.

(c) If the RS and RP or TS and TP relays are released it indicates an operated B or A fuse on the fuse panel at the power, ringing, and tone distributing frame. Replace the fuse.

6.05 When all operated fuses are replaced, observe the NVG lamp. If the lamp is extinguished no further action is required.

6.06 If after replacing the fuses as outlined in 6.04 (a), (b), and (c), the fuse operates, proceed as follows:

(a) Replace the associated power supply with a spare power supply. If no spare power supply is available proceed as outlined in (d).

(b) Replace the fuse. Observe that the NVG lamp is extinguished. This indicates that the trouble is in the power supply removed from service.

(c) If the fuse operates after replacing the power supply with a spare, it indicates that the trouble is in the no-voltage alarm circuit. Proceed as outlined in (d).

(d) Observe the relays as outlined in 6.04 (a), (b), and (c). The released relay or relays indicate that the trouble is in that part of power supply or no-voltage alarm circuit associated with the released relay or relays. Proceed as follows:

(1) When the trouble is cleared replace the fuse.

(2) Observe that the NVG lamp is extinguished.

(3) Reconnect the regular power supply if it has been removed from service.

6.07 If the NVG lamp is not extinguished and no fuses are operated, it indicates that the trouble is in either the power supply circuit or the no-voltage alarm circuit. Proceed as follows:

(a) Replace the power supply and no-voltage alarm unit with a spare unit if available. If no spare power supply is available, proceed as outlined in (d).

(b) If the NVG lamp is extinguished when the spare power supply is connected no further action is required other than clearing the trouble in the disconnected power supply and restoring it to service.

(c) If the NVG lamp is not extinguished when the spare power supply is connected, it indicates that the trouble is at the no-voltage alarm circuit. Proceed as outlined in (d).

(d) Observe the RP, TP, RS, and RS relays. A released relay indicates that the trouble is in that part of the circuit associated with the released relay. For example, released RS and RP relays indicate possible trouble in the MRS-R power supply, the RS relay winding, the E, F, G, or H diodes, the RS capacitor or the E resistance. When the trouble is cleared the NVG lamp is extinguished.

CROSS-POWER SUPPLIES TO TRUNKS

6.08 If in response to a major alarm, the NVA and CA lamps are found lighted on the message register power supply, momentarily operate the associated AR key to silence the alarm. If the lamps are extinguished it indicates that the cross is no longer present and no further action is required.

6.09 If after the momentary operation of the AR key, the alarm persists and the associated NVA and CA lamps remain lighted, momentarily operate the ACO key to release the alarm and extinguish the NVA lamp. Observe that the NVG lamp lights.

6.10 The lighted CA lamp indicates that the trouble is a cross between the MRS-RP and MRS-TP leads supplying power to the trunk circuits.

6.11 When the trouble is cleared, momentarily operate the AR key on the associated no-voltage alarm circuit. Observe that the CA and NVG lamps are extinguished.

7. TAKING EQUIPMENT OUT OF SERVICE

POWER SUPPLY AND NO-VOLTAGE ALARM UNIT

7.01 Caution: Removing the power supply and no-voltage alarm unit from service results in a no-charge condition on chargeable messages. Therefore, when the power supply is taken out of service replace it with a substitute unit. If no substitute is available the proper departments should be advised as soon as practicable in accordance with local instructions and the trouble affecting the power should be cleared and the power supply restored to service as soon as practicable.

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