

RINGING AND TONE POWER PLANT

862A (J87810)

OPERATING METHODS

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1. GENERAL

1.01 The 862A (J87810A and J87810B) ringing and tone power plant provides 1.5 amperes of interrupted and continuous 20-Hz ringing current, continuous and interrupted precise-call progress tones, and signaling interruptions as required by step-by-step No. 1, and 350A offices. Twenty-Hz ringing current (not audible) is generated by duplicate transistorized dc-to-ac inverters. TOUCH-TONE® dial tone, audible ringing tone, high tone, and busy tone are generated by duplicate transistorized tone generators, each consisting of four oscillators supplying 1-VA amplifiers in different combinations to provide the call progress signals. The output of the amplifiers is supplied to step-down transformers to provide the proper tone levels. Additional outputs of the dial tone amplifiers TT3-1 and TT3-2 are supplied to the 35-VA dial tone amplifiers (if

furnished) to provide sufficient power to supply the first selector shelves to the subscribers who do not have TOUCH-TONE service. One amplifier will provide power for 48 selector shelves (6 frames). For each additional group of 48 selector shelves, a 35-VA amplifier is required, with a maximum of 5 amplifiers per plant.

1.02 This issue does affect the Equipment Test List.

1.03 During normal operation all generators, both the regular side and the reserve side, are powered with the regular side (GEN1) supplying the office load. All generators are continuously monitored for low voltage. All interrupted ringing outputs, as well as interrupted grounds, are continuously monitored for failure of either the ringing switches or the interrupted timing circuits. In the event of a failure of any element in the regular ringing generator, tone generators, or solid state interrupters, the switchboard circuit office load will automatically transfer to the reserve side of the plant. If furnished, the output of each 35-VA dial tone amplifier is separately monitored for low voltage. If the TT2-1, 35-VA amplifier fails, only the office load of the first selector frames will automatically transfer to the reserve 35-VA amplifier. If either the regular 350-1 or 440-1 oscillators or TT3-1 amplifier fail, the switchboard circuits office load and the first selector office load will simultaneously transfer to the reserve side of the plant. Minor alarms are provided if *any* element in either the regular or reserve unit fails. A major alarm is provided if *any* element in the reserve unit fails after an earlier failure in the regular unit, or if any fuse fails.

Caution: *The plant includes automatically controlled equipment. Care must be exercised to prevent transfer to those parts of the plant on which work is to be done. Before starting work on a ringing generator, tone generator, or interrupter, remove the*

power to the side involved by following the procedure outlined in 3.08.

1.04 The **J87810A AC-DC Ringing and Tone Power Plant** (Fig. 1) is used for 2- and 4-party ac-dc ringing, 5-code (type D) ringing and grounds, and 8-party service, while the **J87810B Superimposed Ringing and Tone Power Plant** (Fig. 2) is used for 2- and 4-party superimposed ringing, 5-code (type D) ringing and grounds, and 8-party ground codes. The following items are furnished for these plants:

- (1) RINGING CURRENT—20 Hz, SUP-AUD, 1.5A, 84 to 88±V with -48V dc; 20 Hz, SUP+AUD, 1.5A, 84 to 88±V with +48V dc; 20 Hz, AC-DC AUD, 1.5A, 84 to 88±V with -48V dc; and 105±, 102 to 110V for J87810A power plants, or 20 Hz, SUP-AUD, 1.5A, 84 to 88±V with -38V dc; 20 Hz, SUP+AUD, 1.5A, 84 to 88±V with +38V dc; 20 Hz, AC-DC AUD, 1.5A, 84 to 88±V with -48V dc; 20 Hz, SUP-AUD, 1.5A, (94-101±V), SUP+AUD, 1.5A, (94-101±V); and 105±, 102 to 110V for J87810B power plants
- (2) TOUCH-TONE DIAL TONE—Combined 350 and 440 Hz, 35-VA, 23V rms (TT2), and combined 350 and 440 Hz, 1-VA, 1.7V rms (TT3)
- (3) AUDIBLE RINGING TONE—Combined 440 and 480 Hz, 1-VA, 3.80V rms
- (4) HIGH TONE—A single 480 Hz, 1-VA 0.95V rms
- (5) BUSY TONE—Combined 480 and 620 Hz, 1-VA, 0.60V rms.

1.05 Manual transfer for maintenance purposes is also provided. Power-off switches for each side of the plant are furnished so that the power can be removed from either side. An electrical interlock prevents removal of power from both sides at the same time and guarantees that the office load is connected to the unit that is powered. The plant is powered completely from -48 volt central office battery.

1.06 Both ac-dc and superimposed ringing are provided. The 5-code (type D) interrupted ringing and ground can be provided with either ac-dc or superimposed ringing on an optional basis. The 8-party ground codes are provided in superimposed plants only. For 8-party service in

ac-dc plants, SUP-AUD and SUP+AUD with -48 and +48 superimposing battery, respectively, can be provided. Each dc-to-ac inverter provides two 86-volt outputs, two 97-volt outputs (for dial long lines) and one 105±volt output (for miscellaneous uses, such as PBX feeders or manual switchboards). In superimposed offices the low side of one 20-Hz, 86-volt (A) ac output on each inverter is connected to -48 volts dc, while the other 20-Hz, 86-volt (B) ac output on each inverter is connected to +48 volts dc. The high side of each 86-volt (A) and (B) output is connected to a network that superimposes audible ringing tone on the 20-Hz ringing current. Then the 20-Hz ringing current superimposed on either -48 volt or +48 volt is supplied to the DB1-1, DB2-1 and DB1-2, DB2-2 diode board packages. These board packages have a varistor string in series with the load that drops the dc components by 10 volts. During power failure when the battery is on discharge, control relays short out some of the varistors to hold the dc components between 36 and 40 volts. In ac-dc plants, only the 86-volt (A) and (B) output and networks are required and the diode board packages are not provided.

1.07 In the J87810B superimposed ringing and tone power plant, the +48 volt dc tripping supply is obtained from the 610D dc-to-dc converter, operating from -48 volt dc supply, and the -48 volt dc tripping supply is obtained from the power distributing frame of the regular battery supply. Fusing for 72V dc tripping battery is provided on an A & M only basis using "W" option. The +38 and -38 volt dc superimposed voltages are derived from the +48 and -48 volt dc tripping voltages by means of voltage-dropping diodes in the 20-Hz outputs.

1.08 Instructions are based on the following drawings. For detailed description of the operation of individual circuits, refer to the corresponding circuit description.

SD-81571-01	DC to DC Transistor Converter +48 Volt, 1-1/2 Ampere Output -48 Volt Input, 610D Plant
SD-81768-01	Inverter Circuit—20 Hz, DC to AC, 86V, 1.50A
SD-81866-01	Ringing Circuit—AC-DC and Superimposed Ringing—SXS No. 1 & No. 350A Offices—862A &

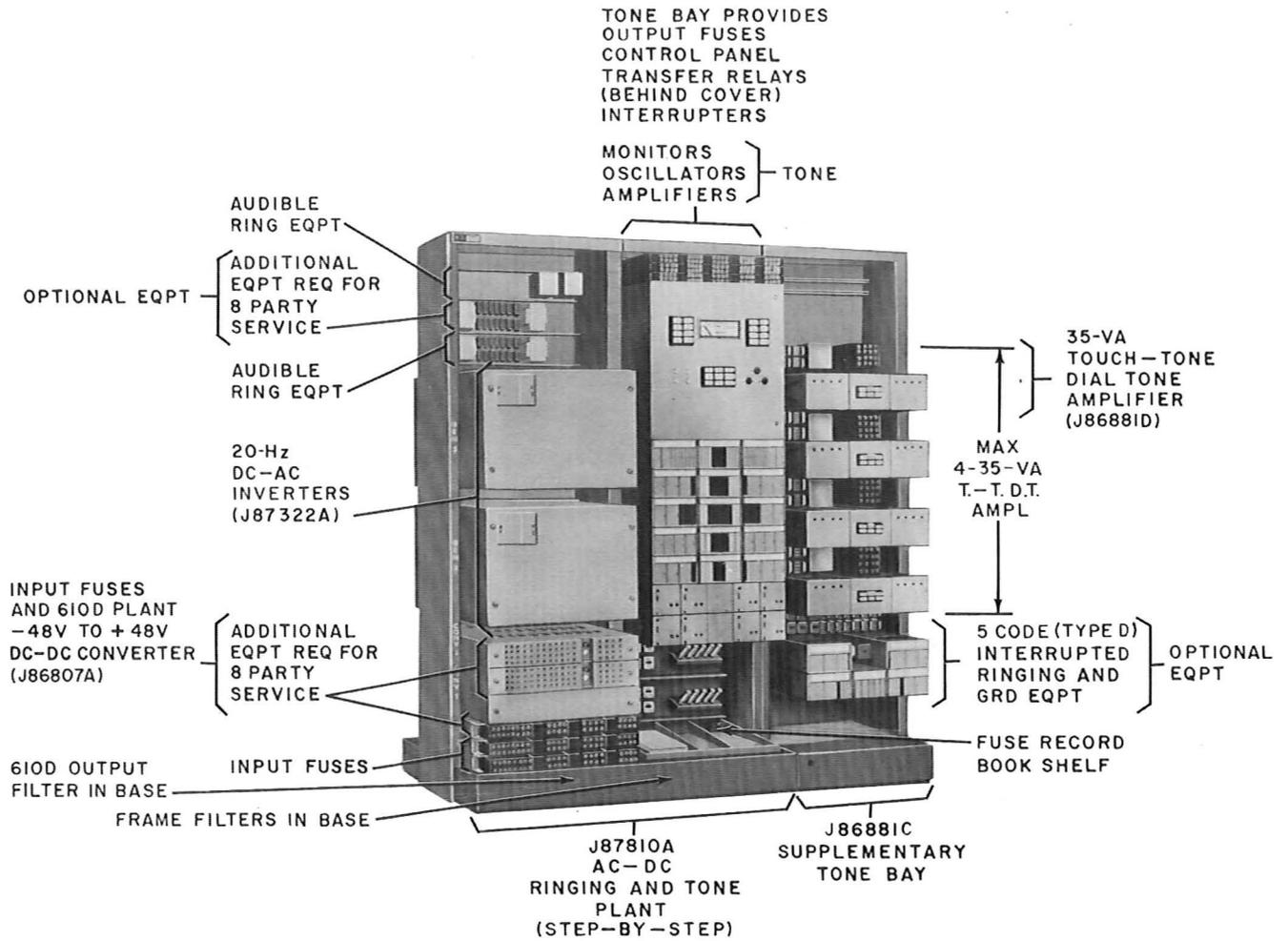


Fig. 1—J87810A AC-DC Ringing and Tone Power Plant (Step-by-Step)

863A Ringing and Tone Power Plant

SD-81885-01 Signaling Circuit—Circuit Pack Schematics

1.09 For more detailed information on the operation and maintenance of individual equipment and apparatus, refer to the appropriate Bell System

Practices. All relays except the 316-type should be adjusted, when required, in accordance with the appropriate Bell System Practice and the circuit requirement tables of the schematic circuit drawings. The 316-type relay should be replaced in the event of a malfunction.

1.10 The abbreviations cw and ccw refer to clockwise and counterclockwise, respectively.

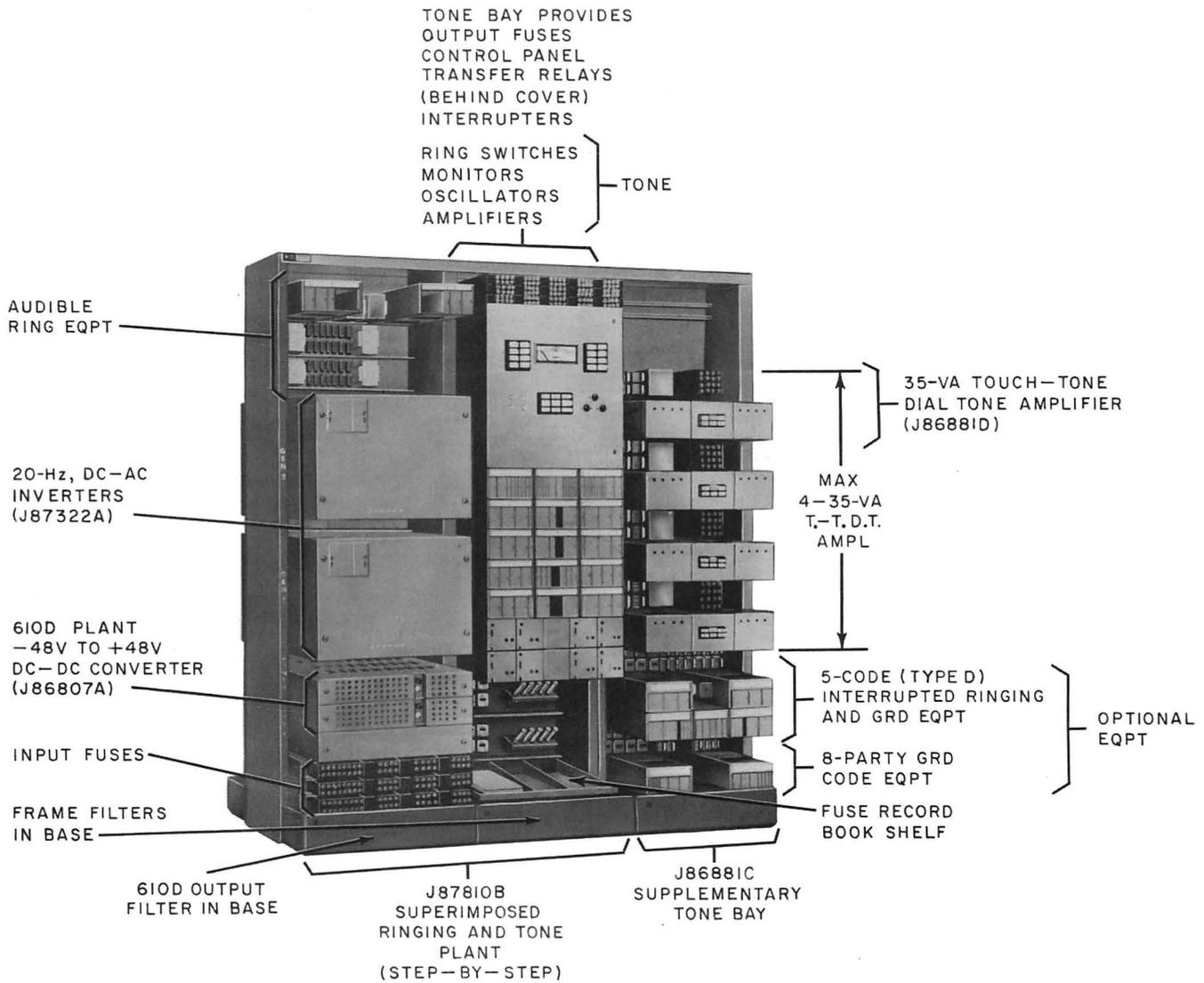


Fig. 2—J87810B Superimposed Ringing and Tone Power Plant (Step-by-Step)

2. LIST OF TOOLS AND TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
411B	Test Pick
723B	Tool
W1AF	Cord (8 1/2 feet long equipped with one 360A tool at each end)
KS-6278	Connecting Clip
—	Blocking Tools as required (Use and apply as outlined in Section 069-020-801.)
TEST APPARATUS	
—	Voltmeter, True RMS, Hewlett-Packard 3400A, 300/100/30/3/1-V, or equivalent such as Voltmeter, True RMS, Greibach Model 500, or voltmeter, AC-DC Thermo, Weston Model 622
KS-14510	Volt-Ohm-Milliammeter
158A	Board Extender

3. OPERATION

Automatic Operation of Plant

3.01 Under normal operating conditions with the regular side of the plant supplying the office load, the regular 20-Hz inverter, tone generators, and interrupter operating properly, the GT relay in the control, transfer, and alarm circuit is shunted down from operating. If any of the outputs of the regular side of the plant fail for any reason, the shunt will be removed, allowing the GT relay to operate in about two seconds and transfer the office load to the reserve side of the plant. The GT lamp and other trouble-indicating lamp(s) lights and a minor alarm sounds. Once operated, the GT relay remains locked operated. When the trouble condition has been cleared, the plant can be restored to normal by depressing the GEN RST switch, transferring the office load back to the

regular side of the plant. The GT lamp and other trouble-indicating lamp(s) extinguishes and the minor alarm silences. If some element in the reserve side of the plant fails without an earlier failure in the regular side of the plant, a trouble-indicating lamp(s) lights to indicate which output has failed and sounds a minor alarm. When the trouble is cleared, the trouble-indicating lamp(s) extinguishes and the minor alarm silences. If some element in the reserve side of the plant fails after an earlier failure in the regular side of the plant, the GF lamp and other trouble-indicating lamp(s) lights and a major alarm sounds. When the trouble is cleared, the trouble-indicating lamp(s) extinguishes and the major alarm silences.

Ringin^g Generators

3.02 One 86-volt output of each of the 20-Hz dc-to-ac inverters is monitored with a low-voltage alarm. When the outputs of the inverters are normal the LVA1 (GEN1) and LVA2 (GEN2) relays are operated. If the output of inverter GEN1 fails, the LVA1 relay releases causing an automatic transfer of the office load to the reserve side of the plant. The GT and LVA1 lamps light and a minor alarm sounds. If the output of inverter GEN2 fails without an earlier failure in the regular side of the plant, the LVA2 lamp lights and a minor alarm sounds. If the output of inverter GEN2 fails after an earlier failure in the regular side of the plant, the GF and LVA2 lamps light and a major alarm sounds.

Tone Generators and 1-VA Amplifiers

3.03 The output signals of all of the tone amplifiers are checked by marginal low-voltage monitors. When the input signal of the low-voltage monitors drops by more than 3 dB, the LV relay releases. Depending upon which LV relay releases, a ground is placed on the associated TT1 or TT2, HT1 or HT2, BT1 or BT2, or AR1 or AR2 lead to light the related trouble-indicating lamp(s). If the regular tone generator is not operating properly, the office load will automatically transfer to the reserve side of the plant; the GT lamp lights; and a minor alarm sounds. If the reserve tone generator fails without an earlier failure in the regular side of the plant, a tone-trouble indicating lamp lights and a minor alarm sounds. If the reserve tone generator fails after an earlier failure in the regular side of the plant, the GF and other tone-trouble indicating lamps light and a major alarm sounds.

Solid State Interrupters

3.04 Interrupter monitors are provided for each of the interrupted ringing and interrupted ground outputs. The IM— relays are normally held operated by contacts of *follow* relays. Both make and break contacts of each *follow* relay are used so that failure in either the operated or released position will result in the release of one or more of the IM— relays long enough to operate the INT3-1 (MON1) or INT3-2 (MON2) relay which locks through its own contacts to the INT1 RST or INT2 RST switch. The INT3-1 relay operated causes an automatic transfer, lights the INT1 and GT lamps, and sounds a minor alarm. The INT3-2 relay operated lights the INT2 lamp and sounds a minor alarm. At least one of the contacts of the *follow* relays in series with the IM— relay windings is closed at any instant. The contacts selected from different *follow* relays to operate the IM— relays are closed so that the loss of an output can be detected. By observing the released IM— relay or relays and the associated *follow* relays, it is possible to determine which output has failed. The INT3-1 or INT3-2 relays can be released after the trouble has been cleared by depressing the INT1 RST or the INT2 RST switch, respectively. The INT1 or INT2 lamp extinguishes. To restore the office load from the reserve side of the plant to the regular side of the plant, depress the GEN RST switch. The GT lamp extinguishes and the minor alarm silences.

Note: To silence the audible alarm after an automatic transfer occurs, depress the GEN TRFR switch. The GEN TRFR lamp lights in addition to the GT and trouble-indication lamps.

35-VA Dial Tone Amplifiers

3.05 The output of each 35-VA amplifier output transformer is monitored by normally operated NV1 and NV2 marginal low-voltage monitors. If either the regular 350-1 or 440-1 oscillators, TT3-1 amplifier, or the TT2-1, 35-VA amplifier fails (the only condition for an automatic transfer), the NV1 relay releases, operating the AT relay to transfer the office load of the first selector frames from amplifier AMP1 to amplifier AMP2. The AT lamp lights and a minor alarm sounds. When the trouble is cleared, the circuit can be restored to normal by depressing the AMP RST switch. If after amplifier AMP1 has failed and amplifier AMP2 in

turn fails, the NV2 relay releases. The NV2 and AF lamps light and a major alarm sounds; (the AT lamp remains lighted). Failure of amplifier AMP2 without an earlier failure of amplifier AMP1 releases the NV2 relay. The NV2 lamp lights and a minor alarm sounds. (See 1.03.)

Note: If the 35-VA amplifiers are mounted remote from this plant, the audible alarm may be silenced after an automatic transfer by depressing the AMP TRFR switch.

Manual Operation of Plant

3.06 Manual transfer of the switchboard circuits office load from the regular side of the plant to the reserve side of the plant is accomplished by depressing the GEN TRFR switch. The GEN TRFR switch locks operated under control of the GEN RST switch; the lamp in the GEN TRFR switch lights; and the GT relay operates in the same manner as with an automatic transfer. The audible alarm is silenced during manual transfer. To restore the plant to normal operation, depress the GEN RST switch. The GEN TRFR and GT lamps extinguish.

3.07 The office load of the first selector frames may be manually transferred from the 35-VA, AMP1 amplifier to the AMP2 amplifier (if furnished) by depressing the AMP TRFR switch. The AT relay will operate and lock operated under control of the AMP RST switch. The AT lamp and the lamp in the AMP TRFR switch light. The audible alarm is silenced during manual transfer. To restore the circuit to normal, first depress the AMP TRFR switch and then depress the AMP RST switch.

3.08 Power can be removed from either side of the plant by depressing either the PWR OFF1 or PWR OFF2 switch. A red lamp in the switch of whichever is depressed will light. To restore the regular side of the plant to normal, depress the PWR OFF1 switch again and then depress the GEN RST switch to restore the switchboard circuits office load to the regular side of the plant. To restore the reserve side of the plant to normal, depress the PWR OFF2 switch again. If 35-VA dial tone amplifiers are furnished, the office load of the first selector frames will automatically transfer from the amplifier AMP1 to amplifier AMP2 when depressing the PWR OFF1 switch. The AT lamp will light and a minor alarm

will sound only if the 35-VA amplifiers are mounted remote from this plant. To restore this circuit to normal, after removing power from the regular side of the plant, depress the AMP RST switch.

3.09 The VM voltmeter is normally connected to the AC-DC AUD or SUP-AUD of GEN1. To check the voltage of GEN2, depress the VM G2 switch. A lamp in the VM G2 switch lights to indicate that it is off-normal. Depress the VM G2 switch again to restore the VM voltmeter connection to GEN1. The lamp in the VM G2 switch extinguishes.

4. ROUTINE CHECKS AND ADJUSTMENTS

4.01 The power failure packages (PF), the tone low-voltage monitors, and the amplifiers are the only packages that require adjustments. These units are factory adjusted and should rarely require readjustments when in service. On most of the circuit packages the adjustments are internal to the packages; therefore, it is necessary to make use of the *158A board extender*. The *723B tool* is required for the removal of the circuit packages.

Caution: *When it is necessary to remove or insert a circuit package, turn off the -48 volt battery to the side of the plant involved by depressing the PWR OFF1 or PWR OFF2 switch. Restore battery by depressing the switch again.*

Tone Generators

4.02 Oscillator Checks

(1) Connect the model 3400A voltmeter, using the 10-volt scale, between the TP1 (grd) and TP2 (output) pin jacks of each of the four oscillators (350, 440, 480, and 620) of GEN2, one at a time and in turn.

Requirement: The voltmeter indicates between 4.0 and 4.6 volts rms on each of the four oscillators.

(2) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.

(3) Connect the model 3400A voltmeter, using the 10-volt scale, between the TP1 (grd) and TP2 (output) pin jacks of each of the four oscillators of GEN1, one at a time and in turn.

Requirement: The voltmeter indicates between 4.0 and 4.6 volts rms on each of the four oscillators.

(4) Disconnect the model 3400A voltmeter.

(5) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.

4.03 1-VA Amplifier Adjustments (read caution under 4.01)

(a) Dial Tone—TT3-2 (GEN2)

(1) Remove the F45 fuse supplying -48 volts to the T6 transformer of GEN2.

(2) Connect the model 3400A voltmeter, using the 3-volt scale, to terminals 5 and 8 of transformer T6, GEN2.

(3) Remove the OSC, 440-2 oscillator, and adjust the ADJ1 potentiometer of amplifier TT-2.

Requirement: The voltmeter indicates 1.2 volts.

(4) Replace the OSC, 440-2 oscillator; remove the OSC, 350-2 oscillator; and adjust the ADJ2 potentiometer of amplifier TT-2.

Requirement: The voltmeter indicates 1.2 volts.

(5) Replace the OSC, 350-2 oscillator.

Requirement: The voltmeter indicates 1.7 ± 0.1 volts.

(6) Replace the F45 fuse.

(b) Dial Tone—TT3-1 (GEN1)

(1) Depress the GEN TRFR switch. The load will transfer to GEN2. The GT and GEN TRFR lamps light.

(3) Remove the F5 fuse supplying -48 volts to the T3 transformer of GEN1.

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(3) Connect the model 3400A voltmeter, using the 3-volt scale, to terminals 5 and 8 of transformer T3, GEN1.

(4) Remove the OSC, 440-1 oscillator, and adjust the ADJ1 potentiometer of amplifier TT-1.

Requirement: The voltmeter indicates 1.2 volts.

(5) Replace the OSC, 440-1 oscillator; remove the OSC, 350-1 oscillator; and adjust the ADJ2 potentiometer of amplifier TT-1.

Requirement: The voltmeter indicates 1.2 volts.

(6) Replace the OSC, 350-1 oscillator.

Requirement: The voltmeter indicates 1.7 ± 0.1 volts.

(7) Replace the F5 fuse.

(8) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.

(c) Audible Ringing Tone—AR1-2 (GEN2)

(1) Connect the model 3400A voltmeter, using the 10-volt scale, to TP1 and TP2 jacks of the AR-2 amplifier, GEN2.

(2) Remove the OSC, 480-2 oscillator, and adjust the ADJ1 potentiometer of amplifier AR-2.

Requirement: The voltmeter indicates 3.35 volts.

(3) Replace the OSC, 480-2 oscillator; remove the OSC, 440-2 oscillator; and adjust the ADJ2 potentiometer of amplifier AR-2.

Requirement: The voltmeter indicates 3.0 volts.

(4) Replace the OSC, 440-2 oscillator.

Requirement: The voltmeter indicates 4.5 volts.

(d) Audible Ringing Tone—AR1-1 (GEN1)

(1) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.

(2) Connect the model 3400A voltmeter, using the 10-volt scale, to TP1 and TP2 jacks of the AR-1 amplifier, GEN1.

(3) Remove the OSC, 480-1 oscillator, and adjust the ADJ1 potentiometer of amplifier AR-1.

Requirement: The voltmeter indicates 3.35 volts.

(4) Replace the OSC, 480-1 oscillator; remove the OSC, 440-1 oscillator; and adjust the ADJ2 potentiometer of amplifier AR-1.

Requirement: The voltmeter indicates 3.0 volts.

(5) Replace the OSC, 440-1 oscillator.

Requirement: The voltmeter indicates 4.5 volts.

(6) Depress the GEN RST switch. The load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.

(e) High Tone—HT1-2 (GEN2)

(1) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 7 of transformer T7, GEN2.

(2) Adjust the ADJ1 potentiometer of amplifier HT-2.

Requirement: The voltmeter indicates 0.95 volt.

(f) High Tone—HT1-1 (GEN1)

(1) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.

(2) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 7 of transformer T4, GEN1.

- (3) Adjust the ADJ1 potentiometer of amplifier HT-1.

Requirement: The voltmeter indicates 0.95 volt.

- (4) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.

(g) Busy Tone—BT2-2 (GEN2)

- (1) Remove the F46 fuse supplying -48 volts to the T8 transformer of GEN2.

- (2) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 6 of transformer T8, GEN2.

- (3) Remove the OSC, 620-2 oscillator, and adjust the ADJ1 potentiometer of amplifier BT-2.

Requirement: The voltmeter indicates 0.47 volt.

- (4) Replace the OSC, 620-2 oscillator; remove the OSC, 480-2 oscillator; and adjust the ADJ2 potentiometer of amplifier BT-2.

Requirement: The voltmeter indicates 0.37 volt.

- (5) Replace the OSC, 480-2 oscillator.

Requirement: The voltmeter indicates 0.60 volt.

- (6) Replace the F46 fuse.

(h) Busy Tone—BT2-1 (GEN1)

- (1) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.

- (2) Remove the F6 fuse supplying -48 volts to the T5 transformer of GEN1.

- (3) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 6 of transformer T5, GEN1.

- (4) Remove the OSC, 620-1 oscillator, and adjust the ADJ1 potentiometer of amplifier BT-1.

Requirement: The voltmeter indicates 0.47 volt.

- (5) Replace the OSC, 620-1 oscillator; remove the OSC, 480-1 oscillator; and adjust the ADJ2 potentiometer of amplifier BT-1.

Requirement: The voltmeter indicates 0.37 volt.

- (6) Replace the OSC, 480-1 oscillator.

Requirement: The voltmeter indicates 0.60 volt.

- (7) Replace the F6 fuse.

- (8) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.

4.04 Audible Ringing Power Amplifier Adjustments

(a) Audible Ringing Tone—AR2-2 (GEN2)

- (1) Remove the F61 and F85 fuses supplying -48 volts to the T10 transformer of GEN2.

- (2) Connect the model 3400A voltmeter, using the 10-volt scale, to terminals 7 and 8 of transformer T10, GEN2.

- (3) Adjust the INPUT ADJ potentiometer of amplifier AR2-2 as required.

Requirement: The voltmeter indicates 3.8 volts.

- (4) Replace the F61 and F85 fuses.

(b) Audible Ringing Tone—AR2-1 (GEN1)

- (1) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.

- (2) Remove the F21 and F77 fuses supplying -48 volts to the T9 transformer of GEN1.

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(3) Connect the model 3400A voltmeter, using the 10-volt scale, to terminals 7 and 8 of transformer T9, GEN1.

(4) Adjust the INPUT ADJ potentiometer of amplifier AR2-1 as required.

Requirement: The voltmeter indicates 3.8 volts.

(5) Replace the F21 and F77 fuses.

(6) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.

4.05 35-VA Amplifier Adjustments

(a) Dial Tone—TT2-2 (AMP2)

(1) Connect the model 3400A voltmeter, using the 30-volt dc scale, to terminals 7 and 8 of transformer T12, AMP2.

(2) Adjust the INPUT ADJ potentiometer of amplifier TT2-2 as required.

Requirement: The voltmeter indicates 23 volts.

(b) Dial Tone—TT2-1 (AMP1)

(1) Depress the AMP TRFR switch. The office load of the first selector frames will transfer to amplifier AMP2. The AT and AMP TRFR lamps light.

(2) Connect the model 3400A voltmeter, using the 30-volt dc scale, to terminals 7 and 8 of transformer T11, AMP1.

(3) Adjust the INPUT ADJ potentiometer of amplifier TT2-1 as required.

Requirement: The voltmeter indicates 23 volts.

(4) Depress the AMP TRFR switch and then depress the AMP RST switch. The office load of the first selector frames will transfer back to amplifier AMP1. The AT and AMP TRFR lamps extinguish.

4.06 Low-Voltage Monitor Adjustments

(a) Dial Tone—TT3-2 (MON2)

(1) Rotate the R1 potentiometer of monitor LVTT-2 fully ccw.

(2) Remove the OSC, 350-2 oscillator.

Requirement: The TTLV2 lamp lights.

(3) Slowly rotate the R1 potentiometer ccw until the TTLV2 lamp extinguishes.

(4) Slowly rotate the R1 potentiometer ccw until the TTLV2 lamp lights.

(5) Replace the OSC, 350-2 oscillator. The TTLV2 lamp extinguishes.

(b) Dial Tone—TT3-1 (MON1)

(1) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.

(2) Rotate the R1 potentiometer of monitor LVTT-1 fully ccw.

(3) Remove the OSC, 350-1 oscillator.

Requirement: The TTLV1 lamp lights.

(4) Slowly rotate the R1 potentiometer ccw until the TTLV1 lamp extinguishes.

(5) Slowly rotate the R1 potentiometer ccw until the TTLV1 lamp lights.

(6) Replace the OSC, 350-1 oscillator. The TTLV1 lamp extinguishes.

(7) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.

(c) Audible Ringing Tone—AR1-2 (MON2)

(1) Rotate the R1 potentiometer of monitor LVAR-2 fully ccw.

(2) Remove the OSC, 480-2 oscillator.

Requirement: The ARLV2 lamp lights.

- (3) Slowly rotate the R1 potentiometer cw until the ARLV2 lamp extinguishes.
- (4) Slowly rotate the R1 potentiometer ccw until the ARLV2 lamp lights.
- (5) Replace the OSC, 480-2 oscillator. The ARLV2 lamp extinguishes.
- (d) Audible Ringing Tone—AR1-1 (MON1)
- (1) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.
- (2) Rotate the R1 potentiometer of monitor LVAR-1 fully ccw.
- (3) Remove the OSC, 480-1 oscillator.
- Requirement:** The ARLV1 lamp lights.
- (4) Slowly rotate the R1 potentiometer cw until the ARLV1 lamp extinguishes.
- (5) Slowly rotate the R1 potentiometer ccw until the ARLV1 lamp lights.
- (6) Replace the OSC, 480-1 oscillator. The ARLV1 lamp extinguishes.
- (7) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.
- (e) Busy Tone—BT2-2 (MON2)
- (1) Rotate the R1 potentiometer of monitor LVBT-2 fully ccw.
- (2) Remove the OSC, 620-2 oscillator.
- Requirement:** The BTLV2 lamp lights.
- (3) Slowly rotate the R1 potentiometer cw until the BTLV2 lamp extinguishes.
- (4) Slowly rotate the R1 potentiometer ccw until the BTLV2 lamp lights.
- (5) Replace the OSC, 620-2 oscillator. The BTLV2 lamp extinguishes.
- (f) Busy Tone—BT2-1 (MON1)
- (1) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.
- (2) Rotate the R1 potentiometer of monitor LVBT-1 fully ccw.
- (3) Remove the OSC, 620-1 oscillator.
- Requirement:** The BTLV1 lamp lights.
- (4) Slowly rotate the R1 potentiometer cw until the BTLV1 lamp extinguishes.
- (5) Slowly rotate the R1 potentiometer ccw until the BTLV1 lamp lights.
- (6) Replace the OSC, 620-1 oscillator. The BTLV1 lamp extinguishes.
- (7) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.
- (g) High Tone—HT1-2 (GEN2)
- (1) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 7 of transformer T7, GEN2.
- (2) Slowly rotate the ADJ1 potentiometer of amplifier HT-2 as required.
- Requirement:** The voltmeter indicates 0.67 volt.
- (3) Rotate the R1 potentiometer of monitor LVHT-2 fully ccw.
- Requirement:** The HTLV2 lamp lights.
- (4) Slowly rotate the R1 potentiometer cw until the HTLV2 lamp extinguishes.
- (5) Slowly rotate the R1 potentiometer ccw until the HTLV2 lamp just lights.
- (6) Slowly rotate the ADJ1 potentiometer of amplifier HT-2 as required.
- Requirement:** The voltmeter indicates 0.95 volt and the HTLV2 lamp extinguishes.
- (h) High Tone—HT1-1 (GEN1)

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- (1) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.
- (2) Connect the model 3400A voltmeter, using the 1-volt scale, to terminals 5 and 7 of transformer T4, GEN1.
- (3) Slowly rotate the ADJ1 potentiometer of amplifier HT-1 as required.

Requirement: The voltmeter indicates 0.67 volt.

- (4) Rotate the R1 potentiometer of monitor LVHT-1 fully ccw.
- (5) Slowly rotate the R1 potentiometer cw until the HTLV1 lamp extinguishes.
- (6) Slowly rotate the R1 potentiometer ccw until the HTLV1 lamp just lights.
- (7) Slowly rotate the ADJ1 potentiometer of amplifier HT-1 as required.

Requirement: The voltmeter indicates 0.95 volt and the HTLV1 lamp extinguishes.

- (8) Disconnect the model 3400A voltmeter.
- (9) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.

Ringling Generators

4.07 PF1 and PF2 Monitor Adjustment (Superimposed Offices Only)

(a) Generator 2

- (1) Using the 100-volt dc scale of the model 3400A voltmeter, connect the negative lead to the TP1 jack of the PF2 circuit pack and the positive lead to ground.
- (2) Operate and hold the S1 switch and rotate the PF TST (R1) potentiometer as required.

Requirement: The voltmeter indicates -47 volts dc.

- (3) Rotate the PF ADJ (R4) potentiometer cw until the PF2 relay releases; then slowly rotate the PF ADJ (R4) potentiometer ccw until the PF2 relay operates.

- (4) Release the S1 switch.

Requirement: The PF2 relay releases.

(b) Generator 1

- (1) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.
- (2) Using the 100-volt dc scale of the model 3400A voltmeter, connect the negative lead to the TP1 jack of the PF1 circuit pack and the positive lead to ground.
- (3) Operate and hold the S1 switch and rotate the PF TST (R1) potentiometer as required.

Requirement: The voltmeter indicates -47 volts dc.

- (4) Rotate the PF ADJ (R4) potentiometer cw until the PF1 relay releases; then slowly rotate the PF ADJ (R4) potentiometer ccw until the PF1 relay operates.

- (5) Release the S1 switch.

Requirement: The PF1 relay releases.

- (6) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.

Distribution Fuse Alarm Checks

Caution: The WIAF cord is equipped with an internal resistance of 188 ohms and must not be substituted by any other similar cord as serious equipment damage may result.

4.08 Battery Distribution Circuit Alarm Check

- (1) Depress the GEN TRFR switch. The office load will transfer to GEN2. The GT and GEN TRFR lamps light.

(2) Using a WIAF cord with a KS-6278 connecting clip attached to one end and a 411B test pick attached to the other end, attach the connecting clip to the distribution bus bar of Step 1 for generator 1 as shown in Table A. Then insert the test pick through the aperture in the front of any *one* of the fuses in the associated group. The alarm relay shown in the table operates; the FA lamp lights; and the audible major alarm sounds.

(2) Repeat similar checks on each subsequent step (2 through 5) for generator 1, as shown in Table A.

(3) Depress the GEN RST switch. The office load will transfer back to GEN1. The GT and GEN TRFR lamps extinguish.

(4) Attach the connecting clip of the WIAF cord to the distribution bus bar of Step 6 for generator 2, as shown in Table A. Then insert the test pick through the aperture in the front of any one of the fuses in the associated group. The alarm relay shown in the table operates; the FA lamp lights; and the audible major alarm sounds.

(5) Repeat similar checks on each subsequent step (7 through 10) for generator 2, as shown in Table A.

4.09 Power Ringing and Tone Distribution Circuit Alarm Check

(1) Using a WIAF cord with a KS-6278 connecting clip attached to one end and a 411B test pick attached to the other end, attach the connecting clip to the distribution bus bar of Step 1 as shown in Table B. Then insert the test pick through the aperture in the front of any *one* of the fuses in the associated group. The alarm relays shown in the table operate; the FA lamp lights; and the audible major alarm sounds.

(2) Repeat similar checks on each subsequent step (2 through 28), as shown in Table B.

5. TROUBLE

5.01 Trouble in the plant is normally detected by visual trouble-indicator lamps in the control panel and by audible minor or major alarms. If any element in the regular 20-Hz inverter, tone generators, or interrupter fail, the office load of the switchboard circuits will automatically transfer

TABLE A

	STEP	DISTRIBUTION BUS BAR	FUSE TO BE CHECKED	ALARM RELAY
GENERATOR 1	1	-48V	F1 to 8, 10 to 20, 22, or 23	FA1
	2		F25, 26, 29, or 30	
	3		F33 to 37	
	4		F225, 226, 229, or 230*	
	5	+48V	F73 to 75, 89, 90, or 93	
GENERATOR 2	6	-48V	F41 to 48, 50 to 60, 62, or 63	FA1
	7		F27, 28, 31, or 32	
	8		F65 to 69	
	9		F227, 228, 231, or 232*	
	10	+48V	F81, 82, 91, 92, 95	

* Provided 35-VA dial tone amplifiers are furnished.

TABLE B

STEP	DISTRIBUTION BUS BAR	FUSE TO BE CHECKED	ALARM RELAY
1	105±	F97, 98, 101, or 102	FA1, FA2
2	AC-DC AUD (Z) SUP-AUD (Y)	F99, 100, 103, or 104	FA1, FA3
3	MR R1 BR1 (Z) SUP-BR1 (Y)	F105, 106, 109, or 110	
4	MR R1 BR2 (Z) SUP-BR2 (Y)	F107, 108, 111, or 112	
5	MR R1 BR3 (Z) SUP-BR3 (Y)	F113, 114, 117, or 118	
6	MR R2 BR1	F115, 116, 119, or 120	
7	MR R2 BR2	F121, 122, 125, or 126	
8	MR SUP+BR3 (Y)	F123, 124, 127, or 128	
9	CODE 1 GEN	F129, 130, 133, or 134	FA1, FA3
10	CODE 2 GEN	F131, 132, 135, or 136	
11	CODE 3 GEN	F137, 138, 141, or 142	
12	CODE 4 GEN	F139, 140, 143, or 144	
13	CODE 5 GEN	F145, 146, 149, or 150	
14	AC-DC AUD (Y)	F147, 148, 151, or 152	
15	MR SUP+BR1 (Y)	F153, 154, 157, or 158	
16	MR SUP+BR2 (Y)	F155, 156, 159, or 160	
17	SUP+AUD, +48V (X) SUP+AUD, +38V (Y)	F161, 162, 165, or 166	
18	+TRP	F163, 164, 167, or 168	FA1
19	TT3	F169 to 176	FA1, FA4
20	HT1	F177, 178, 181, or 182	
21	BT2 60 IPM	F179, 180, 183, or 194	FA1, FA5
22	BT2 120 IPM	F185, 186, 189, or 190	
23	BT2	F187, 188, 191, or 192	
24	TT-1	F193 to 200	
25	TT-2	F201 to 208	
26	SUP-AUD, 94-101V (Y)	F209, 210, 213, or 214	
27	SUP+AUD, 94-101V (Y)	F211, 212, 215, or 216	
28	TT2	F217 to 222	FA, FA1, (FA7)

X — AC-DC Ringing
Y — Superimposed Ringing
Z — AC-DC Ringing

to the reserve side of the plant. If 35-VA amplifiers are furnished, the office load of the first selector frames will automatically transfer to the reserve amplifier whenever there is a failure of the regular 350-1 or 440-1 oscillators, TT3-1 amplifier, or the TT2-1, 35-VA amplifier. Trouble-indicating lamps and minor or major audible alarms disclose the general origin of the trouble location. The attached trouble charts are provided to assist maintenance personnel in the analysis of the trouble-indicator lamps of any affected unit in the ringing and tone generators, solid state interrupter, and the 35-VA amplifier (if furnished). Table C identifies each trouble-indicator lamp associated with the ringing and tone generators and the 35-VA amplifiers (if furnished). Tables D through H identify failures of the interrupted ringing or interrupted ground outputs of the solid state interrupters. Any failure of the interrupters will light either the INT1 lamp for the regular unit or the INT2 lamp for the reserve unit. The interrupter monitor (IM—) relays are normally operated. Under a trouble condition, these relays may release permanently or may alternately release and operate. Before attempting to localize the source of trouble, depress the PWR OFF1 or PWR OFF2 switch to remove the power from the side of the plant affected, and then depress it again to restore the power. Then depress the INT1 RST or INT2 RST switch. If this does not clear the trouble condition, refer to the appropriate trouble chart, Tables D through G, to localize the trouble. To illustrate, each of the machine ringing outputs, R1G BR1, R1G BR2, and R1G BR3 from the ringing switches are supplied to half-wave rectifiers to drive the *follow* relays BR1—, BR2—, and BR3—. Both make and break contacts of each *follow* relay are used so that a failure in either the operated or released state will

result in the release of an IM— relay. By observing the *follow* relays it is possible to determine which output has failed. Using Table D, for instance, an assumption will determine that the IM1-1 and BR1-1 relays have released, indicating a failure of the R1G BR1 output lead. It will be required to alternately replace each unit of suspected faulty equipment, retesting the circuit after each replacement. In this case the RR1-1, CP A757 circuit pack, should be first replaced, followed by the RS1-1, CP A756 circuit pack. If the replacement of these two equipments does not clear the trouble, then replace one at a time, in turn, the circuit packs associated with the output lead R1G BR1 shown in Table H.

6. TROUBLE CHARTS

6.01 Trouble charts are contained in Tables C through H. The titles are as follows:

Table C—Ringing and Tone Generators and 35-VA Amplifiers

Table D—Interrupter Monitors for 2- and 4-Party—AC-DC Ringing

Table E—Interrupter Monitors for 2- and 4-Party—Superimposed Ringing

Table F—Interrupter Monitors for 5-Code (Type D)—AC-DC and Superimposed Ringing

Table G—Interrupter Monitors for 8-Party Ground Codes—Superimposed Ringing

Table H—Interrupter Output Leads Designations

TABLE C
TROUBLE CHART
RINGING AND TONE GENERATORS AND 35-VA AMPLIFIERS

LAMP	INDICATION
GT	Trouble condition in the regular 20-Hz inverter, tone generator, or interrupter. Indicates that all transfer relays operated to transfer the office load of the switchboard circuits from the regular to the reserve side of the plant. A minor audible alarm sounds.
FA	Operated fuse(s) in the battery distribution for both the regular and reserve units, distribution circuit to switchboard circuits, or distribution circuit to first selector frames. Some of the operated fuses in the battery distribution of the regular unit automatically transfer the office load of the switchboard circuits to the reserve unit. A major audible alarm sounds for all operated fuses.
GF	Indicates that some element in the reserve unit has failed after an earlier failure in the regular unit. A major audible alarm sounds.
HTLV1 (HTLV2)	The LV relay in the LVHT-1 (or LVHT-2) monitor has released. The single 480-Hz frequency from the HT1-1 (or HT1-2) amplifier dropped below 3 db from normal output. Indicates a possible defective HT1-1 (or HT1-2) amplifier or 480-1 (or 480-2) oscillator (see 3.03).
TT3LV1 (TT3LV2)	The LV relay in LVTT-1 (or LVTT-2) monitor has released. The combined 350- and 440-Hz frequencies from the TT3-1 (or TT3-2) amplifier dropped below 3 db from normal output. Indicates a possible defective TT3-1 (or TT3-2) amplifier, 350-1 (or 350-2) oscillator, or 440-1 (or 440-2) oscillator (see 3.03).
BTLV1 (BTLV2)	The LV relay in the LVBT-1 (or LVBT-2) monitor has released. The combined 480- and 620-Hz frequencies from the BT2-1 (or BT2-2) amplifier dropped below 3 db from normal output. Indicates a possible defective BT2-1 (or BT2-2) amplifier, 480-1 (or 480-2) oscillator, or 620-1 (or 620-2) oscillator (see 3.03).
ARLV1 (ARLV2)	The LV relay in the LVAR-1 (or LVAR-2) monitor has released. The combined 440- and 480-Hz frequencies from the AR1-1 (or AR1-2) amplifier dropped below 3 db from normal output. Indicates a possible defective AR1-1 (or AR1-2), 440-1 (or 440-2) oscillator, 480-1 (or 480-2) oscillator (see 3.03).
LVA1 (LVA2)	Low/or no 86-volt (A) ac output from inverter GEN 1 or 86-volt (B) ac output from inverter GEN 2 (see 3.02).
VMG2	Indicates that the VMG2 switch is operated off-normal. Depress the VMG2 switch to restore the voltmeter connection from GEN 2 to GEN 1 (see 3.09).

TABLE C
TROUBLE CHART (Cont)
RINGING AND TONE GENERATORS AND 35-VA AMPLIFIERS

LAMP	INDICATION
PWR OFF 1 (PWR OFF 2)	Indicates that the PWR OFF 1 (or PWR OFF 2) switch is manually operated off-normal and power is removed from the associated side of the plant. Depress the PWR OFF 1 (or PWR OFF 2) switch to restore the power. If PWR OFF 1 lamp was lighted, depress the GEN RST switch to restore the office load of the switchboard circuits to the regular side of the plant (see 3.08).
GEN TRFR	Indicates a manual transfer of the office load of the switchboard circuits from the regular to the reserve side of the plant (see 3.06).
*AMP TRFR	Indicates a manual transfer of the office load of the first selector frames from amplifier AMP 1 to amplifier AMP 2 (see 3.07). To restore circuit to normal, depress the AMP TRFR switch again, then depress the AMP RST switch.
*AT	Indicates an automatic transfer of the office load of the first selector frame from amplifier AMP 1 to amplifier AMP 2 (see 3.08). Check for defective amplifier TT2-1 or amplifier TT3-1. AT lamp also lights with a manual transfer.
*NV2	Failure of AMP 2 without a prior failure of amplifier AMP 1 provides a lighted NV2 lamp and the minor alarm sounds. If after amplifier AMP 1 has failed, amplifier AMP 2 in turn fails the AT and AF lamps also light and a major alarm sounds.
*AF	Amplifier AMP 2 has failed after an earlier failure of amplifier AMP 1. The AT, NV2 lamps also light and the major alarm sounds.

* Provided 35-VA dial tone amplifiers are furnished.

TABLE D

TROUBLE CHART

INTERRUPTER MONITORS FOR 2- AND 4-PARTY AC-DC RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED	EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT1	IM1-1		RR1-1 CP A757	2-14-34		
		BR1-1	RS1-1 CP A756	2-18-9	R1G BR1	F33
		BR2-1	RS2-1 CP A756	2-18-19	R1G BR2	F34
		BR3-1	RS3-1 CP A756	2-18-29	R1G BR3	F35
	IM2-1		RR2-1 CP A757	2-14-38		
		R2 BR2-1	RS5-1 CP A756	2-16-19	R2G BR2	F37
		R2G-1	R2 GRD-1 316M Rly		R2 GRD	
		R2 BR1-1	RS4-1 CP A756	2-16-9	R2G BR1	F36
	IM3-1		RR2-1 CP A757	2-14-38		
		R2 BR1-1	RS4-1 CP A756	2-16-9	R2G BR1	F36
		R2 BR2-1	RS5-1 CP A756	2-16-19	R2G BR2	F37
	IM4-1		RR1-1 CP A757	2-14-34		
		R2G-1	R2 GRD-1 316M Rly		R2 GRD	
		BR1-1	RS1-1 CP A756	2-18-9	R1G BR1	F33
		INT2-1	INT1-1 316M Rly		INT	
	IM5-1	INT2-1	INT1-1 316M Rly		INT	
		RR2-1	RR1-1 316M Rly		RR	

TABLE D

TROUBLE CHART (Cont)

INTERRUPTER MONITORS FOR 2- AND 4-PARTY AC-DC RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT1	IM6-1		RR1-1	CP A757	2-14-34		
			RR2-1	CP A757	2-14-38		
		INT2-1	INT1-1	316M Rly		INT	
		BR1-1	RS1-1	CP A756	2-18-9	R1G BR1	F33
		R2 BR1-1	RS4-1	CP A756	2-16-9	R2G BR1	F36
		RR2-1	RR1-1	316M Rly		RR	
	IM8-1		RR1-1	CP A757	2-14-34		
		BR3-1	RS3-1	CP A756	2-18-29	R1G BR3	F35
		PK2-1	PK1-1	316M Rly		PK	
	IM9-1		RR1-1	CP A757	2-14-34		
		RR2-1	RR1-1	316M Rly		RR	
		PK2-1	PK1-1	316M Rly		PK	
		120-1	120 BR3-1	276B Rly			
		60-1	60 BR3-1	276B Rly			
		BR3-1	RS3-1	CP A756	2-18-29	R1G BR3	F35
	IM10-1	30B-1	30A-1	276B Rly		30	
		60-1	60 BR3-1	276B Rly		60	
		120-1	120 BR3-1	276B Rly		120	

TABLE D

TROUBLE CHART (Cont)

INTERRUPTER MONITORS FOR 2- AND 4-PARTY AC-DC RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT2	IM1-2		RR1-2	CP A757	2-14-62		
		BR1-2	RR1-2	CP A756	2-18-93	R1G BR1	F65
		BR2-2	RS2-2	CP A756	2-18-83	R1G BR2	F66
		BR3-2	RS3-2	CP A756	2-18-73	R1G BR3	F67
	IM2-2		RR2-2	CP A757	2-14-58		
		R2 BR2-2	RS5-2	CP A756	2-16-73	R2G BR2	F69
		R2G-2	R2 GRD-2	316M Rly		R2 GRD	
		R2 BR1-2	RS4-2	CP A756	2-16-83	R2G BR1	F68
	IM3-2		RR2-2	CP A757	2-14-58		
		R2 BR1-2	RS4-2	CP A756	2-16-83	R2G BR1	F68
		R2 BR2-2	RS5-2	CP A756	2-16-73	R2G BR2	F69
	IM4-2		RR1-2	CP A757	2-14-62		
		R2G-2	R2 GRD-2	316M Rly		R2 GRD	
		BR1-2	RS1-2	CP A756	2-18-93	R1G BR1	F65
		INT2-2	INT1-2	316M Rly		INT	
	IM5-2	INT2-2	INT1-2	316M Rly		INT	
		RR2-2	RR1-2	316M Rly		RR	

TABLE D

TROUBLE CHART (Cont)

INTERRUPTER MONITORS FOR 2- AND 4-PARTY AC-DC RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT2	IM6-2		RR1-2	CP A757	2-14-62		
			RR2-2	CP A757	2-14-58		
		INT2-2	INT1-2	316M Rly		INT	
		BR1-2	RS1-2	CP A756	2-18-93	R1G BR1	F65
		R2 BR1-2	RS4-2	CP A756	2-16-83	R2G BR1	F68
		RR2-2	RR1-2	316M Rly		RR	
	IM8-2		RR1-2	CP A757	2-14-62		
		BR3-2	RS3-2	CP A756	2-18-73	R1G BR3	F67
		PK2-2	PK1-2	316M Rly		PK	
	IM9-2		RR1-2	CP A757	2-14-62		
		RR2-2	RR1-2	316M Rly		RR	
		PK2-2	PK1-2	316M Rly		PK	
		120-2	120 BR3-2	276B Rly			
		60-2	60 BR3-2	276B Rly			
		BR3-2	RS3-2	CP A756	2-18-73	R1G BR3	F67
	IM10-2	30B-2	30A-2	276B Rly		30	
		60-2	60 BR3-2	276B Rly		60	
		120-2	120 BR3-2	276B Rly		120	

TABLE E
TROUBLE CHART

INTERRUPTER MONITOR FOR 2- AND 4-PARTY SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED	EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT1	IM1-1		RR1-1 CP A757	2-14-34		
		BR1-1	RS1-1 CP A756	2-18-9	S-BR1	F33
		BR2-1	RS2-1 CP A756	2-18-19	S-BR2	F34
		BR3-1	RS3-1 CP A756	2-18-29	S-BR3	F35
	IM2-1		RR2-1 CP A757	2-14-38		
		R2 BR1-1	RS4-1 CP A756	2-18-40	R2 BR1	F36
		R2G-1	R2 GRD-1 316M Rly		R2 GRD	
		R2 BR2-1	RS5-1 CP A756	2-16-40	R2 BR2	F37
	IM3-1		RR1-1 CP A757	2-14-34		
			RR2-1 CP A757	2-14-38		
		R2 BR2-1	RS5-1 CP A756	2-16-40	R2 BR2	F37
		R2 BR1-1	RS4-1 CP A756	2-18-40	R2 BR1	F36
	IM4-1		RR1-1 CP A757	2-14-34		
		R2G-1	R2 GRD-1 316M Rly		R2 GRD	
		BR1-1	RS1-1 CP A756	2-18-9	S-BR1	F33
		INT2-1	INT1-1 316M Rly		INT	
	IM5-1	INT2-1	INT1-1 316M Rly		INT	
		RR2-1	RR1-1 316M Rly		RR	

TABLE E

TROUBLE CHART (Cont)

INTERRUPTER MONITOR FOR 2- AND 4-PARTY SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT1	IM6-1		RR1-1	CP A757	2-14-34		
			RR2-1	CP A757	2-14-38		
		RR2-1	RR1-1	316M Rly		RR	
		INT2-1	INT1-1	316M Rly		INT	
		R2 BR1-1	RS4-1	CP A756	2-18-40	R2 BR1	
		BR1-1	RS1-1	CP A756	2-18-9	S-BR1	
	IM7-1		RR3-1	CP A757	2-14-42		
		BR1+1	RS6-1	CP A756	2-16-9	S+BR1	F89
		BR2+1	RS7-1	CP A756	2-16-19	S+BR2	F90
		BR3+1	RS8-1	CP A756	2-16-29	S+BR3	F93
	IM8-1		RR1-1	CP A757	2-14-34		
		BR3-1	RS3-1	CP A756	2-18-29	S-BR3	F35
		60-1	60 BR3-1	276B Rly		60	
		RR2-1	RR1-1	316M Rly		RR	
		120-1	120 BR3-1	276B Rly		120	
		PK2-1	PK1-1	316M Rly		PK	
	IM9-1		RR1-1	CP A757	2-14-34		
		PK2-1	PK1-1	316M Rly		PK	
		BR3-1	RS3-1	CP A756		S-BR3	
	IM10-1	30B-1	30A-1	276B Rly		30	
		60-1	60 BR3-1	276B Rly		60	
		120-1	120 BR3-1	276B Rly		120	

TABLE E

TROUBLE CHART (Cont)

INTERRUPTER MONITOR FOR 2- AND 4-PARTY SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT2	IM1-2		RR1-2	CP A757	2-14-62		
		BR1-2	RS1-2	CP A756	2-18-93	S-BR1	F65
		BR2-2	RS2-2	CP A756	2-18-83	S-BR2	F66
		BR3-2	RS3-2	CP A756	2-18-73	S-BR3	F67
	IM2-2		RR2-2	CP A757	2-14-58		
		R2 BR1-2	RS4-2	CP A756	2-18-62	R2 BR1	F68
		R2G 2	R2 GRD-2	316M Rly		R2 GRD	
		R2 BR2-2	RS5-2	CP A756	2-16-93	R2 BR2	F69
	IM3-2		RR1-2	CP A757	2-14-62		
			RR2-2	CP A757	2-14-58		
		R2 BR2-2	RS5-2	CP A756	2-16-93	R2 BR2	F69
		R2 BR1-2	RS4-2	CP A756	2-18-62	R2 BR1	F68
	IM4-2		RR1-2	CP A757	2-14-62		
		R2G-2	R2 GRD-2	316M Rly		R2 GRD	
		BR1-2	RS1-2	CP A756	2-18-93	S-BR1	F65
		INT2-2	INT1-2	316M Rly		INT	
	IM5-2	INT2-2	INT1-2	316M Rly		INT	
		RR2-2	RR1-2	316M Rly		RR	

TABLE E

TROUBLE CHART (Cont)

INTERRUPTER MONITOR FOR 2- AND 4-PARTY SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT2	IM6-2		RR1-2	CP A757	2-14-62		
			RR2-2	CP A757	2-14-58		
		RR2-2	RR1-2	316M Rly		RR	
		INT2-2	INT1-2	316M Rly		INT	
		R2 BR1-2	RS4-2	CP A756	2-18-62	R2 BR1	
		BR1-2	RS1-2	CP A756	2-18-93	S-BR1	
	IM7-2		RR3-2	CP A757	2-14-54		
		BR1+2	RS6-2	CP A756	2-16-83	S+BR1	F91
		BR2+2	RS7-2	CP A756	2-16-73	S+BR2	F92
		BR3+2	RS8-2	CP A756	2-16-62	S+BR3	F95
	IM8-2		RR1-2	CP A757	2-14-62		
		BR3-2	RS3-2	CP A756	2-18-73	S-BR3	F67
		60-2	60 BR3-2	276B Rly		60	
		RR2-2	RR1-2	316M Rly		RR	
		120-2	120 BR3-2	276B Rly		120	
		PK2-2	PK1-2	316M Rly		PK	
	IM9-2		RR1-2	CP A757	2-14-62		
		PK2-2	PK1-2	316M Rly		PK	
		BR3-2	RS3-2	CP A756		S-BR3	
	IM10-2	30B-2	30A-2	276B Rly		30	
		60-2	60 BR3-2	276B Rly		60	
		120-2	120 BR3-2	276B Rly		120	

TABLE F

TROUBLE CHART

INTERRUPTER MONITOR 5-CODE (TYPE D) AC-DC AND SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT1	IM11-1		RR5-1	CP A757	3-4-31		
		C4G-1	RS12-1	CP A756	4-4-9	C4G	F22
		C5G-1	RS13-1	CP A756	4-4-19	C5G	F23
	IM12-1		RR4-1	CP A757	3-4-27		
		C2G-1	RS10-1	CP A756	3-6-19	C2G	F19
		C3G-1	RS11-1	CP A756	3-6-29	C3G	F20
	IM13-1		RR4-1	CP A757	3-4-27		
			RR5-1	CP A757	3-4-31		
		C1G-1	RS9-1	CP A756	3-6-9	C1G	F18
		C4G-1	RS12-1	CP A756	4-4-9	C4G	F22
	IM14-1		RR4-1	CP A757	3-4-27		
		C3G-1	RS11-1	CP A756	3-6-29	C3G	F20
		C1G-1	RS9-1	CP A756	3-6-9	C1G	F18
	IM15-1		RR4-1	CP A757	3-4-27		
			RR5-1	CP A757	3-4-31		
		C4G-1	RS12-1	CP A756	4-4-9	C4G	F22
		C5G-1	RS13-1	CP A756	4-4-19	C5G	F23
		C2G-1	RS-10-1	CP A756	3-6-19	C2G	F19

TABLE F

TROUBLE CHART (Cont)

INTERRUPTER MONITOR 5-CODE (TYPE D) AC-DC AND SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT1	IM16-1		RR1-1	CP A757	2-14-34		
			RR4-1	CP A757	3-4-27		
		C2G-1	RS10-1	CP A756	3-16-19	C2G	F19
		C1G-1	RS9-1	CP A756	3-6-9	C1G	F18
		BR2-1	RS2-1	CP A756	2-18-19	S-BR2	F34
INT2	IM11-2		RR5-2	CP A757	3-4-65		
		C4G-2	RS12-2	CP A756	3-4-93	C4G	F22
		C5G-2	RS13-2	CP A756	3-4-83	C5G	F23
	IM12-2		RR4-2	CP A757	3-4-69		
		C2G-2	RS10-2	CP A756	3-6-83	C2G	F19
		C3G-2	RS11-2	CP A756	3-6-73	C3G	F20
	IM13-2		RR4-2	CP A757	3-4-69		
			RR5-2	CP A757	3-4-65		
		C1G-2	RS9-2	CP A756	3-6-93	C1G	F18
		C4G-2	RS12-2	CP A756	3-4-93	C4G	F22
	IM14-2		RR4-2	CP A757	3-4-69		
		C3G-2	RS11-2	CP A756	3-6-93	C3G	F20
		C1G-2	RS9-2	CP A756	3-6-93	C1G	F18
	IM15-2		RR4-2	CP A757	3-4-69		
			RR5-2	CP A757	3-4-65		
		C4G-2	RS12-2	CP A756	3-4-93	C4G	F22
		C5G-2	RS13-2	CP A756	3-4-83	C5G	F23
		C2G-2	RS10-2	CP A756	3-6-83	C2G	F19

TABLE G

TROUBLE CHART

INTERRUPTER MONITORS FOR 8-PARTY GROUND CODES SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED		EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
INT1	IM17-1	CDG-1	CD-1	316M Rly		CD	
		CEG-1	CE-1	316M Rly		CE	
		CFG-1	CF-1	316M Rly		CF	
	IM18-1	CDG-1	CD-1	316M Rly		CD	
		CEG-1	CE-1	316M Rly		CE	
		CFG-1	CF-1	316M Rly		CF	
	IM19-1	CAG-1	CA-1	316M Rly		CA	
		CEG-1	CE-1	316M Rly		CE	
		CFG-1	CF-1	316M Rly		CF	
	IM20-1	CAG-1	CA-1	316M Rly		CA	
		CDG-1	CD-1	316M Rly		CD	
		CEG-1	CE-1	316M Rly		CE	
INT2	IM17-2	CDG-2	CD-2	316M Rly		CD	
		CEG-2	CE-2	316M Rly		CE	
		CFG-2	CF-2	316M Rly		CF	
	IM18-2	CDG-2	CD-2	316M Rly		CD	
		CEG-2	CE-2	316M Rly		CE	
		CFG-2	CF-2	316M Rly		CF	
	IM19-2	CAG-2	CA-2	316M Rly		CA	
		CEG-2	CE-2	316M Rly		CE	
		CFG-2	CF-2	316M Rly		CF	

TABLE G
TROUBLE CHART (Cont)

INTERRUPTER MONITORS FOR 8-PARTY GROUND CODES SUPERIMPOSED RINGING

LAMPS	IM- RELAYS	FOLLOW RELAYS	EQUIPMENT TO BE CHECKED OR REPLACED	EQUIPMENT LOCATION	OUTPUT LEADS	FUSES
	IM20-2	CAG-2	CA-2 316M Rly		CA	
		CDG-2	CD-2 316M Rly		CD	
		CEG-2	CE-2 316M Rly		CE	

TABLE H
TROUBLE CHART
INTERRUPTER OUTPUT LEAD DESIGNATIONS

OUTPUT LEAD DESIGNATION	EQUIPMENT TO BE CHECKED OR REPLACED	EQUIPMENT LOCATION INTERRUPTER 1	EQUIPMENT LOCATION INTERRUPTER 2
120 IPM	CP A5	2-20-15	2-20-79
	CP A340	2-20-21	2-20-73
	CP A341	2-20-29	2-20-65
60 IPM	CP A5	2-20-15	2-20-79
	CP A340	2-20-23	2-20-71
	CP A341	2-20-31	2-20-63
30 IPM	CP A4	2-20-17	2-20-77
	CP A340	2-20-23	2-20-71
	CP A341	2-20-31	2-20-63
R1G BR1	CP A5	2-20-15	2-20-79
	CP A4	2-20-17	2-20-77
	CP A340	2-20-23	2-20-71
	CP A341	2-20-31	2-20-63
R1G BR2	CP A5	2-20-15	2-20-79
	CP A340	2-20-23	2-20-71
	CP A341	2-20-31	2-20-63
R1G BR3	CP A5	2-20-15	2-20-79
	CP A340	2-20-23	2-20-71
	CP A341	2-20-31	2-20-63
R2G BR1	CP A4	2-20-17	2-20-77
	CP A340	2-20-25	2-20-69
	CP A341	2-20-32	2-20-62
PK	CP A4	2-20-17	2-20-77
	CP A340	2-20-23	2-20-71
		2-20-25	2-20-69
	CP A341	2-20-31	2-20-63
		2-20-32	2-20-62
R2 GRD	CP A4	2-20-19	2-20-75
	CP A340	2-20-25	2-20-69
		2-20-27	2-20-67
	CP A341	2-20-32	2-20-62
		2-20-34	2-20-60
R2G BR2	CP A4	2-20-17	2-20-77
		2-20-19	2-20-75
	CP A5	2-20-15	2-20-79
	CP A340	2-20-23	2-20-71
		2-20-25	2-20-69
	CP A341	2-20-31	2-20-63
		2-20-32	2-20-62

TABLE H
TROUBLE CHART (Cont)
INTERRUPTER OUTPUT LEAD DESIGNATIONS

OUTPUT LEAD DESIGNATION	EQUIPMENT TO BE CHECKED OR REPLACED	EQUIPMENT LOCATION INTERRUPTER 1	EQUIPMENT LOCATION INTERRUPTER 2
INT	CP A4	2-20-19	2-20-75
	CP A5	2-20-15	2-20-79
	CP A340	2-20-23	2-20-71
		2-20-27	2-20-63
	CP A341	2-20-31	2-20-63
		2-20-34	2-20-60
C1G	CP A4	3-04-21	3-04-73
C2G	CP A4	3-04-21	3-04-73
		3-04-23	3-04-71
		3-04-41	3-04-53
C3G	CP A4	3-04-21	3-04-73
		3-04-23	3-04-71
		3-04-41	3-04-53
C4G	CP A4	3-04-21	3-04-73
		3-04-23	3-04-71
		3-04-41	3-04-53
C5G	CP A4	3-04-23	3-04-71
		3-04-41	3-04-53
		3-04-39	3-04-55
CA	CP A4	3-00-1	3-00-93
		3-00-3	3-00-91
		3-00-7	3-00-87
CD	CP A4	3-00-3	3-00-91
		3-00-5	3-00-89
CE	CP A4	3-00-1	3-00-93
		3-00-3	3-00-91
		3-00-5	3-00-89
CF	CP A4	3-00-5	3-00-89