GATES

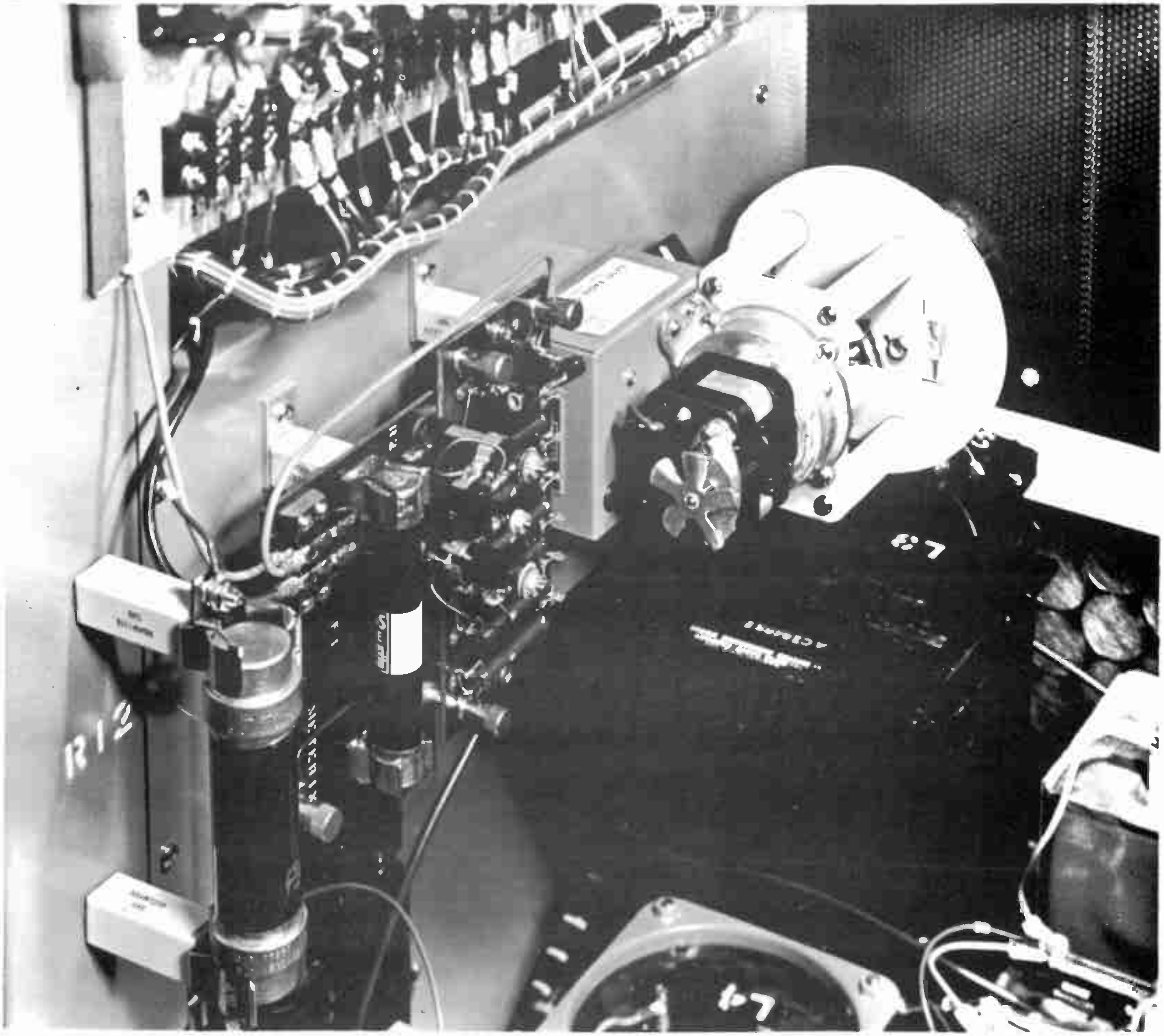
INSTRUCTIONS FOR INSTALLING AND OPERATING

THE GATES' MODEL BC-250T

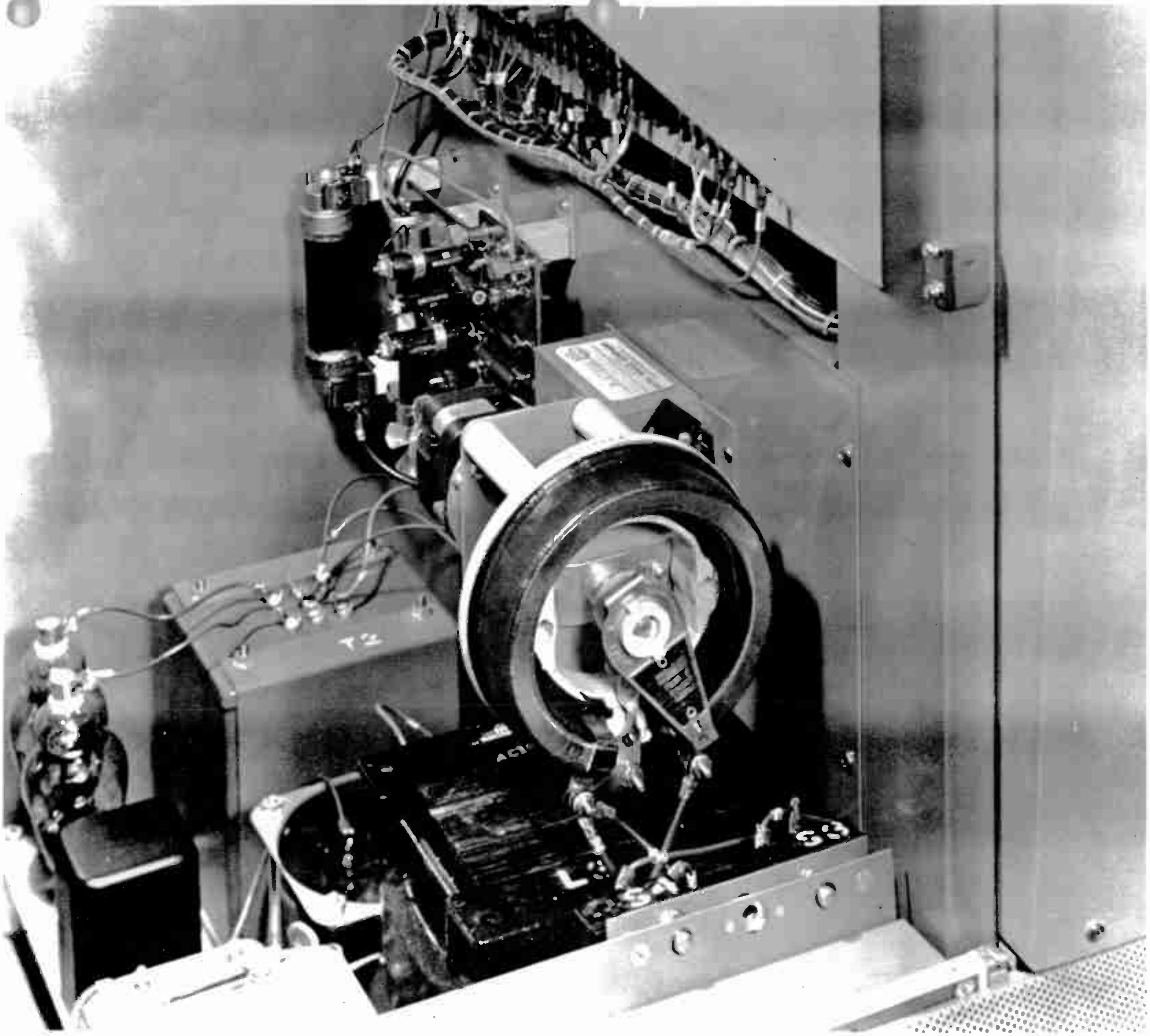
250 W. TRANSMITTER

IB-875

Gates Radio Company
Quincy, Illinois



REMOTE CONTROL ACCESSORIES
BC-IT, BC-500T, BC-250T



REMOTE CONTROL ACCESSORIES
BC-IT, BC-500T, BC-250T

ADDENDA SHEET

INSTALLATION INSTRUCTIONS FOR REMOTE CONTROL

IN

GATES TRANSMITTERS BC-1T, BC-500T, BC-250T

Refer to the following overall transmitter schematic diagrams:

BC-1T - C-78180
BC-500T - E-25569
BC-250T - E-25582

A steel plate, drilled for mounting the M-4719 Plate Voltage Kit, M-4720 Plate Current Kit and M-4703 Rheostat Assembly, is available for the installer's use. Tapped mounting holes for this plate have been provided in the cabinet corner supports, directly beneath the terminal boards and contactors (right side of transmitter as viewed from front). Photographs showing the remote control kits in place is included with these instructions.

M-4703 Motor Rheostat Assembly

As viewed from the rheostat end of this assembly, with the three rheostat terminals to the left, strap the center terminal (arm) to the top terminal. Since application of "increase" voltage brings about clockwise rotation of the arm (same view), resistance will decrease. With application of "decrease" voltage, the resistance will increase.

The existing plate voltage meters in the BC-1T, BC-500T and BC-250T Transmitters read plate to cathode voltage, whereas the remote control voltage sampling kit will read plate to ground voltage. Therefore, in order for the two meters to track the rheostat must be wired in series with the high voltage lead feeding the final amplifier.

Proceed as follows:

1. Disconnect from modulation reactor L-3, the high voltage lead which runs upward to the final amplifier RF choke L-9. Remove this wire from the cable until sufficient length is available, then connect to one of the motor rheostat terminals.

2. Using Packard cable or a high voltage equivalent, run a lead from the other rheostat terminal to this same modulation reactor terminal discussed in Step 1. Set the transmitter voltage control R-14, for maximum voltage (minimum resistance).

3. The control circuit hook-up between the M-4703 motor and remote control unit is explained in the Remote Control instruction book.

Plate Voltage Extension Kit M-4719

1. Using Packard cable or a high voltage equivalent, connect the M-4719 "HV" terminal to the motor rheostat terminal furthermost from the power supply. Do not connect to the rheostat terminal which goes to the modulation reactor. Connect the M-4719 kit terminal "G" to a good ground point within the transmitter.

2. Refer to the Remote Control Instruction Book for connection of meter sample voltage to remote control unit.

Plate Current Extension Kit M-4720

1. The plate current kit is to be connected between the lower end of the P.A. overload relay K-6 and ground.

2. A ground lead runs from a chassis ground terminal to one of the coil terminals on K-7 modulator overload relay, then to one coil terminal of K-6 P.A. overload relay. Clip out the portion between K-6 and K-7. K-7 is to retain its direct chassis ground since we want only P.A. current to flow through the plate current kit.

3. Both K-6 and K-7 must retain their shunt resistors directly across their respective coils.

4. The "G" terminal of the two-terminal strip on kit M-4720 connects to a good ground point within the transmitter. Run a lead from the other terminal, upward to the K-6 terminal which was formerly grounded.

5. Refer to the Remote Control Instruction Book for connection of sampling voltage to Remote Control Unit.

Remote Plate Start-Stop Circuitry

The BC-1T, BC-500T and BC-250T overall schematic diagrams plainly indicate the necessary connections for filament and plate remote control. The plate start-stop circuitry consists merely of shunting the transmitter plate-start switch with a set of normally open remote control contacts. The plate-stop function is accomplished by connecting a set of normally closed remote contacts in series with the transmitter plate-stop switch.

Remote Filament Start-Stop Circuitry

Note that a jumper is to be removed in the filament contactor circuit. Removal of this jumper disables the holding contacts on the filament contactor. A set of remote normally-open contacts shunted across the transmitter's filament-start switch will then serve as filament start and hold, satisfying FCC requirements for a "fail-safe" circuit. If the telephone line between studio and transmitter fails, or if the remote control equipment becomes defective the remote holding contacts open. This, in turn, causes the filament contactor to drop out, removing the transmitter from the air.

In multiple transmitter installations, the filament-fail safe operation is accomplished in a slightly different manner, so that individual filament control for the various transmitters is possible. Each transmitter employs its individual slave relay associated with its respective transmitter filament contactor. The fail-safe relay in the remote control unit, in turn, holds energized all of the slave relays. The slave relay contacts are wired in series with their respective filament contactor off circuits, providing a holding circuit. Thus, separate on-off filament control is possible for each transmitter. These circuits, along with drawings, are presented in detail in the Remote Control Instruction Book.

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SECTION I

ELECTRICAL DESCRIPTION

Gates transmitter, type BC-250T, has been designed as a completely new 250 watt broadcast unit capable of excellent service in the standard broadcast band. Electrical specifications are as follows:

1. Power output, 250 watts. The Gates BC-250T can be satisfactorily operated at 275 watts output, if necessary, to overcome losses in transmission lines and/or phasing equipment.
2. Frequency Range - 1600 Kc to 540 Kc.
3. Power Supply - 230 volt, 50/60 cycle, 2 wire.
4. Power Consumption - Approximately 1450 watts with normal program modulation of 85%.
5. Frequency Stability - ±10 cycles, obtained by use of vacuum, ovenless quartz crystal assemblies.
6. Type of modulation - High level Class "B" modulation capability 100%.
7. Audio Input - +7 DB ±2 DB for 100% modulation at 1000 cycles.
8. Frequency Response - ±2 DB, 50 to 10,000 cycles.
9. Audio Input Impedance - 150/250/600 ohms.
10. Distortion - 3% or less, 50 cycles to 7500 cycles measured at 95% modulation.
11. Noise - Minus 60 DB below 100% modulation.
12. Carrier Shift - 3%, or less, 0-100% modulation.
13. Output Impedance - To match 50/70 ohms at all frequencies 540-1600 Kc. Coupling unit available for other impedances.
14. Tubes Used -

One - 12BY7A Oscillator	Two - 6BG6G Cathode Follower Audio Drivers
One - 12BY7A First IPA	Two - 810 Class "B" Modulators
Two - 6BG6G Second IPA (parallel operated)	One - 5R4GY Bias Rectifier
Two - 810 Power Amplifier	Two - 866A Intermediate Voltage Rectifier (600/650)
Two - 6BG6G Input Audio	Two - 8008 High Voltage Rectifier (1300 V.)

15. Crystals Used - Provision made for two vacuum mounted ovenless type crystal assemblies, each switchable into oscillator circuit from front panel.
16. Printed Wiring - The oscillator and first IPA, the radio frequency driver, the audio input/cathode follower stage and the feedback ladder assembly are designed around printed wiring.

SECTION II

MECHANICAL DESCRIPTION

1. Overall dimensions - 78" high, 36-1/16" wide and 31-29/32" deep. Back and right hand side are of bolt-on construction. Front door swing is 28".
2. Floor space required - 8 sq. ft.
3. Weight, in operating condition - 750 pounds.

SECTION III

INSTALLATION

This instruction book affords valuable information for persons who are installing and operating the Gates BC-250T transmitter. The following mentioned points should be studied so that the unpacking and setting up procedure will be well in mind when doing the actual work.

1. Check all packing lists for materials supplied.
2. Study the instruction book before attempting to set up the equipment.
3. Have the transmitter location clean so that the various parts can be safely placed out of harms way when the unit is unpacked.
4. It is well to have a mounting base, set in place, upon which the transmitter can be set. This base can be made from 2" x 4" lumber dimensioned as shown in Gates Dwg. A-30585. It should be painted, preferably black. This base should be lagged to the floor and measures taken to insure that the top side of the frame is perfectly level. This will give a good, solid, level base on which the transmitter can be set. This procedure also allows the external transmitter wiring to enter the cabinet from practically any point underneath and be run to the entry holes provided in the base of the cabinet.
5. Use heavy primary wire from the building switch box terminals to the transmitter fuse block. #6 or #8 copper wire should be suitable for these two leads.
6. Be sure the power company has installed large enough service for all the equipment, transmitter, lights, water pump, etc., which will be used at the transmitter site.
7. Do a good job of installing the equipment. Time spent in making the installation as good electrically and mechanically as possible, will pay off in the future by insuring less, off-the-air time.

SECTION IV

BC-250T TRANSMITTER DETAILS

The transmitter has been readied for shipment by having all tubes removed from their respective sockets, relay contacts have been blocked and tied and other parts, such as parasitic suppressors, tube caps and leads, etc., tied down securely to prevent damage during shipment. Vacuum enclosed time delay relays have been removed from their sockets. The power amplifier RF choke, L9, and the coupling capacitor, C9, also have been removed. The connector straps have been adequately tagged for easy, correct re-connection. These components have been adequately marked and packed in cartons that are in turn safely secured within the transmitter. All of the power and modulating equipment has been shipped intact within the cabinet, thus relieving the installation engineer of the re-installation of these components.

Coil L13 located at top rear of cabinet has special mounting straps provided to insure safe travel during transit. These, along with all other packing material, string, tape, etc., should be removed from the components.

All relays should be inspected for free travel of armatures and contacts. The following information concerning the Gates BC-250T, pertains to its general construction and operation. It is highly desirable to study the various sections of the transmitter in order to completely understand and comprehend its operation.

The complete transmitter is built in a welded steel cabinet with most of the low power RF and audio components mounted vertically on a formed aluminum panel and shelf assembly. The high power modulators and power amplifier 810's are located on a tube shelf at the top of this basic assembly. The power amplifier tuning and loading components are mounted on a large aluminum panel assembly at the top of the cabinet. This assembly is perforated to allow the heated air within the cabinet to pass through it and then out of cabinet. Located in the base of the transmitter are the heavy power components, such as power transformer, rectifier filament transformers, filter components, modulation choke and transformer, and rectifier tubes.

The transmitter is completely dead front; there is a perforated metal inner shield extending downward from the power amplifier panel to the air intake panel. The inner shield is joined to the air filter panel by means of two thumb "quick off" fasteners. Near the right hand fastener are the interlocks for the 600 volt and 1350 volt power supplies. All controls are available to the operator through a cut out in this perforated screen panel. If this panel is removed, the 600 volt and 1350 volt power supply interlocks function, removing these voltages from the transmitter.

This transmitter is crystal controlled by means of the M-5422 oscillator unit which is located on the panel and shelf assembly. The crystal change-over switch, S1, along with the frequency adjust variable condensers, C1 and C2, are conveniently located on the front control panel. The M-5422 frequency control unit uses a 12BY7A tube connected circuitwise as an electron coupled oscillator, controlled by a vacuum mounted, ovenless type crystal assembly. Positions for two crystals is provided in the oscillator unit. The untuned plate circuit of the oscillator is capacity coupled to the grid of the first IPA, another 12BY7A physically located in the small oscillator unit. This stage operates under very conservative conditions and makes a fine isolation buffer between the oscillator and the R.F. driver.

Due to the conservative operating potentials and the extremely low crystal currents, the M-5422 oscillator unit has exceptional frequency stability. The crystals are of a low temperature co-efficient type which do not need a heated oven to maintain frequency well within FCC limits. Frequency trimmers, C1 and C2, provide a small degree of frequency adjustment which may be required if the crystals age. The M-5422 oscillator unit is easily tuned to the operating frequency. No tuning is required for the oscillator itself, just insert the crystal, or crystals, and set the crystal selector switch accordingly. The first IPA stage (12BY7A, V2 in unit) must be tuned. Provision is made to supply R.F. voltage from a resistive divider at the output of the M-5422 oscillator to a frequency monitor such as the Gates M-2890. This monitor drive is available between terminal #27 on TB1 and ground. See overall schematic E-25582. For typical voltages occurring in the oscillator unit see Gates Dwg. A-30958. The total plate current drawn by the oscillator and first IPA tubes in the oscillator unit is in the neighborhood of 20 to 25 ma. as measured on the multimeter when the multimeter switch is in the position marked "Plt. Cur. Osc/Buf". The positive plate potential applied to the oscillator unit is derived from the 600 volt power supply through a 20,000 ohm dropping resistor, R9. Printed wiring is used in this oscillator unit.

The second IPA stage uses two 6BG6G beam power pentodes operating in parallel. These tubes have approximately 600/650 volts applied to their plates. The cathode current of the two 6BG6G tubes will run between 150 and 200 ma. depending upon loading and operating frequency. This cathode current is indicated on the multimeter when the selector switch is set to "RF Driver Cath.". The stage is tuned from the front panel by control knob designated at "RF Driver Tuning". This stage will tune from 1600 Kc to 1050 Kc with no padding condenser required. See frequency determining component chart, Gates Dwg. A-30957. There is meter indication of the RF drive supplied to the two 6BG6G's by setting the selector switch to position marked "RF Driver Grid". In normal operation the grid current indication of this stage will be on the order of .3 to .5 ma. With normal voltages applied and adequate grid drive the 6BG6G's in this RF driver stage will supply between 100 and 120 grid mils to the power amplifier. This current will vary according to tuning and operating frequency, but should never run less than 100 ma. This P.A. grid current is also measured by the multimeter, being indicated on the meter when the selector switch is placed in the "Power Amp. Grid" position. The plate dissipation of the two 6BG6G tubes is kept within acceptable limits by the use of a cathode resistor, R2, used for developing some cathode bias. If the drive to this stage is lost, the cathode developed bias will tend to hold the plate current within reasonable bounds. Most of the circuitry of this 2nd IPA stage is made up of printed wiring, only the plate coil, L8, tuning capacitors, C7 and C15, and plate choke, L7, are mounted external to the printed wiring board.

The plate voltage which energizes the two 6BG6G RF drivers is developed in a 600/650 volt power supply using two 866A tubes as rectifiers.

Typical voltages appearing within this stage are shown on Gates Dwg. A-30958 and also on Schematic B-65286.

Neutralization of the power amplifier is accomplished by the "Rice" method, the out of phase voltage being obtained from the 6BG6G tank coil, L8. There are several taps brought out adjacent to the electrical center of this coil, these taps affording rough neutralization. By means of the variable neutralizing condenser, C10 and these taps, it is possible to completely neutralize the 810 tubes in the power amplifier. The neutralizing condenser, C10, can be adjusted from the front of the transmitter, by use of a screw driver working through the small aperture in the lower right side of the upper front panel. The neutralizing condenser, C10, is located directly behind this front panel, its shaft being insulated by means of a slotted bakelite shaft bushing. The power amplifier makes use of two 810 tubes. Most of the power amplifier and output circuitry is mounted on an aluminum panel and chassis, assembly at the top of the cabinet. The heated air passes through the P.A. assembly through numerous openings. This P.A. assembly is made up of PA tank coil, L12, PA tank condensers, C11 and C12, (always operating in parallel) output coils, L13 and L14, loading condensers, C13 and C14, modulation pick-up coil, L15, plate blocking condenser, C9, and plate bypass condenser, C8. The amplifier circuit consists of an "L" and two "T" sections, a circuit proved over the years as one which is flexible and also very effective in attenuation of undesirable harmonics. The coil and capacitor values as supplied with the transmitter, are effective in loading into a 51.5 ohm load. See tuning chart, Dwg. A-30958.

The output circuit of the BC-250T includes a pickup coil, L15, which supplies sufficient RF voltage to operate a modulation monitor such as the Gates MO-3629. This voltage is available at a small terminal board, TB2, located on the front panel, at the left, inside

This amplifier makes use of no variable, air dielectric condensers (except the neutralizing condenser, C10).

The P.A. tank circuit is tuned by means of a rolling contact inductor, L12. This method of tuning is helpful in preventing arcs or flash-overs that may occur in variable air dielectric condensers, especially if the transmitter is used in locations where the dust problem is bad. The P.A. tank condensers are two type G1 Sangamo mica's, always connected in parallel. The combined total value will range from .0004 mfd. at 1600 Kc to .001 mfd. at 540 Kc. The loading condensers, C13 and C14, also vary according to frequency. For information concerning these variable frequency determining components see Gates Dwg. A-30957 included in this instruction book.

The power amplifier plate current is read on M2, a 0-500 MA DC meter. This current will generally run from 260 ma. to 280 ma. depending upon the efficiency and the applied plate voltage. The normal plate voltage, as read on plate voltmeter, M3, will be around 1350 volts, As mentioned previously, the P.A. grid current, as indicated on the multimeter, will be 100 to 120 ma. depending upon frequency, tuning, etc. Two P.A. tuning control knobs are located on the power amplifier panel, the left hand one controls the variable output coil, L14, and is marked "Loading". The right hand knob allows rotation of the variable P.A. tank coil tuning the power amplifier. This control is marked "P.A. Tune". The power amplifier is protected from severe overload by a cathode overload relay. This relay, K6, is located on the aluminum shelf adjacent to the multiple 810 filament transformer, T9. Its coil is shunted by a semi-variable resistor, R21, this resistor allows the trip out point to be varied considerably above and below the normal cathode current drawn by the 810 power amplifier under normal conditions. This relay shunt resistor is adjusted to allow the relay, K6, to pull in at about 325 ma. As normal cathode current will be around 260 to 280 ma. this gives considerable operational latitude before the transmitter will kick off the air. Of course, this adjustment can be made to suit the individual who operates the equipment. When P.A. overload relay, K6, pulls in, its contacts close, completing a 230 volt AC circuit through the coil of master overload relay, K3. K3 energizes and its contacts open, causing the holding circuit of the plate contactor, K2, to open and drop out the plate relay. This de-energizes the main power transformer, T1.

Audio wise, the Gates BC-250T transmitter is novel in many respects. The audio input and audio driver portion is made up of printed wiring. A small bakelite printed board located on the panel and shelf assembly mounts the two 6BG6G audio input tubes, the two 6BG6G cathode follower tubes, along with balance control, condensers and resistors for these two stages.

The audio input connections are made to TB1-29 and TB1-30, with a convenient ground termination on TB1-28. Provisions have been made on audio input transformer, T6, to allow the input impedance to be either 125, 250 or 600 ohms. The input transformer is connected for 600 ohm operation when the transmitter leaves the factory. This will take care of most audio input requirements. A balance control, R3, is located on the printed circuit board near the right hand lower corner. This control is in the cathode circuit of the two 6BG6G audio input tubes, V1 and V2.

By use of this control, low frequency audio distortion can be minimizes. This is best accomplished, when test equipment is available to show the actual distortion present. If no such equipment is handy, it would be reasonable to adjust this balance control to midvalue and so operate the transmitter. The second audio stage, a pair of 6BG6G tubes, V3 and V4, are operated as cathode followers, these tubes provide a low impedance driving source for the grids of the two 810 modulators.

Plate potential for the audio input and cathode followers is provided by the 600/650 volt power supply, mentioned previously as supplying voltage to the M-5422 oscillator unit and the RF driver stage. Normal voltages to be expected at various points in the audio input circuits are given in Gates Dwg. A-30958, typical voltages.

The cathode current of the two audio input tubes, V1 and V2, is measured by multi-meter, the selector switch being set at "Input Audio Cathode". This current will normally run from 5 to 10 ma. The cathode follower tubes, V3 and V4, are biased by voltage controlled by potentiometers, R2 and R1, located on the small aluminum front panel. These controls indirectly adjust the operating bias on the modulators by varying the operating constants of the cathode followers, this causes a bias voltage change on the modulators by having a voltage drop occur across the high resistance cathode resistors, R11 and R12, of the cathode followers. A very smooth modulator bias change can be attained in this manner, making it possible to adjust the modulators for correct operating conditions. There is no meter plate current indication for the cathode follower tubes, V3 and V4, it is believed that if proper modulator operation is had, then the 6BG6G cathode followers are operating satisfactorily.

All external connections to the audio printed wiring is made to numbered terminals, this is shown clearly on small individual drawing C-77711 of this section, and in the overall schematic E-25582.

High level Class "B" modulation is used in the BC-250T, a pair of 810 tubes providing the means. The modulation transformer, T3, working with these tubes is located in the base of the cabinet, on the right hand side, toward the rear. The grids of the modulators are excited by the two 6BG6G cathode followers. The modulators operate with approximately 30 ma. static plate current per tube, this operating parameter being set up from the front panel by use of the two "bias" controls, R1 and R2. To enable the operator to individually adjust each modulator tube, a meter switching circuit has been designed. A three position switch, S1, is located on the aluminum front panel, just below the two bias controls. This switch has markings as follows; in the left position Modulator #1, (V8) is metered, in the right hand position Modulator #2 (V9) is metered and when the switch is in the center position marked "Total", both tube currents are combined and read. These currents are indicated on the modulator front panel meter, M4. The total plate current will be from 250 to 300 ma. during times of heavy modulation.

Each modulator has its filament energized by a separate filament winding on multiple filament transformer, T9. The third winding on this transformer, T9, is 10V, 9 ampere capacity and energizes the filament of the power amplifier tubes, V6 and V7.

The modulators are protected from severe overload by relay, K7. This relay, K7, is also provided with a coil shunt resistor, R22, making it possible to adjust the pull-in point of the relay. For normal program modulation the modulator plate current should not exceed perhaps 300 ma. Under sine wave audio conditions this current may rise to 400 ma. at the higher audio frequencies. A satisfactory setting for the overload relay would be around 450 ma. This will take care of accidental audio peaks that might go through. This overload relay, K7, has its normally open contacts connected in parallel with the normally open contacts of P.A. overload relay, K6. If a modulator overload does occur, the K7 modulator overload relay pulls in causing 230 volts a.c. to be applied to the coil of master overload relay, K3, which in turn energizes and pulls in to open the holding circuit of plate contactor, K2. This removes the high voltage from the modulators and the power amplifier.

Feedback from the plates of the modulators back to the audio input tube grids has been provided. A small bakelite printed wiring board is located on the panel and shelf assembly, directly above the modulation transformer, T3. By means of a resistor/capacitor divider network out of phase voltage is fed back to the audio input. The BC-250T transmitter makes use of approximately 9 DB of feedback measured at 1000 cycles and 90% modulation. This feedback helps to reduce the hum and also improves the distortion figures.

All relays for the operation of the transmitter are mounted on the panel and shelf assembly, the previously mentioned P.A. and the modulator overload relays, K6 and K7, being on the top shelf adjacent to the multiple filament transformer, T9. All other relays are mounted at the bottom of the panel and shelf assembly along with necessary fuses, time delay relays, etc. The main line fuses, F1 and F2, are located at the left bottom section of the inside panel assembly, directly over TB-1. This fuse receptacle is the terminal location for the two 230 volt primary input wires. Fifteen ampere cartridge fuses are used. Next in line is the filament contactor, K1.

Filament contactor, K1, is energized by depressing the filament start switch, S5, located on the front column directly beneath the multimeter. This operation causes the primary input voltage to be connected directly to the primaries of all filament transformer (T4, 8008 fil. trans., T5, 866A fil. trans., T8, dual 6.3 volt fil. trans. for audio, RF driver and osc. unit and T9, the 10 volt multiple fil. trans. for the modulators and power amplifier). At the same time the heater for time delay relay, K5, is energized. After 30 seconds the contacts of K5 (low voltage time delay) close and this action energizes the primary of T2, the 600/650 volt power transformer. (If the interlock switch, S3, is depressed.) Along with this sequence of events, the primary of the bias transformer, T7, is energized and as the bias rectifier, V5, heats, bias voltage is developed. This will be approximately neg. 280 volts. Listing the functions performed when S5, the filament start button, has been depressed, we have --

1. All filaments energized, filament pilot light on, low voltage time delay relay heating.
2. Bias supply energized, neg. 280 volts, developed setting up bias for cathode follower and modulators.
3. 600/650 power supply energized (if low voltage door interlock S3 is depressed). This has energized the plate circuits of the crystal oscillator, first IPA and RF driver and if they are correctly tuned, there will be grid drive to the

power amplifier. Also the 600/650 volts has been applied to the input audio and cathode follower stage.

4. High voltage time delay relay, K4, heated and its control contacts closed. (After primary of T2 is energized.)

Plate contactor, K2, is located next to the filament contactor, near the lower part of the panel and shelf assembly. If the high voltage door interlock switch, S4, is closed and high voltage time delay relay, K4, is heated and its contacts closed, it would be possible to energize this plate contactor, K2, by depressing the plate start button located just beneath the meter column. When plate contactor, K2, closes, several operations occur.

1. The high voltage plate transformer, T1 primary, is energized, developing high voltage (1350/1400 approx.) for P.A. and modulator plates.
2. Plate pilot light energizes.

This would place the transmitter on the air.

The Gates BC-250T transmitter makes use of 3 separate power supplies.

1. Bias Power Supply.

   It is made up of a combined filament and plate transformer T7, working in conjunction with bias rectifier, V5, a 5R4GY, filter choke L6, filter condenser C6 and associated resistors and potentiometers. The bias potentiometers, R1 and R2, indirectly vary the modulator bias, by controlling the cathode follower bias and thus the current flow, through the cathode follower resistors, R11 and R12. There is applied a negative 280 volts between these resistors and ground. An opposing voltage of approximately 240 volts is developed by current flow through R11 and R12, thus putting the difference (about 30/40 volts) on the grids of the modulators.

   This supply energizes when the filament start button is depressed.

2. 600/650 Volt Power Supply

   This supply makes use of a pair of 866A rectifiers, the filaments of which are heated by transformer, T5. The primary of T5 is energized at the time the filament start switch is operated. Approximately 30 seconds after the filaments are energized, and low voltage time delay relay, K5, has heated and closed its contacts, this causing the primary of T2, the 600/650 volt power transformer to energize (if the low voltage door interlock switch S3 is closed) develop approximately 600 volts d.c. after being rectified by V4 and V3, the two 866A rectifiers. This voltage is applied to the M-5422 oscillator unit through a dropping resistor, R9, which reduces it to approximately 195V. The 600 volts is applied to the RF driver. Also, this same voltage is applied to the audio input/cathode follower stages. The primary of this power transformer (T2) is fused by a small fuse, F4, of 3 ampere size.

High voltage for the modulators and power amplifier approximately 1350 volts is developed by a power supply consisting of main power transformer, T1, 8008 filament transformer, T4, swinging choke, L1, smoothing choke, L2, and filter capacitor, C2 and C3. These components are located in the base of the transmitter along the left hand side and toward the front. This high voltage supply is interlocked with the front panel grill and interlock switch, S4.

Provisions have been made to operate the Gates BC-250T transmitter be remote control. The connections are clearly shown on Gates overall schematic E-25582. It is necessary to remove the jumper wire that normally connects between contact #1 and #3 on a filament start contactor, K1, and wire normally connected between TB1-10 and TB1-22.

For shipping purposes, some components have either been removed or mechanically made secure within the cabinet proper. All of the removed items are boxed and the carton containing them is shipped within the cabinet. The following items have been removed -

1. All Vacuum Tubes.
2. Time Delay Relays, K4 and K5.

Contacts of the filament and start relays have been held firm by use of paper and tape. Tube caps and parasitic suppressors have been taped down to prevent damage by vibration during shipment. Certain components have been supported by wooden braces. All of this material should be removed from the transmitter, care should be taken to see that all relays are free of foreign material that would prevent them to operate normally. The connections to the various components that have been removed are clearly tagged for easy and correct replacement. Remove extra coil bracing from L13 which is located in the top, at rear. Check all mechanical connections for tightness.

Replace all vacuum tubes, crystals and time delay relays in their correct sockets, check locations by reference to overall schematic E-25582 and the various pictures that are supplied as a part of this instruction book.

At this time <u>do not</u> place the plate caps on the 866A rectifier, V3, and V4, and the 8008 rectifiers, V1 and V2.

The external connections are few and these are easily made to the BC-250T transmitter. The 230 volt, 50/60 cycle AC enters the cabinet base at the right hand side, near the rear corner. The two primary wires connect directly to the fuse block, XF1. The shielded audio input pair enters the cabinet at the right hand side near the front. These connections are made to the terminals #29 and #30 on TB1. A ground is close by on terminal #28.

The modulation monitor connects to TB2-1 & 2. This terminal board is located on the back side of the tuning and loading panel, at the left front side. This connection can be made with shielded twisted pair, such as is used in audio wiring.

The frequency monitor connects to TB1-27 and 28, the ground being terminal #28. This connection can be made of shielded single conductor wire, or low impedance line such as RG/62U.

A ground stud is provided on the cabinet frame for a transmitter ground connection. Located near the modulation transformer, T3, this connection facilitates the grounding of the transmitter to the overall station ground system. A copper strap can be brought in through the access hole in the right rear base section of the transmitter. (The AC primary wires were brought in through this opening also.) This internal ground follows up the cabinet support and finally connects to the aluminum PA tuning assembly at the top of the cabinet.

The RF output termination is a ceramic feedthrough insulator located close to the output coil, L14. Connection can be either made from the top of the cabinet through an access opening, or the low impedance line can be brought in through the base of the transmitter and connected to the output circuit.

A word of comment here, concerning the station ground system. It should be constructed as good as can be, all connections well made and soldered, or preferably brazed. It is wise to bond all electrical conduit, metal frame work of building, water piping, etc., to the overall ground system. If these suggestions are followed, there will be less trouble over the years as the ground system ages.

SECTION V

INITIAL TUNE-UP OF THE GATES BC-250T

Before proceeding with the initial tune-up of this transmitter, it would be well to re-check the necessary things to be done, before any voltage is supplied. Briefly, check the following list.

1. Proper primary line voltage connected to fuse block, XF1, two 15 ampere fuses should be in the clips of this fuse block.
2. Proper location of all tubes in sockets. These tube locations can be checked by reference to the stencilling in the transmitter and to information furnished in this instruction book. Also, make sure the crystal, or crystals, are in the oscillator crystal sockets. If only one crystal is used, be sure the crystal selector switch, S1, is in the correct position to operate with the one crystal.
3. Check to see that all tie-down twine and other material used in shipping the transmitter, has been removed from the various components, especially the relays.
4. Re-check all components that were installed. Be sure they are connected correctly. The parts and the connectors have been tagged to insure correct replacement.
5. Go over the complete transmitter, checking the tightness of all nuts and bolts, terminal connections, etc.
6. Give all soldered connections a brief looking over. The equipment has passed several rigid inspections during its course of manufacture, but something may have been overlooked that could cause trouble in the future.
7. Make certain the transmitter and associated equipment is well grounded.
8. It is suggested that all audio input wiring be shielded and placed in conduit or wiring troughs, away from A.C. wiring.
9. Be sure the plate leads to the 866A and 8008 rectifier tubes <u>are</u> <u>not</u> placed on the tubes, and that they are free from grounding. This will insure the fact that no high voltage will be present until needed.
10. Make sure the transmitter is connected to a 51/70 ohm load.

Lets go through the procedure to tune the Gates BC-250T to 1400 Kc. The crystals should be for 1400 Kc and so marked. All fuses should be in their correct mountings and 230 volts 50/60 cycle AC should be connected into the transmitter. <u>Use extreme care during tune-up, as there are high voltages developed within the transmitter which could cause death</u> if a person should come in accidental contact. Two door interlock switches are provided on S3, in series with the 600/650 volt power transformer, T2 primary, and the other interlock switch, S4, being in series with the coil of the plate start contactor of the high voltage circuit.

Place the plate caps on the 866A rectifiers. Depress the filament start switch on the transmitter front panel. This will cause filament relay, K1, to pull in and in turn energize all filament transformers (T4, 8008 rectifier fil., T5, 866A rectifier fil., T8, dual 6.3 fil. for 6BG6G's, T9, dual 10 volt PA and mod. fil. and T7, the bias fil. and plate). At the same moment, time delay relay, K5, will heat and after approximately 30 seconds its control contacts will close and this will complete and primary circuit of 650 volt power supply. When this 650 volt supply energizes, there will be reduced plate potential (approximately 195 volts going into the M-5422 crystal oscillator unit, being dropped down by series resistor, R9.) The combined tube current drain as indicated by the multimeter when selector switch is set on "Plate Cur. Osc/Buf" will be on the order of 20 to 25 ma. The oscillator circuit itself is untuned, the buffer (or 1st IPA stage) is tuned to frequency by means of a slug in coil, L3 and capacitor, C9. This stage can be accurately tuned by setting the multimeter switch on "RF Driver Grid" position and then adjusting L3 and C9 for maximum grid current on the multimeter. This will be on the order of .3 to .5 ma. Now set selector switch to minimum cathode current. This current may run from 150 to 200 ma. depending upon frequency, loading, etc. Please note that on 1400 Kc no RF driver tank padding condenser is used. For frequency determining parts and frequencies where they are needed throughout the transmitter, please refer to Gates Dwg. A-30957 entitled "Tuning Chart". With these readings already obtained, set the multimeter selector switch to "PA Grid". There should be approximately 100 to 140 grid ma. flowing, depending again on frequency, tuning, loading, etc. At this point set the multimeter selector switch to "Input Audio Cath.". The multimeter should indicate from 5 to 10 ma. in this position.

At this moment there is grid drive to the power amplifier indicating that the complete front end of the RF section is operating satisfactorily. Also, the audio portion has been energized, and the bias supply delivering bias to the cathode followers and subsequently, to the grids of the modulators, (at this point, the bias voltage could be checked). See Gates schematic C-77711, Audio Input/Cathode Follower schematic, or Dwg. E-25582, the overall schematic. Terminal lug #11 will have minus 280 volts on it, as measured from this terminal (#11) to ground. This is normal voltage it can vary somewhat from transmitter to transmitter in production. The right side of the transmitter cabinet would have to be removed for this check, be sure to replace before continuing the tune-up.

At this time in the tune-up procedure it would be advisable to turn the bias controls, R1 and R2, completely counterclockwise as far as they will go. This would be to the "MAX" position, which would in turn place maximum bias voltage on the two 810 modulators. This will be on the order of 70 volts or so, enough to cut the plate current off on the modulators. Now shut the transmitter down by depressing the Fil. Stop Switch, S6. This will remove all voltages from the transmitter, with the exception of the 230 V. AC primary. Again refer to the Dwg. A-30957 entitled "Tuning Chart BC-250T". From the chart check the active turns listed for P.A. tank coil, L12, for coil L13 and for output coil L14. Adjust each coil to have the same number of active turns as called for, this will be approximately what is required, it may vary a few turns, one way or the other. For 1400

Kc there will be approximately 19 active turns in L12, 8 turns in L13, and 7.3 turns in L14. The P.A. tank padders will be two .0002 mfd. G1 condensers (C11 and C12, the input loading condenser .002 mfd. (C13) and output loading condenser .002 mfd. (C14). This setup will give us a starting point from which we can proceed to neutralize and tune up the final amplifier. We are now ready to check neutralization and P.A. tuning. A grid dip meter, wave meter with some sort of indicator, or a flash lamp connected to a few turns of insulated wire will do as a neutralization indicator. Of course, a very good neutralization indicator is already built in the transmitter, namely, the power amplifier grid current meter. Two methods of neutralization will be described; first that of using the grid current for neutralization indication.

1. Have load connected to the power amplifier.
2. Energize all filaments by depressing the Fil. Start switch. After approximately 30 seconds the oscillator, 1st IPA and 2nd IPA are in operating condition and grid current will be flowing in the power amplifier. (The multimeter switch is set on "P.A. Grid Cur." position).
3. Set the neutralizing condenser, C10, at maximum capacity. This control is conveniently located on the top front P.A. panel near the right hand lower corner.
4. Adjust the P.A. tank coil, L12, tuning by means of the right hand knob on the P.A. panel (Marked "PA Tune") when resonance is reached, the grid current as indicated on the multimeter will dip noticeably.
5. Change the neutralizing condenser setting by a small amount (gradually decreasing capacity) then re-resonate the power amplifier, noting the dip in the grid current. As the correct neutralizing point is reached, the grid current dip will become less and less pronounced until the complete neutralization is effected, this will be indicated by no deflection of the grid current meter when resonance is obtained. Under these conditions, the amplifier should be neutralized for all practical purposes. There are several taps brought out on RF driver coil, L8, as a starting point to the above procedure, use the exact center tap, then if neutralization cannot be obtained, move this grid lead over one tap and repeat neutralizing procedure. A set of conditions will be found that will neutralize the power amplifier satisfactorily.

NEUTRALIZING WITH A FLASHLIGHT BULB

The same procedure will apply as previously mentioned to provide power amplifier grid current. A flashlamp bulb is a sensitive and inexpensive R.F. indicator. The bulb should be connected in series with a couple of turns of insulated wire, approximately the same diameter or a little smaller, than the PA tank coil, L12. Place this coil and lamp RF indicator in close inductive relation with L2.

1. Set the neutralization condenser at maximum capacity.
2. Very carefully tune the power amplifier toward the resonance point. It is important to tune slowly, because if the resonance point is obtained quickly there most likely will be sufficient RF in the power amplifier tank to burn out the flash lamp bulb.
3. Adjust the coupling between the lamp coil and L12 so that the lamp will glow brightly when resonance is reached. Now decrease the neutralizing condenser capacity a bit, the lamp brilliance will decrease, adjust the power amplifier tuning again for resonance which may cause the lamp to brighten up a bit. Continue this operation until the lamp goes out. The amplifier will be satisfactorily neutralized under this condition.
4. Remove the lamp and coil RF indicator from the transmitter. Remember, all of these neutralizing procedures are done with the high voltage removed from the power amplifier. As yet we have not connected the 8008 plate leads to the tubes.

DE-ENERGIZE ALL FILAMENTS

Remove the front perforated screen. Refer to the tuning chart A-30957 and check the power amplifier loading condensers, C13 and C14 mounted in the top portion of the transmitter. For 1400 Kc these capacitors will be a .002 mfd. value, for 50 ohm output, also check the tuning chart for approximate number of turns for L13 and L14. Set up these coils in the transmitter according to this information. Place a tube connector on one 8008 rectifier tube. This procedure will allow a partial supply of voltage from the high voltage rectifier system. Place in position the front screen which again closes the two interlock switches, S3 and S4.

Start the transmitter again by operating the Fil/Start Switch. After 30 seconds the osc. and buffers will be energized with high voltage and grid current will again be flowing in the power amplifier grid circuit. After 10 seconds press the Plate Start Switch and plate voltage should be applied to the power amplifier and modulators. Adjust the "Power Amplifier Tune" control for minimum plate current as shown on the P.A. plate meter, M2. By manipulation of the "P.A. Tuning" control and the "P.A. Loading" control, adjust the tuning of the amplifier until it is so loaded that the plate current will show approximately 150 ma. on M2, and P.A. Plate voltage will indicate about 800 volts on M3. With this loading condition, the transmitter will be ready for the application of operating high voltage.

Shut down the transmitter, remove the front protective screen. Place the second 8008 rectifier into the high voltage rectifier circuit by connecting the plate lead to the plate cap.

Replace the protective screen, locking it in place and by so doing closing the door interlocks, S3 and S4. Again start the transmitter by operating the Filament Start Switch. After a 40 second delay press the Plate Start tab. The plate current will now indicate approximately 260 to 280 ma. on the P.A. plate meter, M2, with the P.A. plate voltmeter, M3 reading 1300 to 1400 volts. With this input the output will be approximately 250 watts. The normal efficiency to be expected will range just around 70%. The RF end of the transmitter should be operating satisfactorily, the rated output being dissipated in load.

It will be remembered that previously, the modulator bias controls, R1 and R2, were turned completely counterclockwise (to the indicated "MAX" position). This applied maximum bias voltage to the modulator grids. With the transmitter operating and producing power into the load, now adjust the modulator static plate current. Set the modulator switch, S1, to position marked "Mod. #1". Now adjust the left hand bias potentiometer in clockwise rotation until the modulator plate meter, M4, indicates approximately 30 ma. This will be normal resting current of the #1 modulator tube (V8). Now, place the modulator switch in the right hand position marked "Mod. #2". Adjust the right hand bias potentiometer clockwise until the modulator meter again reads 30 ma. This is the resting plate current of the modulator #2 (V9). Now place the modulator switch in the center position marked "Total"., the modulator meter, M4, will then read the total static plate current of 60 ma. This modulator cathode current switch makes it possible to balance the modulators easily, while the transmitter is on the air, on program. During a slight lull in programming, the modulator cathode meter, M4, will drop back, and at this time the modulator current switch could be placed in each position quickly and any unbalance detected and corrected. The meter readings on the transmitter should be somewhat close to those shown on Dwg. A-30958 entitled "Typical Meter Readings", included in this instruction book. Remember these are typical and could vary somewhat with no detrimental effect to the operation of the transmitter. The operator is given a slight control over the plate input by operation of resistor, R14.

The adjusting disc extends through the cabinet support directly in line with the "RF Driver Tuning" control. This control is marked "Plate". Clockwise rotation increases the plate voltage, with a total variance on the order of 100 volts. Directly below the "Plate" disc is the filament resistor control also a disc. This control allows a slight variance in the primary voltage to all filament transformers and to the bias transformer. A filament voltmeter, M1, indicates the voltage on the power amplifier tubes, this normally runs at 10 volts A.C. By use of the filament adjustment control, the voltage on the P.A. filaments can be kept at 10 volts, when this occurs, all filament voltages in the transmitter are correct, as is the developed D.C. bias from the bias supply.

SECTION VI

GENERAL OPERATING PROCEDURE

The Gates BC-250T transmitter makes use of vacuum mounted ovenless crystals for the control of operating frequency.

These crystals are capable of holding the transmitter frequency within a range of $\pm$10 cycles over the standard broadcast band. There is no adjustment required by the user of this type of crystal assembly, no air-gaps, thermostat settings, etc. The only adjustment that may have to be made is the one which allows for "Zeroing in" of the crystal frequency. If the crystal frequency is off a few cycles, it can be brought back to Zero deviation by the slight adjustment of the variable capacitors marked "Freq. 1" and "Freq. 2". These controls will allow about a $\pm$30 cycle change at 1600 Kc and $\pm$10 cycles at 540 Kc.

If the crystal adjustments are being made at a new station, there will be no accurate way of setting the frequency to exactly "zero". The station can go on the air with the assurance that the operating frequency will be somewhere within the range of the "Vernier" control, as mentioned above.

The external monitoring source can advise the frequency deviation and the engineer at the station can adjust one crystal to "zero". After the number one crystal has been so adjusted it would be well to adjust the station's frequency monitor to coincide with the transmitter. (The frequency monitor should have been heating a sufficient length of time to stabilize the information supplied by the manufacturer should be followed).

Once the station frequency monitor has been calibrated and is working satisfactorily, the station engineer has a reliable source of frequency measurement and can from this point go ahead and adjust the second crystal, using the station frequency monitor as a standard. For the station that has been on the air and has a calibrated frequency monitor in operation, the station engineer can simply make the two crystal adjustments while observing the results on the monitor.

MODULATION MONITOR CONNECTIONS

The Gates BC-250T transmitter has a small pick-up coil, L15, connected between output coil, L14, and the feedthru insulator, to be used for excitation of a modulation monitor such as the Gates MO-2639. The connections are made to a small barrier strip terminal board, TB2, located on the back side of power amplifier and loading front panel, at the left hand side near the bottom. The modulation monitor should be connected to this terminal board by a suitable length of coax cable similar to RG/62U. Entry into the cabinet can be made by means of access holes located in the base of the transmitter.

FREQUENCY MONITOR CONNECTIONS

The Frequency Monitor RF connections are made to terminals #27 and #28 on TB1, terminal #27 being the hot lead, #28 the ground side. The Frequency Monitor can be connected to these terminals by means of a suitable length of coax cable, such as RG/62U.

Good reliable, day in and day out, service is possible only when the equipment has proper care and maintenance. Set up a schedule of cleaning and inspection. This work, if properly done, will minimize the amount of lost air time.

Keep the equipment clean and free from dust. This routine work will have to be done at intervals, depending upon the local conditions, under which the transmitter is operating.

Periodically check all mechanical connections within the transmitter. Connections may work loose due to vibration, temperature changes, etc., it is well to check ever so often.

Relays can be a source of trouble if not properly maintained. See that armatures are operating freely, making sure that no foreign matter can find its way into the moveable parts. The contact surfaces should be inspected and burnished periodically to prevent pitting and heating. If a relay contact burnishing tool is not available use a very fine grade of sandpaper, sparingly.

Printed wiring is used in four sections of the Gates BC-250T transmitter.

A - Oscillator Unit, M-5422
B - Portion of the RF Driver Stage, M-5566.
C - Input Audio/Cathode Follower Section, M-5547
D - Feedback Ladder Assembly.

Printed Wiring has a very definite place in modern transmitters. In production, all units are uniform as far as wiring characteristics are concerned, servicing of the equipment is made easier due to the manner in which the components are mounted and connected into the circuitry. All printed wiring boards, used in the BC-250T transmitter, have been treated with a silicone varnish on the copper side. This treatment guarantees reliability of operation under severe operation conditions. It is recommended that during the cleaning and maintenance period, these printed wiring sections of the transmitter be cleaned with a soft bristle brush. No other servicing will be required.

Provision has been made in the Gates BC-250T transmitter for easy maintenance and replacement, if necessary, of all meters. The five large 4" meters are mounted on the cabinet assembly vertically along the right hand side. A decorative vertical cover extends the full height of the cabinet, this cover being easily removed, thus exposing the complete meter complement as well as the start/stop switches.

SECTION VII

SUMMARY

A radio broadcast transmitter regardless of its size, cannot be fully described, and/or all of the operating problems that arise cannot be fully anticipated and information given in any instruction book.

Information has been given that will cover most installations. There has been provided in this instruction book schematics of all pertinent circuits of the Gates BC-250T, photographs, and overall schematic, Gates Dwg. E-25582, Tuning Chart Gates Dwg. A-30957, Typical Voltages, Dwg. A-30958 and an overall parts list that ties into the overall schematic.

In preparing this instruction book, it has been recognized that the installation engineer undoubtedly is very familiar with general broadcast procedures and that many of the things referred to in this book are well known to him. It is suggested, however, that the installation engineer and personnel who will operate the transmitter, not only familiarize themselves with the contents of this instruction book, but more important, with the transmitting equipment itself.

The Gates Radio Company in designing the BC-250T broadcast transmitter has done everything possible to provide the finest equipment available today. It is not possible to supply the operating location, the actual ground system and, in some instances, the associated equipment that will be used with this transmitter. Because of this, certain things must be left for the user of the equipment to do and certain problems solved. In every instance the use of good engineering practice and sound fundamental reasoning will develop the desired high quality results expected and made possible by this equipment.

It is repeated again, make a good installation, eliminate hasty methods in doing so, you will help to minimize future off-the-air time. Also remember, that cleanliness and "preventive maintenance" for this transmitter will pay large dividends in uninterrupted service. Take some time each week for cleaning the inside and outside of the transmitter and associated equipment, testing tubes, checking all connections and doing the other things that might be classed under the general heading of "preventive maintenance". In case a problem might arise in which the Gates Radio Company could help, do not hesitate to call. Co-operation with users of Gates equipment to help in every way to obtain maximum service and satisfaction, is the aim of Gates Radio Company.

WARRANTY

This equipment is warranted by Gates Radio Company of Quincy, Illinois to be free from defects in workmanship and material and will be repaired or replaced in accordance with the terms and conditions set forth below:

1. Gates Radio Company believes that the purchaser has every right to expect first-class quality, materials and workmanship and has created rigid inspection and test procedures to that end, and excellent packing methods to assure arrival of equipment in good condition at destination.

2. Gates Radio Company will endeavor to make emergency shipments at the earliest possible time giving consideration to all conditions.

3. Gates Radio Company warrants new equipment of its manufacture for one (1) year and (six (6) months on moving parts), against breakage or failure of parts due to imperfection of workmanship or material, its obligation being limited to repair or replacement of defective parts upon return thereof f.o.b. Gates Radio Company's factory, within the applicable period of time stated. Electron tubes shall bear only the warranty of the manufacturer thereof in effect at the time of the shipment to the purchaser. Other manufacturers' equipment covered by a purchaser's order will carry only such manufacturers' standard warranty. These warranty periods commence from the date of invoice and continue in effect as to all notices, alleging a defect covered by this warranty, received by Gates Radio Company prior to the expiration of the applicable warranty period.

The following will illustrate features of the Gates Radio Company warranty:

<u>Transmitter Parts</u>: The main power or plate transformer, modulation transformer, modulation reactor, main tank variable condensers all bear the one (1) year warranty mentioned above.

<u>Moving Parts</u>: As stated above, these are warranted for a period of six (6) months.

<u>Electron Tubes</u>: As stated, electron tubes will bear such warranty, if any, as provided by the manufacturer at the time of their shipment. Gates Radio Company will make such adjustments with purchasers as given to Gates Radio Company by the tube manufacturer.

<u>All other component parts (except as otherwise stated)</u>: Warranted for one (1) year.

Abuse: Damage resulting from abuse, an Act of God, or by fire, wind, rain, hail, in transportation, or by reason of any other cause or condition, except normal usage, is not covered by this warranty.

4. Operational warranty - Gates Radio Company warrants that any new transmitter of its manufacture, when properly installed by purchaser and connected with a suitable electrical load, will deliver the specified radio frequency power output at the output terminal(s) of the transmitter, but Gates Radio Company makes no warranty or representation as to the

coverage or range of such apparatus. If a transmitter does not so perform, or in the event that any equipment sold by Gates Radio Company does not conform to any written statement in a contract of sale relative to its operating characteristics or capabilities, the sale liability of Gates Radio Company shall be, at the option of Gates Radio Company, either to demonstrate the operation of the equipment in conformance with its warranty, or to replace it with equipment conforming to its warranty, or to accept its return, f.o.b. purchaser's point of installation and refund to purchaser all payments made on the equipment, without interest. Gates Radio Company shall have no responsibility to the purchaser under a warranty with respect to operation of equipment unless purchaser shall give Gates Radio Company a written notice, within one (1) month after arrival of equipment at purchaser's shipping point, that the equipment does not conform to such warranty

5. Any item alleged by a purchaser to be defective, and not in conformance with a warranty of Gates Radio Company shall not be returned to Gates Radio Company until after written permission has been first obtained from the Gates Radio Company home office for such return. Where a replacement part must be supplied under a warranty before the defective part can be returned for inspection, as might be required to determine the cause of a defect, purchaser will be invoiced in full for such part, and if it is determined that an adjustment in favor of the purchaser is required, a credit for an adjustment will be given by Gates Radio Company upon its receipt and inspection of a part so returned.

6. All shipments by Gates Radio Company under a warranty will be f.o.b. Quincy, Illinois or f.o.b. the applicable Gates Radio Company shipping point.

7. Gates Radio Company is not responsible for the loss of, or damage to, equipment during transportation or for injuries to persons or damage to property arising out of the use or operation of Gates equipment. If damage or loss during transportation occurs, or if the equipment supplied by Gates Radio Company is otherwise damaged, Gates will endeavor to make shipment of replacement parts at the earliest possible time giving consideration to all conditions. It is the responsibility of a purchaser to file any claim for loss or damage in transit with the transportation company and Gates will cooperate in the preparation of such claims to the extent feasible when so requested.

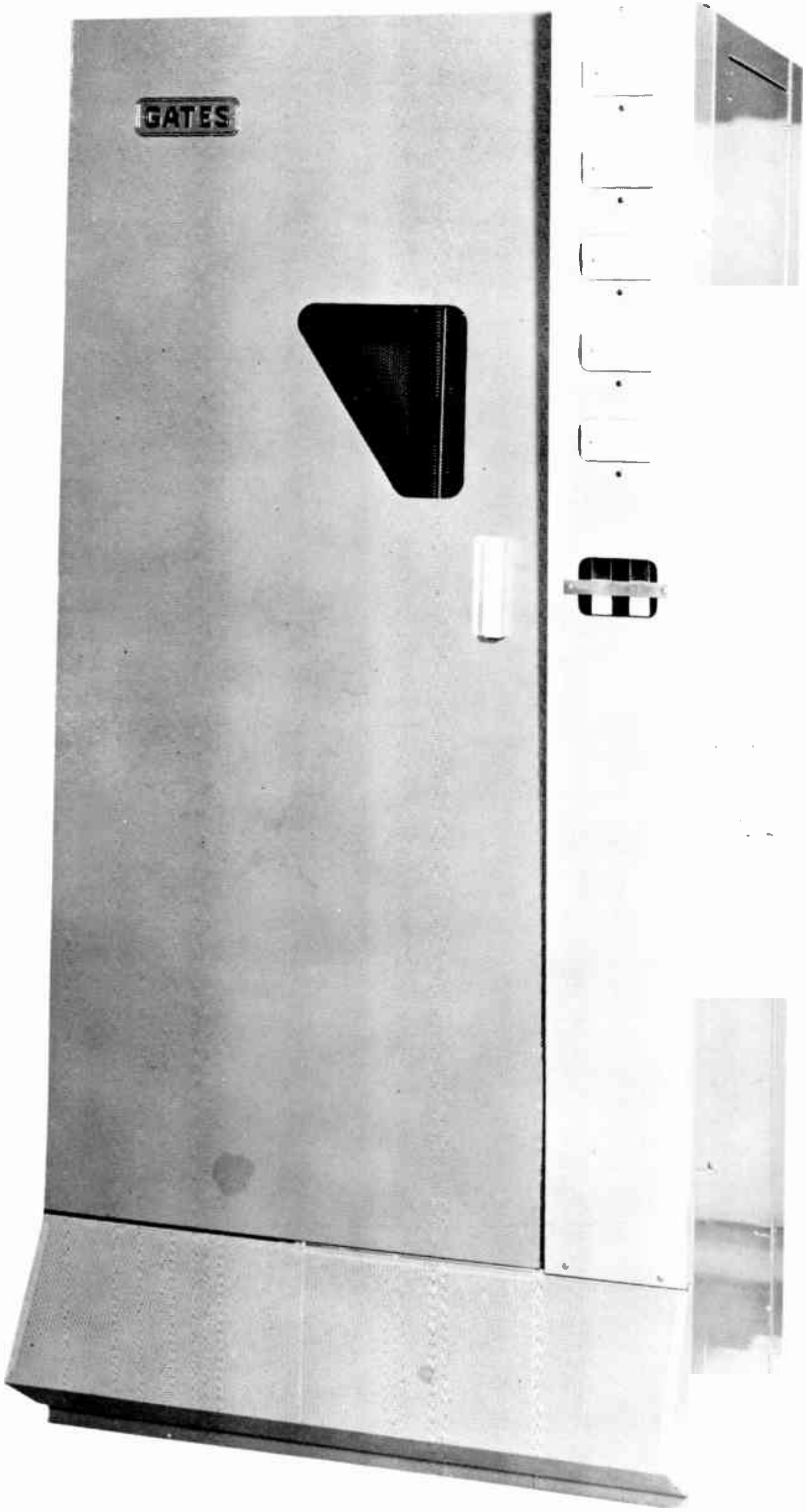
8. Gates Radio Company, in fulfilling its obligations under its warranties, shall not be responsible for delays in deliveries due to depleted stock, floods, wars, strikes, power failures, transportation delays, or failure of suppliers to deliver, acts of God, or for any condition beyond the control of Gates that may cause a delayed delivery.

9. This warranty may not be transferred by the original purchaser and no party, except the original purchaser, whether by operation of law or otherwise, shall have or acquire any rights against Gates Radio Company by virtue of this warranty.

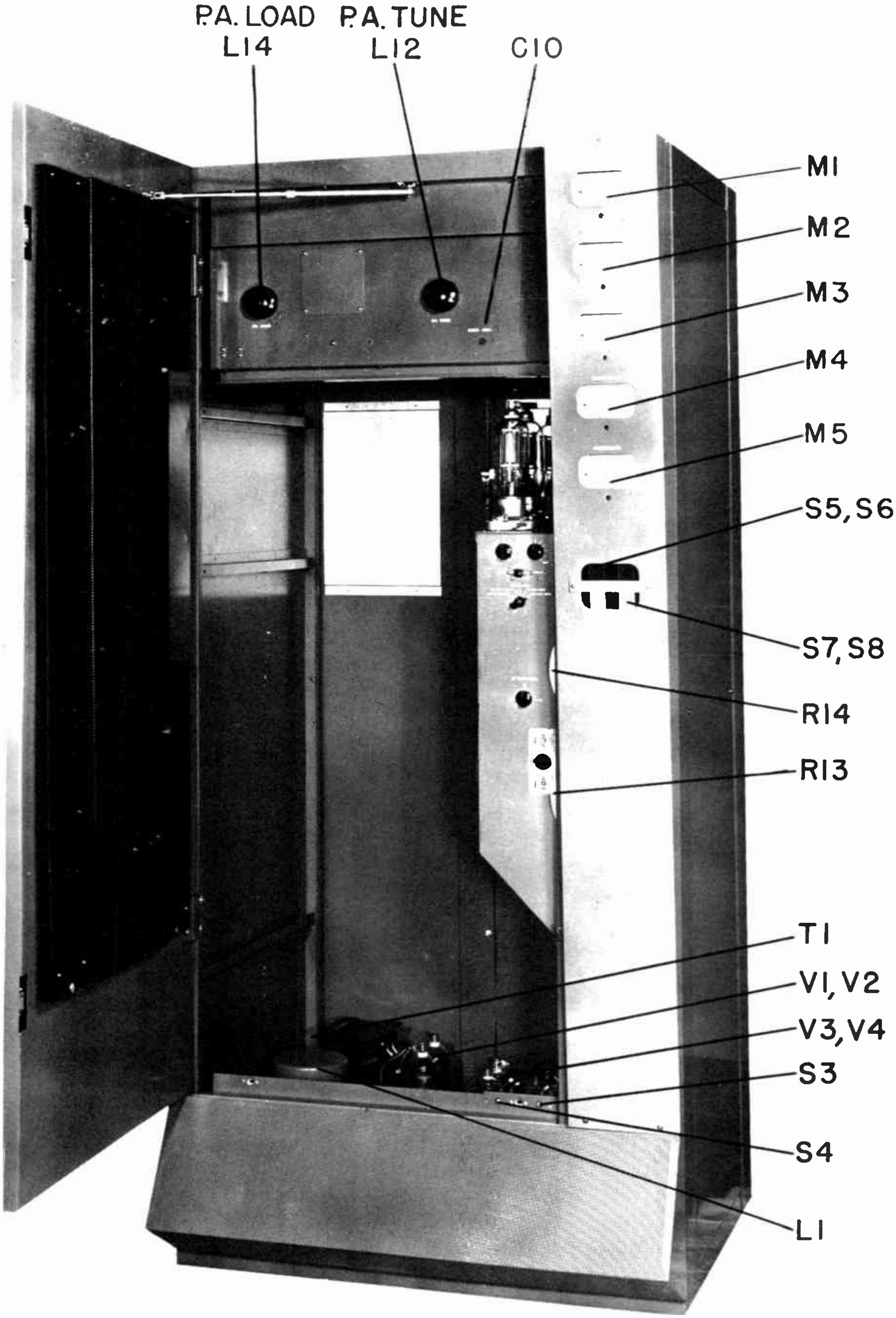
10. Gates Radio Company reserves the right to modify or rescind, without notice, any warranty herein except that such modification or rescission shall not affect a warranty in effect on equipment at the time of its shipment. In the event of a conflict between a warranty in a proposal and acceptance and a warranty herein, the warranty in the proposal and acceptance shall prevail.

11. This warranty shall be applicable to all standard Gates catalog items sold on or after March 1, 1960.

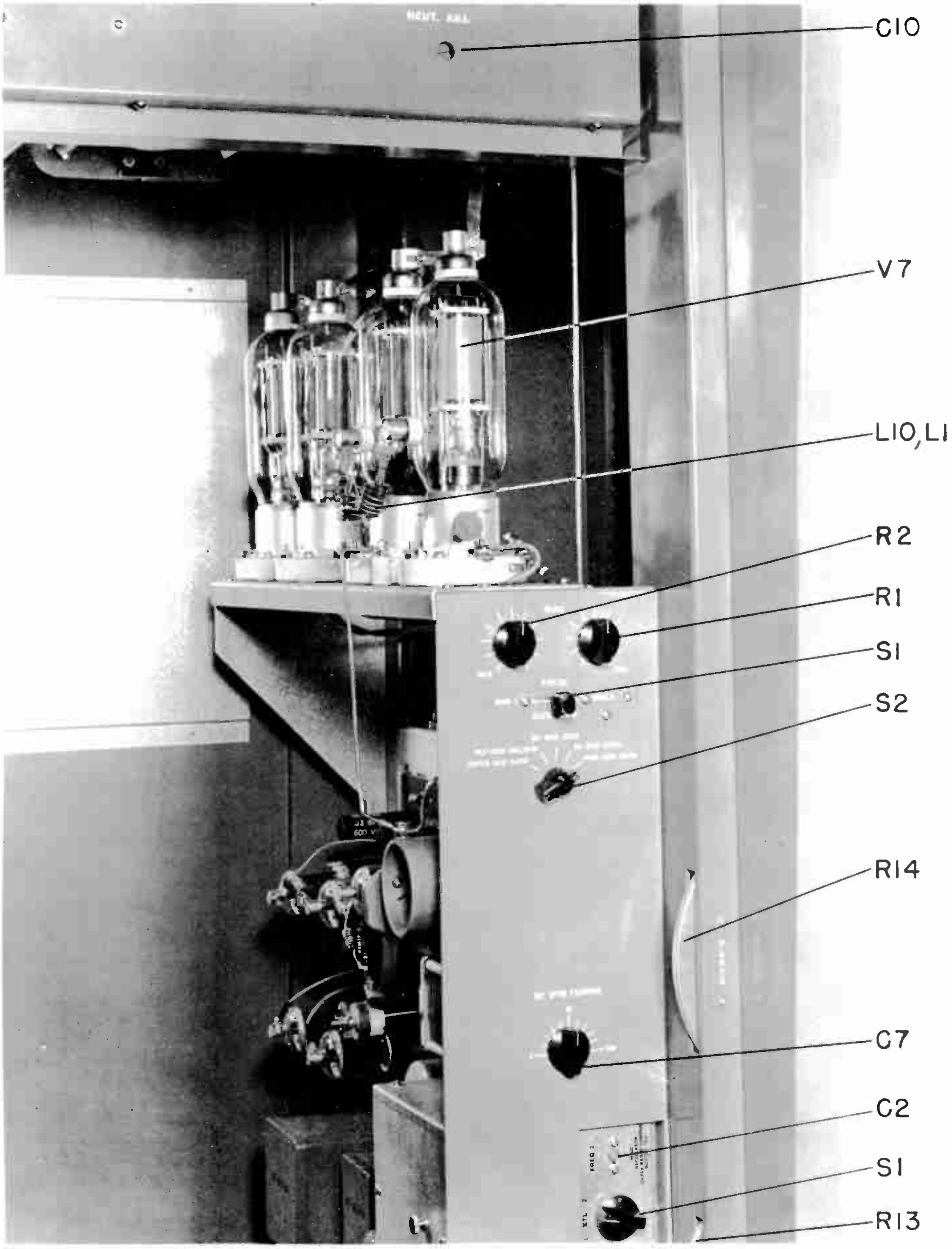
Gates Radio Company
Quincy, Illinois



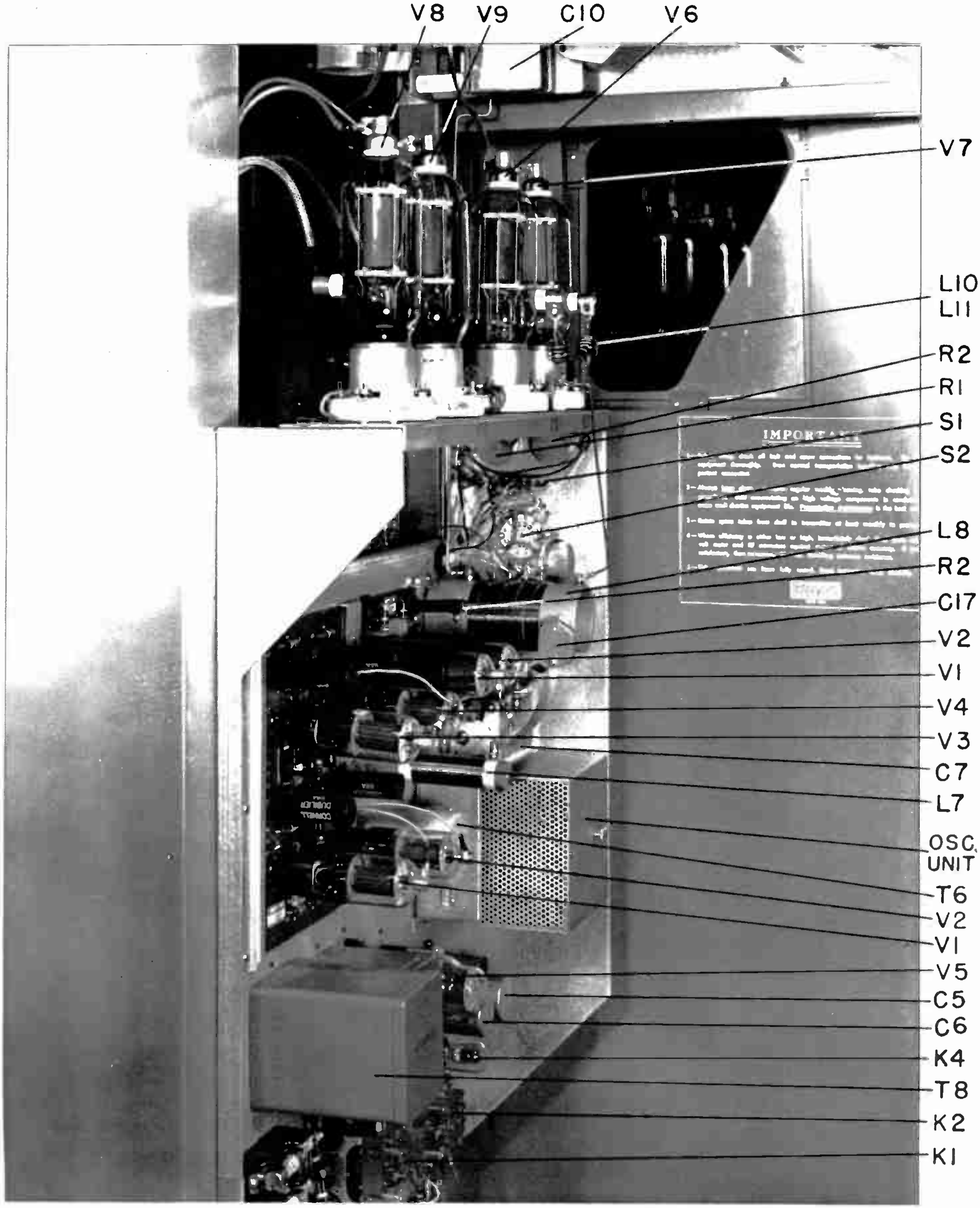
BC-1T, BC500T, BC250T
A.M. TRANSMITTERS



FRONT VIEW BC250T
250 W. A.M. TRANS.
M-5627 DL-141

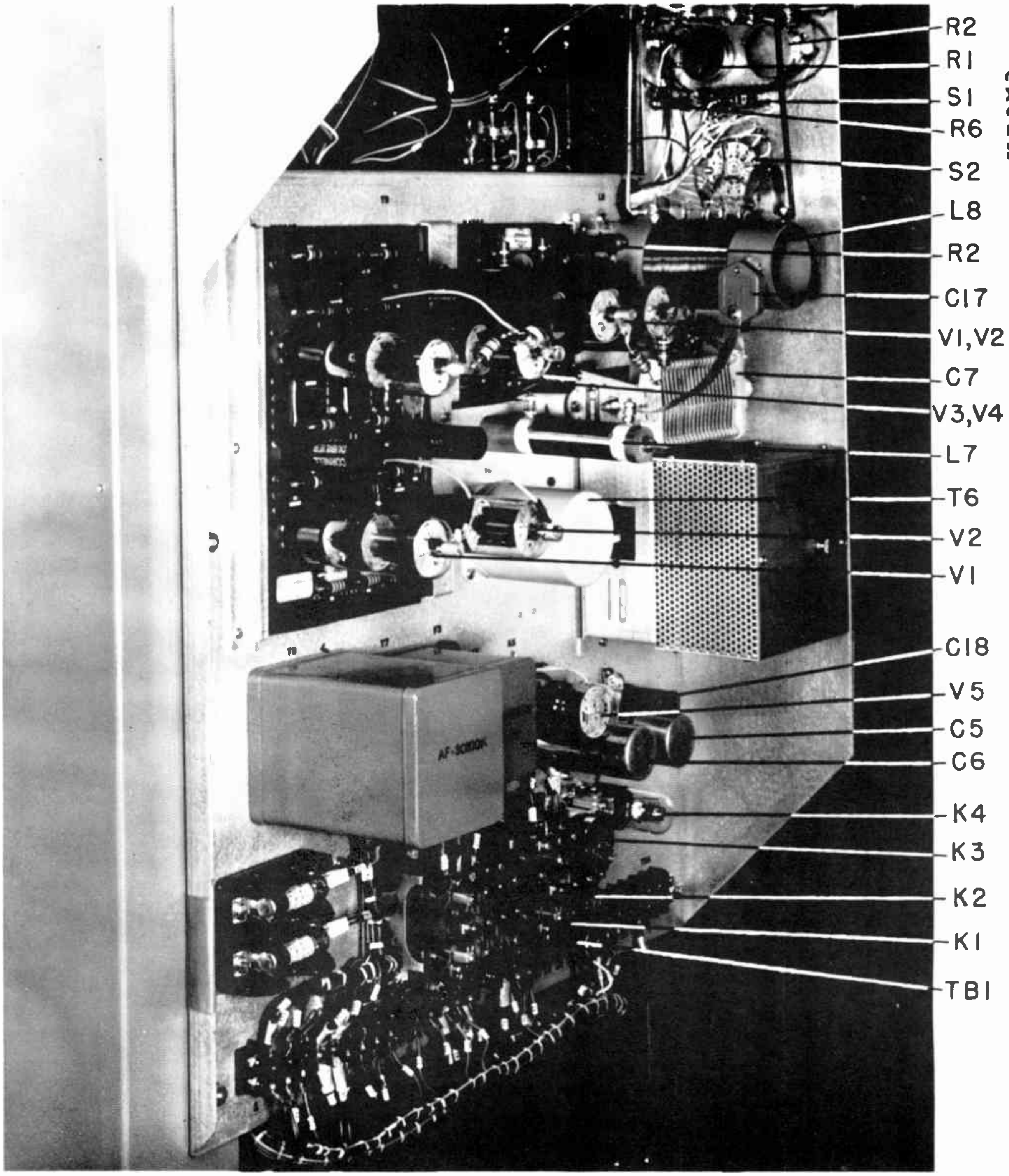


CONTROL PANEL, BC250T
250 W. A.M. TRANS.
M-5627 DL-143

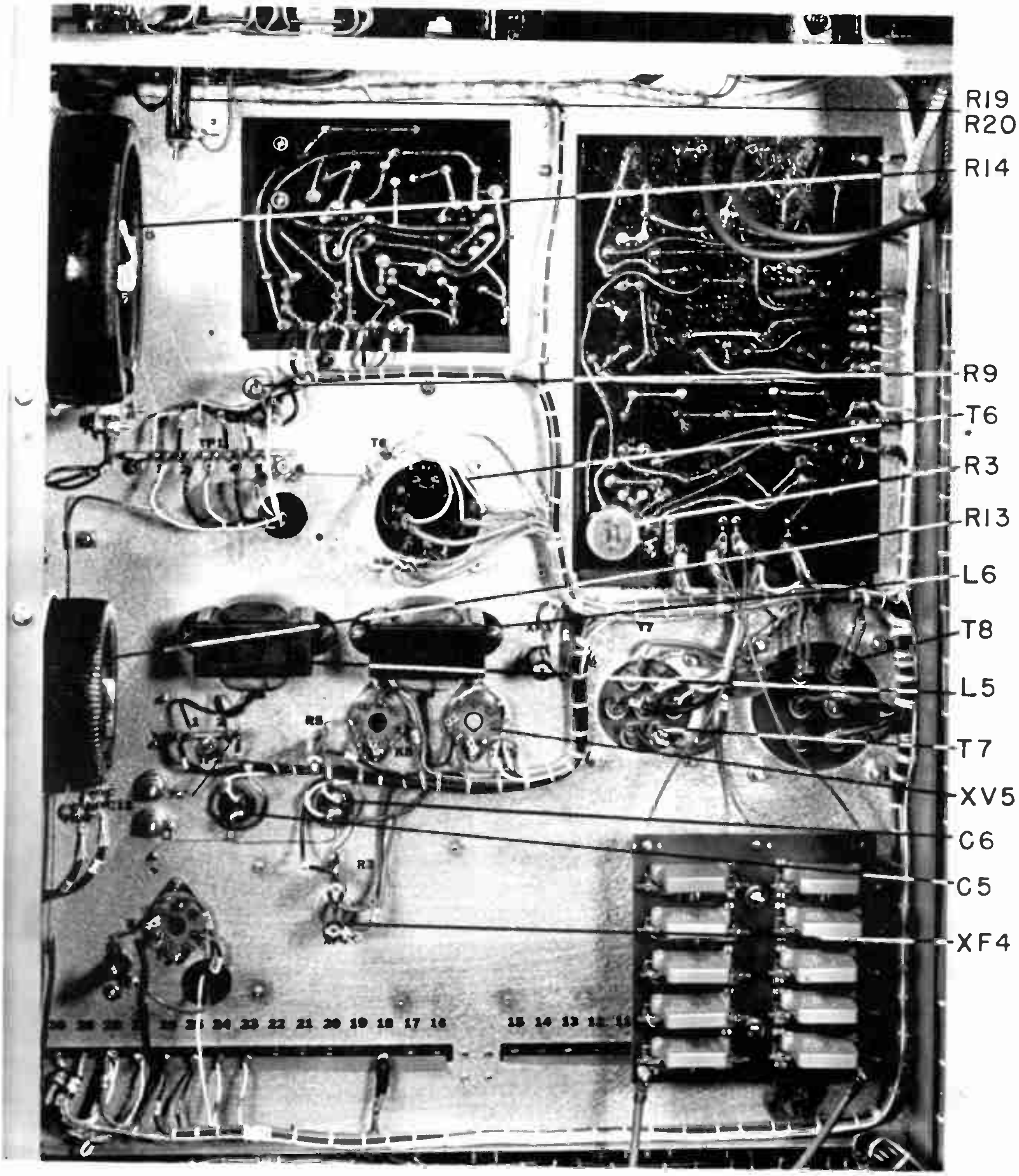


INSIDE CABINET VIEW
BC250T, 250 W.
A.M. TRANS. M5627

DL-145



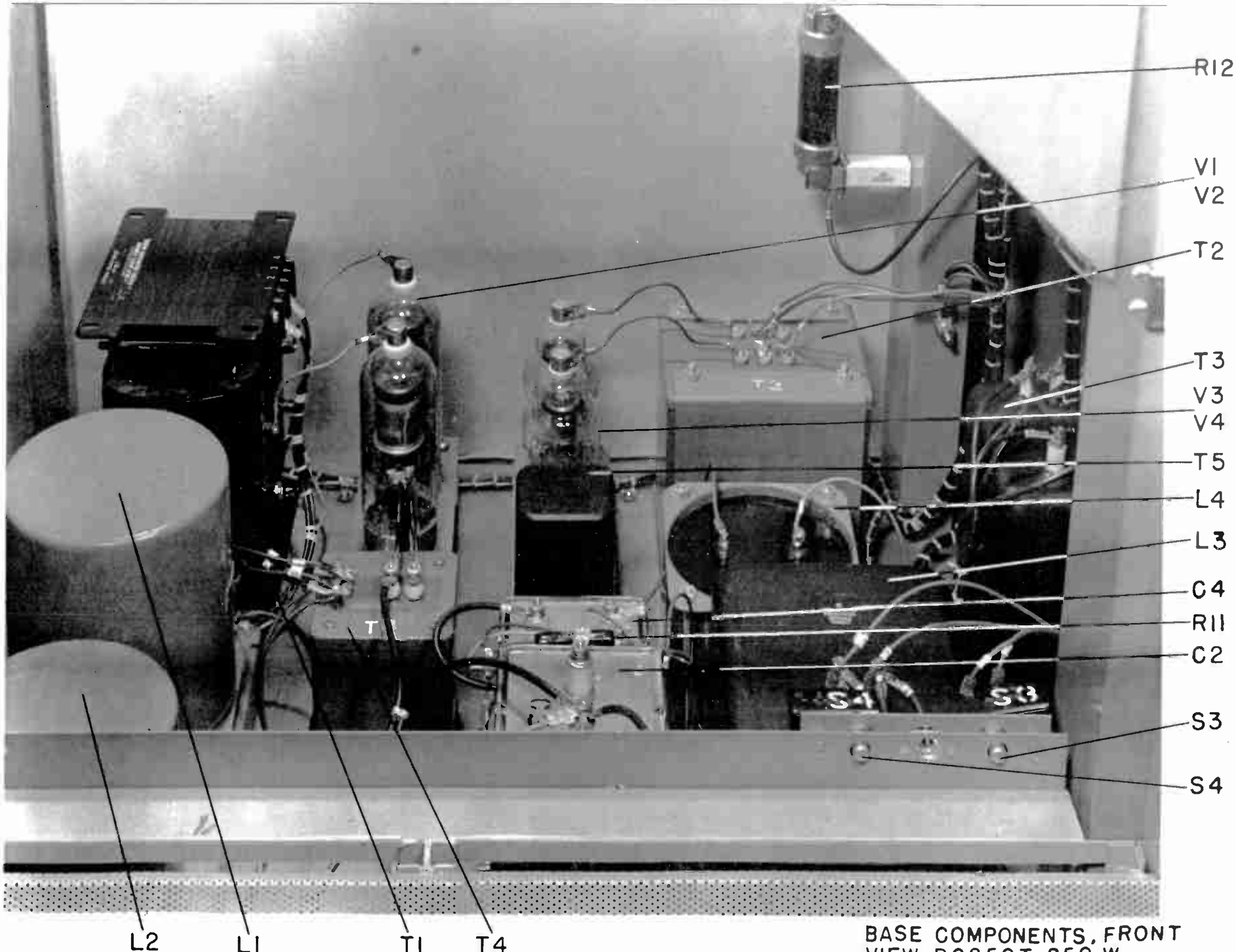
INSIDE CABINET VIEW,
BC-1T, BC500T, BC250T
A.M. TRANSMITTERS



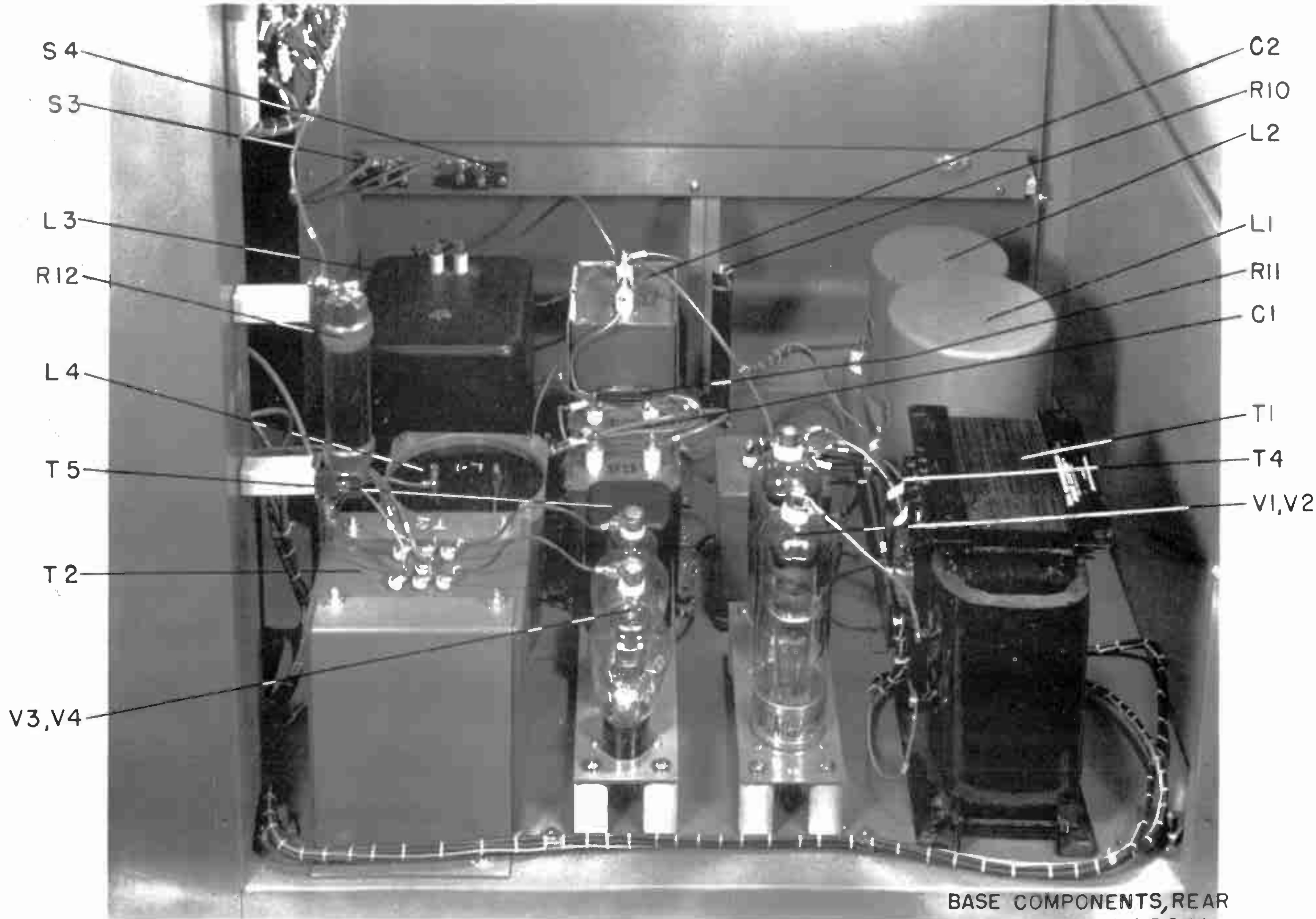
BACK VIEW, PANEL &
SHELF ASSEMBLY,
BC-1T, BC500T, BC250T
A.M. TRANSMITTERS

DL 1 3 3

SIDE VIEW, P.A. & MOD.
SECTION BC250T, 250 W.
A.M. TRANS. M-5627 DL-144

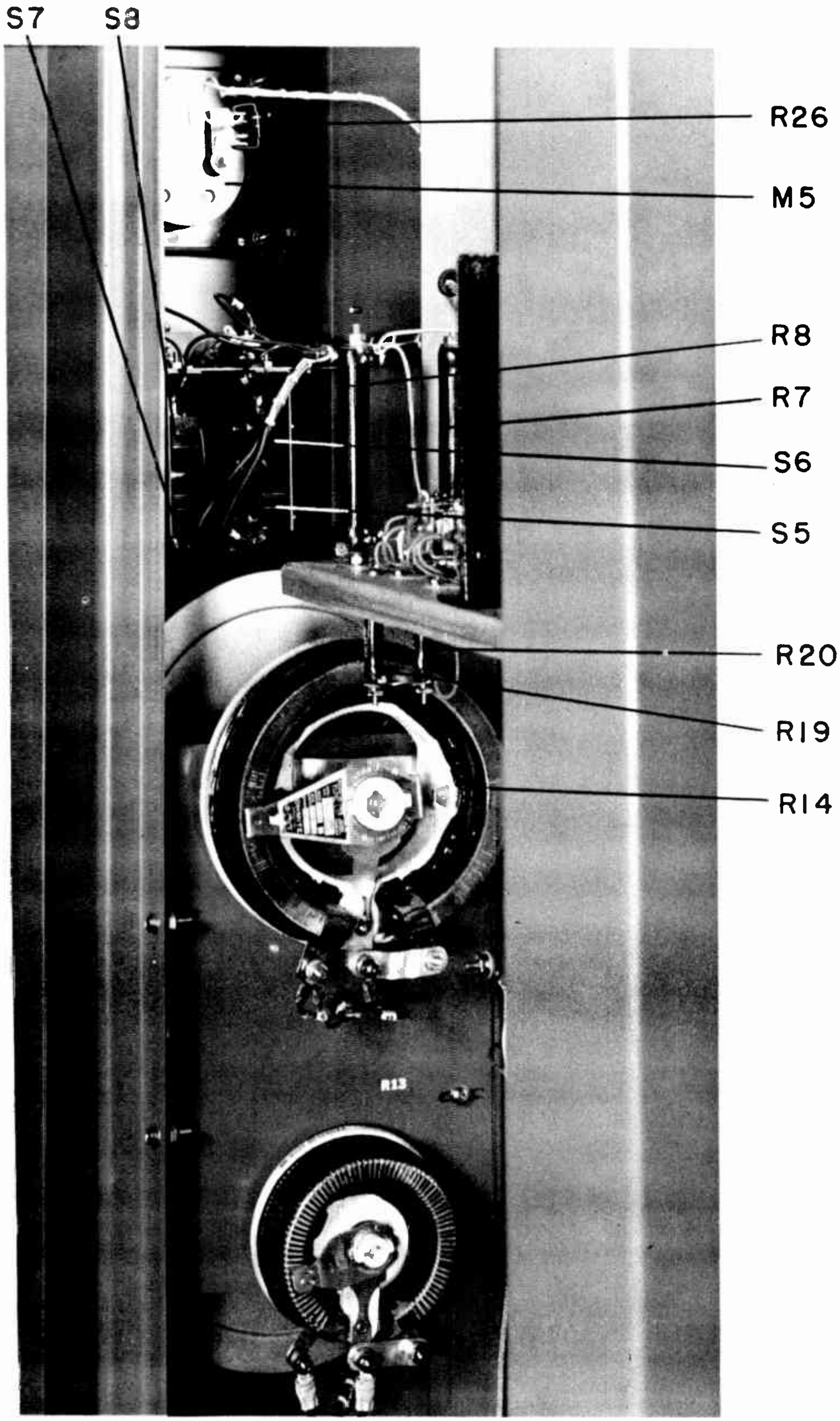


BASE COMPONENTS, FRONT
VIEW BC250T, 250 W.
A.M. TRANS. M5627 DL-147

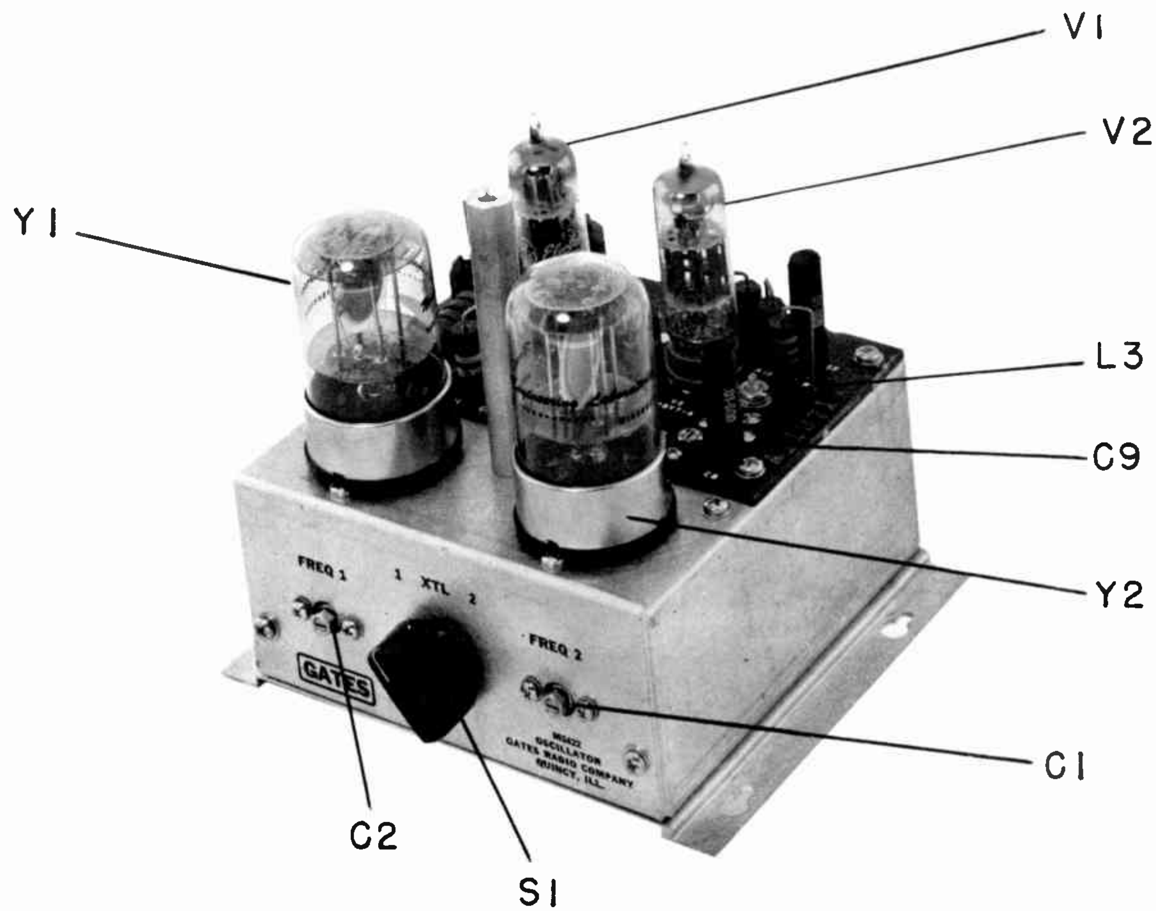


BASE COMPONENTS, REAR VIEW, BC250T, 250 W. A.M. TRANS. M-5627

DL-146



CONTROLS, FIL. & PLATE
START/ STOP & ADJUST
BC-1T, BC500T, BC250T
A.M. TRANSMITTERS



OSCILLATOR UNIT,
M5422

TRANSMITTER CABINET ASSEMBLY
PARTS LIST BC-250T XMTR.

Symbol No.	Drawing No.	Description
C1		Cap., Filter, 10 mfd., 1000(V)W.
C2		Cap., Input Filter, 8 mfd., 2000 V. (W)
C3		Cap., Output Filter, 2 mfd., 2000 V. (W)
C4		Cap., Coupling, 2 mfd., 2000V(W)
C10	C-77697-101	Neut. Condenser Assembly
L1		Swinging Choke (Pt. of C-19199-101)
L2		Smoothing Choke (Pt. of C-19199-101)
L3		Modulation Reactor
L4		Filter Choke
R10		Resistor, Bleeder, 100K ohm, 100W.
R11	A-30526-101	Resistor, Bleeder
R12		3 meg., 3KV, Precision Meter Multiplier
R13		Control (Fil. Rheostat) 15 ohm, 150 W.
R14		Control (Plate Rheostat) 400 ohm, 300 W.
S3,S4		Interlock Switch, (See Drawing B-65300-101)
T1	AP-7235E	Transformer, High Voltage Power
T2	AP-30097K	Transformer, 600 V. Power
T3		Modulation Transformer
T4	AF-10456K	Transformer, Filament
T5		Transformer, Filament
V1,V2		Tube, 8008
V3,V4		Tube, 866A
XV1,XV2		Socket (8008 rectifier)
XV3,XV4		Socket (866A rectifier)

AUDIO INPUT & DRIVER PRINTED CIRCUIT ASS'Y

Symbol No.	Drawing No.	Description
C1,C2		Cap., .00027 mfd. Mica
C3		Cap., .47, 400 V.
C4,C5		Cap., .01 mfd., 600 V.
C6,C7		Cap., .33 mfd., 600 V.
C8		Cap., .01 mfd., 1000V(W)
C9		Cap., .0001 mfd., Mica
L1,L2	A-30531-101	Parasitic Suppressor

Symbol No.	Drawing No.	Description
R1,R2		Resistor, 33K ohm, 2W., 10%
R3	A-3404-8	Control, 1000 ohm, Wirewound
R4,R15,R16		Resistor, 82K ohm, 2W., 10%
R5		Resistor, 120K ohm, 2W., 10%
R6,R7		Resistor, 100K ohm, 2W., 10%
R8,R9		Resistor, 470K ohm, 2W., 10%
R10		Resistor, 10K ohm, 2W., 10%
R11,R12		Resistor, 10K ohm, 10W.
R13,R14		Resistor, 47K ohm, 2W., 10%
R19,R20		Resistor, 20 ohm, 1W., 5%
R21		Resistor, 8200 ohm, 2W., 10%
R22,R23		Resistor, 47 ohm, 2W., 10% (Part of L1 & L2)
R17,R18		Resistor, 47 ohm, 2W., 10%
V1,V2 V3,V4		Tube, 6BG6G
XV1,XV2, XV3,XV4		Socket

R. F. DRIVER PRINTED CIRCUIT ASSEMBLY

C1,C2,C3,C4, C5,C6,C7		Cap., .01 mfd., 1000V. (W)
L1		Choke, 2.5 mh
L2,L3	A-30520-101	Parasitic Suppressor
R1		Resistor, 12K ohm, 2W., 10%
R2		Resistor, 250 ohm, 20W.
R3,R4,R5		Resistor, 3 ohm, 1W., 5%
R6,R8		Resistor, 47 ohm, 2W., 10% (Used on L2 & L3)
R7,R9		Resistor, 47 ohm, 2W., 10%
R10		Resistor, 15K ohm, 20W.
R11,R12		Resistor, 20 ohm, 1W., 5%
V1,V2		Tube, 6BG6G
XV1,XV2		Socket

BASIC P.A. TUNING AND LOADING ASSEMBLY

C8,C9		Cap., .001 mfd.
C11,C12		Cap., (Det. by Freq.)
C13,C14		Cap., (Det. by line impedance)
L9		P.A. Plate Choke (Det. by freq.)
L10,L11	A-30908-103	Parasitic Suppressor, P.A. Grid
L12	105-VB-3735F	Gates Coil, P.A. Tank
L13	26-FB-2843F	Gates Coil, Input loading

Symbol No.	Drawing No.	Description
L14	30-VB-2344F	Gates Coil, Output Loading
L15	B-65501-101	Monitor Coil
M6		R.F. Line Current Meter, 0-3 r.f. amp.
R15,R15A,R15B R16,R16A,R16B		Resistor (Part of L10 & L11)
TB2,TB3		Terminal Board

BASIC METER AND SWITCH PANEL

Symbol No.	Drawing No.	Description
A1,A2		Lamp, (See Dwg. C-77705-101)
M1		Meter, Fil. Voltmeter, 0-15V. A.C.
M2		Meter, P.A. Plate Current, 0-500 MA DC
M3		Meter, P.A. Voltmeter, 0-1 MADC w/0-3000 V. Scale
M4		Meter, Modulation, 0-500 MADC
M5		Multimeter, 0-1 MA D.C., w/0-30, 0-300 MA D.C. Scale
R26	A-10534-101	Multimeter Series Resistor Ass'y
S5,S6, S7,S8	C-77705-101	Fil. & Plate Start Stop Switch Ass'y
XA1,XA2		Socket, (See Dwg. C-77705-101)

BASIC PANEL & SHELF ASSEMBLY (R.F. AUDIO, RELAY & BIAS)

Symbol No.	Drawing No.	Description
C5,C6		Cap., 4 mfd., 600 V. Oil Filled
C7		Cap., 6BG6G plate
C15		Cap., (Det. by Freq.)
C16,C19,C20, C21,C22,C25		Cap., .01 mfd., 1000V.(W)
C17		Cap., .002 mfd., 1200 V.(W)
C18		Cap., 1 mfd., 1000V.
C23,C24		Cap., .01 mfd., 600V.(W) Type H, (See Dwg. C-77708)
F1,F2		Fuse, 15A non-renewable, 250 V.
F3		Fuse, 3A
F4		Fuse, 3 amp. Slo-Blo
K1,K2		Fil. Plate, Start-Stop relay, 230V. Coils
K3		Master O.L. Relay, 230V., 50/60 cyAC
K4		Time Delay, H.V. Relay
K5		Time Delay 600V. Relay
K6,K7		Overload Relays, 6V. D.C.

Symbol No.	Drawing No.	Description
L5,L6		Choke, Isolation Filter & Bias
L7	A-30518-101	2nd IPA Choke
L8	B-65284-101	Plate Coil
R1,R2	A-3404-6	Bias Control, 10K ohms, 4W. Wirewound
R3		Resistor, 5000 ohm, 10W.
R4,R5		Resistor, 6000 ohm, 10W.
R6		Resistor, 2500 ohm, 10W.
R7,R8		Resistor, 5000 ohm, 50W.
R9		Resistor, 20,000 ohm, 25W.
R19,R20		Resistor, 7.5 ohm, 10W.
R21,R22		Resistor, Adjustable, 20 ohm, 10W.
R23,R24,R25		Resistor, 3 ohm, 1W., 5%
S1	A-10900-2	Mod. Switch
S2		Multi Meter Switch
T6	AI-3002	Transformer, Audio Input
T7	AP-30098K	Transformer, Bias
T8	AF-30100K	Transformer, Multi-Fil. 6.3 V.
T9	AF-30257E	Transformer, Multi-Fil. 10V.
TB1	A-30544-101	Terminal Board Assembly
TP1	B-11729-19	Tie Point
V5		Tube, 5R4GY
V6,V7,V8,V9		Tube, 810
XF1		Fuse Block
XF3,XV4		Fuseholder
XK4,XK5,XV5		Socket
XV6,XV8,XV9	C-77897-101	P.A. & Mod. Socket Assembly

FEEDBACK LADDER ASSEMBLY

Symbol No.	Drawing No.	Description
C1,C2		Cap., .0015 mfd., 1200 V. (W)
C3,C4,C5, C6,C7,C8, C9,C10		Cap., .0001 mfd., 1200 V. (W)
R1,R2		Resistor, 82K ohm, 2W., 5%
R3,R4,R5, R6,R7,R8, R9,R10		Resistor, 2.2 megohm, 2W., 5%

M-5422 OSCILLATOR UNIT FOR AM TRANSMITTER

Symbol No.	Drawing No.	Description
C1,C2		Variable Cap., 3.9-50 mmfd.
C3		Cap., 24 mmfd., 500 V.(W)
C4		Cap., 800 mmfd., 500V. (W)
C5,C7,C8		Cap., .01 mfd., 600V.
C6,C11		Cap., 100 mmfd., 500 V.(W)
C9		Variable Cap., 6.7-140 mmfd.
C10		Cap., 100 mmfd. 500 V.(W)
J1		Receptacle
L1.L2		R.F. Choke, 2.5 mh
L3		Variable Coil, 105-200 mh.
R1,R6		Resistor, 100K ohm, 2W., 10%
R7		Resistor, 150 ohm, 2W., 10%
R3,R9, R10,R11		Resistor, 27K ohm, 2W., 10%
R4		Resistor, 15K ohm, 2W., 10%
R5,R8		Resistor, 10K ohm, 2W., 10%
R12		Resistor, 1000 ohm, 2W., 10%
R13		Resistor, 47K ohm, 2W., 10%
R14		Resistor, 10 ohms, 1W., 5%
R2		Resistor, 1000 ohm, 2W., 10%
S1	A-30316-101	Rotary Switch
V1,V2		Tube, 12BY7A
XV1,XV2		Noval Socket
XY1,XY2		Crystal Socket
Y1,Y2		Crystal

TUNING CHART BC-250T
51.5 OHM OUTPUT
FW.

L9 P.A. RF Choke
1600 KC to 1200 KC - C16465-193
1200 KC to 540 KC - C18494-102

C11, C12 Always
In Parallel

FREQUENCY	1600	1550	1500	1450	1400	1350	1300	1250	1200	1150	1100	1050	1000	950	900	850	800	750	700	650	600	540
FIRST IPA COIL, L3	Slug Adjusting Screw Turned All Out								Slug Adjusting Screw Halfway Extended								Slug Adj. Screw All Way In.					
FIRST IPA TUNING COND., C9	Tune Complete Band With Capacitor, C9																					
SECOND IPA COIL, L8	Tune Complete Band With Coil, L8																					
SECOND IPA TUNING COND., C7	Condenser C7, Used on All Frequencies																					
SECOND IPA PADDING COND., C15	Not Used										F1B .0002						F1B .0004		F1B .0006		F1B .00075	
PA TANK CONDENSERS C11,C12 1 PARALLEL	Two .0002 G1 in Parallel								Two .00025 G1 In Parallel					Two .0003 G1 In Parallel			Two .0004 G1 In Parallel				Two .0005 G1 in Parallel	
PA TANK COIL, L12 TURNS, APPROX.	14.8	15.8	16.5	17.5	18.8	19.6	20.9	22.4	18.3	19.3	20.9	22.1	23.5	24.8	25.2	27.0	24.7	26.0	30.4	33.0	34.2	36.7
PA TANK COIL, L12 IND. MICROHY.	16.8	19.0	21.0	23.5	27.0	29.5	33.5	38.5	25.5	28.5	33.5	37.5	42.5	47.0	48.5	55.0	47.0	52.0	69.0	83.0	89.0	103.0
COIL, L13 TURNS APPROX.	8	6	5	5	8	9	10	11	9	5	6	7	8	7	10	11	9	9	12	12	14	4
COIL, L13 IND. MICROHY.	2.1	1.2	.82	.82	2.1	2.6	3.3	4.0	2.6	.82	1.2	1.6	2.1	1.6	3.3	4.0	2.6	2.6	4.8	4.8	6.5	.53
INPUT LOADING CONDENSER C13, F2L	.002								.003								.004					
COIL, L14 TURNS APPROX.	8.2	7.0	6.7	5.4	7.1	7.5	7.7	7.9	9	3.3	8.6	8.1	7.9	7.0	12.2	12.9	12	11.7	13.1	13.5	15	17
COIL, L14 IND. MICROHY	3.85	2.8	2.55	1.68	2.9	3.2	3.4	3.55	4.6	3.9	4.2	3.75	3.55	2.8	8.3	9.4	8.2	7.7	9.7	10.3	12.8	16.4
OUTPUT LOADING COND. C14, F2L	.002											.003					.004					
TANK Q	12.8	12.4	12.0	11.6	11.1	10.8	10.4	10.0	12.0	11.4	11.0	10.5	10.0	11.3	10.8	10.2	12.8	11.9	10.6	10.4	11.8	10.6
OUTPUT CURRENT INTO 51.5 OHMS	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
FREQUENCY	1600	1550	1500	1450	1400	1350	1300	1250	1200	1150	1100	1050	1000	950	900	850	800	750	700	650	600	540

A-30957

TYPICAL VOLTAGE CHART
GATES' BC-250T 250W AM TRANSMITTER

These measurements made with a Simpson #260 Volt-Ohmmeter, a 20,000 ohms per volt D.C. and 1000 ohms per volt A.C. instrument. DC Voltages to GROUND.

First Audio Input (V1, V2, 6BG6G's)
- Plate Volts - 275 D.C.
- Screen Volts - 200 D.C.
- Filament Volts - 6.3 A.C.
- Cathode Volts - 49 D.C.

Cathode Follower (V3, V4, 6BG6G's)
- Plate Volts - 650 D.C.
- Screen Volts - 230 D.C.
- Cathode Volts Neg. - 70 D.C.
- Filament Volts - 6.3 A.C.

Modulators (V8, V9, 810's)
- Plate Volts - 1400
- Plate Current, Statis - 20/25 MA Each
- Bias Volts - Approx. 50/60 volts Neg.
- Filament Volts - 10 A.C.

Crystal Oscillator (V1, 12BY7A)
- Plate Volts - 100 D.C.
- Screen Volts - 50 D.C.
- Cathode Volts - .8 D.C.
- Filament Volts - 6.3 A.C.

First IPA (V2, 12BY7A, A part of Osc.)
- Plate Volts - 205 D.C.
- Screen Volts - 105 D.C.
- Cathode Volts - 3.5 D.C.
- Filament Volts - 6.3 A.C.

Second IPA (V1, V2 Parallel 6BG6G's)
- Plate Volts - 650 D.C.
- Screen Volts - 400 D.C.
- Cathode Volts - 45 D.C.
- Filament Volts - 6.3 A.C.

Power Amplifier
- Plate Volts - 1350
- Plate Current - 250/280 MA.
- Bias Volts - 330 D.C.
- Filament Volts - 10 A.C.

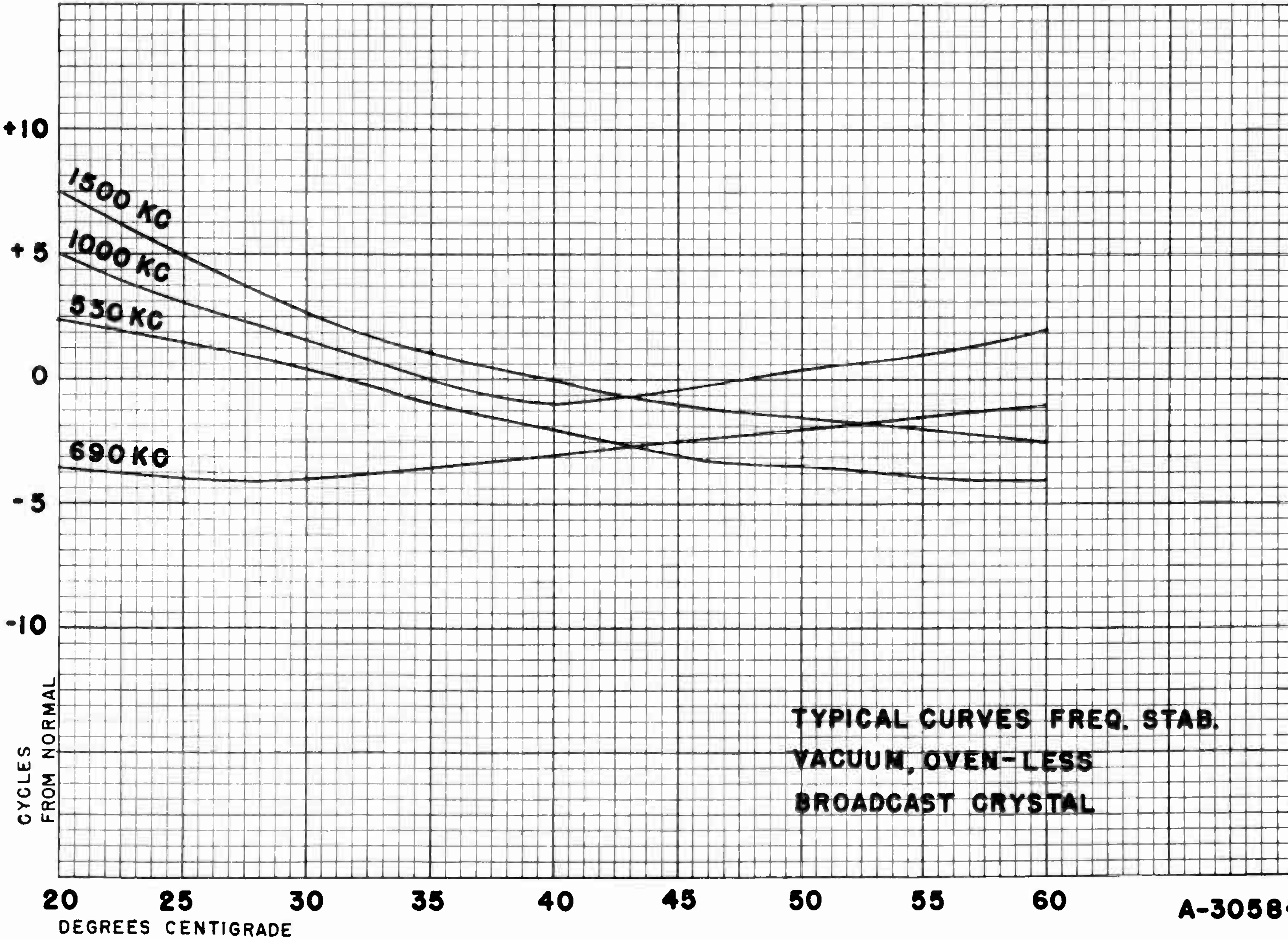
Bias Supply
- Output of Supply, measured at terminal #11 of Audio Printed Board - Neg. 280V.

Intermediate Plate Supply
- Output of Supply, Measured at L5, Terminal #2 - 600/650V. D.C.

High Voltage Plate Supply
- Output of Supply at hot end of bleeder, R10 1400V. D.C.

A-30958

A-30584

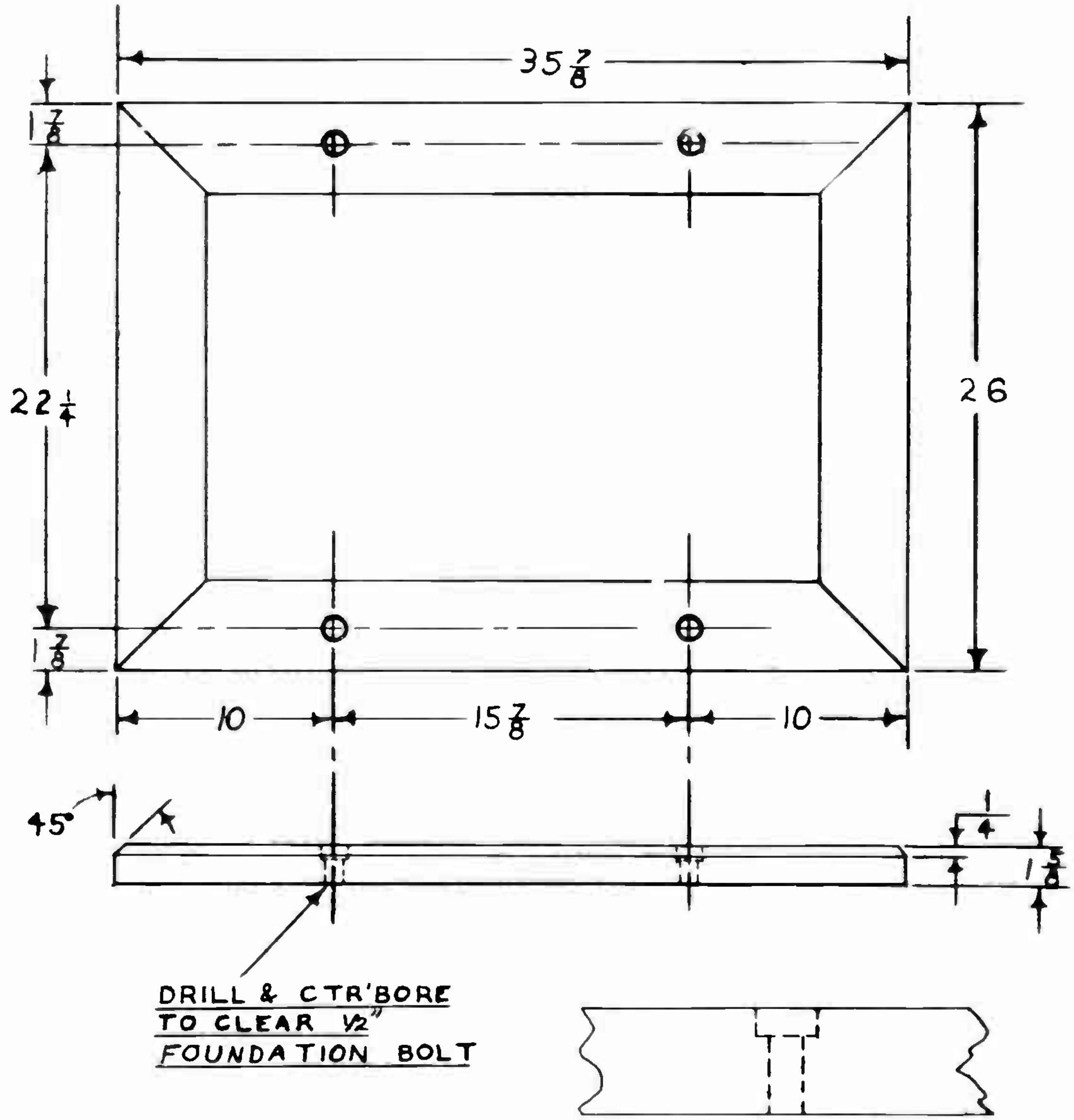


A-30584

104	103	102	101	GR. NO. / FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS		A 30585 SCALE $\frac{1}{8}$" = 1"

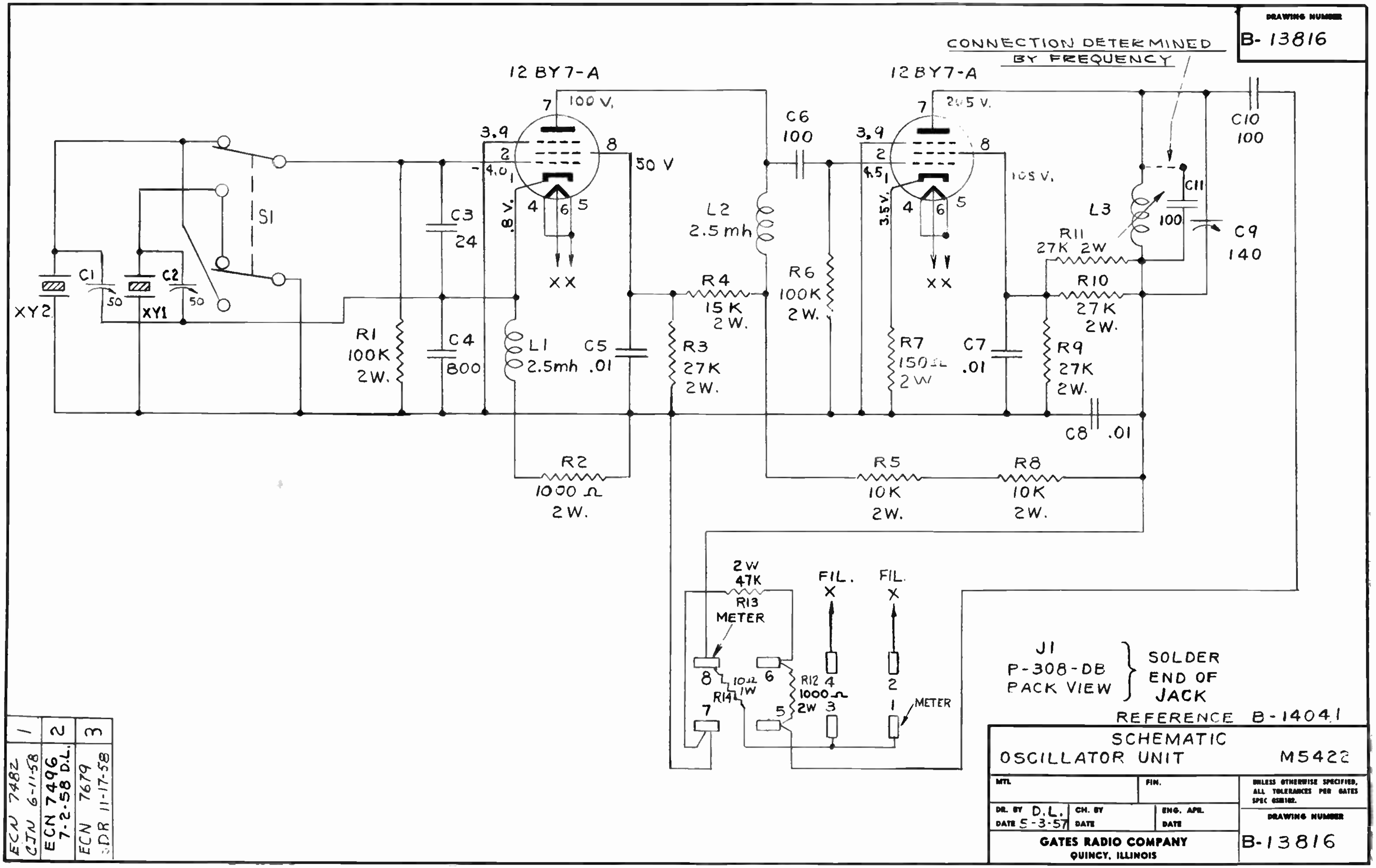
LIST OF PARTS

QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATL.



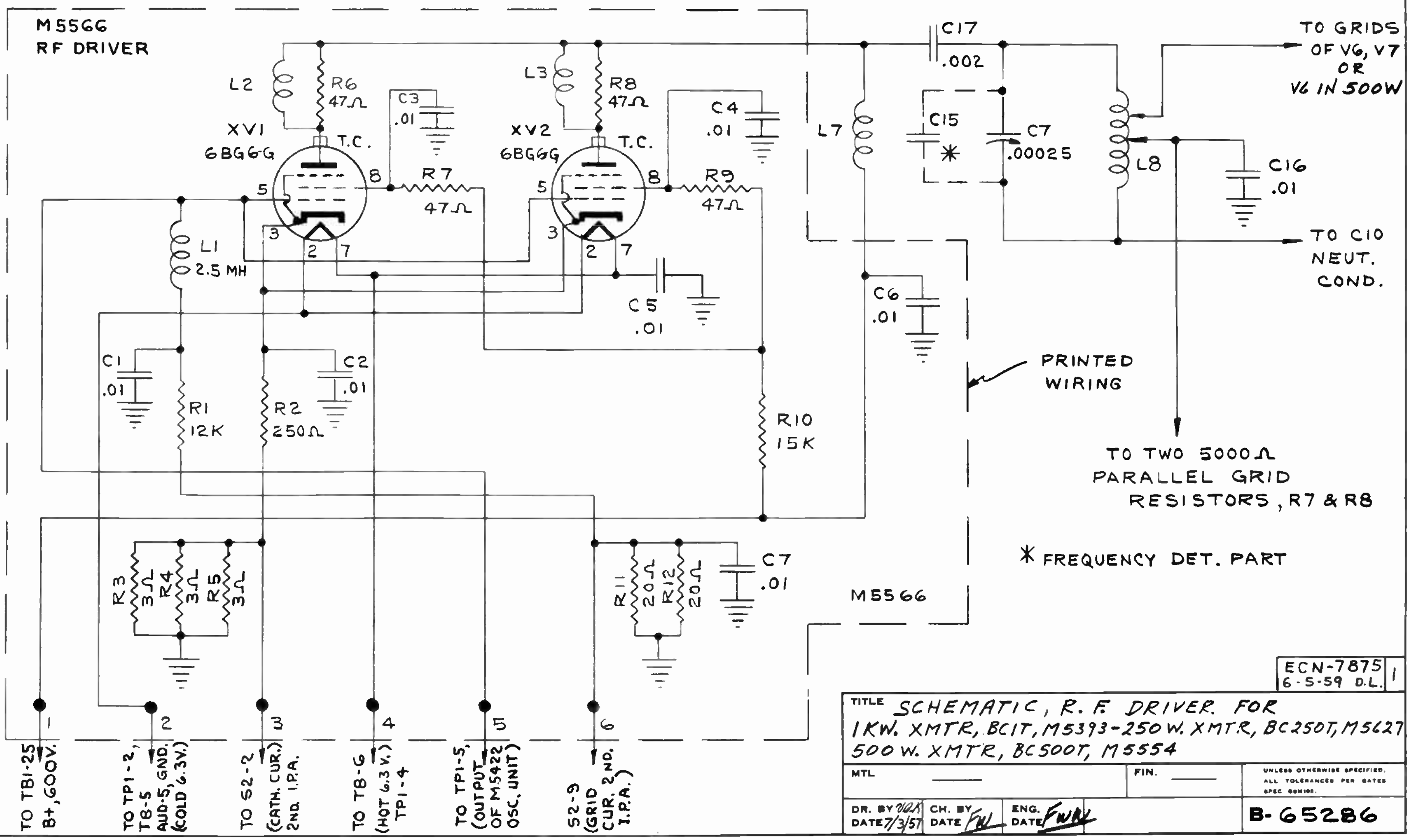
BOLT HOLE DETAIL

CH. BY LW DATE 9/19/57	MTL. 2"X4" YEL. PINE		TITLE WOOD BASE FOR 1KW AM XMTR BC1T M5393	UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC GRM108.
DR. BY TRB DATE 7-17-57	ENG. R.L. 8-8-57	FIN. GA3		A 30585



DRAWING NUMBER
B-13816
CONNECTION DETERMINED BY FREQUENCY
12 BY7-A
100 V.
3,9
2
8
-4.0
50 V
4
6
5
.8 V.
X X
12 BY7-A
245 V.
4.5
105 V.
3.5 V.
C6
100
C10
100
C11
100
C9
140
L3
S1
C1
50
C2
50
XY2
XY1
C3
24
C4
800
R1
100K
2W.
L1
2.5mh
C5
.01
L2
2.5 mh
R4
15 K
2 W.
R6
100K
2 W.
R3
27K
2W.
R7
150Ω
2 W
C7
.01
R11
27K 2W
R10
27K
2W.
R9
27K
2W.
C8
.01
R2
1000 Ω
2W.
R5
10K
2W.
R8
10K
2W.
2 W
47K
R13
METER
FIL.
FIL.
10Ω 1W
R14
R12
1000 Ω
2W
METER
J1
P-308-DB
PACK VIEW
SOLDER END OF JACK
REFERENCE B-14041
SCHEMATIC
OSCILLATOR UNIT
M5422
MTL
FIN.
UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC
DR. BY D.L.
DATE 5-3-57
CH. BY
DATE
ENG. APR.
DATE
DRAWING NUMBER
B-13816
GATES RADIO COMPANY
QUINCY, ILLINOIS
1 ECN 7482 CJN 6-11-58
2 ECN 7496 7-2-58 D.L.
3 ECN 7679 JDR 11-17-58

						FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS				B-65286 SCALE ____
106	105	104	103	102	101	GR. NO.	LIST OF PARTS				
QTY.	QTY.	QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATERIAL



ECN-7875 6-5-59 D.L. | 1

TITLE SCHEMATIC, R.F. DRIVER FOR 1KW. XMTR, BC1T, M5393-250W. XMTR, BC250T, M5627 500 W. XMTR, BC500T, M5554

MTL ____ FIN. ____

UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC GGM100.

DR. BY WQK DATE 7/3/57 | CH. BY FWL DATE | ENG. FWK DATE

B-65286

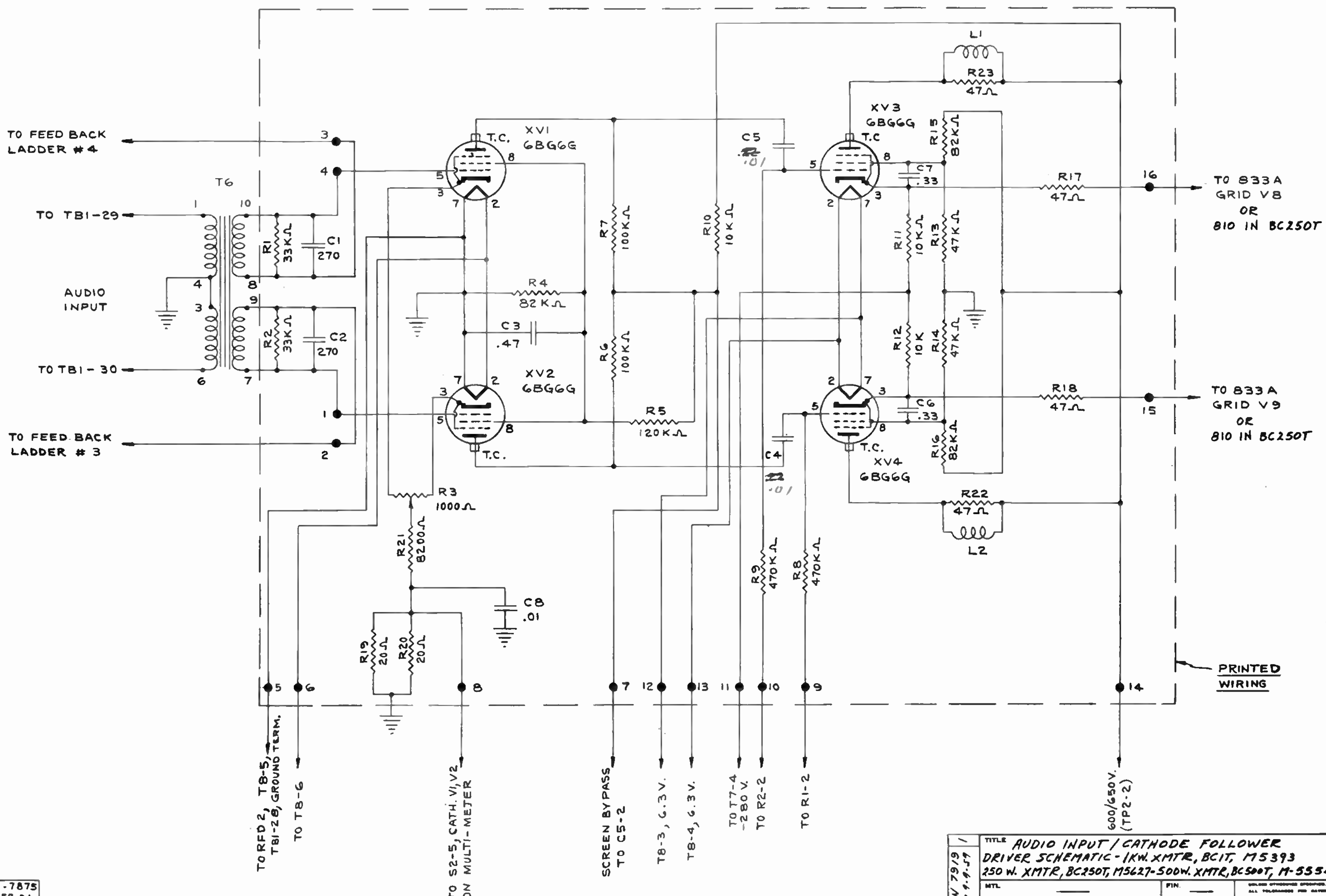
GATES RADIO COMPANY
QUINCY, ILLINOIS

C-77711

SCALE ——

LIST OF PART

106 QTY.	105 QTY.	104 QTY.	103 QTY.	102 QTY.	101 QTY.	ITEM	REFERENCE	PT. or G.N.	FIN.	DESCRIPTION	MATERIAL



TITLE AUDIO INPUT / CATHODE FOLLOWER DRIVER SCHEMATIC - 1KW. XMTR, BC1T, M5393 250 W. XMTR, BC250T, M5627-500W. XMTR, BC500T, M-5554

MTL. —— FIN. ——

DR. BY URK DATE 7/6/57 CH. BY FWH DATE ENG. FWH DATE

C-77711

2	ECN-7875 6-5-59 D.L.
1	ECN 7270 JN 12-27-57

ECN 7919 AWC 9-9-59

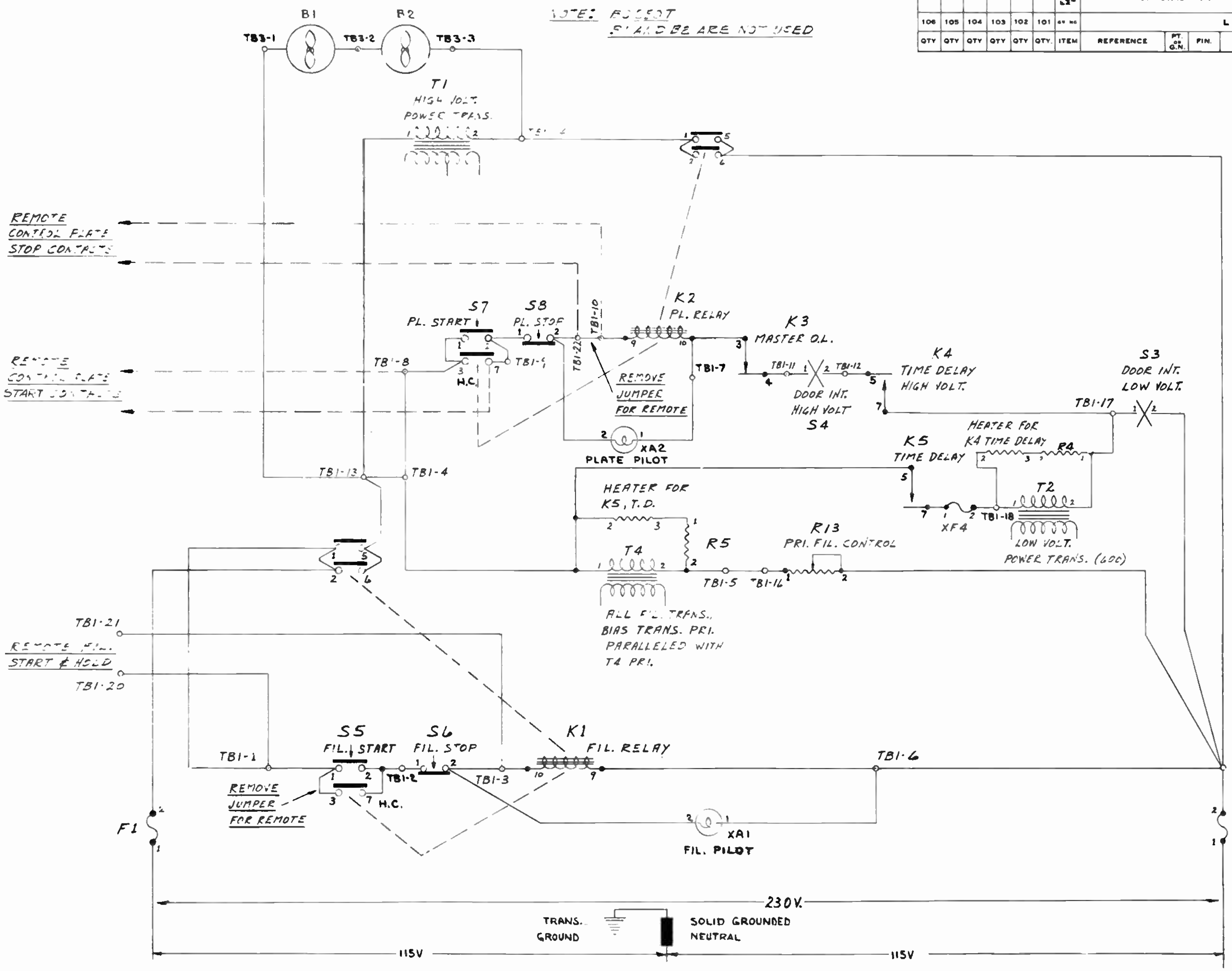
GATES RADIO COMPANY
QUINCY, ILLINOIS

C-77723

SCALE —

LIST OF PARTS

106	105	104	103	102	101						
QTY	QTY	QTY	QTY	QTY	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATERIAL



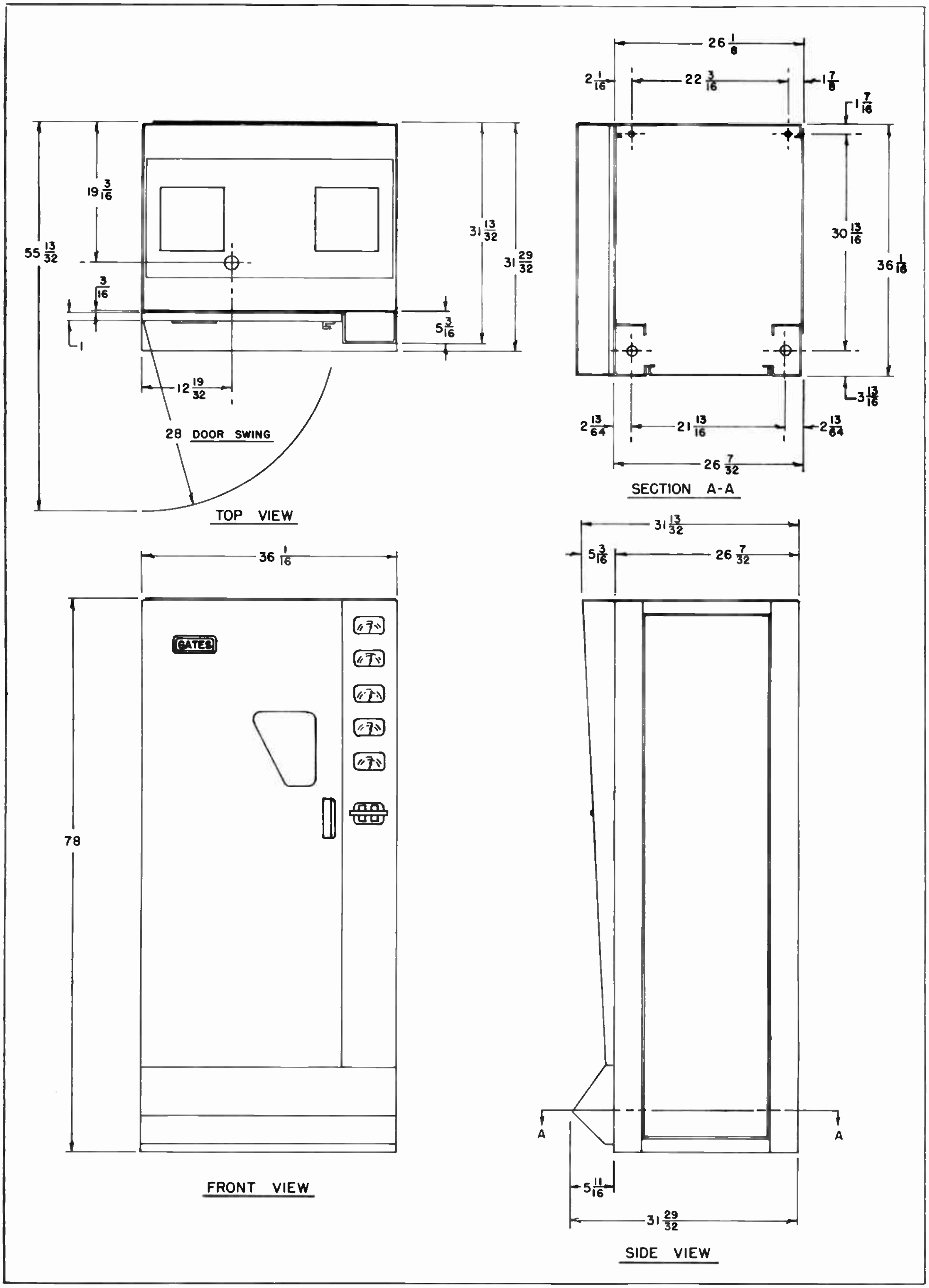
ECN 7884 HMC 6-23-59

TITLE SIMPLIFIED CONTROL SCHEMATIC
1 KW. XMTR, BC1T, M5393 - 250 W. XMTR, BC250T, M-5627
500 W. XMTR, BC500T, M5554

MTL. | FIN. —

DR. BY R.W. DATE 9-4-57 | CH. BY GWW DATE | ENG. GWW DATE

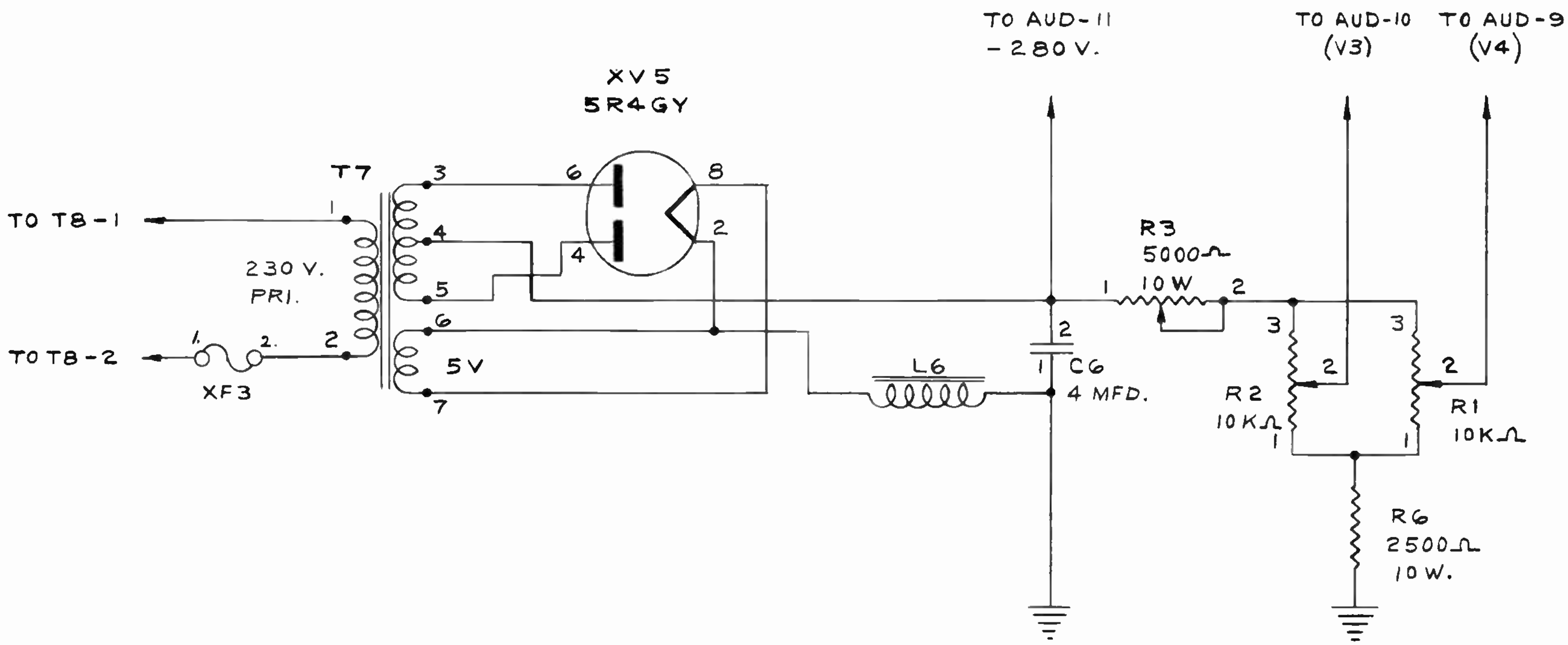
C-77723



THIS DWG. PERTAINS TO -
1 KW. XMTR, BC1T, M5393
250W. XMTR, BC250T, M5627
500W. XMTR, BC500T, M5554

C-C77

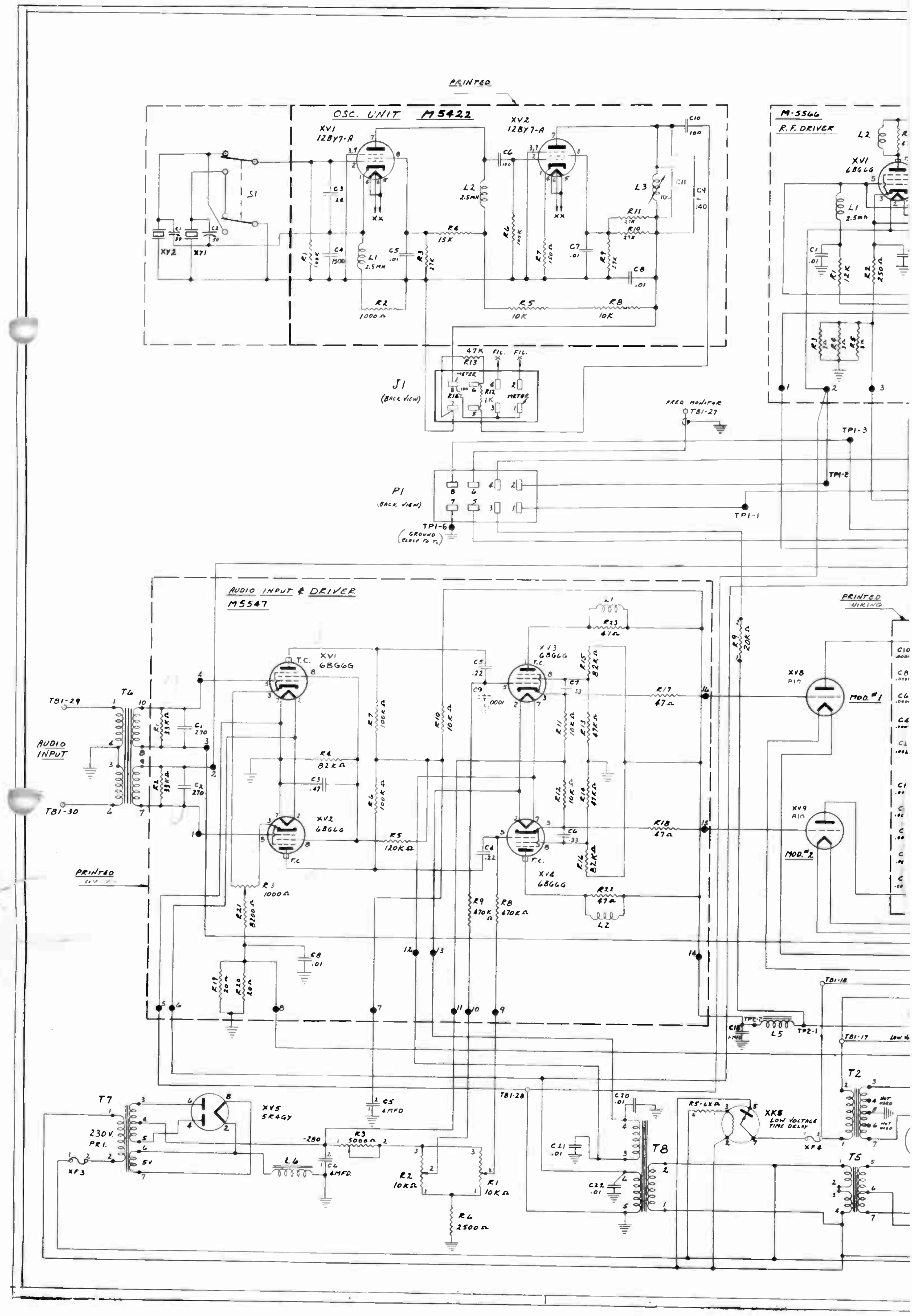
FIRST MADE FOR							GATES RADIO COMPANY QUINCY, ILLINOIS					B-65293 SCALE
106	105	104	103	102	101	SR. NO.	LIST OF PARTS					
QTY.	QTY.	QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION		MATERIAL

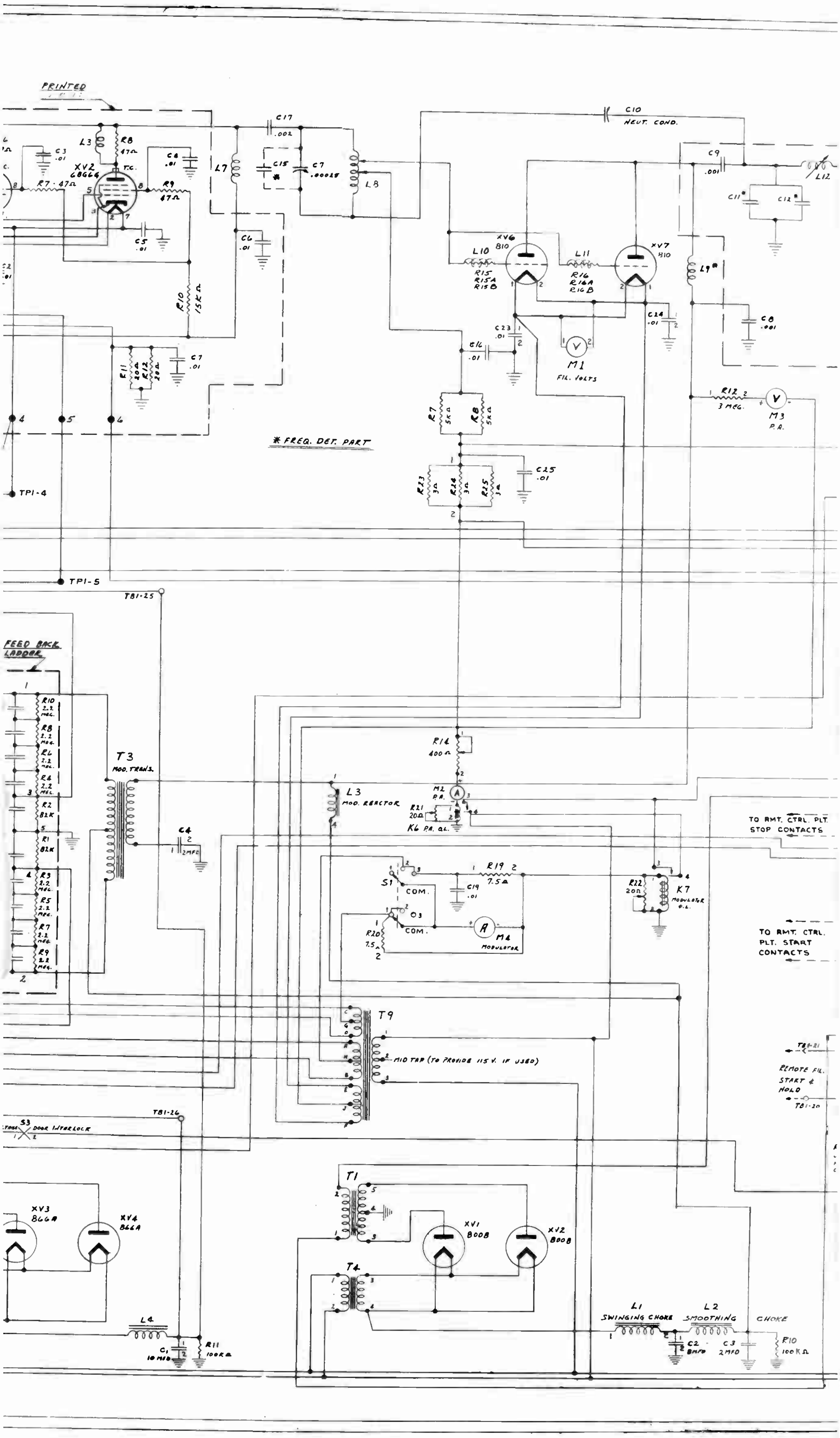


TITLE *BIAS SUPPLY (SCHEMATIC)*
1KW. XMTR, BC1T, M5393 - 250W XMTR, BC250T-M5627
500W XMTR, BC500T, M5554

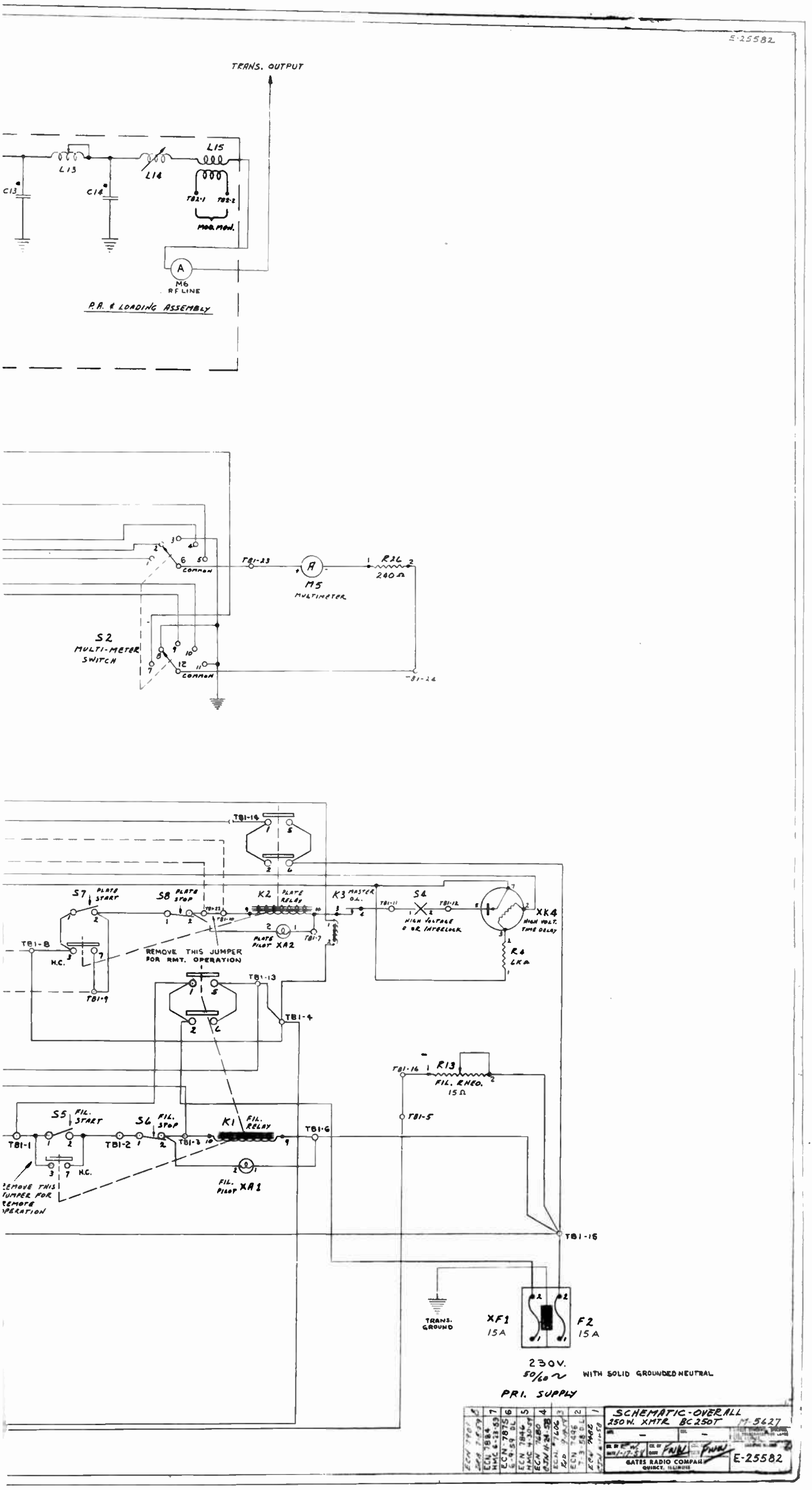
MTL	FIN.	UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC 6SM100.
DR. BY V.B.K. DATE 7/5/57	CH. BY FWM DATE	ENG. FWM DATE

B-65293


PRINTED
OSC. UNIT M5422
XV1
12BY7-A
XV2
12BY7-A
S1
XY2
XY1
M-5566
R.F. DRIVER
XV1
6BG6G
J1
(BACK VIEW)
FREQ MONITOR
TB1-27
P1
(BACK VIEW)
TP1-1
TP1-2
TP1-3
TP1-6
AUDIO INPUT & DRIVER
M5547
XV1
6BG6G
XV2
6BG6G
XV3
6BG6G
XV4
6BG6G
T6
TB1-29
TB1-30
AUDIO INPUT
PRINTED
PRINTED WIRING
XV8
MOD. #1
XV9
MOD. #2
T7
XV5
5R4GY
230V PRI.
XF3
L6
T8
XK8
LOW VOLTAGE TIME DELAY
XF4
T2
T5
L5
TB1-17
TB1-18
TB1-28



PRINTED
XV2
6BG6G
R7 47Ω
R8 47Ω
R9 47Ω
R10 15KΩ
C17 .002
C15 *
C7 .00025
L7
L8
C10 NEUT. COND.
C9 .001
L12
C11 *
C12 *
XV6 810
XV7 810
L10
L11
R15 R15A R15B
R16 R16A R16B
L9 *
C8 .001
C23 .01
C24 .01
C16 .01
M1 FIL. VOLTS
R12 3 MEG.
M3 P.A.
R7 5KΩ
R8 5KΩ
C25 .01
R23 3Ω
R24 3Ω
R25 3Ω
* FREQ. DET. PART
TP1-4
TP1-5
TB1-25
FEED BACK LADDER
T3 MOD. TRANS.
C4 2MFD
L3 MOD. REACTOR
R16 400Ω
M2 P.A.
R21 20Ω
K6 P.A. O.L.
S1
R19 7.5Ω
C19 .01
R20 7.5Ω
M4 MODULATOR
R22 20Ω
K7 MODULATOR O.L.
TO RMT. CTRL. PLT. STOP CONTACTS
TO RMT. CTRL. PLT. START CONTACTS
T9
MID TAP (TO PROVIDE 115 V. IF USED)
REMOTE FIL. START & HOLD
TB1-21
TB1-20
TB1-26
S3 DOOR INTERLOCK
XV3 866A
XV4 866A
T1
T4
XV1 800B
XV2 800B
L4
C1 10 MFD
R11 100KΩ
L1 SWINGING CHOKE
L2 SMOOTHING CHOKE
C2 8MFD
C3 2MFD
R10 100KΩ


E-25582
TRANS. OUTPUT
L13
L14
L15
C13
C14
TB2-1
TB2-2
MOD. MON.
M6
RF LINE
P.A. & LOADING ASSEMBLY
COMMON
TB1-23
M5
MULTIMETER
R26
240 Ω
S2
MULTI-METER SWITCH
S7 PLATE START
S8 PLATE STOP
K2 PLATE RELAY
K3 MASTER O.L.
S4
HIGH VOLTAGE DOOR INTERLOCK
XK4
HIGH VOLT. TIME DELAY
R4
6KΩ
PLATE PILOT XA2
REMOVE THIS JUMPER FOR RMT. OPERATION
TB1-8
TB1-9
TB1-13
TB1-4
TB1-16
R13
FIL. RHEO.
15 Ω
TB1-5
S5 FIL. START
S6 FIL. STOP
K1 FIL. RELAY
TB1-1
TB1-2
TB1-3
TB1-6
N.C.
FIL. PILOT XA1
REMOVE THIS JUMPER FOR REMOTE OPERATION
TB1-15
TRANS. GROUND
XF1
15A
F2
15A
230V.
50/60 ~
WITH SOLID GROUNDED NEUTRAL
PRI. SUPPLY
SCHEMATIC-OVERALL
250W. XMTR BC250T
M-5627
GATES RADIO COMPANY
QUINCY, ILLINOIS
E-25582

REPLACING COMPONENTS ON THE PRINTED CHASSIS

Since this is a destructive operation, the engineer must be reasonably sure that the part is defective before removing it. He may determine this from the D.C. and signal voltage measurements or by visual observation.

WARNING: The copper conductors are only .0027" thick on the printed chassis. They are easily damaged! Do not attempt to pull one component lead loose to check the component. Use only the approved procedure as outlined in the sketches and the sub-paragraphs listed below.

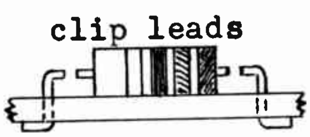
Use a small electric soldering iron (60 watts or less) and allow it to come up to full heat before starting the repair job. The tip must be clean and well tinned.

> CAUTION: Do not use a soldering gun. The extremely high temperature of the tip will damage the phenolic board.

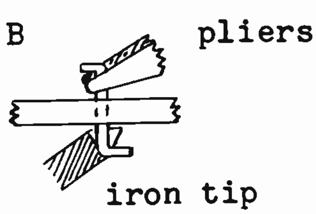
Put the iron tip on the fillet under the chassis, right beside the component lead being removed. Put a gentle, but firm pressure on all leads and components being moved while the heat is applied. Do not hold the iron to the printed chassis for long periods of time. If the lead or component is difficult to remove, make repeated short passes at it rather than one long period that may overheat the board.

1. REMOVING PARALLEL MOUNTED COMPONENTS WITH AXIAL LEADS:

A



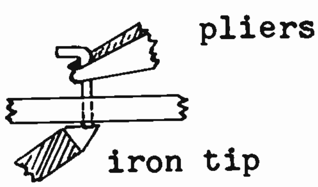
B



push wire through hole until hook can be clipped off.

clip off hook that was soldered to chassis.

C

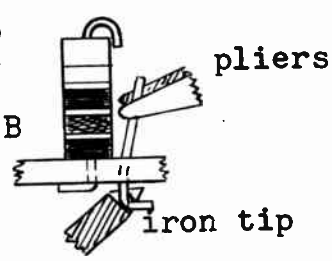


place iron on fillet again and pull the wire out of the hole on the top side of the chassis.

2. REMOVING VERTICALLY MOUNTED RESISTORS AND COMPONENTS WITH AXIAL LEADS:

A

B



place iron on fillet and push wire through the hole until the hook can be clipped off.

clip off hook that was soldered to chassis.

remove wire as illustrated in paragraph 1. (c).

7. REPLACING TUBE SOCKETS:

Tube sockets are very difficult to replace and should not be replaced until you are positive that the one in question is actually defective. Resolder all of the socket pin fillets to assure that this is not the trouble. Inspect the top side to see if the tube pin sleeve is bent and can be straightened. Use a socket alignment tool to re-size. Check continuity from the top to the bottom side of the chassis. If there is a connection and the socket sleeve is not out of alignment or spread open, the socket is O.K. and should not be removed.

(A) If the socket has been damaged or is excessively corroded it must be replaced. Stand the unit so that the chassis is vertical. Hold a small iron to the hex nut in the center of the socket (if the socket is retained in this manner). After the solder has melted, unscrew the retaining screw.

(B) Remove the excess solder from all pin fillets by carrying it away with the tip of the iron. Repeat until all solder that will come loose is removed. Do not hold the iron to the chassis for long periods of time.

(C) Starting at pin 1 or pin 7 (8 or 9 on other sockets), apply the iron and push against the socket to raise it at this point. Use the thumb and fingers only to raise socket to prevent damage to the board. The socket will not move very much but any movement at all is helping. Place the iron on each pin in rotation around the socket while pushing up on the side of the socket adjacent to the pin being heated. After several passes around the socket it will no longer be held in by solder. Gently rock the socket and pull it free of the holes.

(D) Use a small metal twist drill as illustrated in paragraph 5 of these instructions to clear the fillet holes of solder.

(E) Install the new socket and put in a new retaining screw similar to the one removed (if retaining screws are used). Do not tighten the nut excessively and put a great strain on the phenolic board.

(F) Solder the screw, nut and each socket pin fillet swiftly and securely. Be sure that there is no solder bridging between adjacent fillets or conductors.

(G) If one of the fillets was damaged in the replacement operation, form a small loop on the end of a small piece of wire. Drop the loop over the socket pin and lay the wire to join the proper conductor. Flow solder on the connections and clip off the excess wire.

From the Engineering Department of
The Gates Radio Company
A Subsidiary of the Harris-Intertype Corp.

HOW CAN WE HELP YOU?

Where problems exist, we want to help. — The best way is to work out the problems together. In that way, you are completely familiar with what is done and future maintenance will be routine.

1. You will note the SERVICE QUESTIONNAIRE. Fill this out completely and mail back today, if possible. Use an extra sheet of paper if further comments are necessary. The following are statements of fact or things to look for. Always remember that most problems have a simple solution. If some of the statements below are elementary, it is because busy, intelligent people often assume that the simple, elementary things are okay.

2. LOW OR HIGH EFFICIENCY. This is important as a first test. As efficiency will vary with transmitter powers, these estimates will help:

250 watts	----	65 to 75% efficiency
500 watts	----	65 to 75% efficiency
1000 watts	----	68 to 77% efficiency
5000 watts	----	72 to 80% efficiency

   (a) The above variances in limits could be for many reasons such as slight meter error, tune-up and/or variance in transmission line length.

3. COMPUTING EFFICIENCY. To compute wattage input, multiply the plate voltage by the plate current in the final radio frequency amplifier. For example, if plate volts were 2500 and plate current was 550 MA., we have:

$$\begin{array}{r} 2500 \\ .550 \\ \hline 1375.000 \end{array}$$

   This means the power input to the final P.A. stage as required to compute power is 1375 watts, which would be approximate for a 1000 watt transmitter. If, at this power input, the transmitter is delivering 1000 watts output as computed by antenna current (see Par. 4), then we find the transmitter is approximately 73% efficient, or:

$$\frac{1000}{1375} = 73\%$$

4. COMPUTING POWER OUTPUT. The formula I^2R is employed here. I = the current reading of your antenna meter at the tower and R = the resistance measurement of your tower as provided by your consultant who measured your tower after it was erected. If the tower resistance was 50 ohms (they vary widely from tower to tower), then the antenna current squared, multiplied by the tower resistance, would be the power output. Using 1000 watts as the transmitter power, we find if the antenna current was $4\frac{1}{2}$ amperes that the square of this, or 4.5 x 4.5, is 20.25 and we have this simple problem:

$$20.25 \times 50 = 1012.5 \text{ (watts)}$$

5. CORRECTING LOW EFFICIENCY. Basically a broadcast transmitter by inherent design cannot produce low efficiency unless it is tuned up incorrectly. If you have low efficiency, your first check should be into an approved dummy antenna. Light bulbs or dummy antennas of unknown resistance under power do not help. As every station should have a dummy antenna for off-hours testing, etc., this should be part of your test equipment. Several types are listed in the Gates catalog and they are not expensive. By use of the dummy antenna, we have a known resistance to compute the transmitter efficiency without using the antenna tower, antenna coupling equipment or transmission line. By using the formula in Par. 4 above, we use the resistance of the dummy antenna as R. The I^2R gives us the power out of the transmitter.

6. When using a dummy antenna and efficiency is low or below that in Par. 2, the first thing to do is check the accuracy of the plate voltmeter and P.A. milliammeter. This is the gas tank that is always full but often turns out to be the offender. Meters are delicate and the transportation company could have dropped the box in just a way to render a meter inaccurate. You must have another meter of known accuracy for both circuits. A reliable volt-ohm-meter will suffice. Be careful as the voltage is lethal. If you find either of these meters is off, you have found the trouble.

7. If all is normal, then reconnect the transmitter to the antenna. Get another R.F. ammeter (perhaps you can borrow one from a nearby station) and check the accuracy of this meter. An error of only a couple tenths on the scale makes a huge difference. Using our example in Par. 4 above, you will note we used a meter reading of 4.5 amperes as an example which gave us 1012.5 watts output. If this meter had read 4.4 amperes, the output would have been 968 watts. Thus, if the meter was off only 0.1 amperes, we lose 44 watts or nearly 5% of our 1000 watts output.

8. ARCING PROBLEMS. Power must go to the antenna. When it gets sidetracked, it has to go somewhere and this often causes arcing. As efficiency, discussed above, tells many stories, we often find that low efficiency and arcing go together. If the dummy antenna shows good efficiency and the antenna itself shows poor efficiency, it means part of the power is not getting to the antenna. This could indicate several things:

   — Improper tuning of antenna coupler.
   — Standing waves on the transmission line usually indicated by different current readings at each end of the line.
   — Improper ground return from the ground radials to the transmitter.
   — Incorrect resistance measurement of the tower.

9. TUNING ANTENNA COUPLER. Your consultant can help you by tuning up your coupler with an R.F. bridge at the same time he measures your tower. — Where this is not possible and a bridge is not available, consult the graphs in the instruction book and use the cut and try method. Result desired is the greatest antenna current without increasing the power input to the transmitter to get the increased antenna current.

10. STANDING WAVES on the transmission line are caused by improper impedance match between the output of the line and the antenna coupler. Poor match between transmitter output and input to line will reduce power transfer and cause low efficiency. Standing waves may also be caused by a poor or no ground on the outer shield of the transmission line. This line should be grounded to the ground radials at the tower end and to the transmitter at the transmitter end.

11. IMPROPER GROUND. Here is where many good installations go astray. We plow in 120 ground radials but fail to connect them well to the transmitter. Remember, this is the second conductor of our radiating circuit. Where the radials are bonded together at the tower, extend at least a 2-inch copper strap directly to the ground of the broadcast transmitter. Do not attach to one radial closest to the transmitter. Vision your transmitter the same as an ordinary light bulb circuit. The transmission line to the tower is one wire. The other is the ground strap from the radials under the tower back to the transmitter. And don't forget to ground the antenna coupler box too. In fact, you can't do enough good grounding.

12. INCORRECT RESISTANCE MEASUREMENT OF TOWER. Here is where Gates might offend a consulting engineer. It can be said that consultants seldom miss because they know the importance but it has happened. We recall one world-famous consultant that came up with a wrong one and there are lots of good reasons, such as an error in the R.F. bridge. One cause is making changes in the ground system after the measurements are made. This one has upset all of us at times. Any good consultant will recheck his measurements if everything points that way. Be sure first because these consultants are mighty accurate. — The importance of this point is understood by reading Par. 4 again. If the resistance was actually 40 ohms instead of 50 ohms, the power output would be 20% less and the efficiency would be nothing short of horrible.

13. FUSE BLOWING. This doesn't happen often but when it does, it is a big problem. Especially in remote control unattended operation. It is a little embarrassing to suggest the fuses as too small. Don't forget the fuse power is computed by a good safety factor as you may have some things on these fuses that you have forgotten about, such as a window fan or a well pump. — Also fuse rating and heat go together. A hot day and border line fuses is asking for trouble.

14. More important is the deeper causes of fuse blowing. Here are a few points:

— In extremely cold weather if you blow a fuse at morning turn-on, it is a safe bet the temperature of the room has gone very low and the mercury in your rectifiers has collected, causing an arc-back. You can correct this by placing a light bulb or small heating element next to the rectifiers which turns on when the transmitter is turned off.

— Dirt or scum is the evil of all transmitters. Enough will cause arc-overs that will blow fuses.

— Look for cable abrasions.

15. It is also important to note that if you have had a fuse blowing ordeal, that after locating the cause, the fuse clips may be so badly charred that you will continue to blow fuses until the clips are replaced. Fuses will often blow while circuit breakers either in the transmitter or in the wall will not act. Fuses are faster but if you have proper size fuses the circuit breaker ahead of them will usually operate first.

16. UNEXPLAINED OUTAGES. This is the one that puzzles all technicians and often the best of them. A transmitter that goes off the air for no reason and can be turned back on by pushing the start button always brings the question, "What caused that?" — Of course, if this happens infrequently we can say it is normal as power line dips, a jump across the arc gap at the tower base, or other normal things will cause this and it should remove the transmitter momentarily to protect it. Some circuits include an automatic carrier reset while other transmitters require the operator, either remote or in attendance, to push the start button. In either case, frequent outages demand the cause to be located.

17. Your transmitter always looks like the offender. It is the device with meters and it is the device that quits if there is a failure anywhere in the entire system. An open or short circuit in a transmission line does not hoist a flag at the point of trouble in the transmission line. It does react at the transmitter. A faulty insulator in an antenna guy wire or a bad connection in the antenna tuning unit only shows at the transmitter. — In fact, as you can see, the transmitter always shows as the offender. Often it is not, in fact more often it is not. — If the drive shaft between your car motor and the rear wheels fails, it does not mean the motor is defective.

18. Earlier we mentioned the need of a dummy antenna at every radio station. Here again we see how valuable it becomes because you can disconnect everything after the transmitter and use the dummy antenna. By quick process of elimination of the tower, coupler, transmission line, tower chokes and ground system, you are able to determine if the transmitter is the offender. By modulating the transmitter and doing regular programming for an hour or so into the dummy antenna you experience the same transmitter outages, then you can hang it on the transmitter. Conversely, if the transmitter gives no trouble into the dummy, you can conclude that the fault is not the transmitter but in what is connected to it.

19. Step by step trouble shooting is always best. Trouble shooting is never on the basis of "It might be this or that." Instead, follow through from the beginning. If the transmitter was okay on the dummy antenna, the question becomes — "Where is the trouble?" If a transmission line connects the transmitter to the antenna coupler, then move the dummy antenna to the far end of the line and repeat the tests. Always remember that tests should be made, in part, under full modulation because often an open or an arc will occur under conditions of the greatest voltage and/or current. If, in this condition, an irregularity is noted, you have found the point of trouble in the transmission line. If not, reconnect the antenna coupler and the next job is to visually observe the antenna coupler under operation. In so doing, you may actually note a small arc or corona during a modulation peak. This could be caused by dirt, a bad connection, or even a component that is defective.

20. It is well to remember that one bad connection in the radiating system can cause outages. Several years ago an engineer solved weeks of investigation by stepping on a poorly brazed connection at the base of the tower. When he did so, he noted the antenna current increase nearly $\frac{1}{2}$ ampere. So don't assume. Be sure the entire chain is well connected. Carelessness around the base of the tower, where wires are brazed and at which point is the hub of the entire ground system, has caused many problems.

21. Other outage conditions not affecting the transmitter are listed for their value in checking:

— Under certain conditions, especially at higher altitudes, the guy insulators will arc across, caused by static. This will always cause an outage as it changes the antenna characteristics. This is hard to find as it is hard to see. Use of field glasses at night is the best way. If it happens, the vulnerable insulators should be shunted with a resistor. Write our Engineering Department for advice, giving full antenna detail when writing.
— At times the arc gap at the base of the tower is set too close or has accumulated dirt. This causes an arc to ground under high modulation.
— A crack in the tower base insulator is unlikely but keeping it clean is very necessary. A low resistance path at this point can cause trouble.
— Look at the tower chokes. Though they are husky, they are in a vulnerable position as to lightning.
— Shunt fed towers (no base insulator) are usually more sensitive to static bursts than series fed towers. The best method is to try and make the feed line to the tower equal the impedance of the transmission line.
— One side of the tower lighting circuit shorted to the tower itself can cause a lot of trouble, yet the lights may function perfectly.

22. OTHER OUTAGES. If the transmitter is the offender or it acts improperly on a dummy antenna, the process of elimination by starting at the first and following through is preferred unless the cause is actually known. The following hints may help both as to outages and improper operation:

(FALL OUT) The transmitter kicks out a relay at high modulation. Possibly the overload relay is set too sensitive. Look for an arc at any variable condenser. If this condition is noted, it usually indicates improper tune-up or lack of complete neutralization. Improper L/C ratio means the amount of coil to the amount of capacitor used can cause high circulating current and arcs. Use of more coil and less capacity, and in some instances just the reverse, will solve the problem.

(HARD TO MODULATE) Cause can be either improper impedance match at output of transmitter or low grid drive to the final power amplifier. Consult instruction book for recommended grid drive. Correct match of transmitter to load is covered, in part, in the instruction book. The remainder depends on local conditions. It is a very important part of good performance. Indication is a sluggish line or antenna meter, does not move up under modulation or even moves down.

(BAD REGULATION) Usually power line is too small and voltage varies at input under modulation. Often hard to find as public utility meters and graphs are slow speed. Best check is to apply sine wave to transmitter. Check line voltage at zero modulation and then at 100% modulation. If line voltage drops at 100% modulation, then call your utility company. Watch for high line voltage. If much over the stated primary voltage for the transmitter, you are headed for parts failure. Likewise, low line voltage causes poor performance. — Improper loading of the transmitter to the tower will also cause poor regulation.

23. SHORT TUBE LIFE is usually not the fault of the tubes. Instead, is caused by over-working the tubes. If efficiency is low, tubes must put out more watts to make it up and thus last longer. Answer is get the efficiency up (see Par. 2). Arc-overs anywhere, may under certain conditions, cause the big tubes, the expensive ones, to self-oscillate. Find and stop the arc-over. Short tube life is compared to using more gas if the car is running up hill all the time. Eliminate the cause for your running up hill and tube life will be long.

24. POOR QUALITY can be for so many reasons that to list them all would take many pages. It seems foolish to even suggest that a poor stylus in the transcription turntable is a cause for poor quality, but it happens. — Every station must take proof of performance measurements. This proof of performance equipment is usually owned by the radio station. In fact, it is difficult to keep a radio station at top performance without one. With this equipment, each major equipment may be checked for distortion, noise and frequency response and it is these checks that tell good or bad quality. Where studios are separate from transmitter, even the quality of the telephone line may be checked.

25. Poor quality is often guessed at as to cause and yet we all know that the finest broadcast transmitter is only as good as the microphone used, which is to say, "A broadcast system is as strong as its weakest link." We thus can agree that poor quality usually ties down to any one item in the entire system. By use of proof of performance equipment, we find out what this item is and fix it. — Though this data is not intended in any way to be sales data, some may wonder where to get "Proof of Performance Equipment". This will be found in the Gates catalog. The SA-131 complete proof of performance package sells for $498.00 and is available on time payments as we feel every station should have one regardless of budget.

26. Earlier it was stated that poor quality is possible from many places. The obvious is easiest to find, such as the poor microphone or bad turntable styli. Radio frequency leakage is often a cause for poor quality. This leakage is where a small amount of R.F. voltage gets into other equipment, such as the limiter, audio cables, and in combination installations the speech input console. — In most cases, this leakage is small enough to be quickly eliminated but also small enough to be hard to indicate by use of the usual methods such as a small neon lamp, etc. ——— R.F. leakage is usually caused by lack of grounding or grounds at varied potentials. Grounding to one common ground is best. Of course, be sure you have a ground connection. Once in awhile a

full rack of equipment will be found with the only ground coming through a shield of the audio cable. This, of course, is poor grounding and copper strap should be employed.

27. Care should always be taken not to run R.F. cables in the same conduit or cable group as audio cables. For example, running the coaxial connecting cables from transmitter to monitors in the same cable as audio lines would be very wrong. Likewise, inserting high and low level cables, even if individually shielded, in the same conduit or cable group is very wrong. A high level circuit would be any output circuit. A low level circuit would be any input circuit. Thus, a microphone or turntable pair in the same conduit or cable group as the output of the program amplifier or monitoring amplifier would be asking for trouble.

28. Poor quality is possible through overloading. All equipment is usually rated as to maximum input and output levels. For example, if an input circuit is rated at 0 Db., this means that putting more than 0 Db. into this circuit is overloading. If an output circuit is rated at +18 Db. and you are developing +24 Db., the distortion goes up. —— Careful attention to good sensible engineering practice is the answer. Short-cuts, speed in getting the equipment installed and throwing long known precautions to the wind cause many quality problems and usually demand rework.

29. THE CHIEF ENGINEER. He has the job of keeping everybody happy —— listeners, manager and stockholders. When trouble comes, he is under pressure. He will do his best to correct trouble as fast as he can. It is well to remember that electronic equipment has many circuits and many avenues of travel. Where problems are known, the solution is usually quick. Where the problem has to be found, the solution will take longer. —— It is well to remember that if equipment did not need maintenance, it would not need a Chief Engineer. The greatest service he renders is the insistence on regular preventive maintenance and his being there when problems arise.

30. PREVENTIVE MAINTENANCE. Few of us would fly in commercial airlines if we felt the planes were not carefully checked after every flight and, of course, they are. —— We even check our automobile tires before we take a trip. Our lives are lived and protected, even our homes are run on preventive maintenance. The good wife cleans to prevent moths. ———— In broadcasting equipment, preventive maintenance is mandatory. Most offages can be eliminated before they happen by checking before instead of fixing afterwards.

31. Dirt is the <u>first</u> cause of all trouble. Excessive heat is Number 2. With the advent of unattended operation, both have grown. With the transmitter in a locked building, it is cleaned much less and with the windows closed it becomes an oven in summer months. In all cases, remember:

—— The dirt-free transmitter is the trouble-free transmitter.
—— The cool transmitter is the longest lasting transmitter.

Clean once weekly and duct hot air out of closed transmitter buildings. Check tubes at least monthly. Poor tubes mean poor quality and eventual outage. Rotate the bigger tubes every month. Include spares in this rotation, both to prevent gassing and also remember the guarantee will run out. If you have a defective spare and you rotate it into the equipment, you will find the defect before the guarantee runs out.

32. Other things in preventive maintenance include oiling of motors in blowers and turntables, burnishing relay contacts as needed, cleaning attenuators, checking batteries where used, cleaning inside of all equipment. The inside is more important than the outside. Every station should have a small suction type cleaner such as used to clean an overstuffed chair. This will pick out dirt and dust from pesky trouble-making nooks and corners. If we take a leaf from the Navy book which says <u>everything</u> must at all times be sparkling clean or what is called "Shipshape" ——— we have preventive maintenance in the complete form.

33. ADEQUATE TEST EQUIPMENT. When you go out to take pictures you must have a light meter to test exposure time. This light meter has nothing to do with the camera. It is test equipment.

34. Comparatively, you can neither maintain nor correct without the tools to do the job. An investment in expensive broadcasting equipment dictates a modest investment in the necessary equipment to keep it operating at top performance. Listed below is suggested test equipment for the average radio station. Where the station is directional (uses more than one tower), an item or two more will be required, such as a field strength meter for sure. Here is the suggested list:

—— Dummy antenna.
—— Proof of performance equipment consisting of:
1. Audio oscillator.
2. Distortion meter.
3. Gain set.
4. R.F. pickup coil or rectifier.
—— Good grade volt-ohm-meter.
—— Spare antenna current meter.
—— Oscilloscope.

35. GATES ASSISTANCE TO HELP YOU. The Gates Radio Company sincerely believes that the best type of assistance it can render to the technical personnel in the radio broadcast field is in full cooperation with them in solving any problem, no matter how small. It is believed that the solution of any problem is best accomplished by getting to the seat of it through mutual working together between the station engineer and Gates technical people. As we all have a certain amount of pride, there is often some reluctance to write, asking about a problem that might seem simple. It is emphasized that often the problem that appears the simplest might be the most complex. It is only by the asking of questions that assistance can be rendered.

36. Gates engineers and technical personnel invite the correspondence of the technical people that are using Gates equipment, and for that matter, even if they are not using Gates equipment, and are willing and ready to spend any amount of time necessary to not only be of help and assistance but to make the life of the broadcast technician more pleasant -- and most important of all, to make the radio broadcasting equipment always a pleasant experience by continued satisfactory performance.

GATES RADIO COMPANY - - QUINCY, ILLINOIS, U. S. A.

RP

REPLACING COMPONENTS ON THE PRINTED CHASSIS

Since this is a destructive operation, the engineer must be reasonably sure that the part is defective before removing it. He may determine this from the D.C. and signal voltage measurements or by visual observation.

WARNING: The copper conductors are only .0027" thick on the printed chassis. They are easily damaged! Do not attempt to pull one component lead loose to check the component. Use only the approved procedure as outlined in the sketches and the sub-paragraphs listed below.

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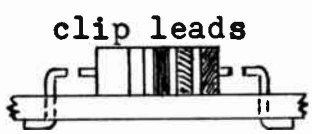
> CAUTION: Do not use a soldering gun. The extremely high temperature of the tip will damage the phenolic board.

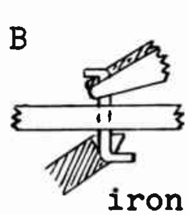
Put the iron tip on the fillet under the chassis, right beside the component lead being removed. Put a gentle, but firm pressure on all leads and components being moved while the heat is applied. Do not hold the iron to the printed chassis for long periods of time. If the lead or component is difficult to remove, make repeated short passes at it rather than one long period that may overheat the board.

1. REMOVING PARALLEL MOUNTED COMPONENTS WITH AXIAL LEADS:

A



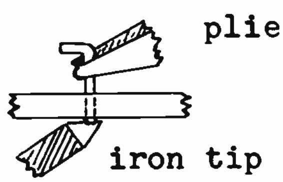
B



push wire through hole until hook can be clipped off.

clip off hook that was soldered to chassis.

C

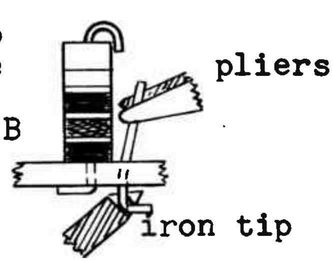


place iron on fillet again and pull the wire out of the hole on the top side of the chassis.

2. REMOVING VERTICALLY MOUNTED RESISTORS AND COMPONENTS WITH AXIAL LEADS:

A

B

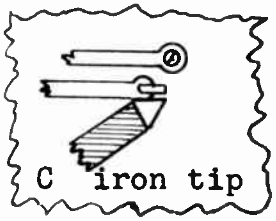


place iron on fillet and push wire through the hole until the hook can be clipped off.

clip off hook that was soldered to chassis.

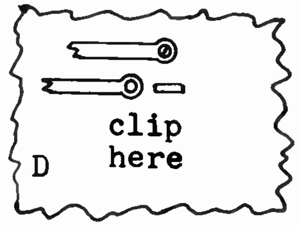
remove wire as illustrated in paragraph 1. (c).

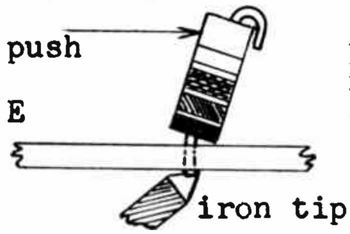
2. (continued)



place the iron against the folded wire and rotate it away from the conductor leading into the fillet (2-c).

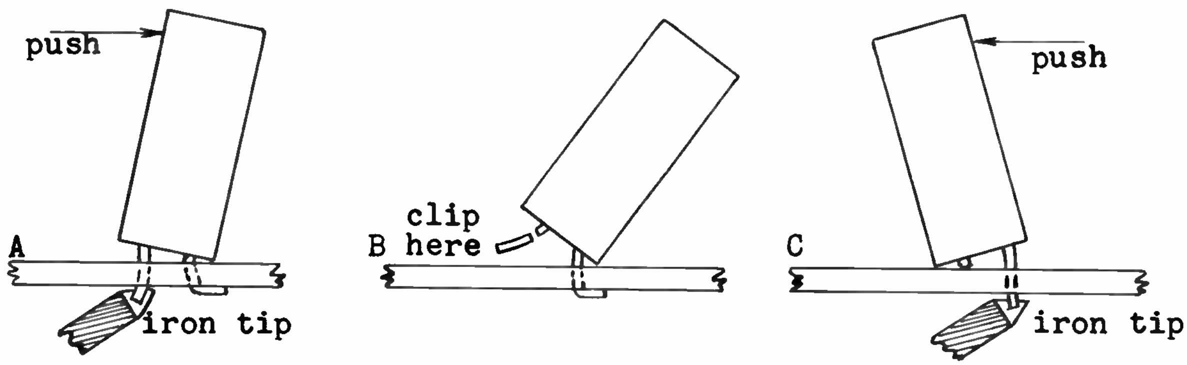
cut the wire as near the chassis as possible after removing as much excess solder as possible. Remove solder by carrying it away with the iron tip and wiping the tip on a clean cloth. Repeat until the hook can be clipped with small sharp diagonal cutters, illustrated in (2-D).





place iron on fillet again and push the resistor body over until the lead comes out of the hole.

3. REMOVING PRINTED WIRING TYPE CAPACITORS:

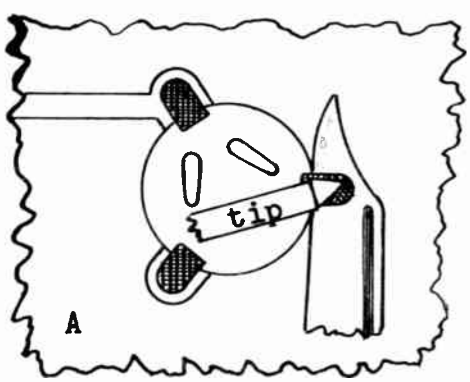


(A) hold iron tip on one of the folded leads, as soon as the solder melts - push gently but firmly on the side that will lift this lead. The capacitor should be pushed over just far enough to clear the lead from the hole.

(B) cut the lead off to prevent it from going back into the hole when removing the other lead.

(C) hold the iron tip to the other lead and push the capacitor over until it comes free.

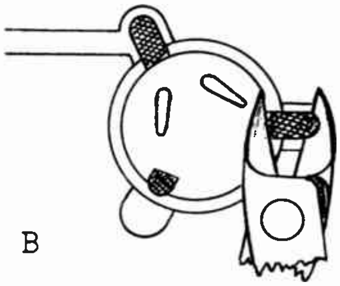
4. REMOVING SADDLE TYPE ELECTROLYTIC CAPACITORS:



Place the iron tip on top of the folded over mounting ear. As the solder melts, slip a thin knife between the mounting ear and the copper conductor pad. DO NOT PRY THE TAB UP WITH THE KNIFE! See (4-B) for bending ears away from chassis. When the knife is completely under the ear, remove iron and let the solder cool.

Repeat on other two mounting ears.

4. (continued)

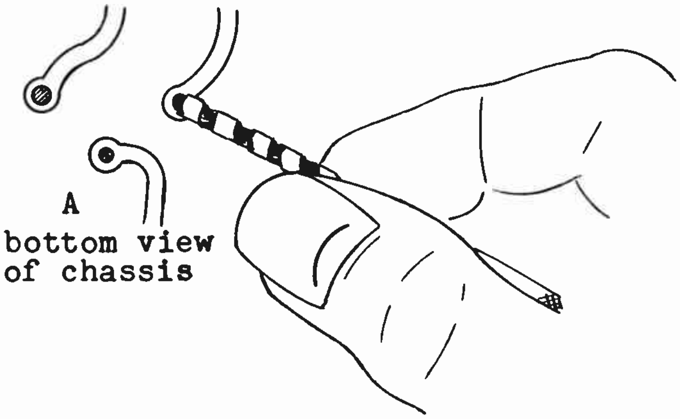


B

Using a pair of small sharp diagonal cutters, bend the mounting ears up and away from the copper conductor pads. DO NOT PRY THE MOUNTING EARS UP WITH A KNIFE OR SCREWDRIVER!

Repeat the process on the other two mounting ears and drop the capacitor off the board.

5. PREPARING THE HOLES FOR THE REPLACEMENT COMPONENT:

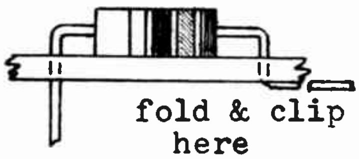


Use a small metal twist drill (1/8" dia. or less) to clear the <u>hole only</u> in the fillet of solder. Twirl the drill by hand. Do not attempt to remove all of the solder in one turn, do it slowly and carefully.

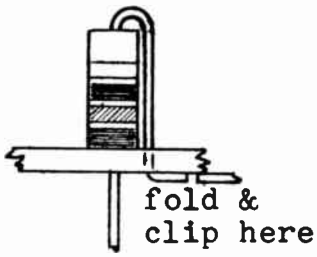
Do not attempt to increase the hole size, just remove the solder. It is soft and easily removed in this way.

6. REPLACING THE COMPONENTS:

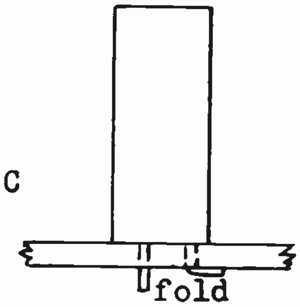
A



B



C



(A) & (B) Fold the leads on the new part to the same spacing as the mounting holes. Insert the part and fold the leads under the chassis to hold the part tightly against the top of the chassis. Clip off the excess wire.

Put the iron tip on the fillet and lead. Solder swiftly and securely. If the printed chassis is damaged by accident it is seldom necessary to scrap it. If one of the conductors is broken, lay a piece of small wire (#18 to #24 AWG) across the break and solder each end to the conductor. If a fillet is pulled loose, break it off to get rid of the loose end. Fold the new component lead toward the end of the conductor and solder the lead to the conductor. If the component lead is cut too short, lay a small piece of wire across the gap solder it in.

7. REPLACING TUBE SOCKETS:

Tube sockets are very difficult to replace and should not be replaced until you are positive that the one in question is actually defective. Resolder all of the socket pin fillets to assure that this is not the trouble. Inspect the top side to see if the tube pin sleeve is bent and can be straightened. Use a socket alignment tool to re-size. Check continuity from the top to the bottom side of the chassis. If there is a connection and the socket sleeve is not out of alignment or spread open, the socket is O.K. and should not be removed.

(A) If the socket has been damaged or is excessively corroded it must be replaced. Stand the unit so that the chassis is vertical. Hold a small iron to the hex nut in the center of the socket (if the socket is retained in this manner). After the solder has melted, unscrew the retaining screw.

(B) Remove the excess solder from all pin fillets by carrying it away with the tip of the iron. Repeat until all solder that will come loose is removed. Do not hold the iron to the chassis for long periods of time.

(C) Starting at pin 1 or pin 7 (8 or 9 on other sockets), apply the iron and push against the socket to raise it at this point. Use the thumb and fingers only to raise socket to prevent damage to the board. The socket will not move very much but any movement at all is helping. Place the iron on each pin in rotation around the socket while pushing up on the side of the socket adjacent to the pin being heated. After several passes around the socket it will no longer be held in by solder. Gently rock the socket and pull it free of the holes.

(D) Use a small metal twist drill as illustrated in paragraph 5 of these instructions to clear the fillet holes of solder.

(E) Install the new socket and put in a new retaining screw similar to the one removed (if retaining screws are used). Do not tighten the nut excessively and put a great strain on the phenolic board.

(F) Solder the screw, nut and each socket pin fillet swiftly and securely. Be sure that there is no solder bridging between adjacent fillets or conductors.

(G) If one of the fillets was damaged in the replacement operation, form a small loop on the end of a small piece of wire. Drop the loop over the socket pin and lay the wire to join the proper conductor. Flow solder on the connections and clip off the excess wire.

From the Engineering Department of
The Gates Radio Company
A Subsidiary of the Harris-Intertype Corp.

(15) Your transmitter

Plate voltage at: no modulation ________ 90% modulation ________

P.A. Plate current at: no modulation ________ 90% modulation ________

P.A. Grid current at: no modulation ________ 90% modulation ________

Line or antenna current at: no modulation ________ 90% modulation ________

A.C. line volts at: no modulation ________ 90% modulation ________

NOTE: For 90% modulation measurements use a constant tone and not program.

(16) In your opinion, how does transmitter sound? ________

(17) If answer to 16 is "poor" state following:

Date proof of performance made ________

By whom ________

—Response curve of transmitter: 50 cycles ________ 400 cycles ________

1000 cycles ________ 2500 cycles ________ 5000 cycles ________

7500 cycles ________ 10,000 cycles ________

—Distortion: 50 cycles ________ 100 cycles ________

1000 cycles ________ 5000 cycles ________

—Noise: Db. reduction below 100% modulation ________

(18) Have you experienced part failures? ________

If so, state what: ________

(19) Have you experienced severe electrical storms recently? ________ (Important as it helps in many instances to find trouble).

(20) Give your opinion as to the cause or fault of your problem. Use another sheet of paper, if need be. ________

(21) Have you experienced any arcing? If so, state where: ________

(22) State make of power tubes used (the larger, more expensive tubes): ________

(23) Where station has been on the air long enough, state tube life as follows:

P.A. tube No. 1 ________ hours

P.A. tube No. 2 ________ (if used) hours

Mod. tube No. 1 ________ hours

Mod. tube No. 2 ________ hours

Main rectifiers ________ hours

SPEECH INPUT EQUIPMENT:

(24) Make of speech equipment ________ Model ________

When purchased ________

(25) Make of transcription turntables ________

Model ________ When purchased ________

(26) State make of pickup as follows:

Arm ________

Head ________

Filter or equalizer ________

Preamplifier ________

Styli: ☐ diamond ☐ sapphire

(27) State your opinion of fault or cause of speech equipment problem. Use another sheet of paper, if need be. ________

(28) Make of limiter ________ Model ________

When purchased ________

(29) Do you use a constant level amplifier such as a Gates Sta-Level or GE Uni-Level? ________

(30) Are studios separate from transmitter? ________

(31) If answer to 30 is Yes, have you run a response curve on the connecting telephone line? ________

How is it? ________

(32) DO YOU OPERATE BY REMOTE CONTROL? ________ INDICATE PART TIME ________ FULL TIME ________

(33) Type of Remote Control System, DC ________, Tone Operated ________ Other ________ Make ________

(34) Do you consider your Remote Control System completely reliable? ________

(35) If you operate with Remote Control full time, what provisions do you have to assure correct operating temperature of transmitter? ________

(36) Is transmitter building heated in winter? ________

(37) Please make rough sketch on another sheet of the Transmitter Building Ventilating System.

THE OVERALL SYSTEM

When all of the equipment from microphone to tower is tied together in a system, the following information will help:

(38) Do you notice the performance is satisfactory until you add a specific piece of equipment?__________

What is it?__________

What happens when you add it?__________

____

____

____

(39) Please list "Test Equipment" available to Station. Low distortion audio oscillator ☐, distortion meter ☐, scope ☐, volt ohm meter ☐, R F Bridge ☐, other ☐, __________

(40) State anything peculiar to you that may seem either simple or complex that might be worthy to note in analysis. Such things as outages at certain times of the day, or transmitter works well all day but won't turn on immediately in morning, or . . . anything at all that seems odd to you and yet you can't put your finger on it.__________

____

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SUMMARY

In filling out this Questionnaire, do not feel in any way that a problem is too simple to merit comment. It is well to remember that most serious problems have a very simple cause. Gates well understands that often those closest to the problem will often overlook something that becomes easier to solve when a second person such as a Gates engineer is able to look at it, through this Questionnaire, and without the pressure often existing at the scene of action.

GATES RADIO COMPANY — — QUINCY, ILLINOIS, U. S. A.

Subsidiary of Harris-Intertype Corporation

SERVICE QUESTIONNAIRE

If you have a transmitter problem, your filling out answers to the following questions will permit our various engineers to carefully analyze and in many cases solve the problem without expense. Please fill out completely and mail to: Customer Service Section, Gates Radio Company, Quincy, Illinois.

(1) Radio Station__________City__________

(2) Street Address__________ Office Phone__________ Xmitter Phone__________

(3) Chief Engineer__________ Home Address__________

(4) Number of years with Station__________

(5) Make of transmitter__________ Model__________

(6) Date placed in service__________

(7) Is transmitter located in the same building or immediately adjacent to a FM Transmitter_____, TV Transmitter_____, Other__________?

(8) Height of tower__________Tower resistance__________

Date resistance measured__________

Reactance (indicate plus or minus)__________

(9) Method of coupling transmitter to tower (please check):

☐ transmission line ☐ direct coupled

☐ series feed (insulated tower) ☐ shunt feed (no base insulator)

☐ If transmission line employed, please state following:

__________ Type__________ Impedance__________

Length__________

(10) No. of ground radials__________Length__________

Do you use ground screen?__________Size__________

(11) State method of connecting ground system to main ground of transmitter__________

____

____

(12) If antenna coupler used, please state following:

Make__________ Age__________

State antenna current (meter connecting to tower)__________Amps.

State line current at transmitter__________ at coupler__________

(13) If transmitter feeds directional antenna system, please state whether all monitor points checked or measured daily_____, weekly_____, other__________.

(14) Number of towers_____. When installed?__________.

GATES