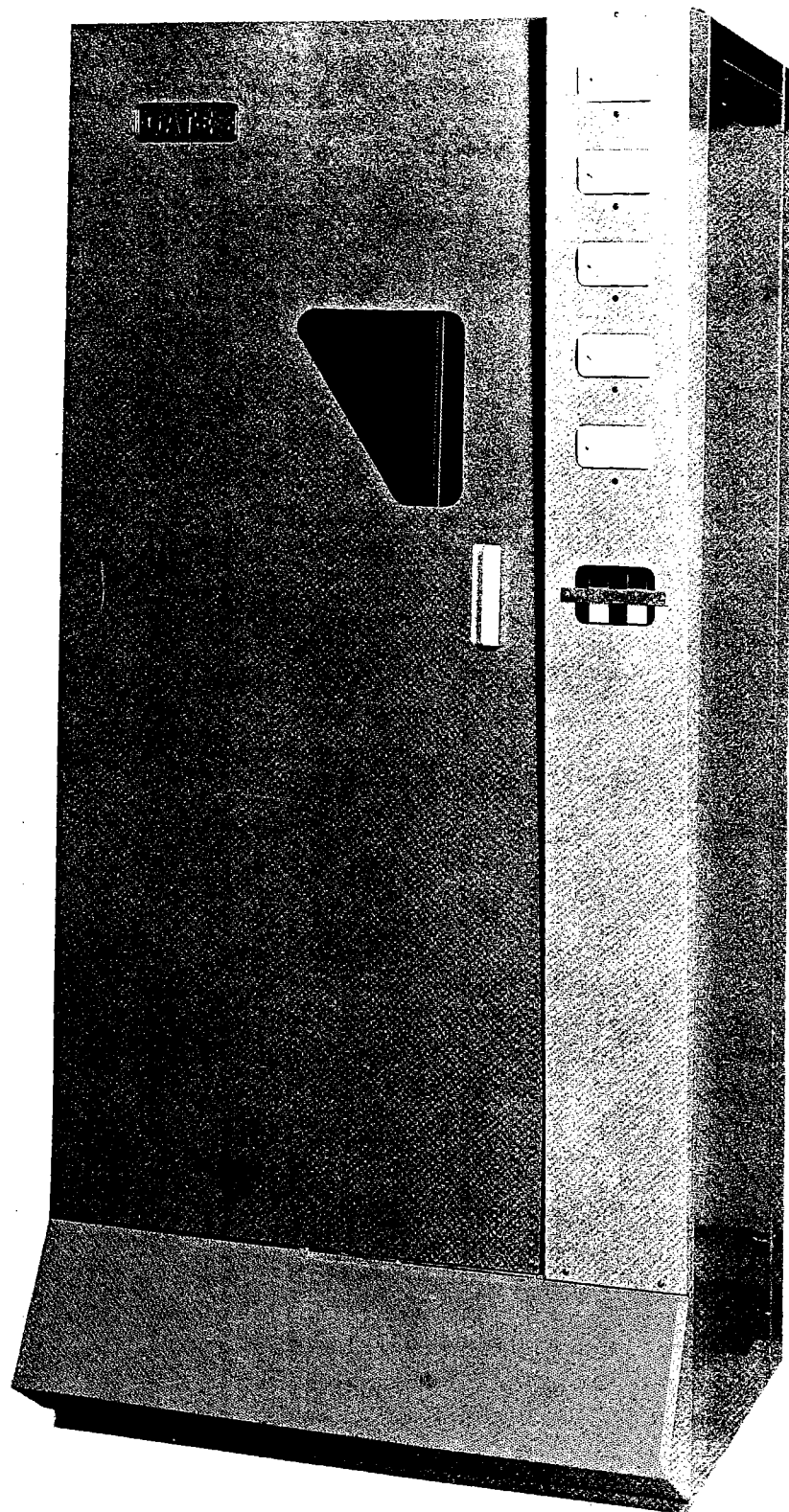


INSTRUCTIONS FOR INSTALLING AND OPERATING
THE GATES MODEL M-5790 BC-1T
1000/250W. BROADCAST TRANSMITTER
IB-888 0001 001

GATES RADIO COMPANY
QUINCY, ILLINOIS



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

INDEX

	<u>Page</u>
AIR FILTERS	18
ANTENNA COUPLING	16
AUDIO INPUT	7
CRYSTALS AND ADJUSTMENT	5, 17
DUMMY ANTENNA	9
FEEDBACK	8
FILAMENT RHEOSTAT	16
FLOOR WEIGHTS	3
FREQUENCY MONITOR	6
GROUND SYSTEM	4
INSTALLATION HINTS	3
INTERMEDIATE POWER AMPLIFIER	9
METERS	18
MODULATION MONITOR	7
MODULATOR BIAS, ADJUSTING	7, 16
NEUTRALIZING	6, 12, 13
PARTS LIST	1 thru 6
PLATE RHEOSTAT	16
POWER AMPLIFIER AND TUNING	6, 14
POWER SUPPLIES:	
HIGH VOLTAGE	9
INTERMEDIATE	9
MODULATOR BIAS	8
PRIMARY LINE	4

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

INDEX

PROTECTION:

MODULATOR	8
POWER AMPLIFIER	7
RELAYS	8, 18
READYING CHECK LIST	9
REMOTE CONTROL	9, 20,21
SPECIFICATIONS, TYPICAL	2
SUCTION FANS	2, 18
TEST EQUIPMENT	18
TRANSMITTER BASE	3
TUBES	3
TUNE-UP PROCEDURE	11,12,14, 15
VOLTAGES AND CURRENTS	14,16,22

M5790 BC-1T, 1000/250W.

GATES RADIO COMPANY
QUINCY, ILLINOIS

ADDENDA SHEET

For BC 1T
& BC 500T

Reference 833A Tube Handling

The Gates BC 1T and its companion transmitter the BC 500T, use 833A power tubes in the modulator and power amplifier stages.

These are of the single wire or thread filament type, as compared to other tubes that may have the filament (heater) contained in a tube, which is commonly called the cathode assembly. Tubes having filaments supported by springs (such as the 833A) require more than normal care in handling. These filament wires are easily broken by sudden heavy vibration. At all times handle the tubes with care, until they are safely inserted in the tube sockets of the transmitter.

At this point, more care is required as the two filament prongs are also the means for securing the tubes in the transmitter. Make sure the connections have some "give" so that no undue strain is placed on the glass to metal seal. As these tubes do expand a bit during operation, the two securing filament connectors must be able to move a bit themselves.

Take care when making the grid and plate connections, do not put any undue strain on these connections also, during tube installation. Of course the connections of the grid and plate should be flexible to allow for expansion of the tube. For shipping or storing it is advisable to use the packing material and carton that the tube was shipped in from the tube manufacturer.

Following these reasonable precautions, there should be no trouble in handling these tubes.

2/17/61

INSTRUCTIONS FOR INSTALLING AND OPERATING
THE GATES MODEL M-5790 BC-1T
1000/250W. BROADCAST TRANSMITTER

In the preparation of this instruction book, we have endeavored to be concise, yet thorough. In several places, symbol numbers are referred to, such as, R1 or S1, etc. These symbol numbers will be found: (a) on picture illustrations in this book, (b) on the wiring diagrams in this book, (c) adjacent to, or on the part itself in the equipment, and (d) on the Parts List. Symbol numbers follow industry standard procedure and have a meaning. "R" means a resistor or rheostat, "C" is always a capacitor, "V" a vacuum tube, "S" a switch, "K" is always a relay, "L" is an inductor, either air or iron core, etc. As you read this book and it might say, "Adjust L12 to resonance", find L12 in the pictures, which in this instance are pictures DL-114 and DL-137, and you quickly understand what to adjust and also gain familiarity at the same time. --- You will find this equipment a pleasure to install and not nearly as difficult as the length of the instruction book might indicate. Instruction books are reference manuals for both installation and future servicing.

IMPORTANT ... If this transmitter is to be unattended, i.e., operated by remote control, care should be taken that winter temperatures inside the transmitter building do not go below 50° Fahrenheit. Mercury vapor rectifier tubes will arc back at low temperatures, often causing serious damage to other expensive components. Protective relays and blower motors may also become sluggish under extreme cold conditions. Failure to provide adequate winter minimum building temperatures will void the guarantee.

3/9/61

-1-

Gates Radio Company
Quincy, Illinois

SPECIFICATIONS

THE FOLLOWING SPECIFICATIONS ARE TYPICAL AND MAY VARY SLIGHTLY WITH VARIOUS MODES OF OPERATION:

1. Rated power output: 1000/250 watts. Capable of 1100/275 watts where directional systems induce losses.
2. Frequency range: 1600 Kc to 540 Kc at the frequency you ordered.
3. Power input: 230 volts, 3 wire, solid neutral, single phase, either 50 or 60 cycles. Provide #4 or larger primary wiring from entrance box to transmitter. Transmitter will consume approximately 4000 watts at 100% modulation.
4. Frequency stability: ± 10 cycles.
5. Audio input: + 12 db \pm 2 db for 100% modulation for both output powers. The output of a Gates SA-39B limiter should be correct for this. If other limiter or audio amplifier is used, be sure and check output capabilities.
6. Input audio impedance: As supplied, 600 ohms, which will also match 500 ohm impedance. It may be connected for 150/250 ohms if desired.
7. Distortion: Rated at 3% from 50 to 10,000 cycles but capable of much better at many frequencies.
8. Noise: 60 db or better below 100% modulation.
9. Carrier shift: 3% or less between 0 and full modulation provided wire size in Point 3 (above) is followed and R.F. load is correctly tuned.
10. R.F. output impedance: Will match loads from 50 to 70 ohms. An antenna coupling unit is usually necessary to match the antenna tower.

OTHER HELPFUL DATA:

- (a) Provision for 2 vacuum type crystals and holders. If you wish a spare, order M5602, giving your frequency.
- (b) The inbuilt dummy antenna will accept 100% modulation and is for 51.5 ohms. See Par. 4 under "How Can We Help You?" in the back of this manual, entitled "Computing Power Output". The dummy antenna is substituted for the tower.
- (c) THE TWO TOP SUCTION FANS can do their best in cooling performance by periodical replacement of the removable air filters located at the front bottom of the transmitter. Order Type M5825 and two are required. The time cycle in replacing filters depends on dust conditions. Normally about three times annually.

3/9/61

-2-

M-5790 BC-1T
1000/250W.

- (d) The floor weight is 800 lbs., or slightly less than 100 lbs. per square foot. Allow 28" for the front door swing. Size: 78" high, 36-1/16" wide and 31-7/8" front to back.
- (e) TUBES: Your 100% tube complement (TK287 if you wish to reorder) is:
- (2) 12BY7A for oscillator and first intermediate amplifier.
 - (6) 6BG6G, of which two are parallel operated as the second intermediate R.F. amplifier, two are push-pull audio input amplifiers and two are cathode follower audio driver amplifiers.
 - (4) 833A tubes, of which two are R.F. power amplifiers in parallel and two are Class B modulators.
 - (2) 8008 main power supply rectifiers.
 - (2) 866A intermediate power supply rectifiers.
 - (1) 5R4GY bias supply rectifier.

If you wish FCC spare tubes, which is the minimum list of spares acceptable to FCC (TK288 if you wish to reorder), these are:

- | | | | |
|-----|--------|-----|-------|
| (1) | 12BY7A | (1) | 8008 |
| (3) | 6BG6G | (1) | 866A |
| (2) | 833A | (1) | 5R4GY |

INSTALLATION HINTS

Most of us do not like to read instruction books. We have tried to be as concise as possible. If you are busy, take this book home and read at your leisure. We believe it will help. Here are a few suggestions:

1. CHECK YOUR PACKING LIST CAREFULLY ... Put as many of the yet to be used components as possible out of harm's way. A tube or crystal has been stepped on, even lost.
2. HAVE THE PREMISES TIDY before going to work. Nothing quite so bad as stirring up a lot of dust with a vigorous broom, to let it settle on components or be sucked into the new air filters.
3. A BASE FOR THE TRANSMITTER ... Look at Drawing A30585 in the back of this book. This base can be quickly made of 2" x 4" lumber. Paint it black. It becomes both a mop base and an easy way to get the wiring in and out of the bottom of the transmitter. Lag this base to the floor. Be sure the top is level. With transmitter on this base, you can mop without fear of water rusting the bottom of the transmitter, and your wiring installation will be easier. It will look snappy too.

4. THE PRIMARY LINE is important. Your transmitter operates on 230 volts and service should be for 4000 watts at least. But don't forget that the utility company will probably provide the same entrance cables for tower lights and all your other equipment even if for 115 volts. Talk this over with your utility company and be sure service is ample --- to be sure, more than ample. We suggest #4 wire from your entrance box to the transmitter. The utility company may prefer larger.
5. A THOROUGH INSTALLATION ... Don't rush. We know new equipment is tempting but a day or two longer in installation will pay big dividends later. Dress wiring nicely. Use plastic tape over any entrance wire that might look like it could chafe against something else.
6. THE GROUND SYSTEM ... Don't overlook the most important thing of all --- a 2" copper strap from your transmitter to where the ground radials join together under your tower. --- It has been overlooked.
7. HOW CAN WE HELP YOU? Read Par. 27 under "How Can We Help You?" in the back of this book. It may save you some re-routing of wires in case you might have forgotten.

GETTING READY ... For shipment all tubes and vacuum enclosed relays are removed, relay contacts blocked and tied, and other parts tied down to prevent damage during shipment. Power amplifier R.F. choke L9 also has been removed. The connector straps have been adequately tagged for easy, correct re-connection.

All packing material, string, tape, etc., should be removed. The front door of the transmitter has been mechanically supported to the cabinet for shipping safety. Remove this support.

All relays inspected for free travel of armatures and contacts. Heavy components such as, the power and modulation transformers, and filter reactors are not removed for shipment but mounting bolts should be re-checked for tightness. Tubes, crystals and the vacuum time delay relays are removed for shipment.

Go over the transmitter. After riding a long distance a bolt could come loose. Put a screwdriver or wrench to all available nuts and bolts. It may take an hour and again save many headaches later. While doing this, look over wiring connections as you go. Look at terminal strips, or in essence --- do the same thing your automobile dealer does when he receives a new car from the factory, go over it from stem to stern.

8. KNOW YOUR TRANSMITTER ... After assembly, let's take a little time to become familiar with it. The following may help as you observe it:
- (a) Most of the low power radio and audio frequency components mount vertically on an aluminum panel and shelf assembly, to the right as you open the front door. This is reached from the inside. You may remove the right side of the cabinet to expose the wiring.
 - (b) At the top of this assembly are the four 833A tubes. Thus, both R.F. and audio circuits start at the bottom and continue toward the top. Note that one of the suction fans is directly above these tubes to instantly remove the hot air.
 - (c) The cabinet ceiling holds the power amplifier tank and loading components. The aluminum chassis holding these components is well perforated for heat release. The second suction fan keeps a steady up-draft for cool operation.
 - (d) Heavy components are in the bottom of the cabinet where air is coolest.
 - (e) Air filters just below the front door may be removed and changed without turning off the transmitter. Change air filters when you can no longer see through them when holding up to a ceiling light. You can brush off heavy accumulation of dirt and dust to add to their life.
 - (f) With the perforated inner shield just behind the front door in place, you can see essentially all of the internal transmitter without turning it off. When you remove this perforated shield, you disengage the interlock switches, turning off 600 volt and 2500 volt supplies.
→ NEVER strap out interlocks. Your life is valuable and memories are short. AMEN
9. DUAL VACUUM MOUNTED CRYSTALS may be mounted in the oscillator unit near the bottom of the vertical panel mentioned in (a) preceding. Crystal change-over switch (S1) and frequency trimmers (C1 and C2) operate from the front. Oscillator tank is untuned and lightly couples to the 12BY7A first R.F. stage, also part of the oscillator chassis. Crystals are low temperature coefficient type. Very low crystal current aids stability. Frequency trimmers, C1 and C2 are touch-up frequency adjustments for each crystal, both for initial tune-up and aging. The first intermediate stage is tuned, but the crystal oscillator is not tuned.

10. FREQUENCY MONITOR is connected at the oscillator unit to terminal #27 and ground. See Drawing 852 5780 001. The Gates M4990 monitor is an excellent companion instrument to the BC-1T transmitter. Plate voltage for the oscillator unit is from the 600 volt intermediate supply through resistor R9.
11. SECOND INTERMEDIATE RF AMPLIFIER has two 6BG6G tubes in parallel. These relatively new husky tubes have 600/650 plate volts applied. Current will run 150 to 200 MA for both tubes, varying as to frequency and load. Current indicates on the multimeter when the multimeter selector switch is set at "RF Driver Cath.". Above 1050 Kc no tank padder is used. Below 1050 Kc a padder is provided, see Chart A-30604. Multimeter switch position "RF Driver Grid" will indicate grid current 0.3 to 0.5 MA, which is normal. The plate and screen voltage of this stage are modulated about 10%. This causes grid drive to the final power amplifier to increase under modulation, improving linearity and reducing distortion.
12. NEUTRALIZATION is only required in the power amplifier. Neutralization of the power amplifier is accomplished by the out of phase voltage being obtained from the 6BG6G tank coil, L8. 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 two 833A tubes in the power amplifier. The neutralizing condenser C10 can be adjusted from the front of the transmitter, by use of a screwdriver working through the small aperture in the lower right side of the upper front panel.
13. POWER AMPLIFIER consists of parallel 833A into an "L" and two "T" sections, unusually effective as to efficiency and harmonic reduction. Refer to Drawing 852 5780 001. Coils L12 and L14 are variable tuned coils for resonance and loading. Other than the neutralizing condenser, there are no variable air condensers used in the power amplifier, which adds greatly to reliability. Grid drive to this amplifier (multimeter switch position "Power Amp. Grid") should be at least 100 MA for good operation. Higher grid drive to 150 MA is acceptable but will vary as to frequency.
14. POWER AMPLIFIER TUNING ... Tank circuit is tuned by variable tank coil L12. Two Type G2 mica padder capacitors in parallel for the tank circuit vary in size as to frequency, as do loading mica capacitors C13 and C14. - Please consult Drawing A-30604 in this book for values. The correct values are supplied for your frequency. Power amplifier plate current will vary from approximately 525 MA to 600 MA at a plate voltage of around 2500/2600. This is for 1 KW power output. When the transmitter is operated at 250 watts output the P.A. plate current will drop to 260/280 MA and the plate voltage will also be reduced to 1250/1350. The tank coil is tuned by the large knob marked "P.A. Tune" and the output tuning for load is marked "Loading".

3/9/61

-6-

M-5790 BC-1T
1000/250W.

15. MODULATION MONITOR operates from pickup coil L15 (Drawing 852 5780 001) and connects to terminal strip TB1A. Semi-variable resistor R8A located adjacent to TB1A allows the modulation monitor output voltage to be varied. By this arrangement the modulation monitor input can be maintained at correct value, both for 1000W. and 250W. operation. The RF line ammeter is the last component prior to the antenna. The Gates MO-2639 or M5693 modulation monitors are excellent companion instruments.
16. POWER AMPLIFIER PROTECTION ... Overload is guarded by relay K6 located near the 833A filament transformer T9. With semi-variable shunt resistor R21, any adjustment is possible for desired overload tripping of the relay. As factory adjusted, tripping point is at 700 MA or about 20% over normal operating current of the power amplifier, when the transmitter is delivering 1000 watts output. Relay K6 actually controls master overload relay K3, which when open, disconnects the main power transformer.
17. AUDIO INPUT is connected to terminal strip TB1, terminals 29 and 30, and is wired for 500/600 ohms. If 150/250 ohms is desired, change input transformer connections on transformer T6 (Drawing C-77711) by breaking the jumper between 3 and 4 and connecting 1 to 3 and 4 to 6. In testing, distortion can often be improved by adjustment of variable control R3 located on the audio printed wiring formica board. As no improvement would be noticeable to the ear, if test equipment is not available, set R3 at mid-point. Cathode current for the push-pull 6BG6G first audio tubes is indicated from 5 to 10 MA on multimeter switch position "Input Audio Cathode". No meter readings are taken on the second audio stage as their operation controls the bias to the modulators and the proper operation of the modulators indicates proper operation of this stage.
18. MODULATOR BIAS is adjusted for each 833A modulator by controls R1 and R2 located on the inner front panel, and R3 and R3A (two resistors, one 5000 ohm and the second a 12,000 ohm semi-variable). These controls vary the operating constant of the cathode follower driver stage, causing a bias change on the modulators by causing a voltage change at resistors R11 and R12 in the cathode follower stage. This effects extremely smooth and accurate modulator bias. - More information regarding the adjustment of bias control will be given in a later paragraph.

Modulator static current (no signal to audio input) should read about 40 MA per tube as adjusted by the bias controls for 1000 watt operation. For 250 watt carrier, the modulator static plate current will drop to about 25 MA per tube. The bias change, of course, is automatic when power is reduced to 250 watts. Below the modulator bias controls is a 3-position switch. Left position "Modulator 1" and right position "Modulator 2" indicate individual current of each

modulator tube. Center or "Total" position indicates both tubes and this position is used for normal broadcasting. Total modulator current will indicate from 350 MA to 500 MA during heavy modulation of the 1000 watt carrier. At the 250 watt power level, this current will use to around 175 to 200 MA. Reliance on modulator currents is of negligible value and the modulation monitor is the only reliable indication regardless of modulator current.

19. MODULATOR PROTECTION operates through overload relay K7 provided with semi-variable shunt resistor R22. Factory adjustment is for 700 MA tripping even though currents substantially under this would be normal. This is so a quick modulation peak will not put the transmitter off the air. Relay K7 operates with PA overload relay K6, which controls relay K3 to de-energize plate contactor K2, turning off the high voltage.
20. FEEDBACK ... Fourteen decibels of feedback from modulator plates to first audio grids adds greatly to low distortion and noise readings when the transmitter is operating at 1000 watts out. The feedback ladder is on a printed wiring formica board directly above modulation transformer T3. Altering the constants of this feedback ladder will seriously effect performance specifications.
21. RELAYS, including fuses and time delay relays, are located at the bottom of the vertical aluminum panel and shelf assembly, except relays K6 and K7 located near the 833A filament transformer. Fuses F1 and F2 are 30 ampere cart-ridge type, this block accommodates the 230 volt primary line, along with the neutral.

Filament contactor K1 is energized by filament start switch S5 beneath the multimeter. This energizes all filament transformers, the heater for time delay relay K5, the bias power supply and the two fans located in the top of the cabinet. Allow about 30 seconds for time delay relay operation. When the time delay relay closes, this turns on the intermediate power supply and the bias power supply. The door interlock must be closed before these supplies operate. Also the high voltage time delay relay K4 is energized and will permit turning on high voltage through plate contactor K2 by pressing plate start switch below the multimeter. This connects primary voltage to the main plate transformer. With proper tune-up, the transmitter would now be operating if door interlock switch S4 is closed.

22. BIAS POWER SUPPLY is for the modulator tubes and operates in conjunction with the cathode follower driver amplifier. It develops 280 volts to oppose the 210 volts developed in the cathode follower circuit to provide about 60/70 volts to the grids of the modulator tubes when transmitter is producing 1000 watts, this voltage is automatically dropped to approximately 35 volts for 250 watt carrier.

3/9/61

-8-

M-5790 BC-1T
1000/250W.

23. INTERMEDIATE POWER SUPPLY is for all intermediate audio and RF stages for plate voltage. Voltage to the oscillator unit is dropped to 195 volts by resistor R9. Primary of plate transformer T2 is fused (F4) at 3 amperes. Filament transformer T5 (866A tubes) energizes with filament start switch but plate voltage is delayed about 30 seconds by time delay relay K2. Door interlocks must be closed.
24. HIGH VOLTAGE SUPPLY develops 2500/1250 volts direct current for all 833A tubes. All components are in the bottom of the transmitter, including plate transformer T1, rectifier filament transformer T4, swinging choke coil L1, filter capacitor C2 and the pair of 8008 rectifier tubes. Rectifier filaments energize by inserting the "Filament Start Switch". High voltage is applied by pushing the "Plate Start Switch" after allowing time for time delay relay K4 to operate. The plate voltage is changed from 1250 (low voltage) to 2500 (high voltage) by means of power change switch S1A. For low voltage the plate transformer T1 has 115 volts a.c. applied to its primary. For high power (2500 volts) 230 volts a.c. is used. Door interlocks must be closed.
25. REMOTE CONTROL ... Separate pages are included in this instruction book entitled, "Attachment of Remote Control".
26. DUMMY ANTENNA ... This inbuilt feature will be especially appreciated during the first tune-up, but as years go by it will be found indispensable. Knife blade switch S3 is in the lower position to connect the dummy antenna. A lamp on the dummy antenna chassis will flash when the transmitter is connected to the dummy antenna. This is a warning light to make sure the operator returns switch S3 to the upper position to connect to the regular antenna when finished with the dummy antenna.
27. READYING CHECK LIST ... We are nearly ready for tune-up. First, let's recheck as follows:
 - (a) Be sure all packing material is removed, such as braces, tie cords and blocks for relays, etc. This has been covered in "Getting Ready".
 - (b) DO NOT place the plate caps on either the 866A or 8008 rectifier tubes. This will be done later.
 - (c) The 230 volt, 3 wire, primary is connected to fuse block XF1. Entrance of this cable is best at the right rear bottom.
 - (d) Audio input (be sure to use shielded wire) is connected to 29 and 30 on terminal strip TBl. You will wish to ground your cable shield to terminal 28. Entrance is best at the right, front bottom.

3/9/61

-9-

M-5790 BC-1T
1000/250W.

- (e) Modulation monitor connects to terminals 1 and 2 on terminal strip TB1A. Use solid dielectric coaxial cable for this, such as RG-62U. This connection is near K1A.
- (f) Frequency monitor connects to terminals 27 and 28 on terminal strip TB1 (location in (d) above). Use solid dielectric coaxial cable, such as RG-62U. Terminal 28 is a ground connection for the cable shield.
- (g) A big ground stud will be found on the cabinet frame near the location of modulation transformer T3. Connect the 2" copper strap that goes to your ground radials, to this ground stud. This strap may enter the cabinet through the access hole in the right rear, where the 230 volt primary cable enters.
- (h) Connect the RF output to the ceramic feedthrough insulator near output loading coil L14. You may run your coaxial line either through the top entrance hole or the base of the transmitter. This is a heavy line and be sure it is well secured and, of course, the shield portion of the cable grounded to the transmitter ground.
- (i) Grounding is of major importance. Remember it is part of your radiating system but lack of complete grounding will often permit stray radio frequency current to make its way into audio equipment, hindering neutralization of the transmitter, etc. It is wise to bond all electrical conduit, metal frame work of building, water piping, etc., to the overall ground system. If the suggestions are followed, there will be less trouble over the years as the ground system ages.
- (j) Be sure the components shipped separately, such as tubes, crystals and time delay relays, are carefully inspected and then inserted in their proper location.
- (k) You will tune up on the dummy antenna, so the dummy switch will be inserted in the lower two clips. When inserted, a micro-switch (S2) will close, starting the flashing lamp, if the filaments are on.

3/9/61

-10-

M-5790 BC-1T
1000/250W.

TUNE-UP PROCEDURE - 1000 WATT CARRIER

EXTREME CAUTION ... Lethal voltages are applied to certain areas of the transmitter. DO NOT strap out door interlocks. We suggest two people present during initial tune-up so one may observe the other's actions, with the eye on safety. Using normal care and good intelligence, operation around high voltage can be completely safe. CARELESSNESS CAN MEAN DEATH.

For tune-up we will use 1400 Kc as an example. Consult frequency charts in this book for other frequencies. Tune-up at any frequency is similar. Place power change switch S1A in 1 KW position. Step by step, let's now proceed.

- Be sure all voltages are off by turning off both filament and plate start switches. Look at the 833A tubes as a safety measure to be sure they are not lighted.
- Put plate caps on 866A rectifiers.
- Push filament start switch. Tubes will light and time delay relays start in action to close about 30 seconds later.
- Set multimeter switch to "Plate Current Osc./Buf." This reads the combined plate current of the untuned oscillator and first buffer or intermediate amplifier.
- The first intermediate or buffer amplifier is tuned by a slug tuned coil (L3), Drawing M5422. This is usually factory tuned. Tuning is correct if by setting multimeter switch at "RF Driver Grid" a reading of 0.3 MA to 0.5 MA is obtained. If not, adjust L3 and capacitor C9 until a reading, as above, is obtained. Refer to tuning Chart A30604 in this book.
- Set multimeter switch to "RF Driver Cath." Tune control C7 located on front of transmitter by opening door (see front view illustration) until minimum current is obtained. This will vary between 150 MA and 200 MA, depending on frequency. In this instance for 1400 Kc, no driver tank padding capacitor is used. Be sure and consult Chart A30604 and add the padding capacitor C15, if called for on your frequency. This is located on the RF driver unit on the main vertical aluminum panel and shelf assembly.
- Set multimeter switch to "P.A. Grid". If tuning is proper to this point, the meter should indicate between 120 MA and 160 MA. This will vary as to frequency and will also drop slightly when you apply plate voltage to the power amplifier later.

- Set multimeter switch to "Input Audio". Reading should be 5 MA to 10 MA.
- Using a voltmeter, check the modulator bias supply to be sure it is functioning. Remove the right side of the cabinet. Terminal lug #11 will measure about -280 volts against ground. See "Typical Voltage Chart" in this instruction book. The 280 volts will vary slightly with line voltage and this is normal. Replace the cabinet side panel, immediately.
- Turn each modulator bias control, R1 and R2 controlled from the front (door open), entirely counter-clockwise or to "Max." position. This will provide 80 volts of bias to the modulators for minimum current while we are tuning up the radio frequency section. We will come back to this final adjustment later.
- Shut down the transmitter entirely by pressing filament stop switch S6 on the front of the transmitter. Refer to tuning chart A30604. Check the "active turns" listed for: (a) the P.A. tank coil L12, (b) for loading coil L13, and (c) for output coil L14. For your frequency, adjust each coil, either variable or fixed, to what is indicated on the chart. Again, these turns will vary slightly under local installation conditions. In our 1400 Kc tune-up example, we have:

15.7 active turns for P.A. tank coil L12.
 10 active turns for loading coil L13.
 7 active turns for output coil L14.

- Again by consulting Drawing A30604 we find the proper size capacitor for your frequency. Using 1400 Kc as our example, we find:

P.A. tank padder capacitor C11 and C12 -- 2 Type G2 .00025 mfd.
 Input loading capacitor C13 -- .003 mfd.
 Output loading capacitor C14 -- .003 mfd.

NEUTRALIZING ... Attention to this procedure is very important as complete neutralization is mandatory for good performance. Neutralizing means eliminating any RF voltage from the tank circuit of the power amplifier with all RF stages operating except the power amplifier stage. BE POSITIVE the high voltage IS OFF. As yet you should not have the plate caps on the 8008 rectifiers. Keep them off. To be sure, press the high voltage plate start switch to OFF position.

3/9/61

-12-

M-5790 BC-1T
 1000/250W Xmtr.

A grid dip meter, a wave meter with some sort of indicator or a flashlight 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. Keep the dummy 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, plates fully meshed. 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 "P.A. Tune") when resonance is reached, the grid current as indicated on the multimeter will dip noticeably (if not neutralized).
5. Change the neutralizing condenser setting by a small amount (gradually decreasing capacity), then re-resonate the power amplifier (Point 4 above), noting the dip in the grid current. As the correct neutralizing is reached, the grid current dip will become less and less until complete neutralization is effected. This will be indicated by no deflection of the power amplifier grid current meter when resonance is obtained. Under these conditions the amplifier should be neutralized.

In case complete neutralization cannot be obtained, several taps on driver tank coil L8 are provided to aid this. Using the exact center tap, move the grid lead over one tap and repeat the entire neutralization procedure as above. The correct tap will always be found for entire neutralization. --- In many instances your transmitter is tuned at the factory to your frequency. In this case, you will find neutralization is largely a touch-up procedure.

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 RF 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.

3/9/61

-13-

M-5790 BC-1T
1000/250W Xmtr.

Place this coil and lamp RF indicator in close inductive relation with L12.

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 flashlamp 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.

TUNING THE POWER AMPLIFIER

We are ready, after neutralizing is complete and satisfactory, to tune the power amplifier. This is the big amplifier that puts out the power, so we go about it carefully and methodically. Your overload relays should protect the equipment if you do anything wrong, but here we are dealing with power, so watch the power amplifier plate current meter and if readings get too high (above 700 MA), check your overload relays to see why they are not operating. (See Power Amplifier Protection on a preceding page).

- The 833A tubes may have a cherry red glow in the center of their plates. This is normal but a deep red, spread all over the plate of the tube usually indicates excessive current and will be indicated on the plate current meter.
- Turn off all primary voltage by pressing the "Filament Start" switch. We have earlier set all tank and loading coils to the proper "active turns" and capacitors in accordance with your frequency.
- Remove the front screen. Again, be sure all voltage is OFF. Press the filament stop switch again to be sure. Place only one plate cap on an 8008 tube. Leave the other one off. This will provide partial plate voltage that will vary with load but as a guide, approximately 900 volts when 200 MA is drawn by the power amplifier. Now replace the perforated screen.

- Turn on transmitter by pressing the filament start switch. Leave time for the time delay relays to operate. Check to be sure you have in excess of 100 MA grid current to the power amplifier. We are ready for our first try of the power amplifier. Press the "Plate Start" switch.
- Immediately adjust the "Power Amplifier Tune" control for lowest plate current reading on the "P.A. Plate" meter. Keeping this control in one hand, adjust the "P.A. Loading" control. If current goes up, re-adjust "Power Amplifier Tune" for lowest current. When you reach about 200 MA at 900 plate volts, you are near normal, 175 MA at around 950 or 1000 volts is near normal, but much above 200 MA would indicate improper tuning or loading. When tuned, you will be indicating a small amount of RF current in the "Line Current" meter.
- If above is normal, you are ready for total high voltage. Shut down the transmitter by pressing the "Filament Switch" to off. Remove the front door perforated screen, and observe that tubes are off -- just to be sure. Now attach the plate cap to the other 8008 rectifier. Replace the perforated door screen. Make sure it is locked in place to engage interlock switches S3 and S4. --- You are ready to try full power. Press the "Filament Start" switch and wait for the time delay relays to operate.
- Are you brave?? Push the "Plate Start" switch. If you are living right, the power amplifier plate current will rise to between 500 and 600 MA and you will have between 2500 and 2550 plate volts. Your "Line Current" meter will read around 4 amperes. Rotate your "Power Amplifier Tune" control slightly to see if you can raise the line current. Even one-tenth of an ampere is important. Re-adjust your "P.A. Loading" control, watching your line current. --- You have arrived if you approximate these readings.

- ... plate current, 500 to 550 MA.
- ... plate voltage, 2500 to 2550 volts
- ... line current (into 50 ohm dummy), 4.45 amperes

- With inductive tuning, maximum power output does not always occur at minimum power amplifier plate current. Usually one side of tank resonance provides greater output than the other side. Resonance is always lowest plate current achieved by adjusting "Power Amplifier Tune". Check your suction fans for operation. The modulator tubes are probably reading little or no current on the modulator plate meter. --- The efficiency of the power amplifier should be around 70%. Read Par. 3 of "How Can We Help You?" in the back of this book on computing efficiency.

3/9/61

-15-

M5790 BC-1T
1000/250W. Xmtr.

ADJUSTING THE MODULATORS ... Earlier we have moved the modulator bias controls entirely counter-clockwise, or to "Max." position. This gave us maximum bias. Now we want to adjust properly. What we want is 80 MA for both tubes, or 40 MA for each tube. This is easy. Be sure no audio signal is being sent to the transmitter. If your limiter is already connected, close both controls on the limiter. --- Now place the modulator selector switch located just below the modulator bias controls to position "Mod. 1" and adjust the left modulator bias control until the modulator plate meter reads 40 MA. Now place this switch to "Mod. 2" position and adjust the right bias control to 40 MA. By moving this switch to "Total" a reading of 80 MA on both tubes is indicated. This will be your operating position of this switch for broadcasting. This feature allows you to check modulator tubes for balance and re-balance them from time to time as all tubes do not age alike. Slight touch-up of these controls often helps in final distortion readings. Actually perfect balance of static currents is not mandatory. In some cases one tube drawing slightly more static current than the others provides the best measurements. They should not be out of balance severely, however.

- THE PLATE RHEOSTAT marked "Plate" on the inside cabinet support, provides about 200 volts variation for day to day power adjustments. Clockwise rotation increases plate voltage.
- THE FILAMENT RHEOSTAT located adjacent to the plate rheostat adjusts correct primary voltage to all filament transformers and the bias power supply. Adjust this so the "Filament Voltmeter" always reads 10 volts and all other filament and bias voltages will be correct.
- YOUR ANTENNA COUPLING EQUIPMENT, not involved in these instructions, is a very important part of the entire successful operation. The instruction book with the antenna coupler, aids in its alignment. As all towers must be measured by an approved engineer, this engineer could use his radio frequency bridge for proper tune-up of the antenna coupler. Ask him about it. If your operation is directional, the engineer will, of course, tune the entire directional system including the tower coupling equipment.

3/9/61

-16-

M5790 BC-1T
1000/250W. Xmtr.

TUNE-UP PROCEDURE - 250 WATT CARRIER

Let us assume that the transmitter has been operating satisfactorily at 1000 watts power output.

1. Shut down the complete transmitter by depressing the "Filament Stop" tab.
2. Now change the power switch S1A, putting it to the 250 watt position. This operation energizes the coil of the power change relay K1A and sets the transmitter up for 250 watt operation. Now depress the "Filament Start" tab. The filaments will now energize, after about 30 seconds the low voltage will be applied to the low powered stages of the transmitter and bias will be available for the modulators.
3. Again push the "Plate Start" tab, the plate pilot lamp will indicate and power will be in the load approximately 2.2 amperes into 51.5 ohms. DO NOT adjust the bias controls, R1 and R2. If the modulator static plate current of each modulator is not approximately 25 MA, adjust tap "B" on bias resistor, R3A until this condition is obtained.

We have previously adjusted the bias potentiometers, R1 and R2 to give the correct static plate currents at the 1000 watt carrier level and we desire this to remain so. By increasing the total resistance in R3, the bias voltage will decrease and the static plate current will rise; by decreasing the total resistance, the bias voltage will increase and the static currents will decrease. (It will be noted that after R3A resistance is determined, and the adjustment of tap "B" is made, then any re-adjustment of R1 and R2, the bias potentiometers, will effect the static modulator currents at both the 1000 watt and 250 watt carrier level.) By slight re-adjustment of these controls, if necessary, satisfactory modulator operation will be assured at the two output powers.

HELPFUL OPERATION PROCEDURE

THE CRYSTALS are of the vacuum enclosed type. There are no air gaps and the only adjustment are those marked "Freq. 1" and "Freq. 2" which are small trimmer condensers to "zero in" each crystal. These controls will allow about a ± 30 cycle change at 1600 Kc and about ± 10 cycle change at 540 Kc. --- During equipment tests your external frequency measuring source will advise you of your frequency. You can then "zero in" by adjusting the trimmer condensers and then adjust your frequency monitor to correspond. As the frequency monitor has greater accuracy than the transmitter crystals, future "zeroing in" of the transmitter crystals is accomplished by checking against the frequency monitor.

CLEANLINESS cannot be over-emphasized. Please read Par. 30, 31 and 32 of "How Can We Help You?" in the back of this book. Dirt, grime, dust and maintenance negligence cause more outrages than any other cause. Outside cleaning indicates pride of ownership. Inside cleaning will prevent the engineer from being called away from an afternoon's fishing jaunt, later on --- and most important, advertising revenues will not be lost.

AIR FILTERS must be replaced regularly. If not, the hot air will not be removed from the transmitter and heat is next to dust and grime as an offender and trouble maker. We have made it easy to replace them. Open the front door, slip up and out, replace -- don't even turn off the transmitter.

RELAY MAINTENANCE is usually well understood as to procedure and necessity. Dirt and grime will eventually have a binding action on the armatures. Check contacts for pitting. Burnish as need be. A burnishing tool is preferred. If not available, use a very light grade of sandpaper sparingly.

CABINET FANS --- Keep the blades clean, they will run faster and work better to remove more air. They require no lubrication.

PRINTED WIRING is used in certain portions of this transmitter, to protect them, all printed wiring boards are treated with silicone varnish. Use a soft bristled brush to remove dust -- nothing else.

METERS ... The five meters on the vertical column can be replaced, if need be, by removing the entire vertical decorative front grill to expose all meters and the start-stop switches.

ASK YOUR MANAGER to provide you with a suction type vacuum cleaner. The kind you clean a davenport with. This will make sucking out dust from the inside, both easy and pleasurable.

TEST EQUIPMENT ... A broadcasting station must own minimum test equipment. A volt-ohmmeter and an oscilloscope are very desirable and not excessive in cost. Anually, all broadcasters must take proof of performance measurements. Annual tests are the minimum. For top-flight performance to assure the marvelous HI-FI signal capable of this equipment, monthly performance tests are recommended. The Gates SA-131 proof of performance set is recommended to keep a fine broadcasting station continually excellent.

SUMMARY

You have the finest transmitter money can buy. We at Gates cannot always know of the accessories being used. It goes without saying that a poor microphone will insure poor transmission quality, no matter how good the transmitter. Much enters into the final results -- the quality of the telephone line between studio and transmitter, your turntables, control console and even people. --- It is better to have less equipment, all good.

3/9/61

-18-

M5790 BC-1T
1000/250W. Xmtr.

It is well to remember that your transmitter will indicate all performance, good and bad. A loose or broken connection in the transmission line will indicate at the transmitter. A poor connection at the tower will indicate at the transmitter. All problems are reflected on the transmitter. Only your transmitter yells "ouch". So if you have a problem, remember you have more than a transmitter --- you have a system.

Gates engineers will be delighted to correspond or confer by telephone about any questions you might have. Do not hesitate to let us help you. --- We thank you for your business and the confidence placed in us.

3/9/61

-19-

M-5790 BC-1T
1000/250W Xmtr.

ATTACHMENT OF REMOTE CONTROL
IN GATES TRANSMITTERS
BC-1T, BC-500T, BC-250T

Refer to the following overall transmitter schematic diagrams:

BC-1T 852-5780-001
BC-500T E-25569
BC-250T E-25582

A steel plate, drilled for mounting the M4719A plate voltage kit, M4720A plate current kit and M4703 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 are included with these instructions.

M4703 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.

The control circuit hook-up between the M4703 motor and remote control unit is explained in the Remote Control instruction book.

PLATE VOLTAGE EXTENSION KIT, M4719A

1. Using Packard cable or a high voltage equivalent, connect the M4719A "HV" terminal to the motor rheostat terminal furthest from the power supply. Do not connect to the rheostat terminal which goes to the modulation reactor. Connect the M4719A 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, M4720A

1. The plate current kit is to be connected between the lower end of P.A. overload relay K6 and ground.
2. A ground lead runs from a chassis ground terminal to one of the coil terminals on K7 modulator overload relay, thence to one coil terminal of K6 P.A. overload relay. Clip out the portion between K6 and K7. K7 is to retain its direct chassis ground since we want only P.A. current to flow through the plate current.

3/9/61

-20-

M5790 BC-1T
1000/250W. Xmtr.

3. Both K6 and K7 must retain their shunt resistors directly across their respective coils.
4. The "G" terminal of the two-terminal strip on kit M4720A connects to a good ground point within the transmitter. Run a lead from the other terminal, upward to the K6 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.

3/9/61

-21-

M5790 BC-1T
1000/250W. Xmtr.

TYPICAL VOLTAGE CHART

GATES BC-1T 1000/250W. AM TRANSMITTER

These measurements made with a Simpson #260 volt-ohmmeter, a 20,000 ohms per volt DC and 1000 ohms per volt AC instrument. DC voltages to GROUND.

First Audio Input (V1,V2, 6BG6G's)

Plate Volts	275 DC	Same for both powers
Screen Volts	200 DC	" " " "
Filament Volts	6.3 AC	" " " "
Cathode Volts	31 DC	" " " "

Cathode Follower (V3,V4, 6BG6G's)

Plate Volts	580 DC	Same for both powers
Screen Volts	195 DC	" " " "
Cathode Volts Neg.	70 DC	" " " "
Filament Volts	6.3 AC	" " " "

Modulators (V8,V9, 833A's)

	<u>1000 W.</u>	<u>250 W.</u>
Plate Volts	2600 DC	1300 DC
Plate Current, Static	40 MA each	25 MA each
Bias Volts	Approx. 65/70 DC	35 DC
Filament Volts	10 AC	10 AC

Crystal Oscillator (V1, 12BY7A)

Plate Volts	100 DC	Same for both powers
Screen Volts	50 DC	" " " "
Cathode Volts	.8 DC	" " " "
Filament Volts	6.3 AC	" " " "

First IPA (V2, 12BY7A, a part of Osc.)

Plate Volts	205 DC	Same for both powers
Screen Volts	105 DC	" " " "
Cathode Volts	3.5 DC	" " " "
Filament Volts	6.3 AC	" " " "

Second IPA (V1,V2 Parallel 6BG6G's)

Plate Volts	650 DC	Same for both powers
Screen Volts	400 DC	" " " "
Cathode Volts	45 DC	" " " "
Filament Volts	6.3 AC	" " " "

Power Amplifier (V6,V7, 833A's)

	<u>1000 W.</u>	<u>250 W.</u>
Plate Volts	2500 DC	1250 DC
Plate Current	500/550 MA DC	260/280 MA
Bias Volts	360 DC	330 DC
Filament Volts	10 AC	10 AC

Bias Supply

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

Same for both powers

Intermediate Plate Supply

Output of Supply, measured at L5, terminal #2 - 600/650 volt DC

Same for both powers

High Voltage Plate Supply

Output of Supply, measured at top end of Bleeder, R10

1000 W.

250 W.

2600 DC

1300 DC

NOTE: Voltages and currents are approximate, and will vary slightly with line voltage and other local conditions.

IF THEY ARE NEEDED

Listed below are several items mentioned in this instruction book. In case you need any of them, they are listed below with prices.

RG-62U Coaxial cable for connecting frequency and/or modulation monitors to transmitterper ft. .06¢

2" copper strap for grounding transmitter to tower radials per ft. .23¢

Removable air filters, 2 required per transmitter, order catalog M5825 each .95¢

Burnishing tool for cleaning relays, Type TM-1 each .60¢

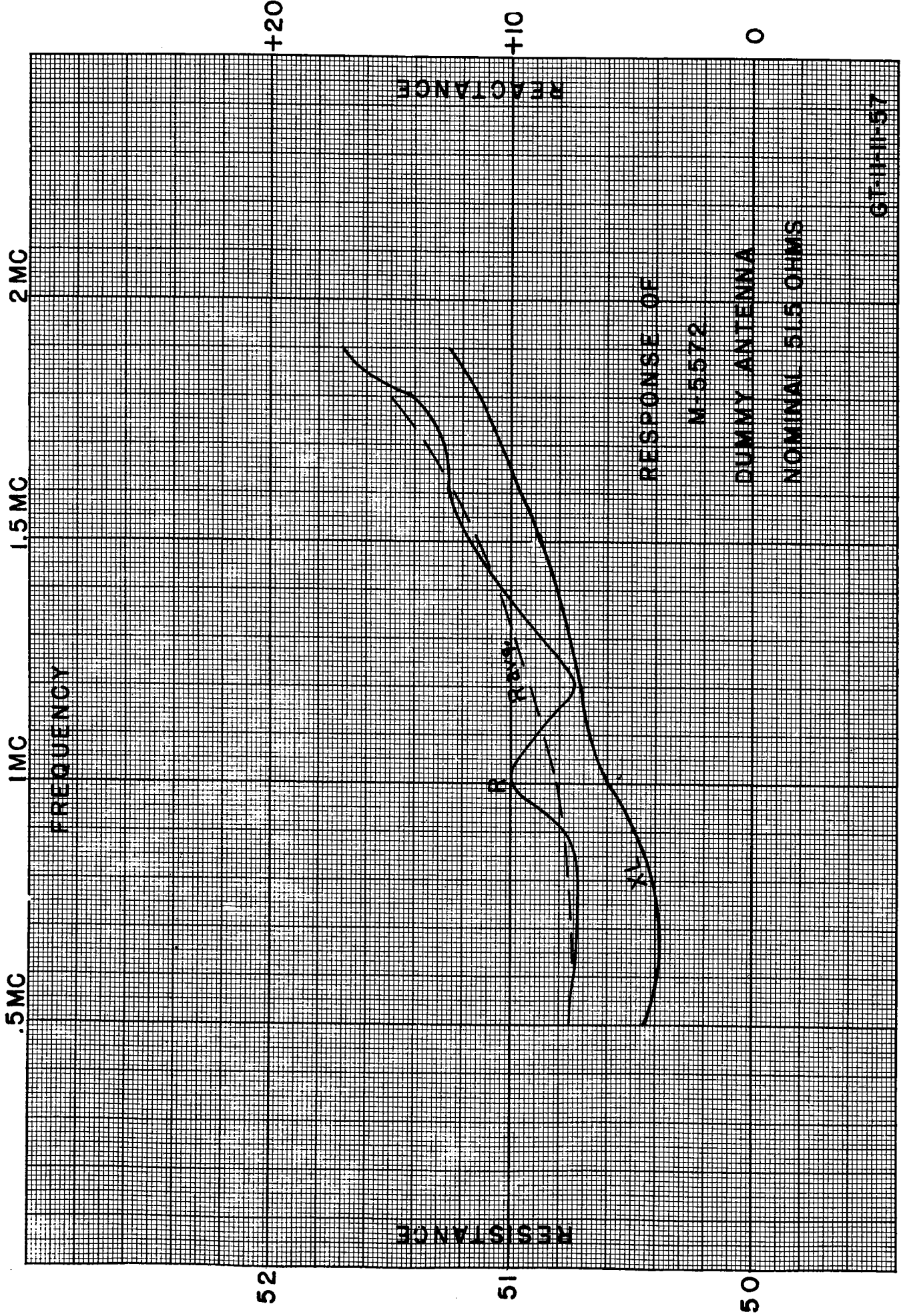
Spare crystal and vacuum holder, please state your frequency when ordering, catalog M5602 .. each \$70.00

Spare 100% tube complement for BC-1T transmitter, a tube for every socket, catalog TK287 set \$271.71

Spare FCC tube complement for BC-1T transmitter, tubes required by FCC as spares, catalog TK288 set \$136.15

SA-131 proof of performance equipment, listed on Page 149 Gates catalog each \$513.00

NOTE: As copper prices vary on the daily market, copper strap and coaxial cable may vary upward or downward from above stated prices.
Terms are F.O.B. Quincy, Illinois



RESISTANCE

REACTANCE

FREQUENCY

RESPONSE OF

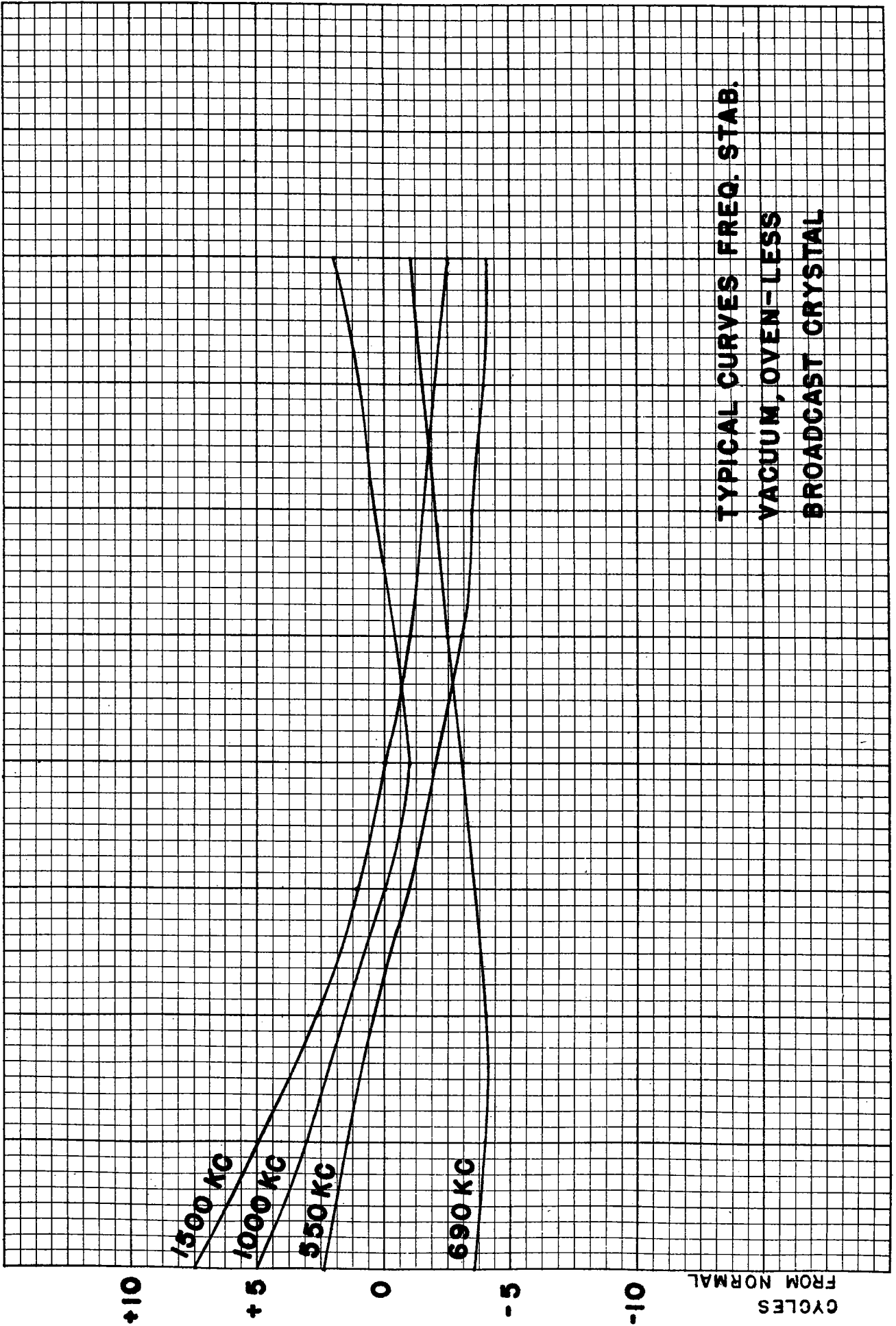
N-55572

DUMMY ANTENNA

NOMINAL 51.5 OHMS

6T-1111-57

A-30905



TYPICAL CURVES FREQ. STAB.
VACUUM, OVEN-LESS
BROADCAST CRYSTAL

DEGREES CENTIGRADE

+10

+5

0

-5

-10

CYCLES FROM NORMAL

PARTS LIST

M-5790 BC-1T TRANSMITTERBASIC CABINET ASSEMBLY

<u>Symbol No.</u>	<u>Drawing No.</u>	<u>Description</u>
B1,B2	2676-PM-101	Fan Assembly
C1		Cap. Filter, 10 mfd. 1000(W)V.
C2		Cap. Input Filter, 8 mfd. 3000(W)V.
C4		Cap. Coupling, 2 mfd. 3000V.
C10	C-77697-101	Neut. Condenser Assembly
K1A	A-35159-101	Relay, Power Change
L1	AC-10458E	Swinging Choke
L2,L3	AC-10465E	Modulation Reactor
L4	AC-38332	Filter Choke
R8A		Res., 50 ohm, 25W. Semi-Var.
R10		Res. Bleeder, 100K ohm, 100W.
R11	A-30626-101	Resistor, Bleeder
R12		Precision Meter Multiplier, 3 megohm, 3 KV.
R13		Control, (Fil. Rheostat), 7½ ohm, 150W.
R14		Control (Plate Rheostat)
S1A		SPST. Toggle Switch (Power Change)
S3,S4		Interlock Switch
T1	AP-10459E	Transformer (High Voltage)
T2	AP-30097K	Transformer (600V. Power)
T3	AM-30469E	Transformer (Mod.)
T4	AF-10456K	Transformer (Filament)
T5		Transformer (Fila.)
TB1A		Terminal Board, Mod. Monitor
V1,V2		Tube, 8008
V3,V4		Tube, 866A
XV1,XV2		Socket (8008 Rectifier)
XV3,XV4		Socket (866A Rectifier)

3/9/61

-1-

BASIC METER AND SWITCH PANEL

<u>Symbol No.</u>	<u>Drawing No.</u>	<u>Description</u>
A1, A2		Lamp
M1		Meter, Fil. Voltmeter, 0-15 V. AC
M2		Meter, P.A. Plate Current, 0-1A. DC
M3		Meter, P.A. Voltmeter, 0-1 MADC, w/O-3000V. Scale
M4		Meter, Modulation, 0-1 amp. DC
M5		Multimeter, 0-1 MADC, w/O-30, 0-300 MADC Scale
R26	A-10534-101	Multimeter Series Res. Assy.
S5; S6, S7, S8	C-77705-101	Fil. & Plate Start-Stop Switch Assy.
XA1, XA2		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-30910-101	Parasitic Suppressor
L12	105-VB-3735F	Coil P.A. Tank
L13	26-FB-2843F	Coil; Input Loading
L14	30-VB-2344F	Coil, Output Loading
L15	A-10391-102	Monitor Coil
M6		Meter, R.F. Line Current, 0-8 RF amp.
R15; R15A; R15B R16; R16A; R16B		Res. (Part of L10, L11)
TB2, TB3		Terminal Board

BASIC PANEL AND SHELF ASSEMBLY
(R.F. Audio, Relay and Bias)

AT1	2673-PM-101	Audio Input Pad
-----	-------------	-----------------

3/9/61

-2-

M-5790 BC-1T Xmtr.
1000/250W.

<u>Symbol No.</u>	<u>Drawing No.</u>	<u>Description</u>
C5, C6		Cap. Plate
C7		Cap. (Det, by Freq.)
C16; C19, C20,		Cap., .01 mfd. 1000(W)V.
C21, C22, C25		Cap., .002 mfd. 1200(W)V.
C17		Cap. 1 mfd. 1000V.
C18		Cap., .01 mfd. 600(W)V.
C23, C24		
F1, F2		Fuse, 30 amp. 250V (non-renewable)
F3		Fuse, 3 amp.
F4		Fuse, 3 amp. Slo-Blo
K1, K2 - 570-0319-		Fil. Plate Start-Stop Relay, 230V. ^{83.25}
K3		Master O.L. Relay, 230V. 50/60 cy.
K4		Time Delay; HV Relay
K5		Time Delay, 600V. Relay
K6		Overload Relay, 6V. DC
K7	AK-12635	Modulator Overload Relay
L5, L6		Choke, Isolation Filter & Bias
L7	A-30518-101	2nd IPA Coil ^{10H 270.5}
L8	B-65284-101	Plate Coil
P1		Socket
R1, R2	A-3404-6	Bias Control, 10K ohm, 4W. Wirewound
R3		Res. 5000 ohm, 10W.
R3A		Res. 12000 ohm, 50W. Adj.
R4, R5		Res. 6000 ohm, 10W.
R6		Res. 2500 ohm, 10W.
R7, R8		Res. 5000 ohm, 50W.
R9		Res. 20,000 ohm, 25W.
R19; R20		Res. 7.5 ohm, 10W.
R21; R22		Res. Adj. 10 ohm, 10W.
R23, R24, R25		Res. 3 ohm, 1W. 5%
R27		Res. 1000 ohm, 20W.
S1	A-10900-2	Mod. Switch
S2		Multimeter Switch
T6	AI-3002	Transformer; Audio Input
T7	AP-30098K	Transformer; Bias
T8	AF-30100K	Transformer, Multi-Fil. 6.3V.
T9	AF-30099E	Transformer, Multi-Fil. 10V.
TB1	A-30544-101	Terminal Board Assembly

3/9/61

-3-

M-5790 BC-1T Xmtr.
1000/250W.

<u>Symbol No.</u>	<u>Drawing No.</u>	<u>Description</u>
TP1	B-11729-19	Tie Point
V5		Tube, 5R4GY
V6;V7, V8,V9		Tube, 833A
XF1 XF3, XF4		Fuse Block Fuseholder
XK4 , XK5, XV5 XV6; XV7, XV8, XV9	C-77708-101	Socket P.A. and Mod. Socket Assy.

FEEDBACK LADDER ASSEMBLY

C1, C2 C3; C4; C5; C6; C7, C8, C9, C10		Cap., .002 mfd. 1200(W)V. Cap., .0001 mfd. 1200(W)V.
R1; R2 R3; R4; R5; R6; R7, R8, R9, R19		Res. 82K ohm, 2W. 5% Res., 2.2 megohm, 2W. 5%

RF DRIVER PRINTED WIRING ASSEMBLY

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

3/9/61

-4-

M-5790 BC-1T Xmtr.
1000/250W.

AUDIO INPUT AND DRIVER PRINTED
CIRCUIT ASSEMBLY

<u>Symbol No.</u>	<u>Drawing No.</u>	<u>Description</u>
C1, C2		Cap., .00027 mfd.
C3		Cap., .47 mfd. 400V.
C4; C5		Cap., .01 mfd. 600V.
C6, C7		Cap., .33 mfd.; 600V.
C8		Cap., .01 mfd., 1000(W)V.
L1, L2	A-30531-101	Parasitic Suppressor
R1, R2		Res., 33K ohm, 2W. 10%
R3	A-3404-8	Control, 1000 ohm
R4, R15, R16		Res., 82K ohm, 2W. 10%
R5		Res., 120K ohm, 2W. 10%
R6; R7		Res., 100K ohm, 2W. 10%
R8, R9		Res., 470K ohm, 2W. 10%
R10		Res., 10K ohm, 2W. 10%
R11; R12		Res., 10K ohm, 10W.
R13; R14		Res., 47K ohm, 2W. 10%
R17; R18		Res., 47 ohm, 2W. 10%
R19, R20		Res., 20 ohm, 1W. 5%
R21		Res., 8200 ohm, 2W. 10%
R22, R23		Res., 47 ohm, 2W. 10% (Part of L1 & L2)
V1, V2, V3, V4		Tube, 6BG6G
XV1, XV2, XV3, XV4		Socket

1 KW DUMMY ANTENNA

A1		Lamp, 60W. 230V (Mounts in S1)
R1; R2; R3; R4 R5, R6, R7, R8		Res., 412 ohms, 190W. non- inductive
S1		Winker
S2		Micro Switch
S3	A-4938-101	Shorting Blade and Handle Assy.
TB1		Terminal Board
XS1		Socket

3/9/61

-5-

M-5790 BC-1T Xmtr.
1000/250W.

M-5422 OSCILLATOR UNIT FOR AM TRANSMITTER

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

3/9/61

M-5790 BC-1T Xmtr.
1000/250W.

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:

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

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

Electron Tubes: 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.

All other component parts (except as otherwise stated): 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

SPECIFICATIONS

Frequency Range: 1600 Kc to 540 Kc
Crystals: 2 Vacuum Crystals

Frequency Tolerance: ± 5 cycles, typical ± 2 cycles.
Supply Voltages: 180-210 Volts D.C. @ 10 MA.
6.3 Volts A.C. @ 1.2 Amps.

Output Impedance: High Z (capacity coupled).
Tubes: 2 Type 12BY7A

Tuning Procedure for the M5422 Oscillator

The following tuning instructions should be followed when placing the M5422 oscillator in operation. If this procedure is not followed, it is possible to tune the oscillator to the 2nd harmonic of the crystal rather than the fundamental.

Information that follows was obtained with the M5422 oscillator connected to its proper R.F. load and 30 feet of RG-62/U cable connected to the monitor terminal #6 with shield to ground or terminal #7.

RG-62/U cable runs 13.5 uufd. per foot, or a total of approximately 400 uufd. effective capacity on the 30 foot length. Shorter lengths of cable on frequencies above 600 KC will effect the tuning of the unit. More tuning capacity (C9) or more turns of the slug in L3 may be required for resonance.

Shorter lengths of monitor cable on frequencies from 600 KC to 540 KC may prevent the unit from tuning to resonance. If this is the case, capacity should be added across the cable to make up the difference in effective capacity. Longer lengths of cable would mean less capacity or less inductance needed for resonance in this frequency range.

It is recommended that the proper length of RG-62/U be used whenever possible.

Frequencies from 1600 KC to 800 KC

1. NO PADDING needed in this range.
2. Make sure that slug of L3 is screwed all the way out.

From 1600 KC to approximately 1100 KC, tune C9 for dip in plate current or peak in grid current of following stage. If C9 does not tune through resonance, screw in slug on L3 a turn at a time until resonance is obtained with C9. 800 KC is tuned with C9 near maximum capacity and slug on L3 screwed in 7 turns. If above procedure is not followed it will be possible for crystal from approximately 900 KC to 800 KC to tune to their 2nd harmonic if slug in L3 has not been screwed down to approximately 7 turns for 800 KC.

Frequencies from 540 KC to 800 KC

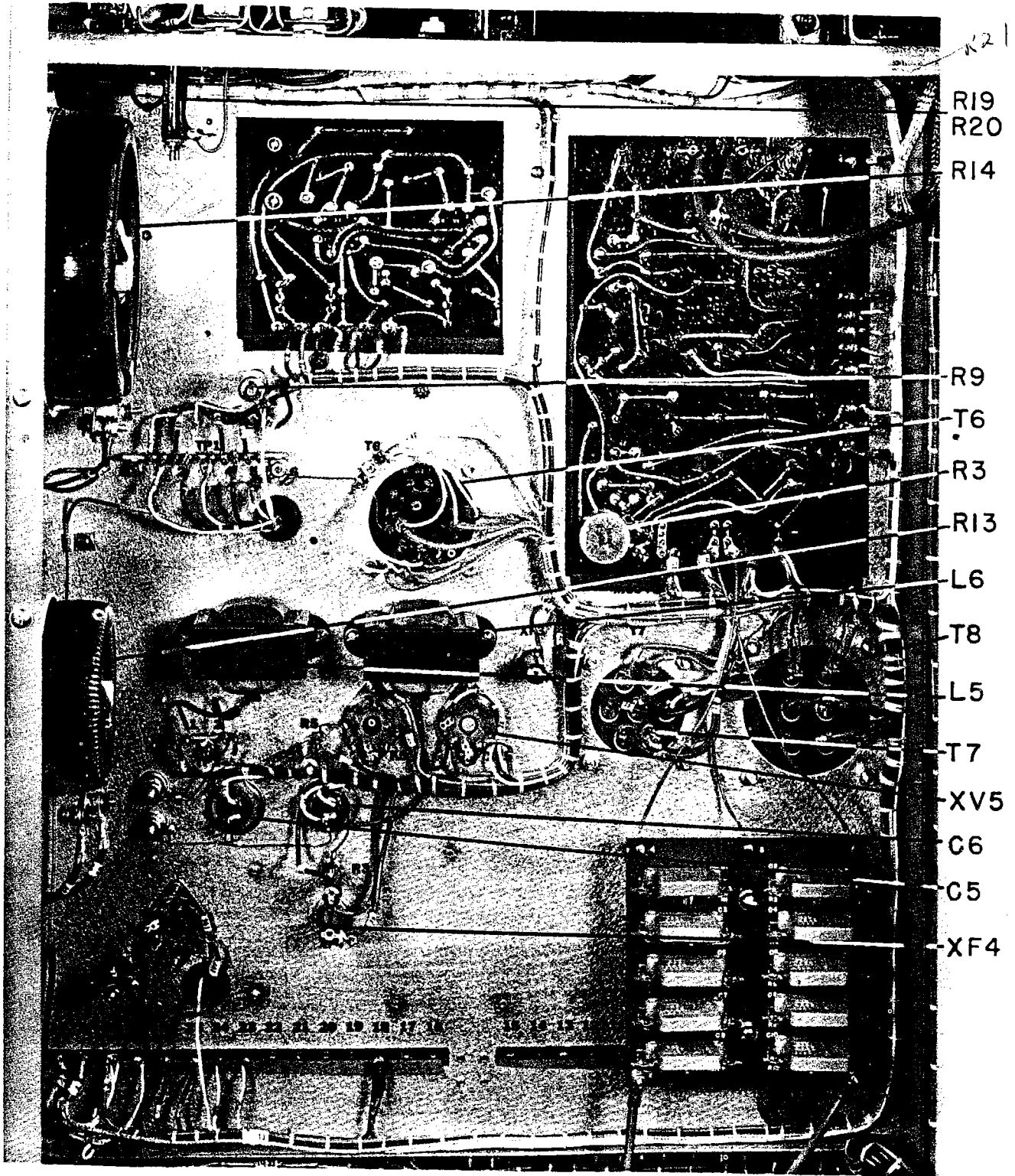
1. The padder (C11) 100 uufd. located on bottom of L3 must be connected in the circuit.
2. Slug on L3 should be screwed down 14 turns.

Frequencies from 540 KC to approximately 600 KC can be resonated with C9. If complete resonance can not be obtained on C9, screw slug on L3 back out a turn at a time until resonance is obtained by tuning C9. At 800 KC resonance will be with C9 near minimum capacity and slug of L3 screwed out approximately 7 turns from starting point (14 turns down).

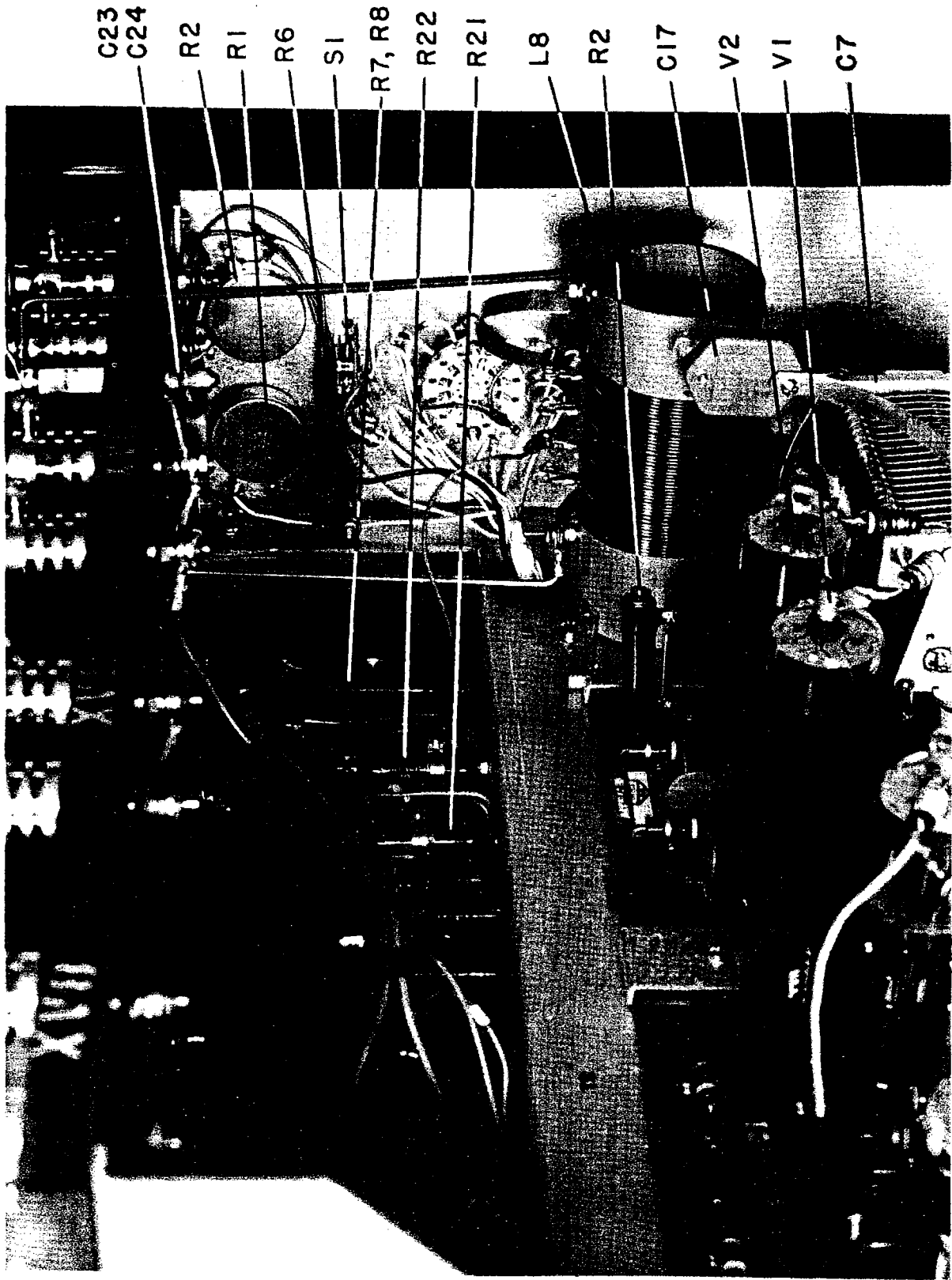
CAUTION - If above procedure is not followed and padder not connected, it will be possible to tune crystals from 540 KC to 800 KC to their 2nd harmonic.

After resonance has been obtained, the crystal may be set to exact frequency by using the frequency monitor. Set the slots of the trimmer condensers, located on the front of the unit, at right angles to the plane of the trimmer mounting screws. With the crystal selector switch turned to #1 crystal, the frequency should be very close to zero. If not, adjust the trimmer FREQ. #1 until frequency is zero or to point desired for operation. Turn crystal selector switch to #2 position and repeat above operation with trimmer FREQ. # 2.

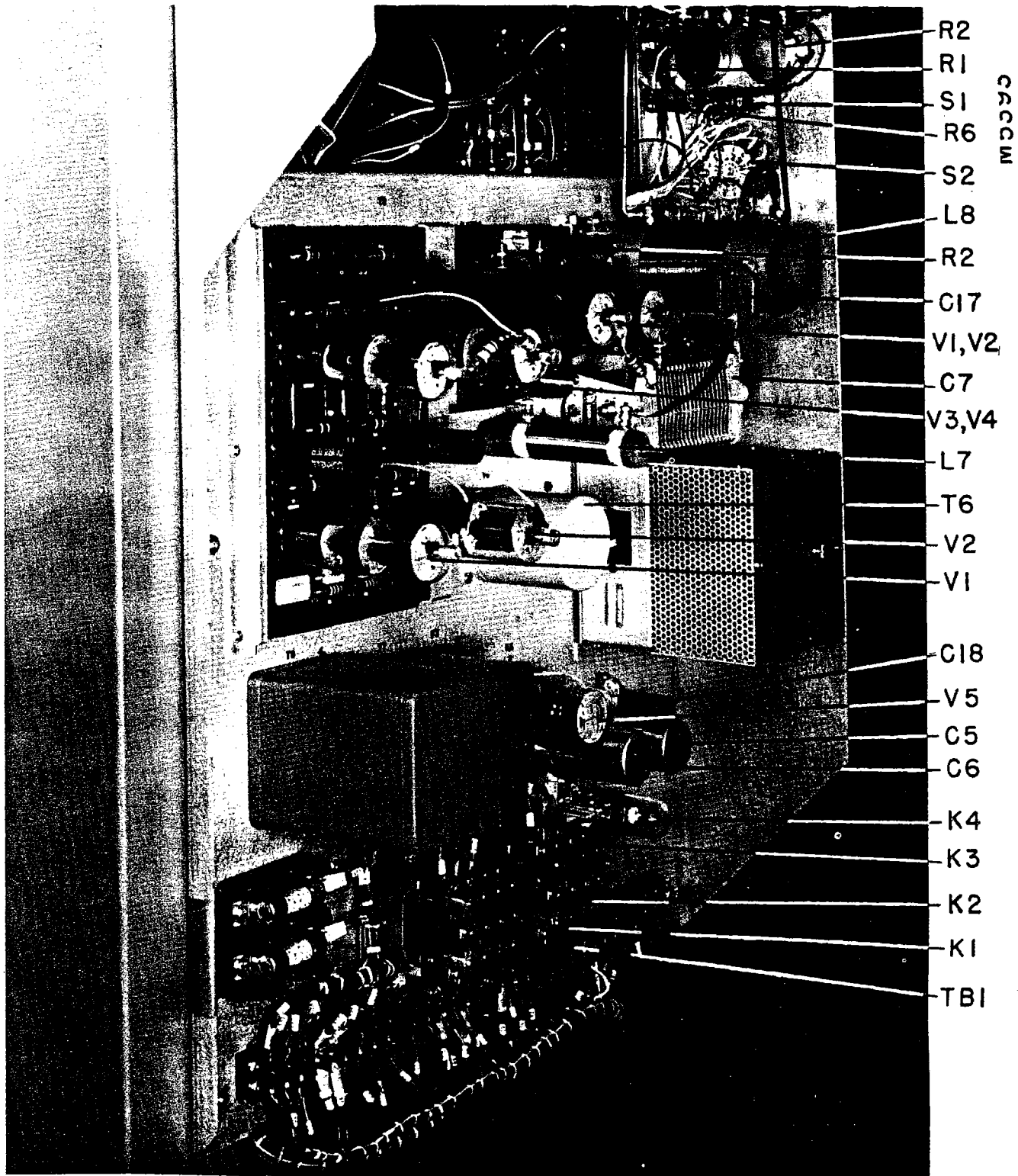
The tuning of these condensers will not effect the resonate tuning of the unit and C9 need not be bothered again. The tuning of C9 will have very little if any effect on the trimmer adjustments.



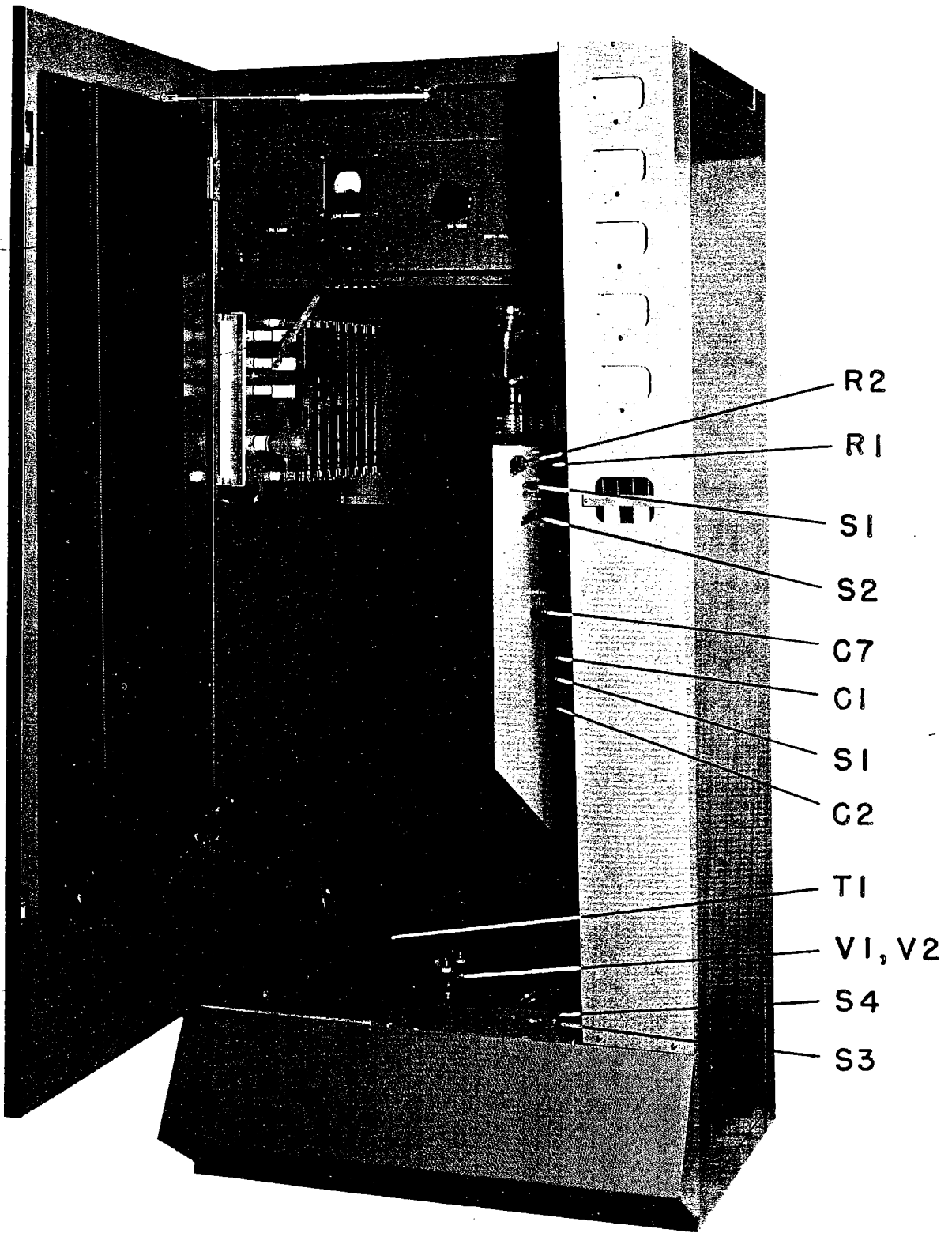
BACK VIEW, PANEL &
 SHELF ASSEMBLY,
 BC-IT, BC500T, BC250T
 A.M. TRANSMITTERS



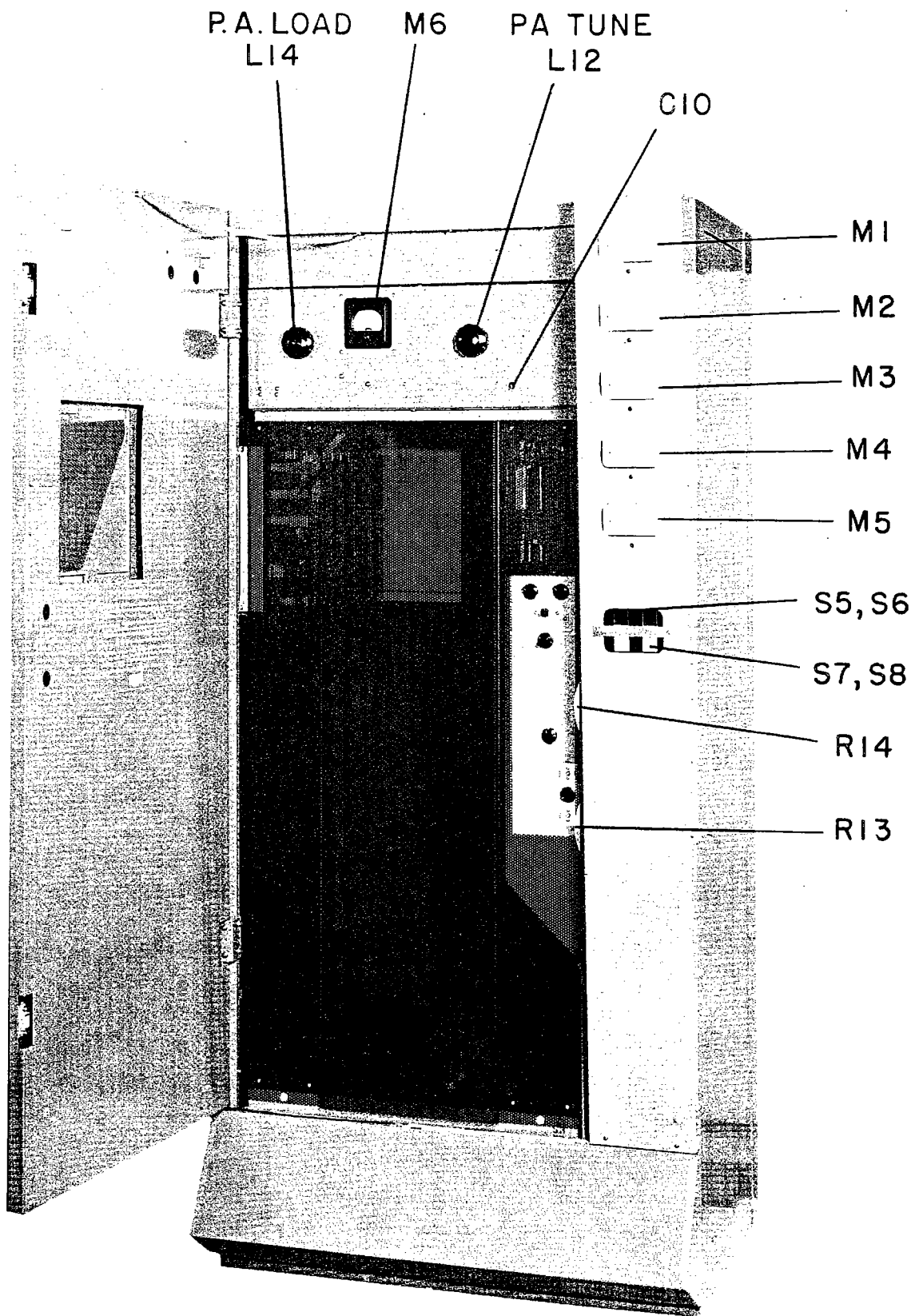
INSIDE VIEW, BC-1T
1000 W, A.M. TRANS.
M5393



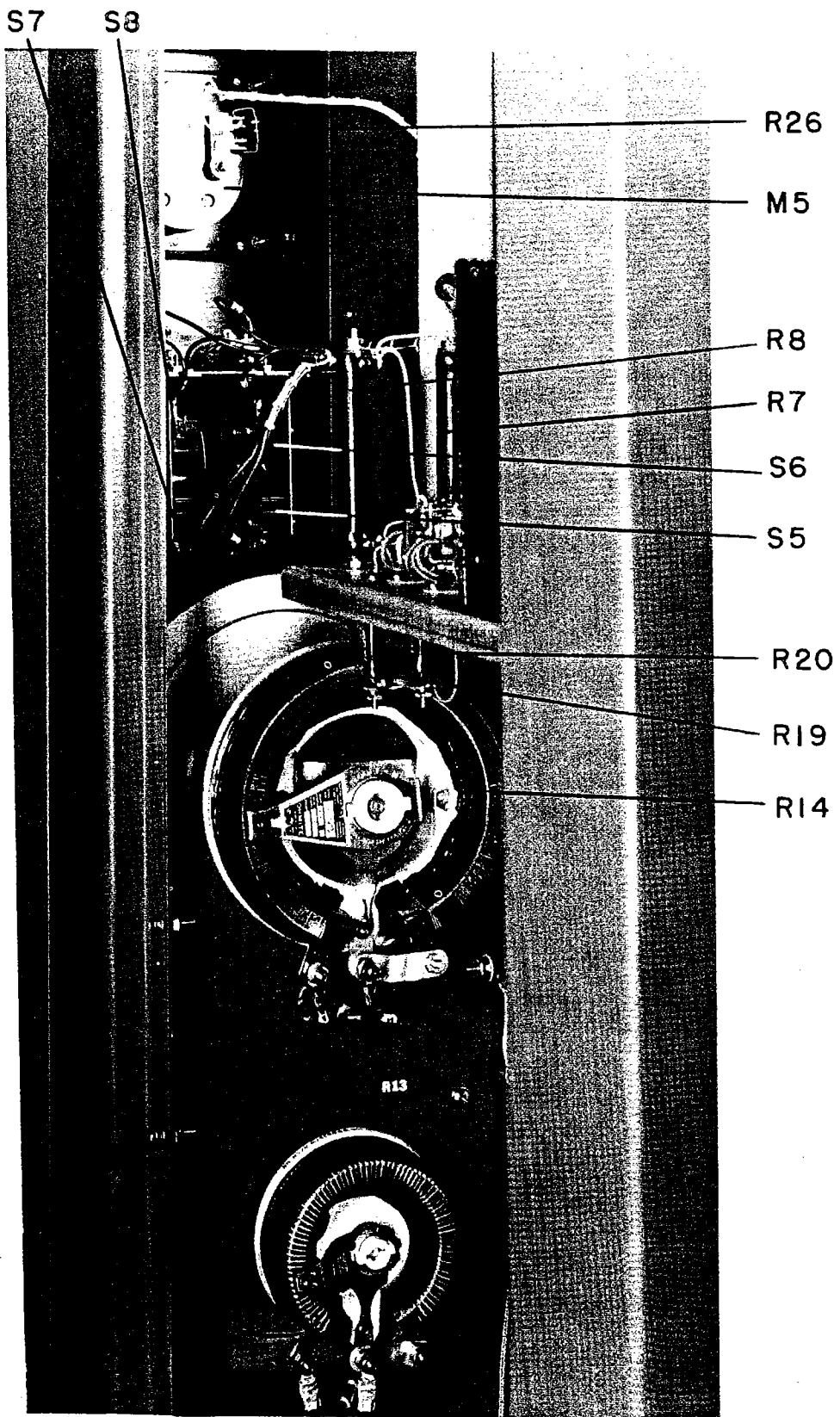
INSIDE CABINET VIEW,
 BC-1T, BC500T, BC250T
 A.M. TRANSMITTERS



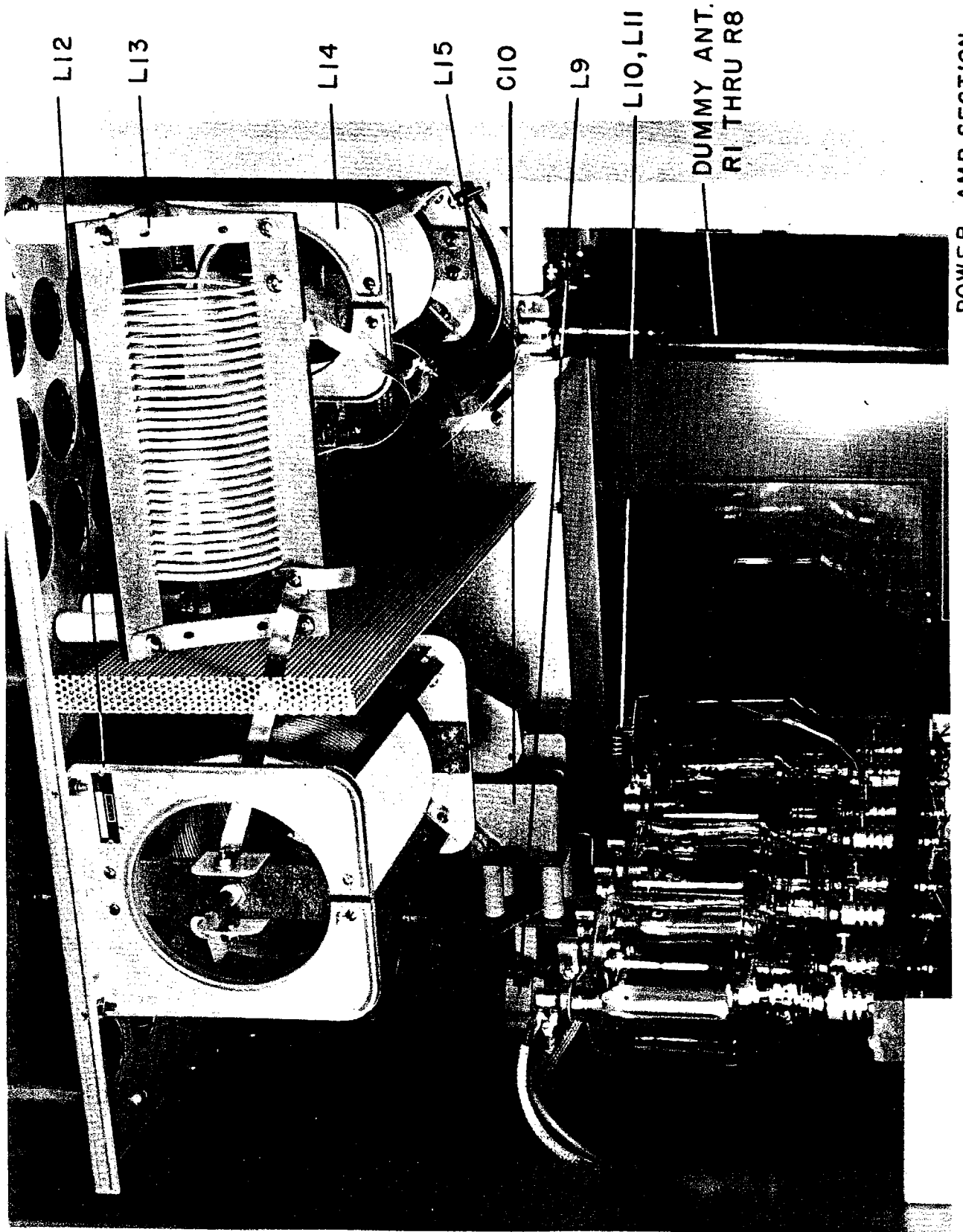
FRONT VIEW, BC-IT
1000 W. A.M. TRANS.
M5393



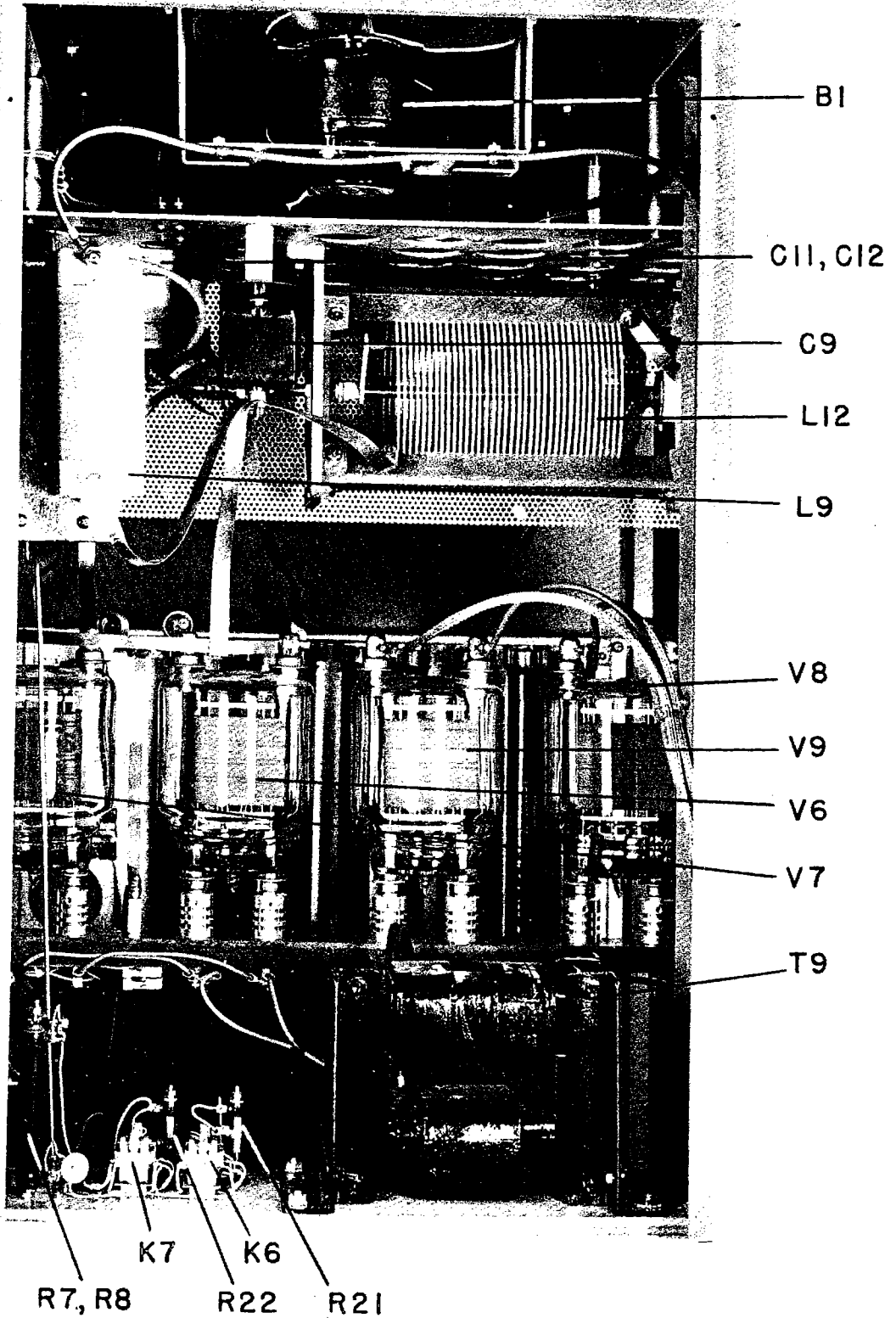
FRONT VIEW, BC-IT
1000 W. A.M. TRANS.
M5393



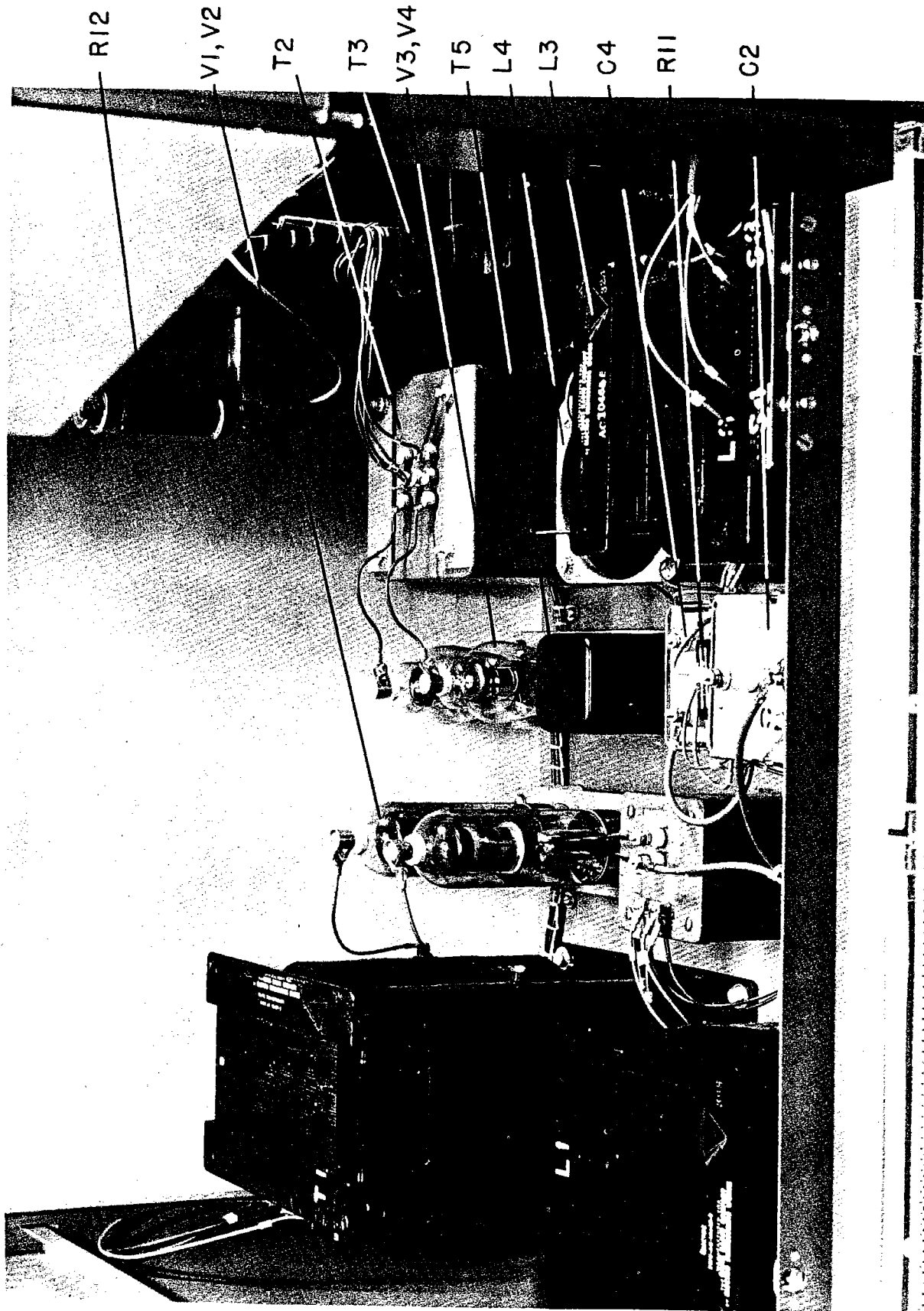
CONTROLS, FIL. & PLATE
START/ STOP & ADJUST
BC-1T, BC500T, BC250T
A.M. TRANSMITTERS



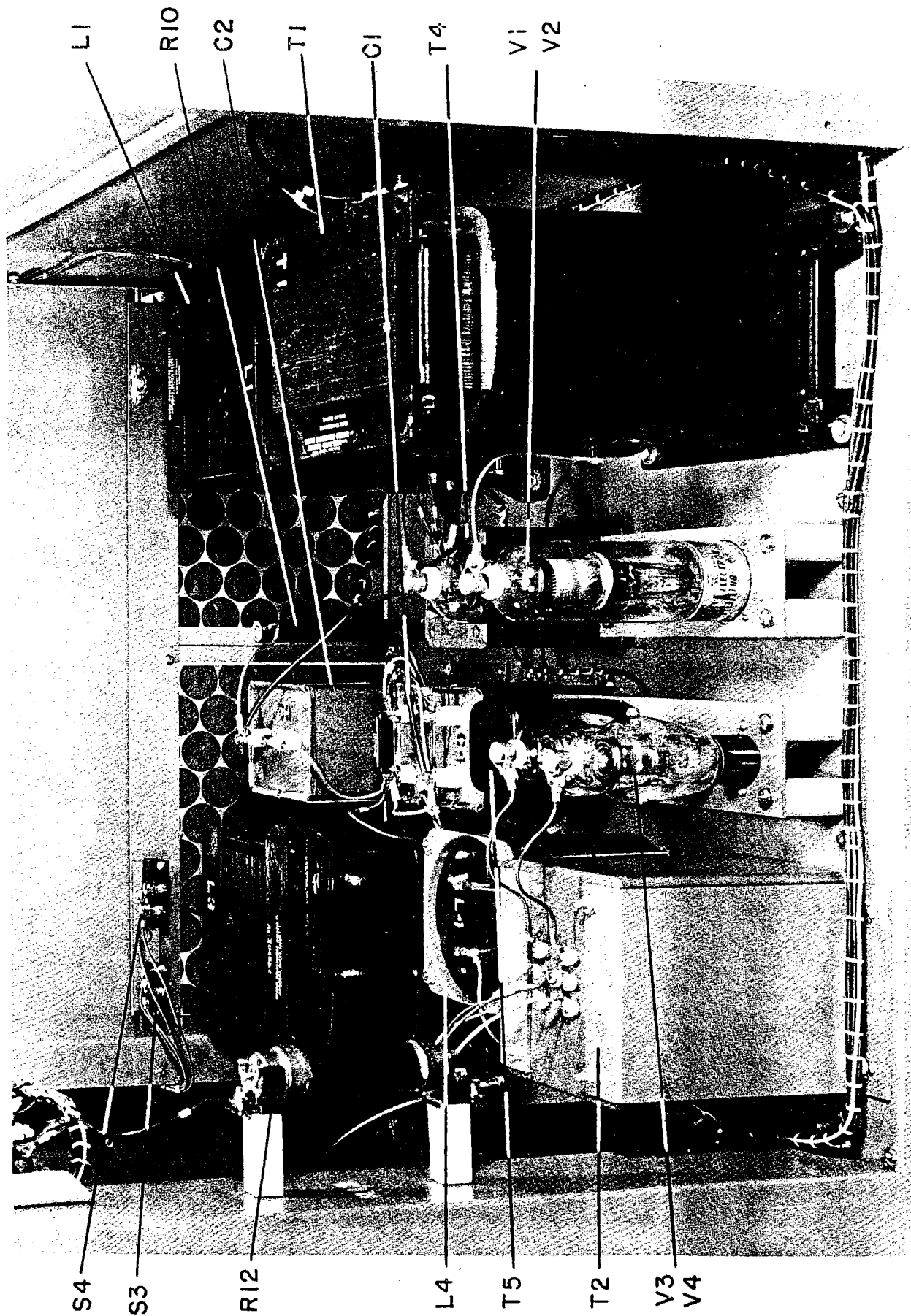
POWER AMP. SECTION
BC-1T, 1000W AM. TRANS.
M5393



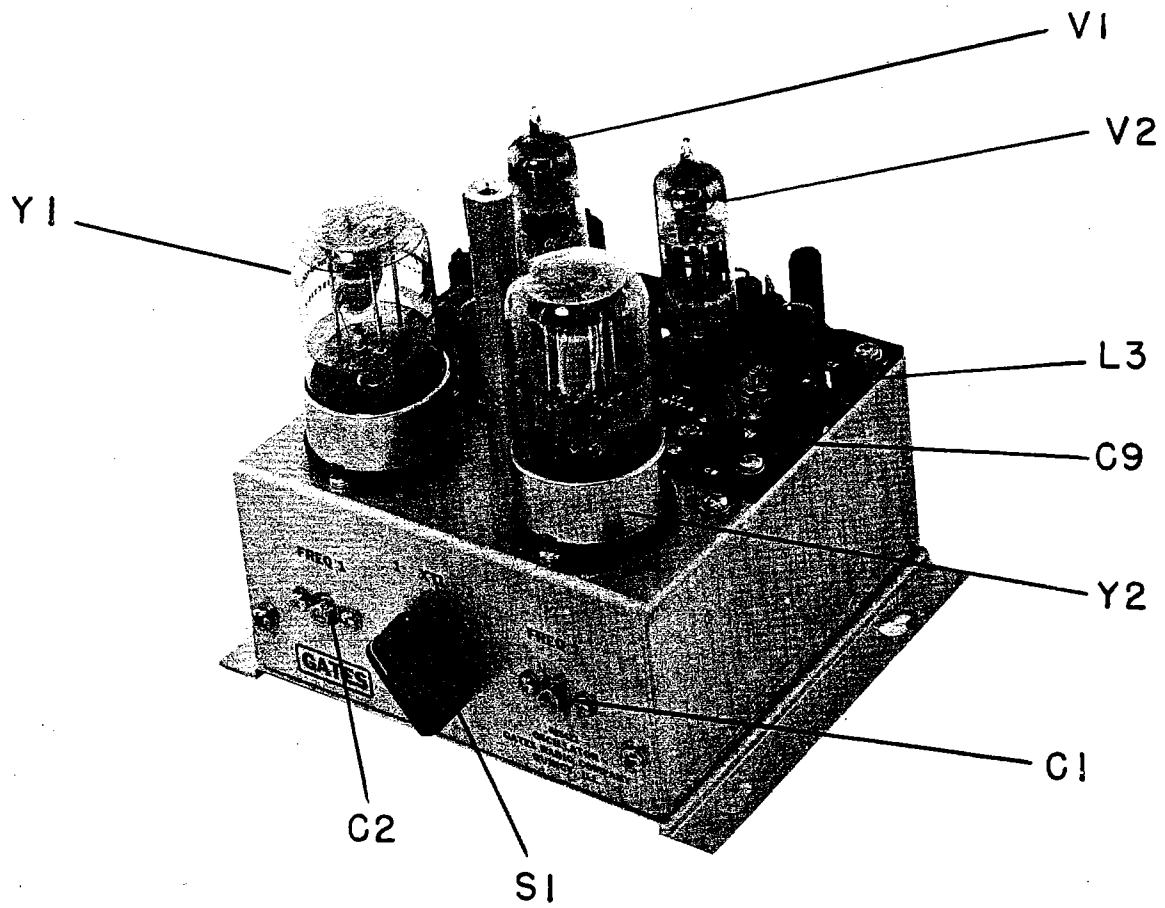
SIDE VIEW, PA. & MOD. SECTION
 BC-1T, 1000W. A.M. TRANS.
 M5393



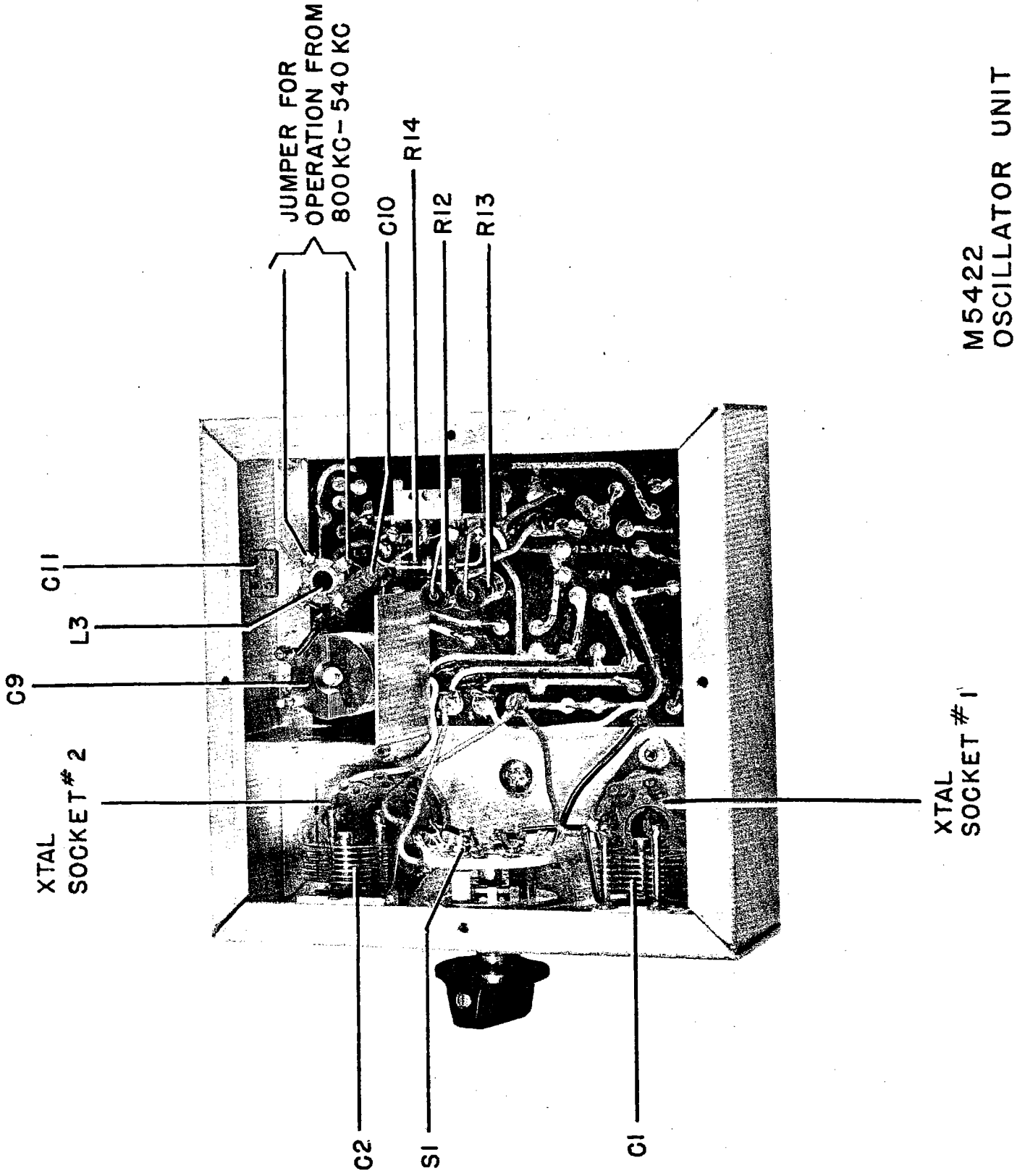
BASE COMPONENTS, FRONT VIEW,
 BC-1T, 1000W. A.M. TRANS. M5393



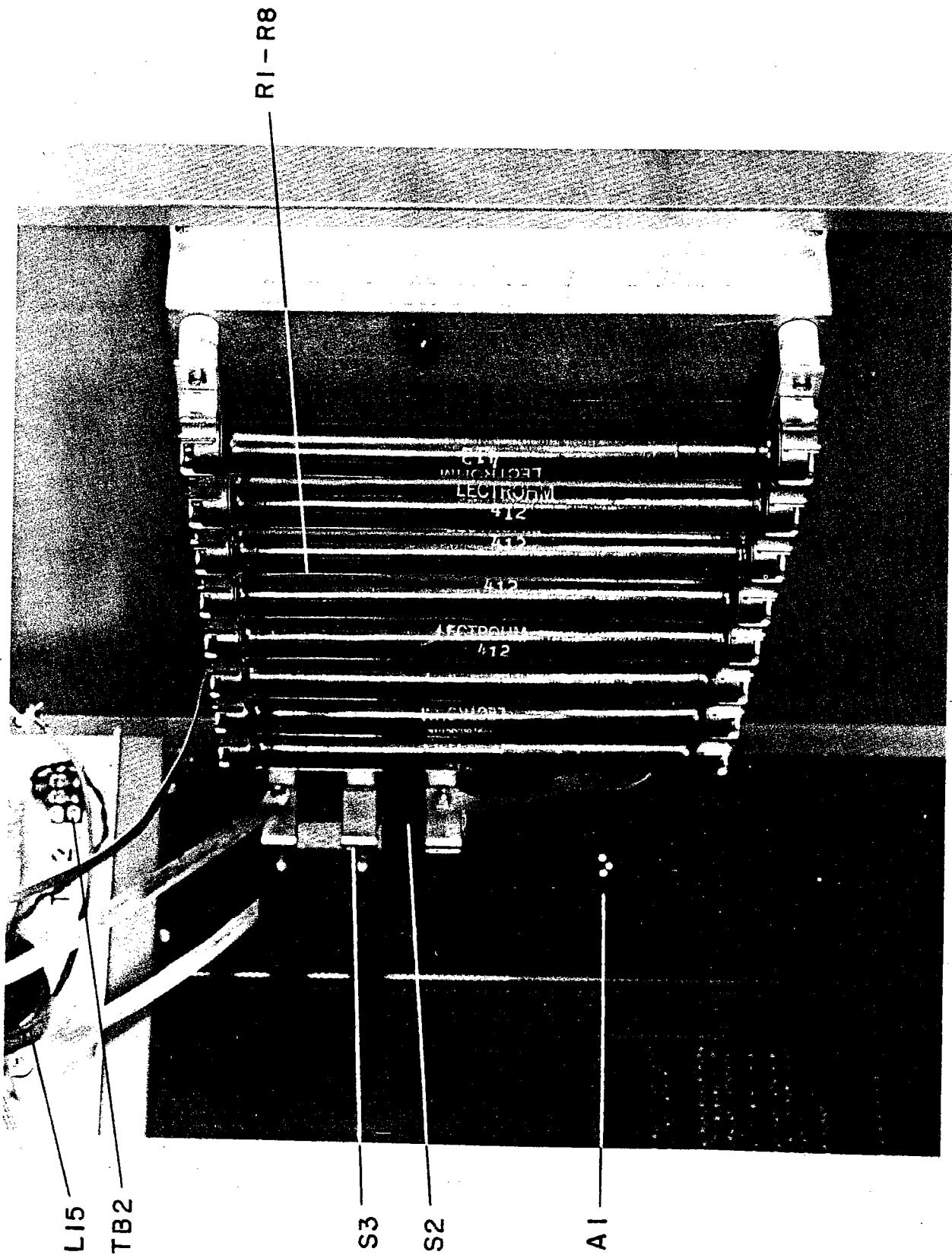
BASE COMPONENTS, REAR VIEW,
 BC-1T, 1000W, A.M. TRANS. M5393



OSCILLATOR UNIT,
M5422



M5422
OSCILLATOR UNIT



L15

TB2

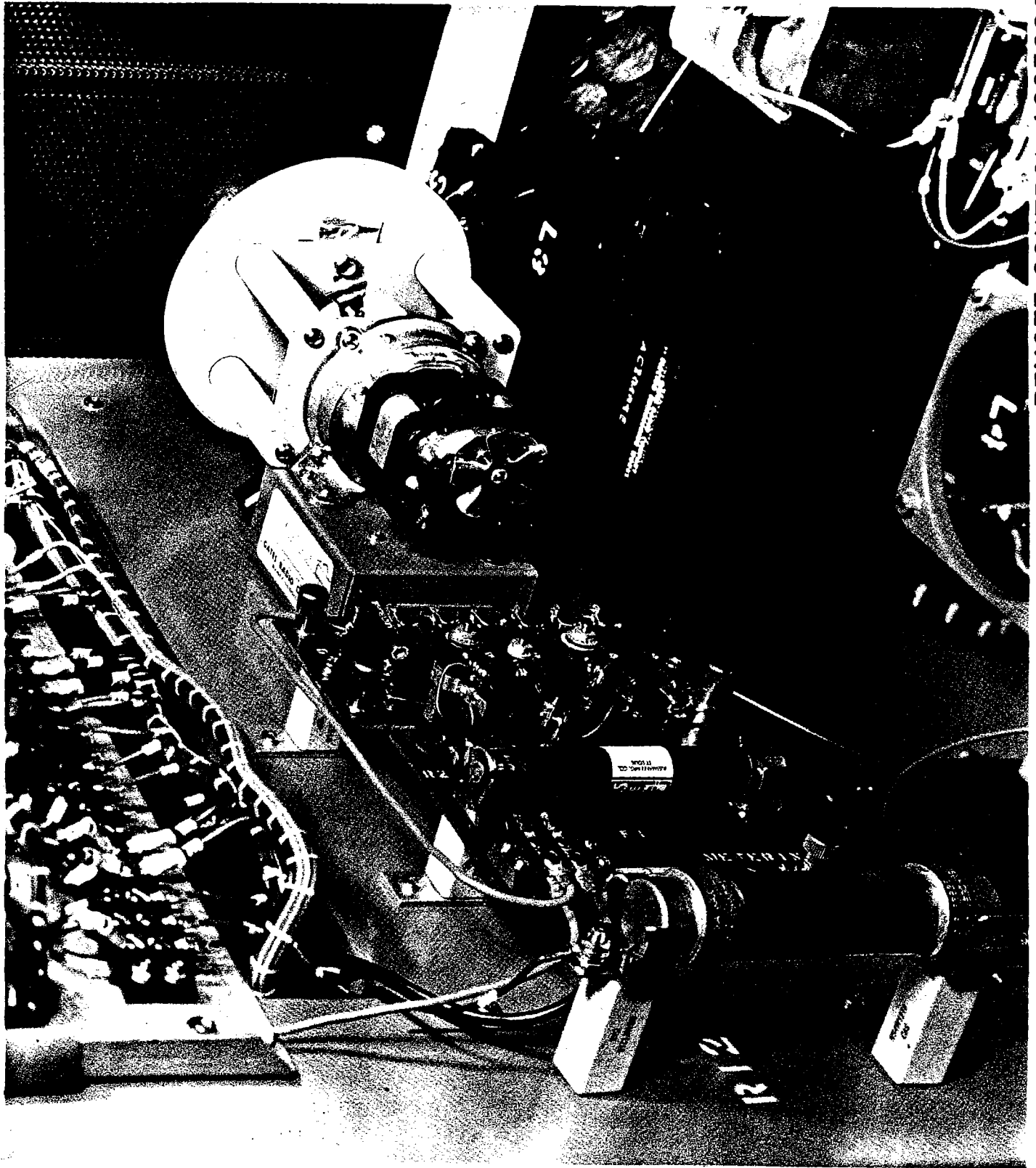
S3

S2

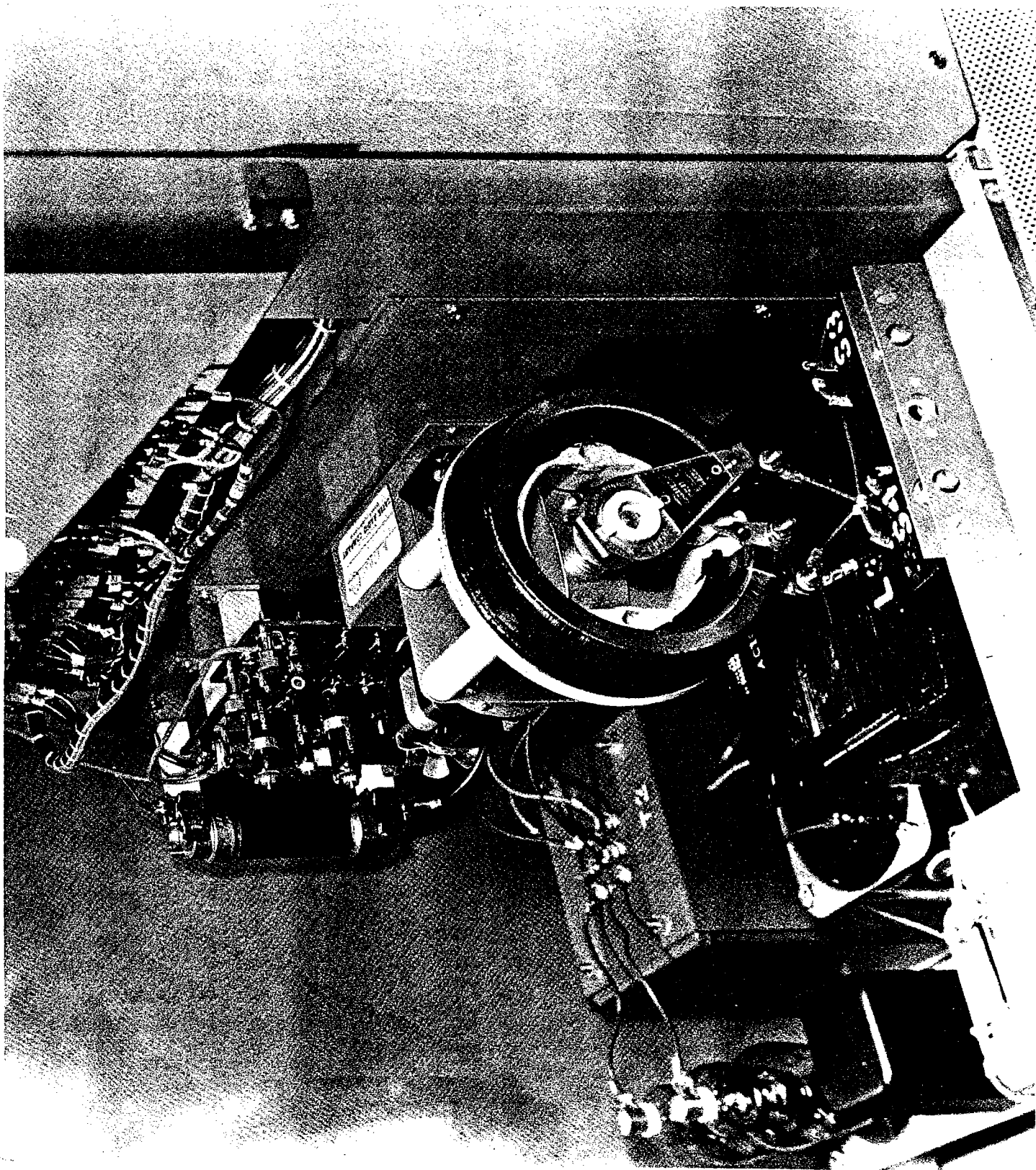
A1

RI - R8

DUMMY ANT. 1KW MOD.
IN BC-IT, 1KW AM TRANS.



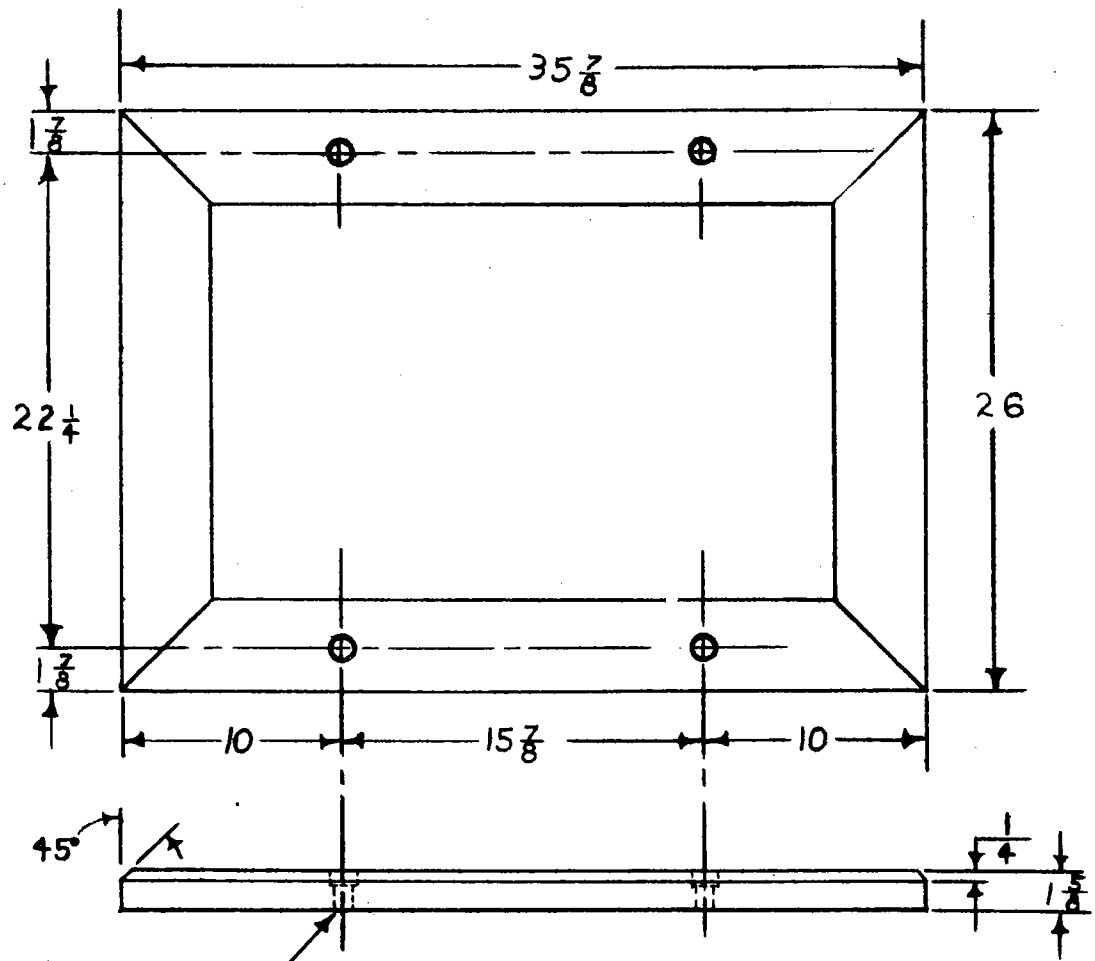
REMOTE CONTROL ACCESSORIES
BC-1T, BC-500T, BC-250T



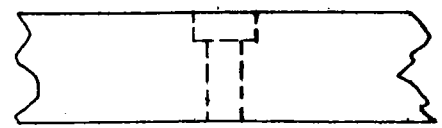
REMOTE CONTROL ACCESSORIES
BC-1T, BC-500T, BC-250T

				FIRST MADE FOR GR. NO.	GATES RADIO COMPANY QUINCY, ILLINOIS			A 30585	
								SCALE $\frac{1}{8}'' = 1''$	

104	105	102	101	LIST OF PARTS					
QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATL.

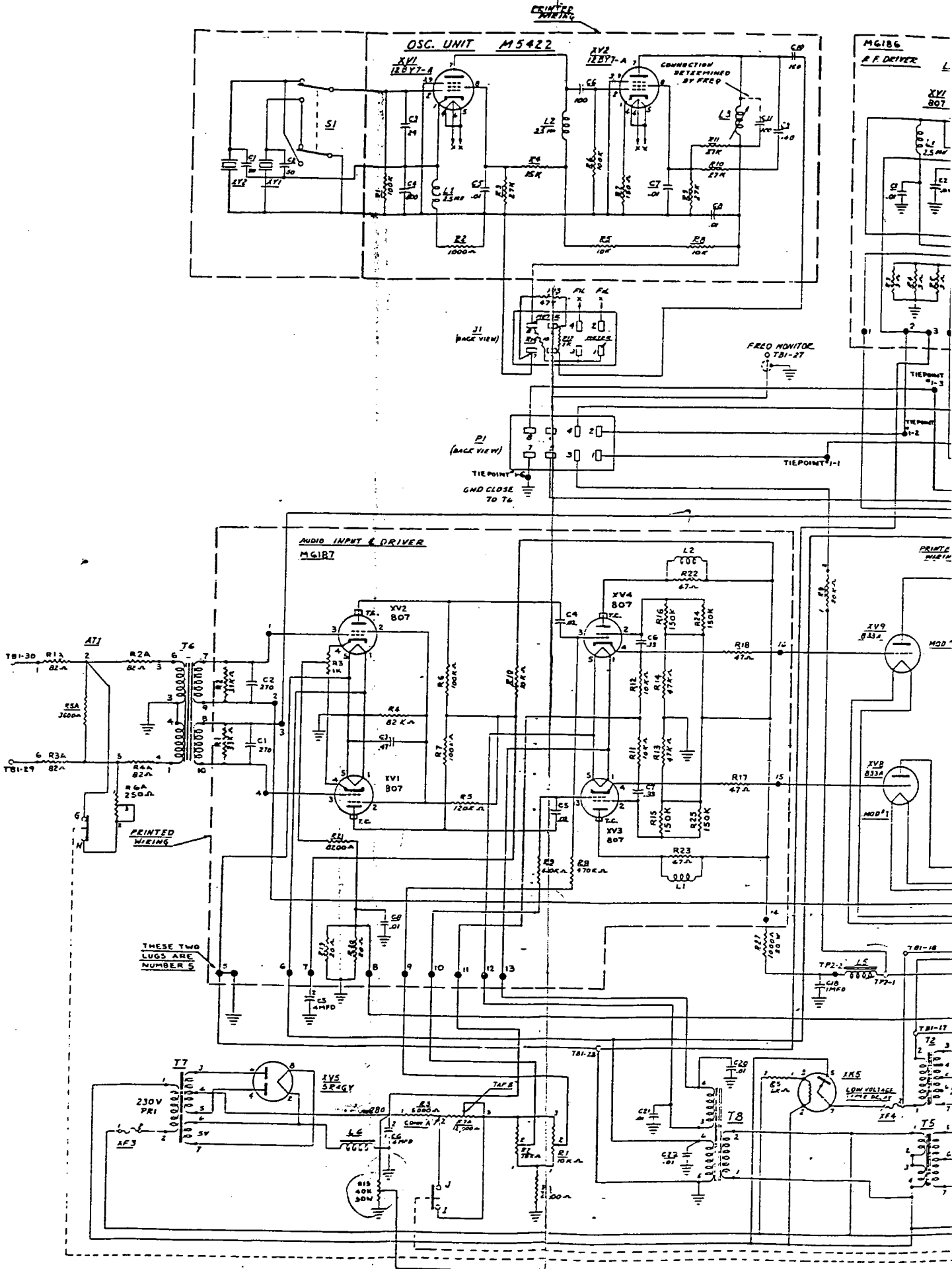


DRILL & CTR'BORE
TO CLEAR $\frac{1}{2}''$
FOUNDATION BOLT



BOLT HOLE DETAIL

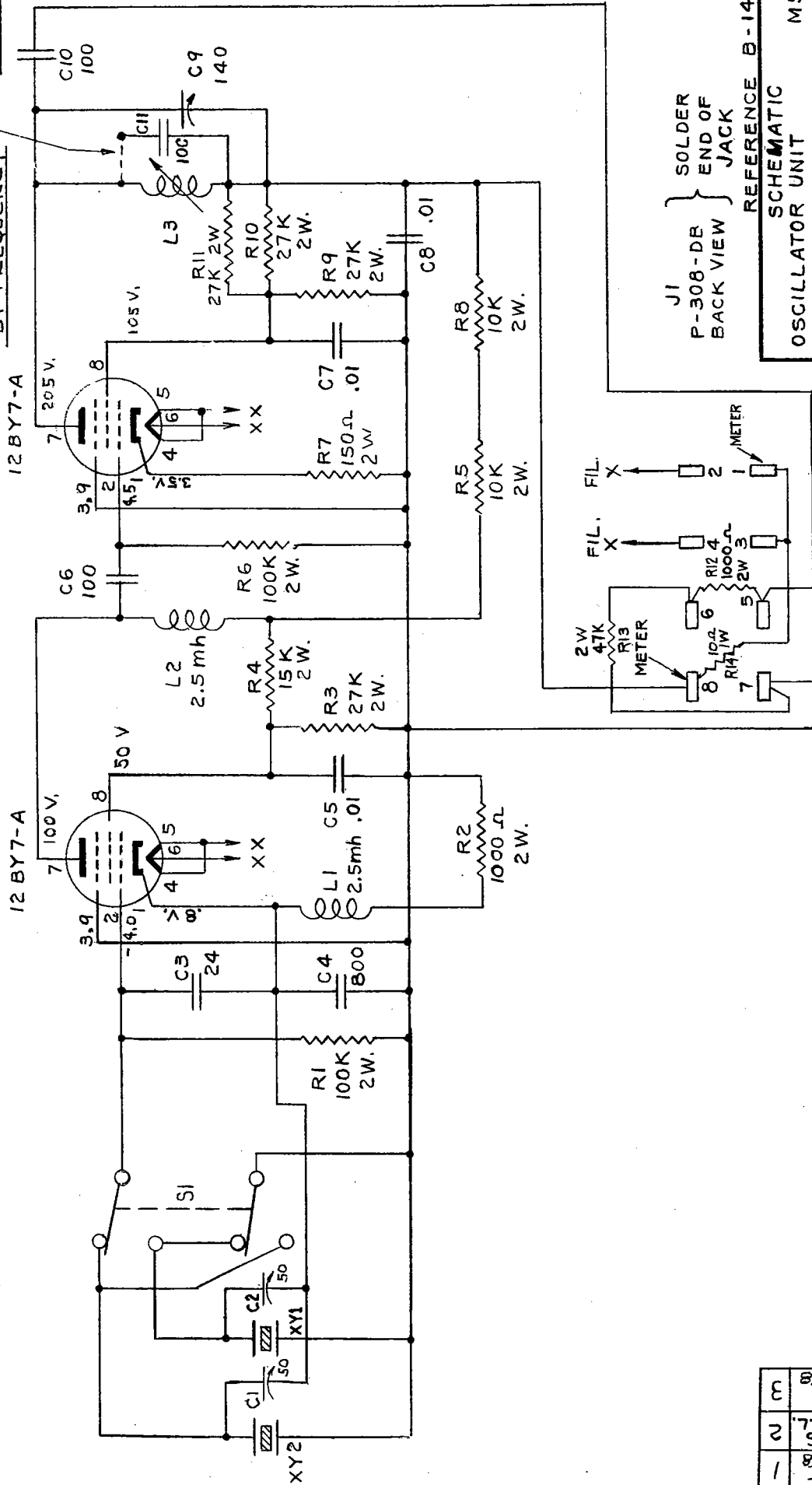
CH. BY <i>dlw</i>	MTL-2"X4" YEL. PINE	TITLE WOOD BASE FOR 1KW AM XMTR BC1T M5393		UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC 68100.
DATE <i>7/19/57</i>				
DR. BY TRB	ENG. <i>B.L.</i>	FIN. <i>GA3</i>	A 30585	
DATE 7-17-57	<i>8-8-57</i>			



DRAWING NUMBER

B-13816

CONNECTION DETERMINED
BY FREQUENCY



J1 } SOLDER
P-308-DE } END OF
BACK VIEW } JACK

REFERENCE B-14041

OSCILLATOR UNIT

M5422

UNLESS OTHERWISE SPECIFIED
ALL TOLERANCES PER GATES
SPEC. G0102.

DRAWING NUMBER

B-13816

MTL

DES. BY D.L.

CH. BY

DATE 5-3-57

ENG. APL.

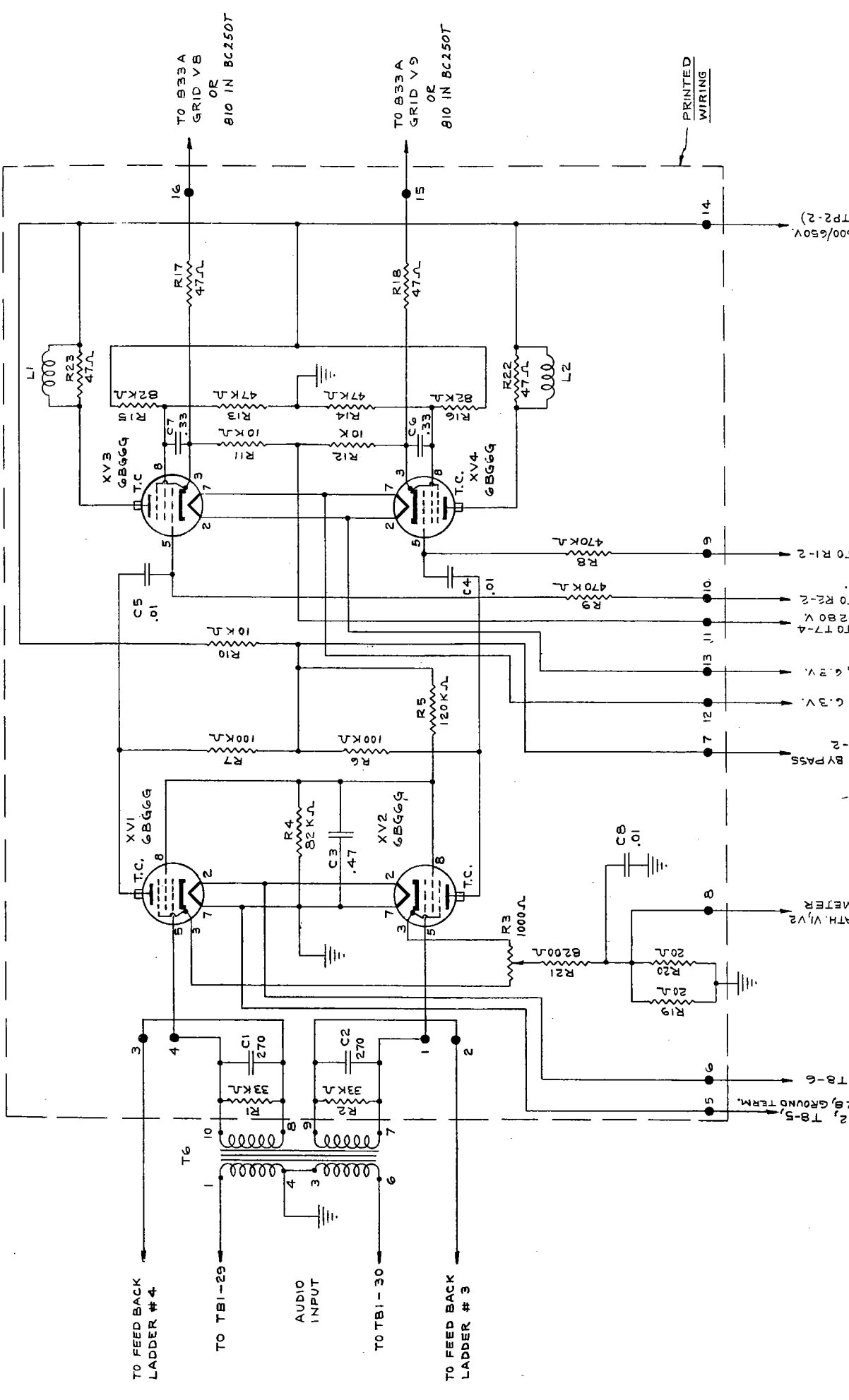
DATE

GATES RADIO COMPANY
QUINCY, ILLINOIS

1	ECN 7482	CTN 6-11-58
2	ECN 7496	7-2-58 D.L.
3	ECN 7679	SDR 11-17-58

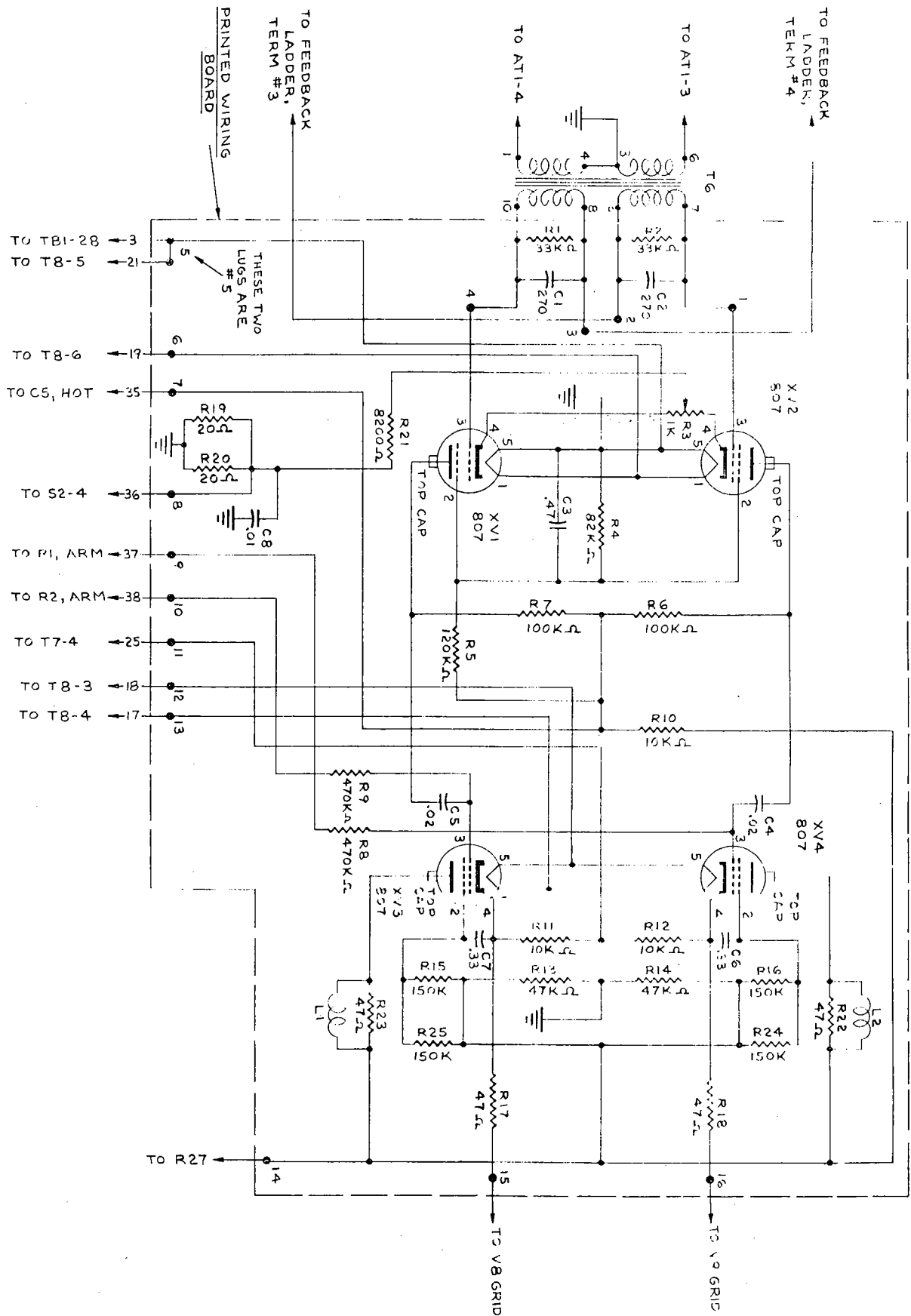
GATES RADIO COMPANY QUINCY, ILLINOIS		SCALE	
REF. DES. NO.	REV. NO.	QTY.	ITEM
108	105	104	103
102	101	100	99
98	97	96	95
94	93	92	91
90	89	88	87
86	85	84	83
82	81	80	79
78	77	76	75
74	73	72	71
70	69	68	67
66	65	64	63
62	61	60	59
58	57	56	55
54	53	52	51
50	49	48	47
46	45	44	43
42	41	40	39
38	37	36	35
34	33	32	31
30	29	28	27
26	25	24	23
22	21	20	19
18	17	16	15
14	13	12	11
10	9	8	7
6	5	4	3
2	1		

DESCRIPTION	REF. GEN.	FIN.	MATERIAL
LIST OF PARTS			

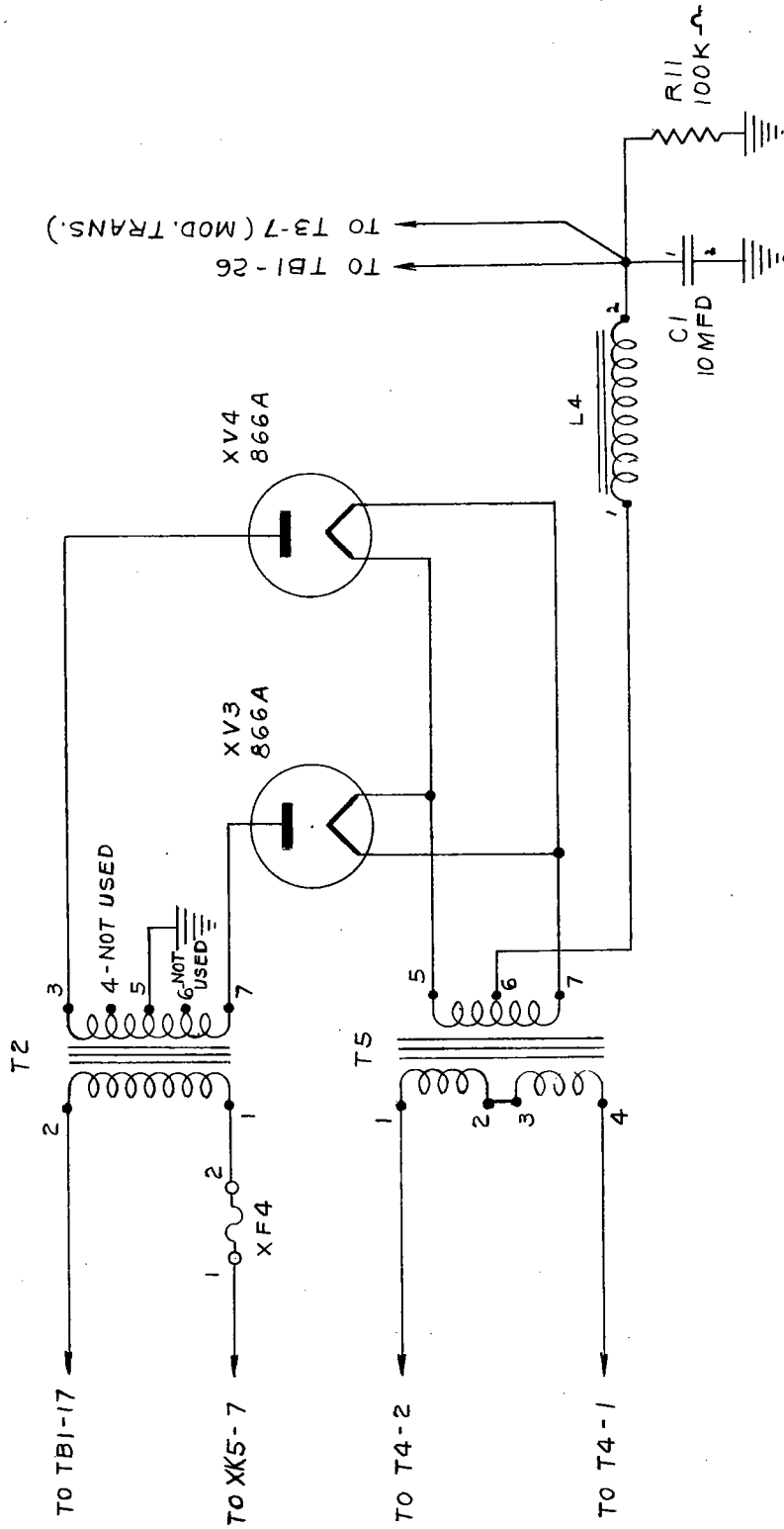


TITLE: AUDIO INPUT / CATHODE FOLLOWER DRIVER SCHEMATIC - 16M.XMTR.BCIT M5593
 250 W. XMTR, Bc150T, M5627-500W.XMTR, Bc150T, M5554
 DATE: 7/6/57
 ENG. DATE: 7/6/57
 CH. BY: B.V.G.
 DATE: 7/6/57

PCN 8142	4	HMC 2-23-40
PCN 7515	3	ECN 7515
PCN 8-8-59	2	AWCS-8-59
PCN 7875	2	16-5-59 D.L.
PCN 7374	1	12-12-57



GATES RADIO COMPANY QUINCY, ILLINOIS		B-65324	
SCALE		SCALE	
LIST OF PARTS			
QTY.	QTY.	QTY.	QTY.
106	105	104	103
102	101	101	101
ITEM	ITEM	ITEM	ITEM
REFERENCE	REF.	FIN.	FIN.
DESCRIPTION		MATERIAL	



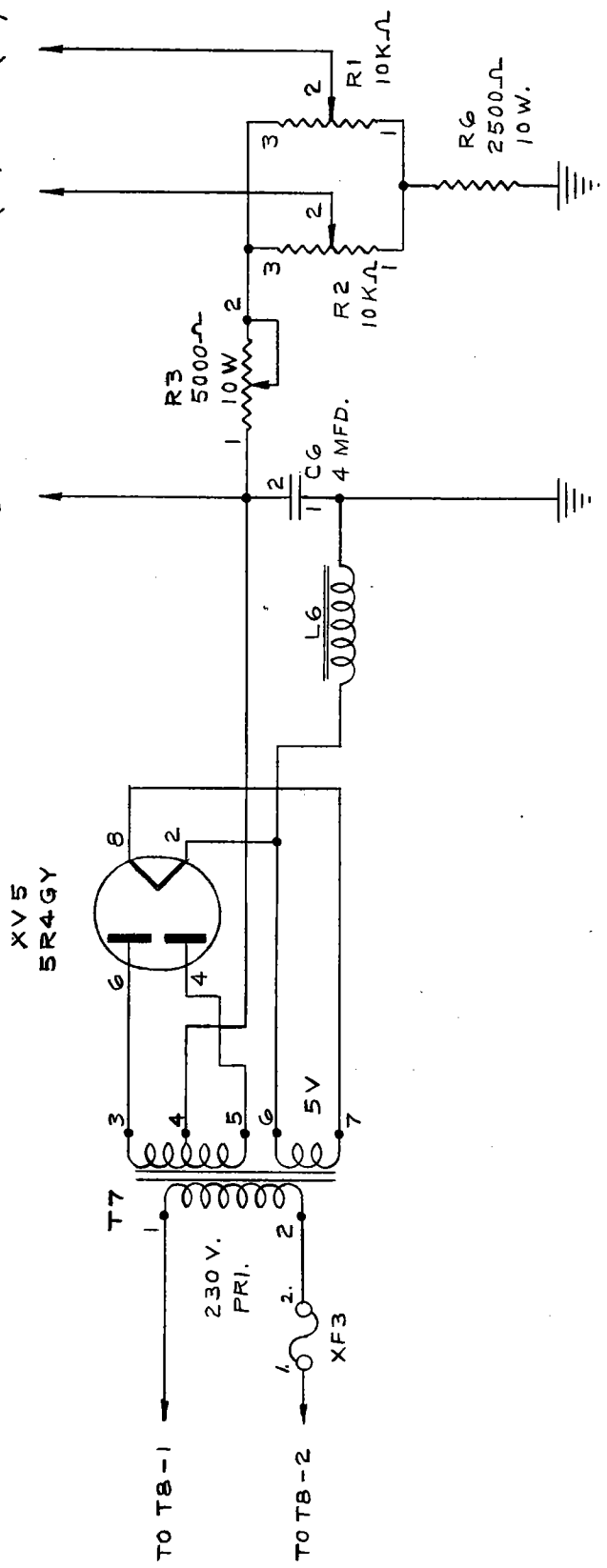
TITLE		INT. VOLTAGE (600/650V.) POWER SUPPLY	
1 KW. TRANSMITTER, BC1T, M5393/M5790		500W TRANSMITTER, BC500T, M5554	
MTC		FIN.	
DR. BY D.L.	CHK. BY	ENG. DATE	
DATE 7/15/50			
UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER DATE SPEC. DRAWING.		B-65324	

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

TO AUD-11
- 280 V.

TO AUD-10 (V3)

TO AUD-9 (V4)



TITLE **BIAS SUPPLY (SCHEMATIC)**

1KW. XMTR, BC117, M5393-250W XMTR, BC430T-M5417

500W XMTR, BC500T, M5554, M5790, 1000/2150W

MTL _____ FIN. _____

UNLESS OTHERWISE SPECIFIED,
ALL TOLERANCES PER GATES
SPEC DRAWING.

DR. BY WJH CH. BY WJH ENG. WJH

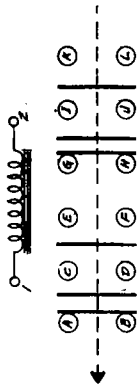
DATE 7/5/57 DATE 7/5/57 DATE 7/5/57

B-65293

837 9603 001

CONTACT ARRANGEMENT, KIA

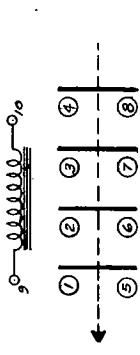
SHOWN ENERGIZED



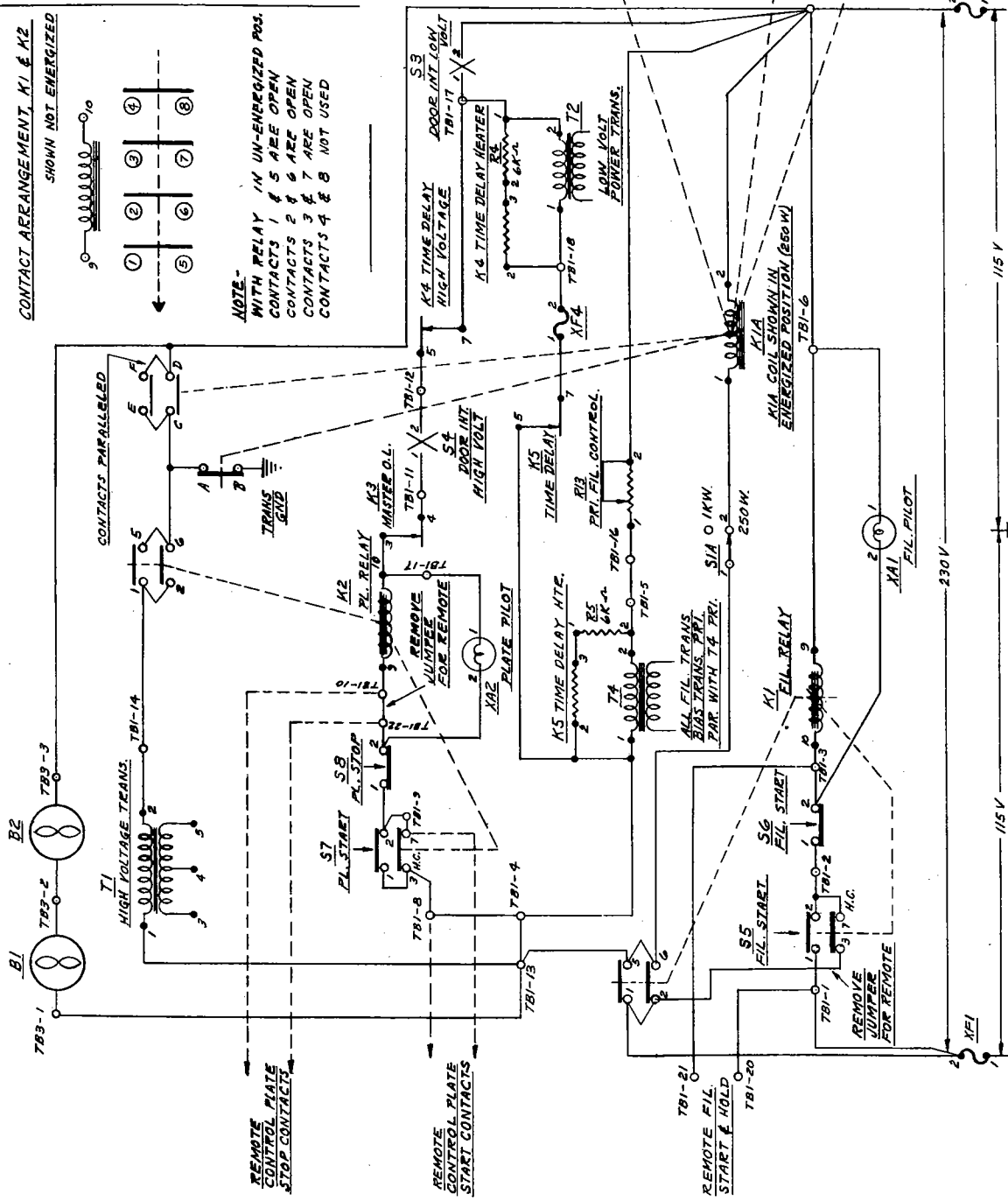
NOTE -
 WITH RELAY IN ENERGIZED POSITION,
 CONTACTS A & B ARE CLOSED,
 CONTACTS C & D ARE OPEN,
 CONTACTS E & F ARE OPEN,
 CONTACTS G & H ARE CLOSED,
 CONTACTS I & J ARE OPEN,
 CONTACTS K & L ARE OPEN

CONTACT ARRANGEMENT, K1 & K2

SHOWN NOT ENERGIZED



NOTE -
 WITH RELAY IN UN-ENERGIZED POS.,
 CONTACTS 1 & 5 ARE OPEN,
 CONTACTS 2 & 6 ARE OPEN,
 CONTACTS 3 & 7 ARE OPEN,
 CONTACTS 4 & 8 NOT USED

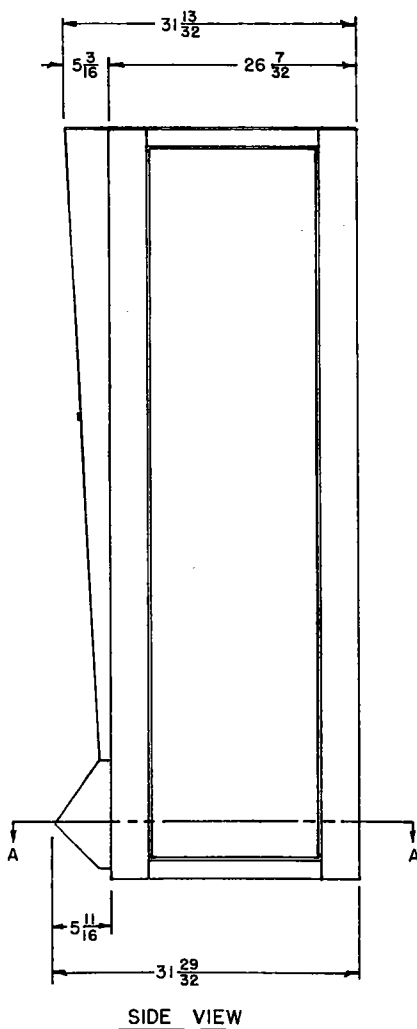
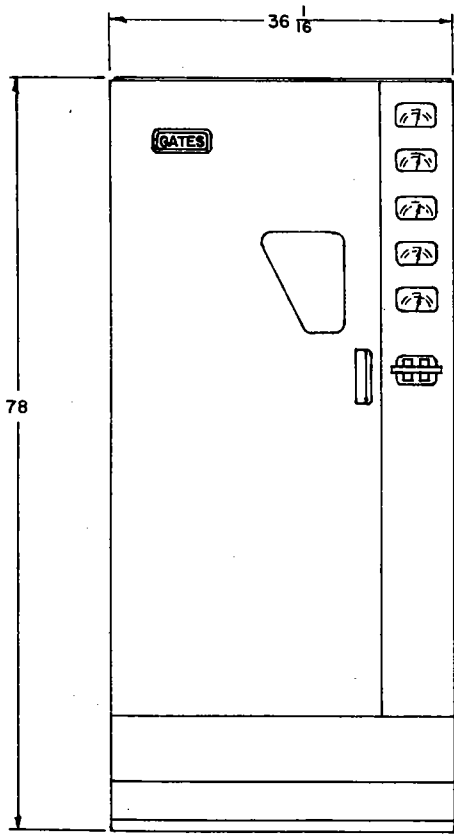
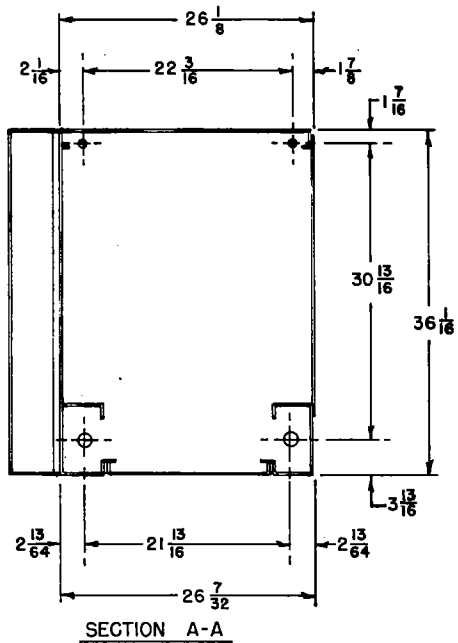
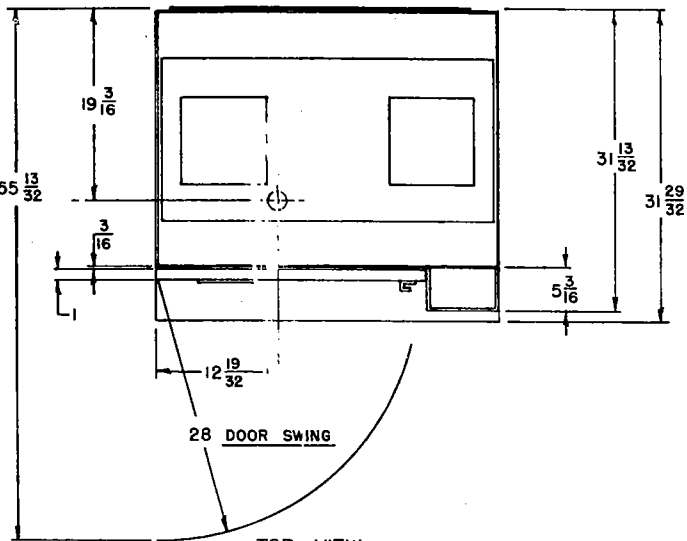


NOTE -
 SEE OVERALL SCHEMATIC 852 578000L

GATES RADIO COMPANY,
 QUINCY, ILLINOIS
 SCHEMATIC SIMPLIFIED CONTROL
 BCT 100/250 W. M5790

DR BY AKC
 CH BY JUV
 DATE 5-9-61
 ENG YUV

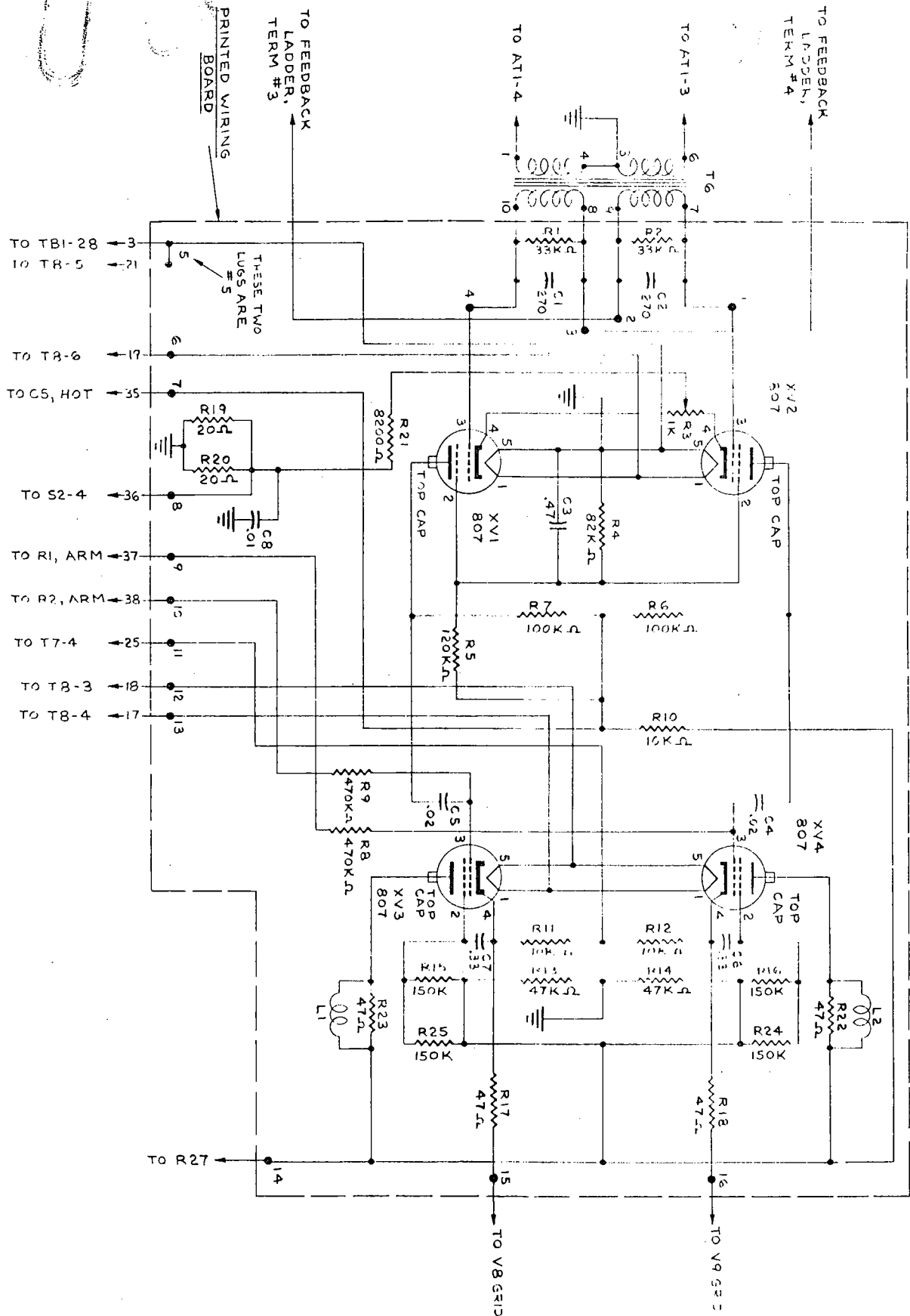
837 9603 001



THIS DNG. PERTAINS TO -
 1 KW. XMT. BC17, M5393
 250W. XMT. CS507, M5427
 500W. XMT. BC500J, M5554

C-77736

C-77736



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:

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

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 4.5×4.5 , 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 first 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 everything 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.