GATES

KIT
Yakima, WA

GATES' BC-500K, 500 WATT BROADCAST TRANSMITTER

The Gates' BC-500K Broadcast transmitter is a completely self-contained 500 watt AM unit, designed for broadcast service within the frequency range of 1600 Kc to 540 Kc.

IB-852
July 14, 1955

Gates Radio Company
Quincy, Illinois

World Radio History

ADDENDA SHEET

INSTALLATION INSTRUCTIONS FOR REMOTE CONTROL IN GATES TRANSMITTERS BC-1J, BC-500K, BC-250L

M-4703 Rheostat Assembly

Refer to drawing B-13417 RDC-10 Remote Equipment

Refer to drawing B-13275 RCM-20 Remote Equipment

The Rheostat Assembly can be conveniently mounted on the cabinet base, right front, near the filament and plate contactors. Tapped 8-32 holes have been provided for machine screw mounting. Using Packard high voltage cable or equivalent, run the two rheostat leads upward through an available hole in the modulator deck to the modulation reactor. Disconnect from the modulation reactor high voltage lead which runs from Modulation Reactor terminal "B" upward to the R.F. Amplifier Deck. Connect one of the rheostat leads to the end of the lead removed, and the other rheostat lead to modulation reactor terminal "B". Set the transmitter's existing plate rheostat to maximum voltage position (minimum resistance).

Plate Voltage Extension Kit M-4719

Refer to Remote Control Instruction Book - drawing C-19233 - figure 1.

Tapped 10-32 holes have been provided adjacent to the filter components for machine screw mounting of the M-4719 Kit. Using Packard cable or a high voltage equivalent connect the M4719 "HV" terminal to the remote rheostat terminal furthermost from the power supply. Do not connect to the rheostat terminal which goes to modulation reactor terminal "B". Connect M-4719 kit terminal "G" to a good ground point within the transmitter.

Plate Current Extension Kit M-4720

Refer to Remote Control Instruction Book - drawing C-19233 - figure 3.

Tapped 10-32 holes have been provided on the cabinet base for mounting the M4720 kit - right side of cabinet - near the front extremity of the cable entrance cutout. The kit is connected at the ground end of the P.A. cathode circuit. Remove the jumper that connects terminal #4 of P.A. overload relay E5 to terminal #4 of relay E4. Do not remove the lead connected from #4 of E4 to ground. The "G" terminal of the two-terminal strip of kit M4720 should be connected to a good ground point within the transmitter. Connect the other terminal to transmitter P.A. overload relay E5 terminal #4.

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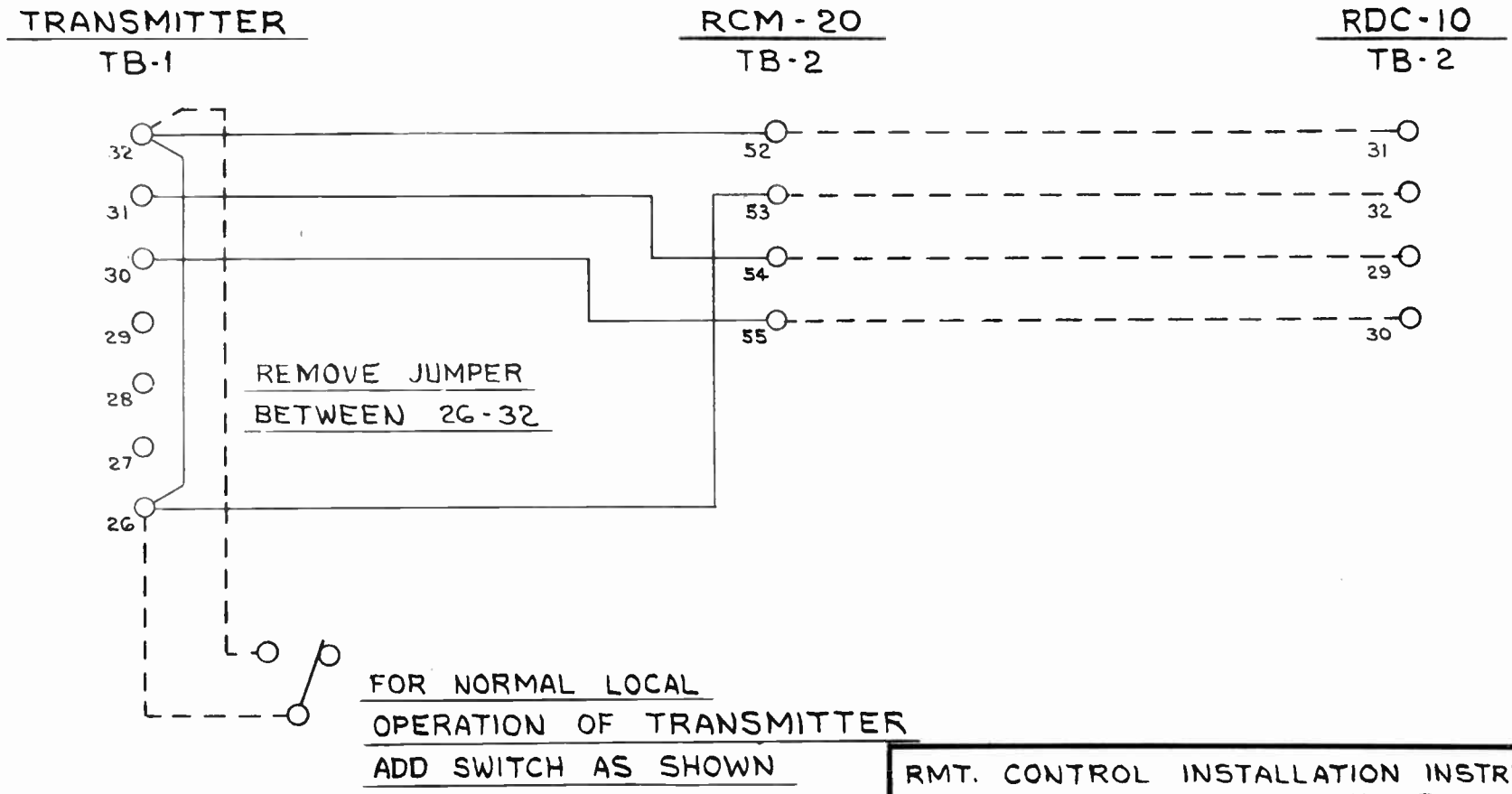
DRAWING NUMBER
A-11404



RMT. CONTROL INSTALLATION INSTRUCTIONS
BC1J-M4915, BC250L-M5147, BC500K-M5157

MTL	FIN.	UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC GSM102.
DR. BY RGK DATE 1-12-55	CH. BY DATE	ENG. APR. V.C.M. DATE

GATES RADIO COMPANY
QUINCY, ILLINOIS

DRAWING NUMBER
A-11404

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ADDENDA SHEET

ATTENTION INSTALLATION ENGINEER

The high voltage meter multiplier, R3, and its' associated mounting assembly have been removed for shipping. These parts are securely wrapped and placed in box and shipped with the Radio Frequency Deck. The installation of this meter multiplier can be easily accomplished by following the information contained on various tags tied to the connecting wires. The multiplier mounting assembly bolts to the underside of the R.F. deck near the left edge as the deck is viewed from the rear. The approximate location has been stencilled with the nomenclature "R3".

D.C. resistance measurements taken on the modulation transformer T6, Gates Drawing AM-10464E.

Center tap to one side of primary, approximately 35 ohms.

Center tap to other side of primary, approximately 100 ohms.

Secondary winding approximately 168 ohms.

July 14, 1955

Gates Radio Company,
Quincy, Illinois

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BC-1J/BC-500K/BC-250L ADDENDA SHEET

There has been added to the Twin Drive Audio Deck a small variable condenser (C61) located on the top of the chassis, near the input audio tube, V9. This condenser is used as a phase corrector and is very useful for minimizing high frequency distortion.

Adjusting Procedure -

The noise and distortion can be brought down to minimum readings by following this procedure during test. Set the modulator bias controls (R66 & R67) so that each modulator is drawing its correct static plate current.

BC-1J - 40 ma per tube, 80 ma total.
BC-500K - 30 ma per tube, 60 ma total
BC-250L - 30 ma per tube, 60 ma total.

Now with 50 cycle audio input check the distortion. Adjust for minimum distortion by use of cathode balance control R41. This control is on left front corner of "Twin Drive" audio deck as transmitter is viewed from the back.

At this point modulate the transmitter with 7500 cycle audio input and check distortion. Adjust the small condenser (C61) also located on the "Twin Drive" audio deck at the front right hand corner of the deck, when transmitter is viewed from the rear, to a position which gives lowest distortion reading at this 7500 cycle audio input.

Now go back to 1000 cycles, modulate the transmitter to correct levels and measure noise. Both noise and distortion readings taken under these test conditions should be satisfactory.

September 29, 1955

Gates Radio Company,
Quincy, Illinois

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I N D E X

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SECTION I - ELECTRICAL SPECIFICATIONS

1. Power output, 500 watts, The BC-500K can be operated at 550 watts output, if necessary, to overcome losses in transmission lines and/or phasing equipment. On special order this transmitter can be adapted for quick change to 250 watts output.

2. Frequency range - 1600 Kc to 540 Kc.

3. Primary power - 230 volts, two wire single phase, 50/60 cycles.

4. Input power - Transmitter draws from 2450 to 3250 watts depending upon percentage of modulation.

5. Frequency stability - ±5 cycles.

6. Type of modulation - Class "B", high level, modulation capability 100%.

7. Audio input impedance - 150/250/600 ohms.

8. Audio input level (100% modulation) 7 DBM, ±2 DBM (100 cycle, sine wave).

9. Audio response - 30 to 10,000 cycles, ± 1-1/2 DB.

10. Distortion - 3% or less, 50 cycles to 7500 cycles measured at 90% modulation.

11. Noise - Minus 60 DB below 100% modulation.

12. Carrier Shift - 4% or less, 0-100% modulation.

13. Output impedance - To match 50/70 ohms at all frequencies, 540-1600 Kc. Coupling unit available for other impedances.

14. Tubes Used -

    One, 6AG7 Osc.
    One, 6AG7, 1st IPA
    One 833A Power Amplifier
    Two, 6146's, 2nd IPA
    Two, 6SN7, 1st Audio and Phase Inverters
    Four, 1622, Audio Driver Tubes
    Two, 833A, Modulators
    Two, 8008's, High Voltage Rectifiers
    Two, 5R4GY Intermediate Voltage Rectifier
    One, 5R4GY, Low Voltage Rectifier
    One, 5R4GY Bias Rectifier
    One, 6AQ5 Clamper Tube
    One, OB2, Voltage Regulator

15. All frequency determining components (except crystal and oven) are included in the R.F. section of the transmitter.

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SECTION II - MECHANICAL DESCRIPTION

1. Overall dimension - 78" high, 42" wide and 30" deep. No space required for door swing, as rear door is of slip-on type.

2. Floor space - 8.7 square feet.

3. Weight unpacked - 800 pounds, approximately.

4. For shipping, the RF deck and the Modulator deck have been removed, along with certain other components such as modulation transformer, modulation reactor, power transformer and filter chokes.

SECTION III - INSTALLATION

This instruction book affords valuable information for persons who are installing and operating the Gates' BC-500K Transmitter. The following mentioned points should be studied so that the unpacking and setting up procedure will be well in mind when doing the actual work.

1. Check all packing lists for materials.

2. Read this instruction book completely before attempting to set up the equipment.

3. Have the transmitter location clean so that the various parts can be safely placed out of harms way when they are unpacked.

4. It is preferable to have a mounting base, in place, upon which the transmitter can be set. This base can be made out of 2 x 4 lumber, preferably painted black. See Gates' Drawing A-10349, a part of this instruction book. This base should be lagged to the floor, and measures taken to make sure the top side of the frame is perfectly level. This will give a good solid, level base upon which the transmitter can set.

5. Use heavy primary wire from the switch box to the AC input terminals on the transmitter. Number four or six wire will be very suitable.

6. Be sure the power company has installed large enough service for all of the equipment, lights, water pump, etc., which will be in use at the transmitter site.

7. Do a good job of installing the equipment. Time spent in making your installation as good electrically and mechanically as possible will pay off in the future. You will have less loss of valuable air time if this idea is followed to the best of the installation engineers ability.

8. Acquaint yourself with this equipment by studying this instruction book and all of the schematics herein.

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SECTION IV - BC-500K TRANSMITTER

For shipping purposes, the following has been removed from the transmitter.

1. The Radio Frequency Deck.
2. The Modulator Deck. Taken off this deck has been the modulation transformer, T6, and the modulation reactor, L21.
3. Main High Voltage Power Transformer, T11.
4. Input Swinging Choke, L22.
5. Output Smoothing Choke, L23. — One Assembly
6. All Tubes and Crystals if supplied.
7. Output Feedthru Insulator.
8. Time Delay Relays, E7 and E8.

The removed items have been separately boxed to help insure safe delivery of the transmitter. Be sure to check the packing lists for any discrepancies. The various parts are all marked with their schematic symbol and replacement within the cabinet should be easily accomplished by checking with the various photographs that are provided as a part of this instruction book.

The output feedthru insulator that has been removed for packing, can easily be replaced in the top of the cabinet. The coil, L15, (Modulation monitor pickup) and the two parasitic suppressor assemblies have also been removed and packed in a carton secured to the R.F. Deck. The copper tubing connection between coils, L13 and L14, has been removed and secured to the R.F. deck.

The following information on the Gates' BC-500K transmitter pertains to the general construction and operation of the unit. It is highly desirable to study the transmitter through its' various sections in order to completely understand and comprehend its operation.

The oscillator is an independent unit mounted on the Radio Frequency Deck at the rear (right side as transmitter is viewed from the rear). This oscillator circuit is the so-called grid-plate and the oscillator output circuit is electron coupled to the grid circuit. This gives good isolation to the crystal and makes for very stable operation. The output of the 6AG7 oscillator tube drives the grid of the first IPA stage, another 6AG7. This stage is tuned. Provision is made for padding this stage for low frequency operation, the condenser terminals are close to the second 6AG7. No padding is required from 1600 Kc to approximately 850 Kc., from this frequency to 540 Kc a 270 mmfd mica condenser is used. This condenser is furnished as a part of the transmitter and will be found in a bag tied to the ground connection on the oscillator unit. The oscillator cathode current, the 6AG7, 1st IPA cathode current and the grid current to the parallel 6146's, are measure by the first three positions on the multi-meter switch, located on the front control panel. These positions are marked Osc. plate, 1st IPA

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plate and 2nd IPA grid. For typical readings obtained in these circuits refer to Gates' Drawing A-10957, which is a part of this instruction book.

The crystal ovens operate on 6.3 volts AC. This voltage is supplied by a small step-down transformer, T1. The crystal holders supplied are of the variable gap type. Be sure to read the directions supplied with each holder. Follow these directions to adjust the air gap which governs the frequency of operation. For very slight changes in frequency, the variable condensers, C3 and C4, can be used. These condensers are in shunt with the crystals and can vary the frequency from 5 to 10 cycles depending on fundamental frequency. Also, at the rear of the oscillator unit is a variable control (R13) which varies the screen voltage of the 1st IPA, 6AG7. This controls the output of this stage. For normal operation, the grid current to the parallel 6146's should be from 2 to 4 ma. This figure can be obtained by adjustment of screen control, R13.

Provision has been made in the 1st IPA stage (6AG7) to supply voltage to operate any standard Frequency Monitor, such as the Gates' MO-2890. This output voltage is available at terminal #6 on TB3. A ground is conveniently located at terminal #7. By connecting a suitable length of Co-ax cable to these terminals and the Frequency Monitor. The installation of the monitor is easily completed.

The oscillator unit is supplied with 550 volts from the Intermediate Voltage Power Supply, located on the Modulator Deck. This supply uses a pair of 5R4GY rectifiers (V19 and V20).

The second IPA stage uses two 6146's operating in parallel. These tubes have approximately 550/600 volts applied to their plates. Full protection is afforded these tubes by use of a screen clamper tube, the 6AQ5(V6). The cathode current of the two 6146's will run between 150 and 200 ma depending upon frequency and loading. This current is indicated by the multi-meter, when the selector switch is set to "2nd IPA plate". The 6146 driver stage is tuned from the front panel by control Knob designated "2nd IPA tune". This stage will tune with no padding from 1600 Kc to approximately 800 Kc. From 800 Kc to 540 Kc. Padding condenser, C23, a 500 mmfd. mica must be paralleled across the tuning condenser, C24. This padding condenser is supplied as standard equipment on all transmitters. If the frequency of operation is such that C23 is not used, remove both jumpers from the variable condenser, C24. Also, take the jumpers off of C23, doing this will preclude any possibility of accidental shorts.

The 6146 RF driver will supply adequate drive to the 833A P.A. tube. The normal grid current, as indicated on the multi-meter, when selected, will run between 80 and 140 ma.

Neutralization of the power amplifier is accomplished by the "Rice" method, the out of phase voltage being obtained from the 6146 tank coil. There are several taps around the mid point on this coil (L9), these taps allow neutralization adjustment.

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One plate of the neutralizing condenser, C26, has mounting slots provided which will enable the operator to slightly adjust this plate to change the spacing of the condenser. This condenser is normally adjusted at the factory and should require no further attention. Neutralization can be further varied by means of the five taps mentioned above.

The power amplifier makes use of one 833A. The output circuit is a combination "pi" and "T", a circuit proved over the years as one which is flexible and also very effective in attenuation of undesirable harmonics. The coil and capacitor values as supplied in the transmitter are effective in loading this transmitter into a 50/70 ohm load.

The output circuit of the transmitter includes a pick-up coil (L15) which supplies sufficient RF voltage to operate a modulation monitor, such as the Gates' MO-2639. This voltage is available at a terminal board located in the top of the cabinet.

This amplifier is rather novel, in that no variable, air dielectric condensers are used for tuning. The tank circuit is tuned by a rolling contact inductor, L12. This method of tuning is helpful in preventing arcs or flash-overs that may occur in variable condensers, especially if there is dust accumulation.

The P.A. tank circuit includes two 250 mmfd. mica condensers, C31 and C32, connected in parallel. These condensers are used for frequencies of 1600 to approximately 850 Kc.

For lower frequencies, 850 Kc to 540 Kc, another mica condenser, C33, 500 mmfd must be paralleled with C31 and C32. This is shown on Gates' schematic, E-25408 which is a part of this instruction book, and tuning chart A-10957.

The power amplifier plate current is read on P.A. plate meter, M4, a 0-500 ma meter. This current will generally run from 320 to 350 ma. depending upon the efficiency and the applied plate voltage. The normal plate voltage as read on Plate Voltmeter, M5, will be around 2000 volts. As mentioned previously, the P.A. Grid Current is indicated on the multimeter will be 80 ma to 140 ma depending upon frequency, tuning, etc.

Two P.A. tuning controls are located on the R.F. deck front panel, toward the top. The Veeder Counter Control on the right tunes the power amplifier plate coil, the counter control on the left adjusts the loading coil, L14.

The modulator deck contains the complete audio system, the bias power supply, 380 volt power supply and 600 volt power supply.

The complete audio driver unit comprised of the audio input transformer the first audio stage and phase inverters (6SN7's) and audio driver tubes (4 - 1622/5881) and the audio driver transformers is built up as a complete unit. This chassis is so mounted, that by disconnecting

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the input wiring from TB6, TB7, and TB9 it can be removed for servicing, if needed.

The output of this audio driver is connected to the grids of a pair of 833A modulators, V15 and V16. Also, on this modulator deck is the modulation transformer, T6, modulation reactor, L21, and coupling capacitor, C58.

The first audio stage makes use of two 6SN7 tubes (V9 and V10) serving a dual purpose, first as a push-pull audio stage and also as phase inverters to drive the push-pull "Twin Drive" audio driver tubes, V11, V12, V13 and V14.

A balance control, R41 is located on the left front top of the audio driver chassis as viewed from the back. This control is in the cathode circuit of the two tubes in the input circuit. It is suggested that this control be used to adjust for lowest distortion at 7500 cycles. If this is done, the balance will hold over the audio range.

The filaments of these tubes are all energized from a 6.3 volt winding on Filament Transformer, T10. This Transformer supplies the two 833A modulator tubes, as well as the 6SN7's and 1622 tubes.

There are two separate feedback loops in the audio system. One makes use of separate tertiary windings on the driver transformers, T4 and T5, producing about 26 db of feedback around the audio drivers. The second feedback loop is taken from the plates of the modulators back to the input audio stage. This loop develops approximately 6 db of feedback. By the use of this feedback the distortion is kept at a low figure. The amount of internal feedback varies as the modulator drive varies. The above figures are based on average modulation of approximately 75%.

The modulators of the BC-500K Transmitter are a pair of 833A tubes operating as class "B" audio amplifiers. These tubes are driven by the "Twin Drive" audio drivers, the four 1622/5881 tubes. The modulators are biased by a separate power supply, the bias voltage is adjustable from the front of the modulator deck panel. These controls are R66 and R67. These controls are adequately marked on the front panel. The static plate current of the modulators will run approximately 60-80 ma as read on meter M2. The plate current will rise to approximately 150-300 ma depending on the percentage of modulation. The modulators are protected by overload relay, E4, located on the relay panel in the base of the transmitter. This relay has its throw out point raised or lowered by a shunt resistor across the relay coil. Normally this relay is adjusted to kick out at about 400 ma. This will allow unavoidable over modulation peaks to occasionally go through and not cut off the transmitter.

The relay panel is located on the right side of the transmitter base, when viewed from the rear. On this relay panel are mounted the following relays:

(a) Relay E1, filament contactor.

(b) Relay E2, plate contactor.

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(c) Relay, E3, master relay.

(d) Relay, E4, modulator overload

(e) Relay E5, P.A. overload

(f) Relay E6, P.A. grid undercurrent

(g) Relay E7, Time Delay Relay

OPERATION

Relay E1, the filament contactor, when energized by depressing the filament start switch located on the front panel, causes all of the filaments in the transmitter to be heated. Also, at the same time the modulator and audio driver bias supply has become operative, putting correct operating bias on these tubes. At this same time, the time delay relay, E7, is also heating and at the end of its' heat cycle, its Normally Open Contacts are closed. Simultaneously the Intermediate voltage time delay relay, E8, is heating and after its operating cycle of from 5 to 10 seconds has passed, 380 volts D.C. is applied to the four audio driver tubes and approximately 550/600 volts is applied to the pair of 6146 RF driver tubes. This intermediate voltage supply is adequately protected by a door interlock S8 which operates in the primary of the intermediate plate transformer, T7. If the back door is off, door interlocks, S6 and S8 mentioned above, will make it impossible to apply high DC voltage of any sort to the transmitter (remember that approximately 100 volts of bias is on and in operation within the transmitter whenever the filaments are lighted). If door interlock switch, S6, is closed it will be possible to apply high voltage to the transmitter. This is accomplished by depressing the plate start switch, located on the front control panel. When this plate start switch is depressed, the coil of relay, E2, the plate relay, is energized applying primary power to high voltage plate transformer, T11, in the transmitter.

OVERLOADS

Also, on the relay panel are two overload relays, modulator overload E4 and P.A. overload, E5. These relays are in the filament center tap return. By means of shunt resistance across the coils of these relays their tripping point is adjusted for satisfactory operation. Both relays, E4 and E5, are set at the factory to kick out at about 400 ma. This gives satisfactory protection to the modulator and P.A. stage. These relays can be re-adjusted by the station engineer to suit his requirements, as desired.

Of interest, also, is relay E6, the P.A. grid undercurrent relay. This relay closes when rectified grid current flows through it, as long as there is sufficient drive the relay will be closed. If for any reason, the grid excitation fails, this relay will de-energize and cause the plate relay, E2, to open up, thus removing high voltage plate power from the transmitter.

The Gates' BC-500K incorporates four D.C. power supplies. The 380 volt supply, using one 5R4GY rectifier (V18) supplies plate and screen voltage to the audio input stage and audio driver stage. This supply becomes operative when the fil. start button is depressed. After the time delay relay E8 has closed and if the door interlock S8 is also closed. This supply has its high voltage winding as a part of T7, its filament voltage is derived from a winding on transformer, T8.

The filter system for this low voltage supply is made up of choke, L19 and filter condenser, C56.

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The RF output terminal of the transmitter is located at the top of the transmitter toward the left front as viewed from the front. A ground stud is provided close to the output insulator for grounding the transmission line. This ground also carries on down to the R.F. section. At the base of the cabinet near the cut-out, is a stud to be used to ground the cabinet to the ground system of the station. The station ground system should be as good as can be made, all connections solid and preferably brazed together. It is wise to bond all electrical conduits, metal frame work of buildings, etc. to the common ground system. Less trouble will be had in years to come if this suggestion is followed, as aging of the ground system will cause no trouble, if it is installed well.

SECTION V - INITIAL TUNE-UP OF GATES' BC-500K

Before proceeding with the initial tune-up of this transmitter, let us recheck the necessary things to be done, before any voltage is applied to the transmitter. Briefly check the following list.

(a) Proper line voltage to terminals 24 and 25 on relay panel. This should be 230 volts, 50/60 cycles.

(b) Proper location of all tubes in sockets. These tube locations can be checked by reference to the stencilling on the unit and to this instruction book.

(c) Check to see that all tie-down twine and other shipping material has been removed from the various components, especially the relays.

(d) Recheck on all components that were installed. Be sure they are connected correctly. The parts have been tagged to help in the correct installation.

(e) Go over the complete transmitter, checking the tightness of all nuts and bolts, terminal board connection, etc.

(f) Give all soldered connections a brief looking over. The equipment has passed several rigid inspections during its course of manufacture, but something could have been overlooked that might give trouble in the future.

(g) Make certain the transmitter and associated equipment is well grounded.

(h) It is suggested that all audio input wiring be shielded and placed in conduit or wiring troughs, away from a.c. wiring.

(i) Be sure the crystal and oven assemblies are in their sockets, they should be heating as soon as the main primary wires are connected to the relay panel. The ovens should be warm to the touch, if not, check fuse, F3, for continuity.

(j) All tubes should be in their correct sockets, all relays free.

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It is suggested at this point, that the transformer leads to the plates of the high voltage rectifiers, 8008's, V21 and V22, be removed from these tubes. This will insure no high voltage D.C. being applied to the transmitter.

Let us tune this transmitter to 1400 Kc. The crystals should be for 1400 Kc operation, the ovens should be heating. Remove plate caps from high voltage rectifiers, V21 and V22, Short out door interlocks S6 and S8.

Depress filament start button on front control panel. This will cause filament relay, E1, to energize which lights all filaments and causes the bias supply to produce bias voltage. This bias voltage should be approximately 100 volts and can be measured as follows. Turn the bias controls, R66 and R67, fully counter-clockwise. This puts maximum bias voltage on the 833A modulators. By use of a good D.C. voltmeter this voltage can be measured from grid of modulator tube V15 to ground. This will be approximately 100 volts. At this time, the fixed bias on the four 1622/5881 audio driver tubes can be checked. Measuring from terminal 3 on TB6 to ground, a voltage of approximately 21 volts should be found. The voltage will be negative on the grids of the modulators and on the terminal board. Adjust 1st IPA screen control on rear of oscillator unit to maximum clockwise rotation. When the filament button was depressed and all filaments energized, the intermediate voltage time delay relay, E8, also becomes actuated and after a short interval of time (5 to 10 seconds) the intermediate voltages were applied to the audio input and driver tubes and the oscillator, 1st IPA and 2nd IPA stages.

Move around in front of the transmitter and tune up. First set Multimeter switch on oscillator plate, multimeter should read approximately 6 to 8 ma oscillator cathode current, change multimeter switch to 1st IPA plate, then adjust 1st IPA control for minimum reading (resonance) on multimeter this will be approximately 8 to 20 ma depending upon setting of screen control, R13. Note that on frequency of 1400 Kc no padder condenser is required at C17. See tuning chart A-10957. Now set multimeter switch to 2nd IPA plate.

Adjust 2nd IPA tuning control to show minimum plate current on multimeter. Note that on frequency of 1400 Kc no padder condenser is required at C23. See tuning chart A-10957. This current will read somewhere between 100 and 150 ma depending upon frequency of operation load, etc. Now set multimeter switch to P.A. Grid, the multimeter should indicate between 80 and 140 ma grid current to the power amplifier. At this time, go back over the complete five settings of the multimeter switch to check the tuning. These readings are typical -

"Oscillator Plate" - 6 to 8 ma.

"1st IPA Plate" - 4 to 15 ma depends on adjustment of screen control R13.

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"2nd IPA Grid" - 2 to 4 ma (if this reading is too high, it can be reduced by adjusting the screen control R13, of the 1st IPA Amplifier)

"2nd IPA Plate" - 100 to 150 ma.

"P.A. Grid" - 80 to 140 ma.

At this time the filament voltage should be checked, the meter, M1, should read 10V. This actually measures the filament voltage of the Power Amplifier Tubes, V7 and V8. All filament primaries are controlled by filament rheostat, R2. When the voltage is adjusted to 10 volts on the PA tube, it is also adjusted simultaneously on all of the other filaments within the transmitter.

Shut down the Transmitter.

Now we are ready to check neutralization of the final power amplifier. Disconnect the transmission line from the transmitter. Perhaps this can be done easier by taking the lead from coil L15 off of variable output coil L14. From the Frequency Tuning Chart we notice that the power amplifier will use the two 250 mmfd. mica condensers in parallel. (The 500 mmfd mica condenser supplied with the transmitter is not used on this frequency). Also, note from the chart that L12 should have approximately 19 turns for frequency of 1400 Kc.

Connect the correct loading condensers C34 and C36 into the output circuit as shown on the tuning chart for frequency of 1400 Kc. For 1400 Kc, C34 a .003 mica is used, as is C36 another .003 mica. C34 is input load condenser and C36 is output load capacitor. C35 and C37 are not used on this frequency. Some sort of RF indicator must be coupled up to the power amplifier tuning coil. This can be a neon bulb mounted on a long rod of bakelite, or a flash lamp connected to a 2 or 3 loop of wire. Either of these make a satisfactory RF indicator. If the amplifier is neutralized, no RF will be indicated in the main tank coil when the variable coil is tuned through resonance. If an indication is shown when amplifier is tuned to resonance, the amplifier is out of neutralization. The amplifier is neutralized by the so-called "Rice" method, that of feeding out-of-phase voltage back to the plate from the input grid circuit. This neutralizing voltage can be varied by adjusting the center tap on the RF driver plate coil L9. There are several taps on this coil adjacent to the electrical center and neutralization can be accomplished by the use of one. If not, de-energize the transmitter, then put the lead on the center tap of coil L9 and adjust the right hand (as viewed from rear plate of the neutralizing condenser, C26. This plate has its mounting flange slotted, making possible a slight adjustment of the spacing of C26. Some setting of this plate will be found which causes the power amplifier to become neutralized when one of the 5 taps on L9 is used. When the resonance tuning point of the power amplifier can be passed through without an indication on the neon bulb or lamp, you can assume the P.A. is satisfactorily neutralized. Another good check is to set the multimeter switch on P.A. grid, then watch this

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grid current while tuning L12 through resonance. If the P.A. grid current remains steady while the amplifier is tuned through resonance it is satisfactorily neutralized. Remove any neutralization indicators. Take short off of door interlock switches S6 and S8.

Be sure the plate voltages are off.

Now place one high voltage lead on one 8008 rectifier. Also replace the output wire from L15 back on output coil L14. Now apply high voltage by depressing Plate Start Button. Tune the Power Amplifier to resonance. Adjust the loading until the plate current meter, M4, reads approximately 150 ma and the plate voltmeter reads about 800 volts. With loading adjusted so that these figures are obtained, shut down the transmitter, be sure it is off. Plate the other cap on the second 8008 rectifier. Again start up the transmitter by applying plate voltage. Rapidly retune to resonance. When properly tuned the plate current will run approximately 320 to 350 ma at 2000 volts. With this input the output should be 500 watts. Efficiency of the BC-500K Transmitter will approximate 72%. The R.F. end of the transmitter should be operating satisfactorily now.

It will be remembered that previously we had turned the modulator bias controls completely counter-clockwise. This applied maximum bias to the two 833A modulator tubes. We will now adjust the modulators. With the transmitter operating and producing power into the load, adjust one bias control until its associated modulator tube draws approximately 30 ma, as indicated on Modulator meter (M2). Now adjust the second bias control until the modulator plate current as indicated on M2 reads 60 ma. This is the normal operating condition.

The meter readings on the transmitter should be somewhat close to those shown on "Typical Meter Readings", a chart in this instruction book. Readings within 10% can be tolerated. The operator is given a slight control over the high voltage applied to the Power Amplifier tubes by adding or decreasing resistance in the high voltage lead to the power amplifier. This is done by varying the P.A. plate rheostat, R1, located on the front control panel.

SECTION VI - GENERAL OPERATING PROCEDURE

(a) The crystal ovens should have been heating for approximately four hours before final frequency adjustments are to be made.

The ovens of the crystal holders should be warm to the touch. The ovens are heated by 6.3 volts as obtained from the secondary of oven heater transformer, T1. The primary of this transformer is connected permanently to the transmitter side of primary fuses, F1 and F2. There is a secondary fuse, F3, also. This gives adequate protection to the oven heater power circuits.

After the heaters have been heating for about four hours, the crystal frequencies should be adjusted to exact operating point. Normally this procedure is as follows.

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If the adjustments are being done at a completely new station, there will be no accurate way of adjusting the transmitter frequency. The transmitter will be checked for correct operating frequency by an external monitoring source. By this method one crystal can be brought to exact frequency. The first adjustment can be made by operation of the air gap. It is possible to set the frequency very close to zero cycles deviation by this adjustment. Then any slight adjustment can be accomplished by varying the crystal shunt condensers, C3 and C4. After the number one crystal has been adjusted to zero deviation from the assigned frequency, then it would be wise to adjust the stations' frequency monitor to coincide with the checked #1 crystal. (Of course the frequency monitor should be in operation in so far as oven temperature is concerned, preferably at least 48 hours). Once the stations' frequency monitor has been calibrated and is working satisfactorily, the station engineer has a reliable source of frequency measurement and can from this point go ahead and adjust the second crystal to frequency by observing the frequency meter while making adjustments of the air gap of the number two crystal.

For the station that has been on the air and has a calibrated frequency monitor in operation, the station engineer can simply adjust the two new crystals to frequency by observing the already operating frequency monitor.

(b) Modulation Monitor Connections. The BC-500K transmitter has a small pick-up coil (L15) connected between output loading coil, L14, and the ceramic feedthru insulator to be used for excitation of a modulation monitor. The connections are made to a small barrier strip terminal board located in the top of the cabinet. The modulation monitor should be connected to this terminal board with a suitable length of co-ax cable, similar to RG-62U.

(c) Frequency Monitor Connections. The frequency monitor R.F. connections are made to terminals 6 and 7 on TB3, number 6 is the hot side, number 7 the ground. The frequency monitor can be connected to this terminal board by means of a suitable length of co-ax cable, such as RG-62U. A word of caution at this point. Be sure to terminate the co-ax on the frequency monitor, otherwise the open circuited co-ax could cause a loading effect on the 1st IPA stage which could cause this stage not to tune.

(d) The Gates' BC-500K Transmitter is cooled by means of a top-of-cabinet ventilating fan which draws the heated air out of the cabinet. The transmitter has a large decorative open type grill in the front, at the bottom, through which cool air is drawn in, then is pulled up through the perforated audio and R.F. decks and out the top. The heated air also rises, so by convection the cabinet air is also changed.

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SECTION VII, TYPICAL VOLTAGE CHARTS
GATES' BC-1J, BC-250L & BC-500K
(No Signal in, measured with Simpson #260 Volt-ohmmeter)

First Audio (1/2 6SN7) V9, V10
Plate volts - 110
Cathode volts - 3
Filament volts - 6.3 A.C.

Phase inverter (1/2 6SN7) V9, V10
Plate Volts - 110
Cathode volts - 3.5
Filament volts - 6.3 A.C.

Audio Drivers, V11, V12, V13, V14
Plate volts - 360
Screen volts - 270
Grid volts --20
Filament volts - 6.3 A.C.

833A Modulators (BC-1J)
Plate volts - 2600 V. DC
Plate Current (Static) per tube - 30 ma.
Bias volts - approximately 65 negative
Filament volts - 10 A.C.

833A Modulators, (BC-500K)
Plate volts - 2600 V. DC
Plate Current (Static) per tube, 20 ma.
Bias volts - approximately 70V. negative
Filament volts - 10 V. A.C.

810's Modulators (BC-250L)
Plate volts - 1400 V. DC.
Plate current (Static) per tube - 25 ma.
Bias volts, approximately 32 negative
Filament volts - 10 V. A.C.

6AG7 Oscillator
Plate volts - 125 (Checked at bottom of choke, L2)
Screen volts - 75
Filament volts - 6.3 A.C.

6AG7, 1st IPA
Plate volts - 400
Screen volts - 115V (Variable by means of R13)
Filament volts - 6.3 A.C.

6146's 2nd IPA
Plate volts - 550/600
Screen volts - 125
Filament volts - 6.3 A.C.

833A Power Amplifiers (Two Tubes) BC-1J
Plate volts - 2500
Plate Current - 500/550 ma.
Bias Volts - Grid leak, 300
Filament Volts - 10 A.C.

833A Power Amplifier (One Tube) BC-500K
Plate volts - 2500
Plate current 270 MA (Approximately)
Bias volts - Grid leak, 250 V.
Filament volts 10 V. A.C.

810's Power Amplifier (Two Tubes) BC-250L
Plate volts 1300-1350 DC
Plate current - 250 ma, approximately
Bias volts, grid leak, 250 V.
Filament volts, 10 V. A.C.

High voltage rectifier output of filter V-2600 for BC-1J and BC-500K.
Approximately 1400 volts for BC-250L.

Intermediate Voltage rectifier output of filter 550/600V.

Low Voltage rectifier, output of filter, 380 V.

Bias rectifier, output of filter 100V. Negative.

Crystal heater voltage, 6.3 V. A.C.

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SECTION VIII - SUMMARY

A radio broadcast transmitter, regardless of its size, cannot be fully described, and/or all the operating problems that arise cannot be fully anticipated and information given in any instruction book. Information has been given in this book that will cover most installations. There has been provided in this book, schematics of all pertinent circuits of the Gates' BC-500K, photographs with symbols that tie into the various schematics and a complete electrical parts list.

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

The Gates Radio Company, in designing the BC-500K Transmitter, has done everything possible to provide for you, the finest equipment. It is not possible for us to provide the location, the ground system and in some instances the other accessories that will be used with this equipment. Because of this, certain things must be left for the installing engineer to do, and certain analysis of problems must be made. In every instance the use of good engineering practices and sound fundamental reasoning will develop the desired high quality results possible from this equipment.

It is repeated again, make a good installation, eliminate hasty methods, in doing so you will keep future outages to a minimum. Also, remember that cleanliness and good maintenance of your broadcast equipment will pay big dividends. Set aside a certain period of time each week for cleaning the inside and outside of the equipment, for testing tubes, making sure all connections are tight and the many other things that can be titled "Good Maintenance". In case of problems that arise in the use of this equipment, please feel free to contact the Engineering Department of Gates Radio Company, who will gladly cooperate with you in every way to obtain the most satisfactory operation of your Gates equipment for the present and in the future.

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SECTION IX - QUESTIONS AND ANSWERS

It is realized by the Gates Radio Company that when installing a new transmitter and especially a completely new radio station, that certain problems arise that at times become perplexing. As the radio transmitter is the only device that can indicate trouble, often times troubles in transmission lines, tower tune-up, etc., will be incorrectly attributed to the transmitter. The following questions are a digest of those most often heard and corrected for our customers. They may help you if you have one or more similar problems.

1. My transmitter arrived with a broken part. How do I handle this?

   Ans.- Your equipment has been shipped in approved shipping boxes and by recognized transportation carriers. Call the delivering carrier at once. He will inspect and note your bill of lading as to the damage. You may then order the needed part and bill the delivering carrier for it when you receive the Gates' invoice.

2. Is breakage covered by the guarantee?

   Ans.- Only when breakage results from actual operating conditions. Breakage in transportation is the transportation company's liability.

3. The equipment works well but the voltage regulation of the power supply exceeds the 5% allowed by F.C.C. Is this a faulty power supply?

   Ans.- No indeed. We suggest placing an A.C. voltmeter across the main power lines. Check the voltage with no modulation. Then recheck with 90% (sine wave) modulation. You will find a lower line voltage under modulation than with no modulation which simply indicates the power source to the transmitter is the offender. This may mean too small wires, too small a pole transformer supplied by the utilities company, or in rare instances, both. Poor regulation can be caused by other things too. Improper tuning of the antenna load is one. Improper neutralization another.

4. I have an intermittant in the transmitter at times it will act normal, other times output power will drop off, plate current will go high and cause transmitter to kick off.

   Ans.- The process of elimination is important here. Check all connections to terminal boards. Make sure all tubes are O.K. Watch the PA grid current. If it fails, the transmitter will automatically go off due to operation of under-current

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grid relay, E6. This would indicate trouble in the oscillator, 1st IPA or 2nd IPA. Is crystal working satisfactory?

5. The power amplifier cannot be tuned to resonance.

Ans.- The power amplifier tank padding condenser, C31, C32 and C33, are mica and very infrequently partially open or short due to their inner construction. The condenser capacity could change in such a way as to make the P.A. untunable, with the original amount of inductance.

The load has changed considerably making it impossible to find P.A. resonance.

The rolling contact on L12, main P.A. inductor, is defective.

6. Plate contactor, E2, closes but no high voltage to P.A. or modulators.

Ans.- Bad contacts on E2, plate relay. Check for burned, or misaligned contacts. If bad, they should be replaced.

Check connections to power transformer, T11. Should show approximately 230V.

Check main rectifier, filaments should be lighted and plate caps on. If bad, replace.

Open filter choke.

7. Everytime the plate start button is depressed, a main fuse will blow.

Ans.- Fuse rating too small, use 30 amp.

Arc-back in 8008 rectifier tubes. Best solution, replace tubes.

Look for frayed wires.

Shorted power component, or filter unit. All chokes and condensers should be checked chokes for shorts to ground, condenser for shorts. Replace defective unit.

8. Transmission is not up to standard, sounds bad.

Ans.- This can be caused by many things.

Over-modulation is a cause of poor quality. Watch the levels. Be sure modulation monitor is adjusted correctly.

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Defective tubes, showing up particularly in the audio section.

Improper voltages in the audio system, caused either by defective component or bad rectifier tubes.

Power amplifier out of neutralization.

Bad audio signal being fed into transmitter.

One side of push-pull audio system becoming in-operative through any cause.

Feedback resistor opening up.

R.F. getting into the audio system.

Loss of filter, causing A.C. hum to rise.

9. The transmitter plate relay will not hold in.

Ans.- The plate relay, E2, coil is in series with the door interlock switch, S6, the master relay, E3, time delay relay, E7, and the bias undercurrent relay, E6. If any of these relays are not properly closed, it will be impossible to energize this plate relay.

If the contactor can be energized but drops out immediately, this indicates an overload, possibly in the modulator or power amplifier. If such is the case, the overload relay involved will energize causing the master relay to operate, which opens the holding contacts of the plate start relay.

10. Have extremely high plate voltage from the main rectifier.

Ans.- Check the D.C. resistance of the input swinging choke, L22. This will measure in the neighborhood of 55 ohms. If this choke is shorted, terminal to terminal, the filter system would have condenser input and voltage would be extremely high.

11. The modulator overload relay, E4, energizes each time the plate start button is depressed.

Ans.- This would indicate trouble in the modulator or in its bias supply.

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Check bias voltage on each grid of 833A modulator. This should read approximately 65 volts negative. If no voltage, check bias rectifier tube, V17.

Check 833A modulator tubes for possible short.

Check bias adjustment resistors, R66 and R67, for open arm.

12. The efficiency of the transmitter is low.

Ans.- The normal efficiency of the Gates' BC-500K runs approx. 72%. If the apparent efficiency is low first check the indicating plate meters. They can be reading high. The antenna meter can be reading low. Check by substitution.

If the efficiency is actually low, possibly the antenna resistance has gone up. This happens slowly over a period of time. A recheck of the antenna resistance is suggested.

Check grid drive, should be between 80 and 140 ma.

Check the tubes, substitute known good ones.

Check the P.A. tuning. One side of resonance will give more output than the other. Tune in this manner.

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ORDERING REPLACEMENT PARTS

When ordering a replacement component please refer to the parts list in this Instruction Book. Identify the component by its' symbol number and if possible its Gates Drawing number. The type of equipment in which the part is used is also necessary.

This procedure will insure the customer receiving the correct component and at the earliest possible date.

July 11, 1955

Gates Radio Company,
Quincy, Illinois

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GUARANTEE

This equipment is fully guaranteed by the Gates Radio Company of Quincy, Illinois, to be free from all defects in materials and workmanship and will be repaired, replaced or adjusted in accordance with the manufacturer's option and terms as outlined below.

1 - Gates believes the purchaser has every right to expect first-class quality materials and workmanship and has created rigid inspection and test procedures plus excellent packing methods to assure good arrival at destination.

2 - Gates agrees to supply daily factory service, and will make emergency shipments at any time where possible.

3 - Gates fully guarantees, under normal and proper usage, all component parts in Gates equipment, except as noted. These parts will be replaced or repaired at the option of Gates as follows:

Transmitter Parts: main power or plate transformer, modulation transformer, modulation reactor, main tank condensers.

(replacements or repairs) - where less than 1 year old...no charge, between 1 and 2 years old 50% or new price

Moving Parts: Guaranteed for six months.

Electron Tubes: Subject to manufacturer's warranty at the time of shipment. Adjustment will be made to the customer as given to Gates Radio Company by the tube manufacturer.

All other component parts: (Except as listed above or below) Guaranteed for one year.

Abuse: Damage resulting from an Act of God, or by fire, wind, rain, hail, or any other condition other than normal usage is not covered by the guarantee.

4 - Date of invoice to original user-purchaser and date of receipt by Gates Radio Company of notification from the customer will determine the age of equipment or parts.

5 - In case of adjustment, as on certain transmitter parts listed above "new price" is Gates' current price at time of replacement and/or adjustment.

6 - This guarantee covers only Gates manufactured parts and complete Gates equipments including all parts therein, with exceptions as noted. Any purchased part not manufactured by Gates will be subject to the manufacturer's guarantee, unless such part is a unit incorporated in Gates manufactured equipment.

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7 - Transcription pickups, regardless of make, are guaranteed for ninety days - said guarantee including every associated part of the pickup except the stylus, which because of its fragility is not guaranteed by Gates.

8 - Where the replacement part in question must be supplied under the guarantee before the defective part can be returned for inspection, as might sometimes be required, the customer will be billed in full and credit or adjustment will be given on receipt of the defective part in accordance with this guarantee and the terms herein. In order for credit adjustment to be received in line with this guarantee the defective or replaced part must be shipped prepaid to Gates Radio Company or to any other destination requested by Gates within two weeks of the date of the invoice covering the replacement part. Any item alleged defective shall not be returned to Gates until after written permission has been first obtained from Gates' home office at your request.

9 - All shipments under this guarantee will be made f.o.b. Quincy, Illinois and all materials returned will be shipped prepaid by the customer f.o.b. Quincy, Illinois

10 - As a material part of this guarantee the customer agrees to employ capable technical personnel to maintain all equipment under this guarantee in good, normal condition, properly serviced and cleaned and to use said equipment as and for the purpose intended by seller. This guarantee does not extend to the supply by Gates of any personnel to make any replacement, repair or adjustment.

11 - Gates shall not be responsible for damages to items in transportation or careless handling; or injuries to persons or damage to property arising out of the use or operation of Gates equipment or parts, but Gates will supply repair or replacement items speedily, which will be billed to the customer who, in turn, will place claim with the carrier, with assistance from Gates if necessary and when so requested.

12 - Delays in fulfilling any part of this guarantee because of depleted stock, floods, war, strikes, power failures, transportation delays, or failure of suppliers to deliver, or because of Acts of God or any other conditions beyond the control of Gates, does not in any way render Gates liable under this guarantee; however, every effort will be made to render prompt service.

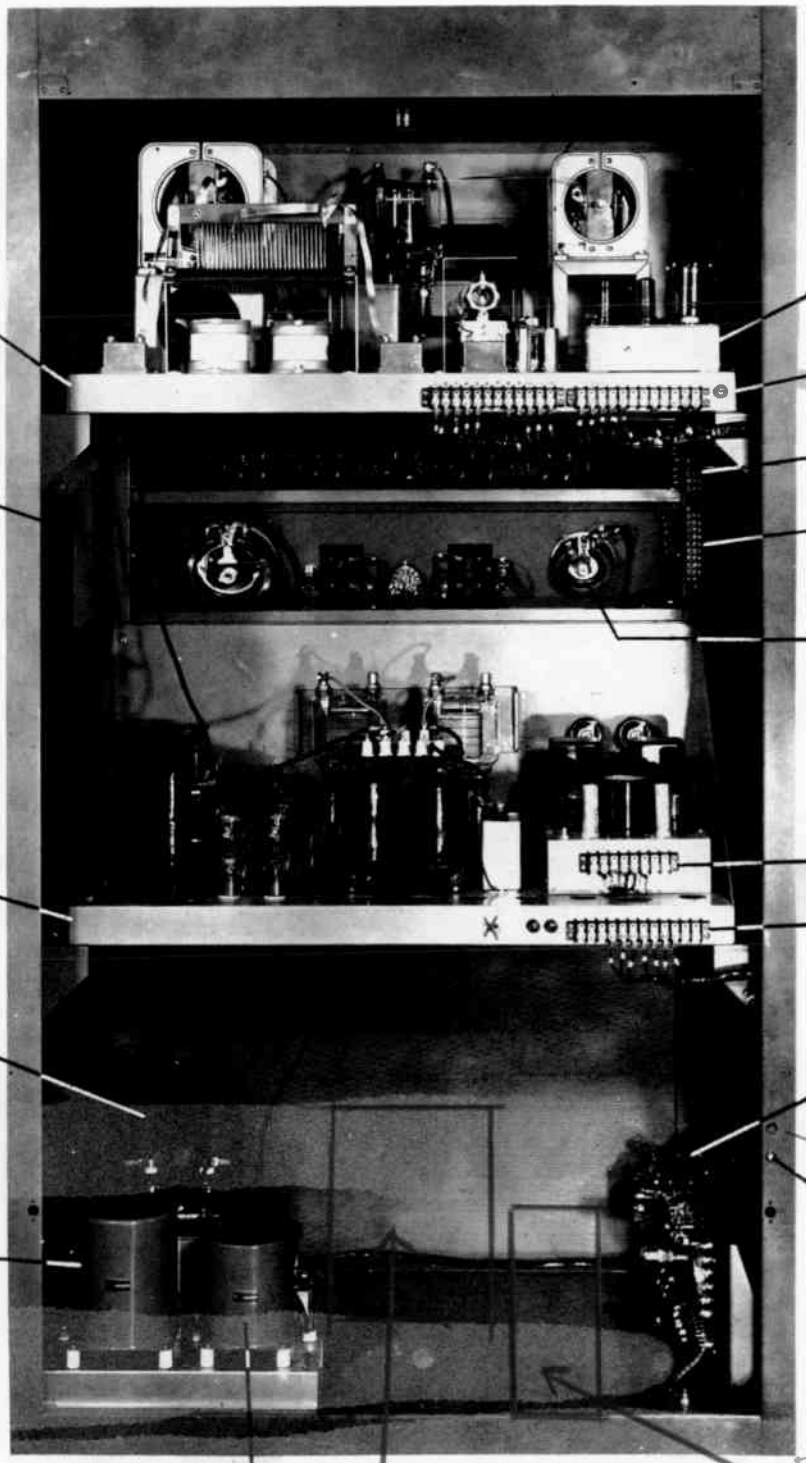
13 - Gates agrees that this equipment sold is manufactured, where need be, under Royalty License Agreements with Western Electric Company and Radio Corporation of America.

14 - This Guarantee is not transferable from the original user-purchaser, and no right of subrogation is given herein.

15 - This Guarantee is effective on all standard Gates cataloged items sold after June 11, 1951.

Gates Radio Company
Quincy, Illinois
"Gatesway"

World Radio History



REAR VIEW BC500K

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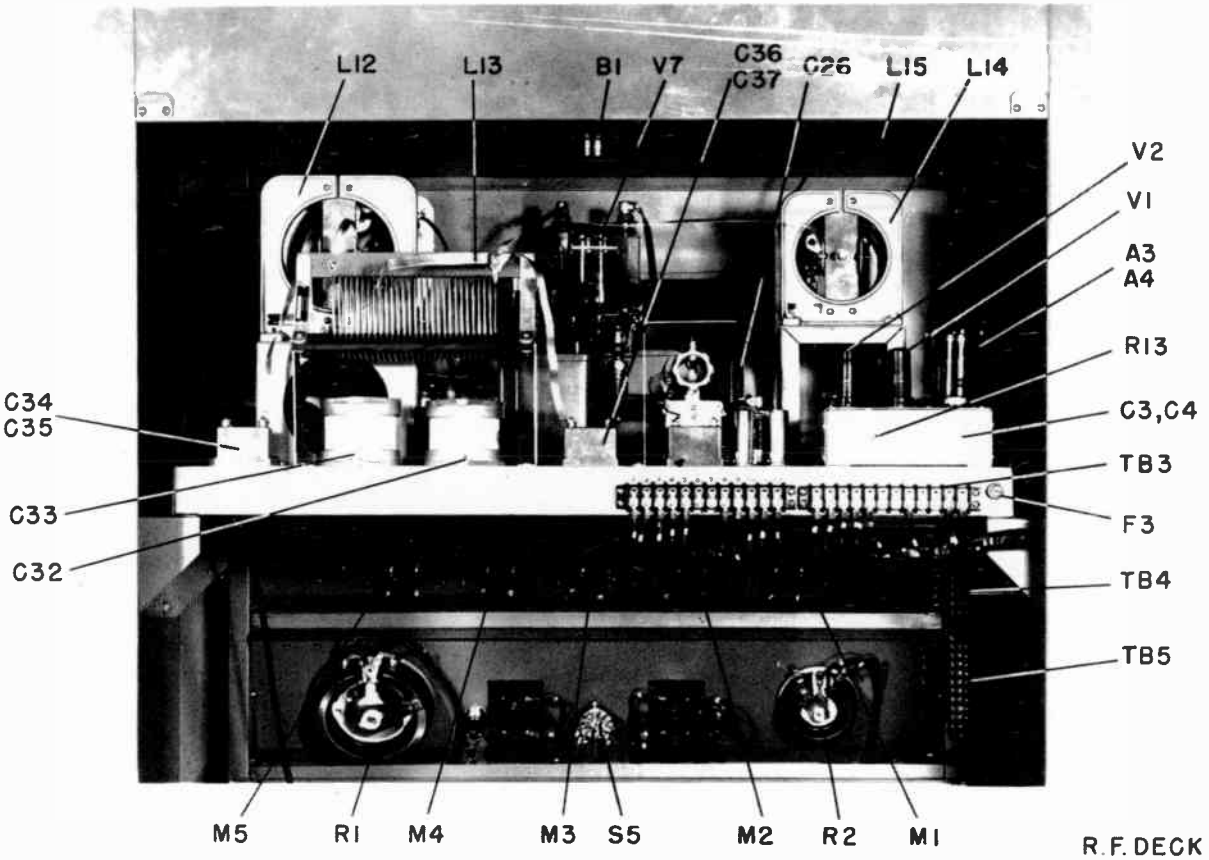
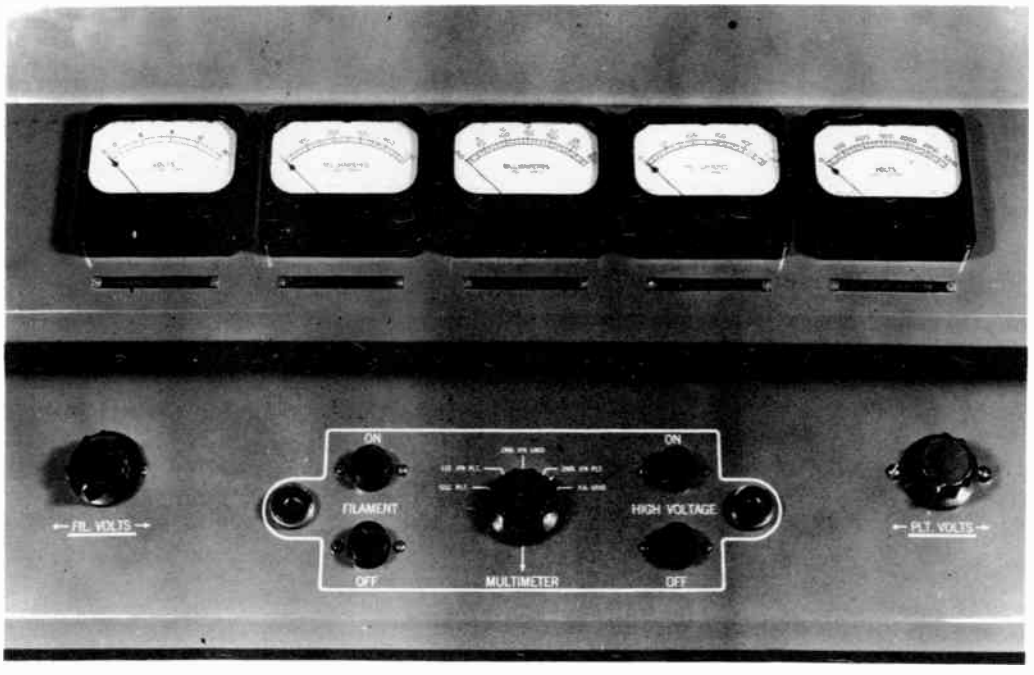


R.F. DECK
BC500K



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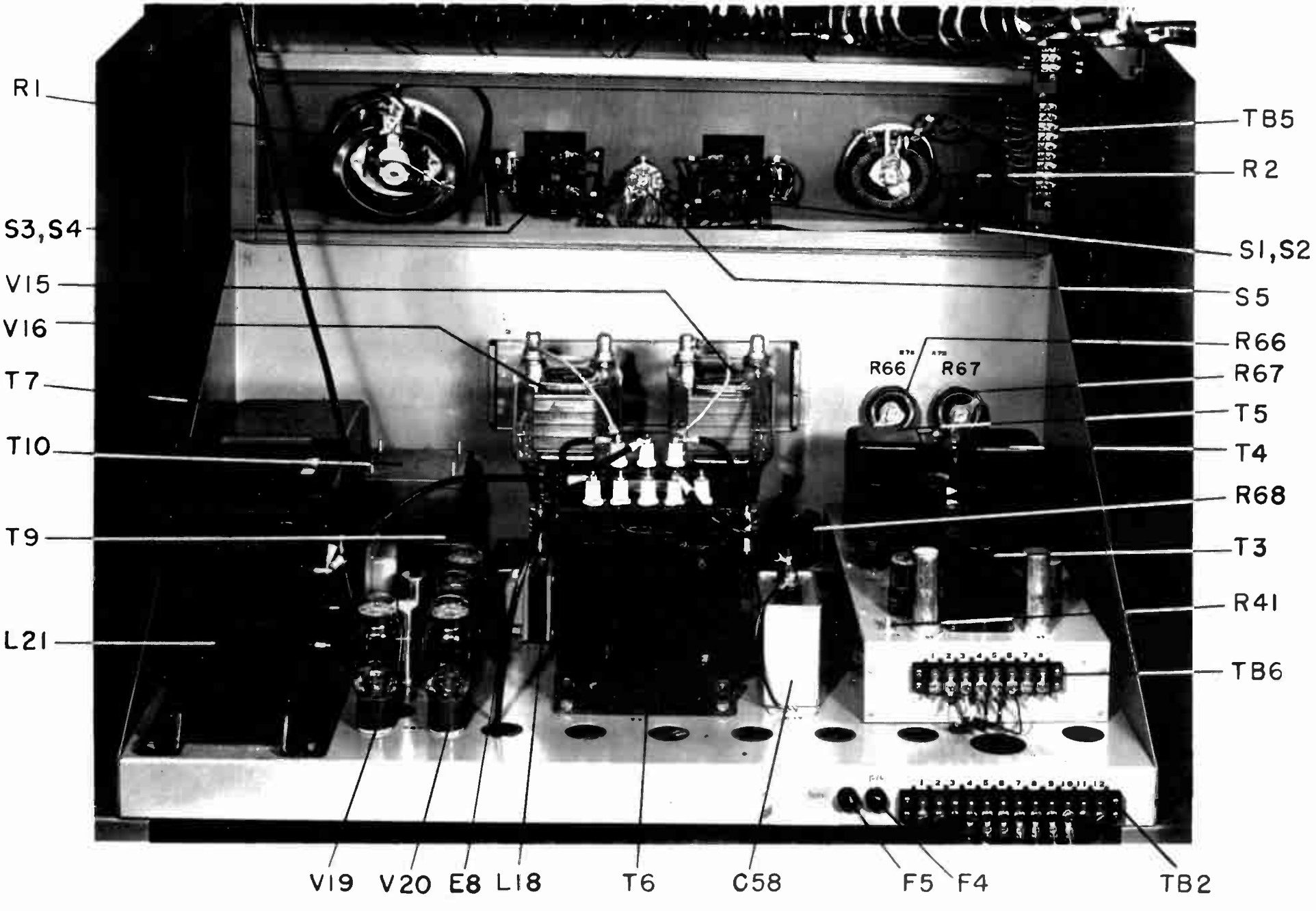

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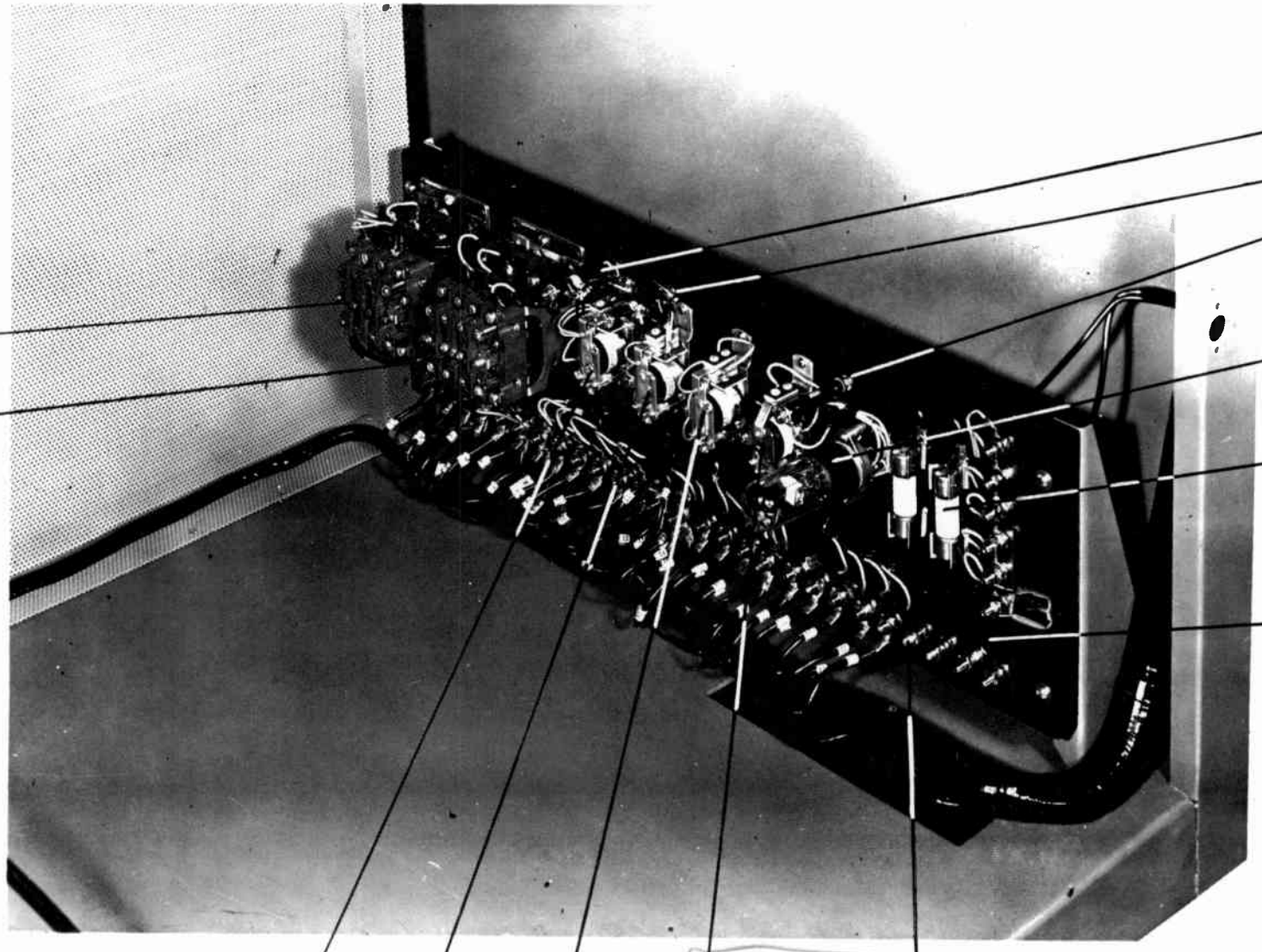

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ELECTRICAL PARTS LIST FOR BC-1J, BC-500K, AND BC-250L

RADIO FREQUENCY DECK

Symbol No.	Dwg. No.	Description
A3		Crystal & Oven
A4		Crystal & Oven
A5		Fuseholder
C1		Capacitor, .1 mfd.
C2		Capacitor, .1 mfd.
C3		Variable Capacitor, 20 mmfd.
C4		Variable Capacitor, 20 mmfd.
C5		Capacitor, 150 mmfd.
C6		Capacitor, 680 mmfd.
C7		Capacitor, .005 mfd.
C8		Capacitor, .005 mfd.
C9		Capacitor, 47 mmfd.
C10		Capacitor, .01 mfd.
C11		Capacitor, .01 mfd.
C12		Capacitor, .0022 mfd.
C13		Capacitor, .0001 mfd.
C16		Variable Capacitor, 300 mmfd.
C17		Capacitor, 270 mmfd.
C18		Capacitor, .005 mfd.
C19		Capacitor, .005 mfd.
C20		Capacitor, .01 mfd.
C21		Capacitor, 1 mfd.
C22		Capacitor, .01 mfd.
C23		Capacitor, .0005 mfd.
C24		Variable Capacitor, 470 mmfd.
C25		Capacitor, .0022 mfd.
C26	C-19180-101	Neutralizing Capacitor Assembly (BC-1J and BC-250L)
C26	C-19180-102	Neutralizing Capacitor Ass'y (BC-500K)
C27		Capacitor, .03 mfd.
C28		Capacitor, .03 mfd.
C29		Capacitor, .001 mfd.
C30		Capacitor, .002 mfd.
C31		P.A. Tank Capacitor, .00025 mfd.
C32		P.A. Tank Capacitor, .00025 mfd.
C33		P.A. Tank Capacitor, .0005 mfd.
C34		Input Loading Capacitor, .003 mfd.
C35		Input Loading Capacitor, .003 mfd.
C36		Output Loading Capacitor, .003 mfd.
C37		Output Loading Capacitor, .003 mfd.
C64, C65, C66, C67, C68		Cap., .01 mfd.
F3		Fuse, 3 amp.
L1		RF Choke, 2.5 MH
L2		RF Choke, 2.5 MH
L3		RF Choke, 2.5 MH

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Symbol No.	Dwg. No.	Description
L4	A-10381-101	First IPA Plate Coil, Gates
L5		RF Choke, 5 MH
(L6 & L7)	A-10486-101	Parasitic Suppressor Assembly
L8	A-10387-101	RF Choke (6146 Plate Assembly) Gates
L9	C-19182-101	Second IPA Plate Coil Assembly
L10	C-16466-102	PA RF Choke Assembly, Gates
L11		RF Choke (MILLER)
L12	105VB3735	PA Tank Variable Coil, Gates
L13	26FB2843	Output Coil, Gates
L14	30VB2344	Output Variable Coil, Gates
L15	A-10391-101	Mod. Mon, Pickup Coil, Gates
L16	C-19182-101	PA Parasitic Suppressor Assembly
L17	C-19182-102	PA Parasitic Suppressor Assembly (BC-1J, BC-250L)
R3		Meter Multiplier Assembly
R4		Resistor, 51K ohm
R5		Resistor, 470 ohm
R6		Resistor, 10 ohm
R7		Resistor, 33K ohm
R8		Resistor, 27K ohm
R9		Resistor, 35K ohm
R10		Resistor, 33K ohm
R11		Resistor, 330 ohm
R12		Resistor, 10 ohm
R13		Control, 50K ohm
R14		Resistor, 51K ohm
R15		Resistor, 8000 ohm
R16		Resistor, 27K ohm
R17		Resistor, 10 ohm
R18		Resistor, 47 ohm (Part of L6 Parasitic)
R19		Resistor, 47 ohm (Part of L7 Parasitic)
R20		Resistor, 1 ohm
R21		Resistor, 100K ohm
R22		Resistor, 56 ohm
R23		Resistor, 20K ohm
R24		Resistor, 5000 ohm
R25		Resistor, 1 ohm
R26		Resistor, 51K ohm
R27		Resistor, 27K ohm
R28		Resistor, 5000 ohm
R29		P.A. Parasitic Resistor
R30		P.A. Parasitic Resistor
R90		Resistor, 47 ohm
S7		Crystal Selector Switch, D.P.D.T.
T1	AF-10461K	Crystal Filament Transformer
T2	AF-10460K	Filament Transformer
TB3		Terminal Board
TB8		Terminal Board

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Symbol No.	Dwg. No.	Description
V1		Oscillator Tube, 6AG7
V2		First IPA Tube, 6AG7
V3		Second IPA Tube, 6146
V4		Second IPA Tube, 6146
V5		Regulator Tube, OB2
V6		Clamper Tube, 6AQ5
V7) V8)		833A Tubes used in BC-1J
V7 (only)		833 A Tube used in BC-500K
V7) V8)		810 Tubes used in BC-250L
X1		Oscillator Socket
X2		First IPA Socket
X3		Second IPA Socket
X4		Second IPA Socket
X5		Regulator Socket
X6		Clamper Socket
(X7 & X8)	D-21627-101	Dual PA Tube Socket Assembly, Gates (BC1J)
X7	D-21627-103	PA Tube Socket Ass'y Gates (BC-500K)
(X7 & X8)	C-19201-101	Dual PA Tube Socket Ass'y Gates (BC-250L)
X24		Crystal Socket
X25		Crystal Socket

MODULATOR DECK

A6		Fuseholder
A7		Fuseholder
C38		Capacitor, .5 mfd.
C39		Capacitor, .5 mfd.
C40		Capacitor, .5 mfd.
C41		Capacitor, .5 mfd.
C42		Capacitor, .5 mfd.
C43		Capacitor, .5 mfd.
C44		Capacitor, .5 mfd.
C45		Capacitor, 20 mfd.
C46		Capacitor, .5 mfd.
C47		Capacitor, 20-20 mfd.
C48		Capacitor, 20-20 mfd.
C49		Capacitor, .0025 mfd.
C50		Capacitor, .0025 mfd.
C51		Capacitor, .0025 mfd.
C52		Capacitor, .0025 mfd.
C53		Capacitor, 20 mfd.
C54		Capacitor, 20 mfd.
C55		Capacitor, 20-20 mfd.
C56		Capacitor, 20-20 mfd.

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Symbol No.	Dwg. No.	Description
C57		Capacitor, 10 mfd.
C58		Audio Coupling Capacitor, 1 mfd.
C61		Variable Trimmer Capacitor 20-125 mmfd.
C62,C63		Capacitor, .01 mfd.
E8		Time Delay Relay
F4		Fuse, 5 Amp.
F5		Fuse, 5 Amp.
L18		Bias Supply Filter Reactor
L19		350 V. Supply Filter Reactor
L20		550 V. Supply Filter Reactor
L21	AC-10465E	Modulation Reactor (BC-1J)
L21	AC-10650E	Modulation Reactor (BC-500K)
L21		Modulation Reactor (BC-250L)
R31		Resistor, 75K ohm
R32		Resistor, 75K ohm
R33		Resistor, 75K ohm
R34		Resistor, 75K ohm
R35		Resistor, 75K ohm
R36		Resistor, 75K ohm
R37		Resistor, 75K ohm
R38		Resistor, 75K ohm
R39		Resistor, 10K ohm
R40		Resistor, 820 ohm
R41	A-3404-8	Control, 1000 ohms
R42		Resistor, 1300 ohm
R43		Resistor, 1300 ohm
R44		Resistor, 820 ohm
R45		Resistor, 10K ohm
R46		Resistor, 51K ohm
R47		Resistor, 51K ohm
R48		Resistor, 51K ohm
R49		Resistor, 51K ohm
R50		Resistor, 62K ohm
R51		Resistor, 8200 ohm
R52		Resistor, 75K ohm
R53		Resistor, 10K ohm
R54		Resistor, 10K ohm
R55		Resistor, 75K ohm
R56		Resistor, 8200 ohm
R57		Resistor, 62K ohm
R58		Resistor, 4700 ohm
R59		Resistor, 4700 ohm
R60		Resistor, 8000 ohm
R61		Resistor, 8000 ohm
R62		Resistor, 4700 ohm
R63		Resistor, 4700 ohm
R64		Resistor, 20 ohm
R65		Resistor, 20 ohm
R66		Rheostat, 1000 ohm
R67		Rheostat, 1000 ohm
R68		Resistor, 250 ohm

World Radio History

Symbol No.	Dwg. No.	Description
R69		Resistor, 62K ohm
R70		Resistor, 100K ohm
R71		Resistor, 75K ohm
R72		Resistor, 27K ohm
R73		Resistor, 2.2 megohm
R74		Resistor, 2.2 megohm
R75		Resistor, 2.2 megohm
R76		Resistor, 2.2 megohm
R77		Resistor, 47K ohm
R78		Resistor, 2.2 megohm
R79		Resistor, 2.2 megohm
R80		Resistor, 2.2 megohm
R81		Resistor, 2.2 megohm
R82		Resistor, 47K ohm
R91		Resistor, 3000 ohm
T3	AI-3002	Input Transformer
T4		Driver Transformer
T5		Driver Transformer
T6	AM-10464E	Modulation Transformer (BC-1J)
T6	AM-10649E	Modulation Transformer (BC-500K)
T6		Modulation Transformer (BC-250L)
T7	AP-10462K	Power Transformer
T8	AF-10463K	Dual Filament Transformer
T9		Bias Transformer
T10	AF-10460K	Filament Transformer
TB2		Terminal Board
TB6		Input Terminal Board
TB7		Output Terminal Board
TB9		Terminal Board
V9		Tube, 6SN7GTA
V10		Tube, 6SN7GTA
V11		Audio Driver Tube, 1622/5881
V12		Audio Driver Tube, 1622/5881
V13		Audio Driver Tube 1622/5881
V14		Audio Driver Tube, 1622/5881
V15) V16)		Modulator Tube, 833A used in BC-1J/BC500K
V15) V16)		810 Tubes used in BC-250L
V17		Bias Supply Tube, 5R4GY
V18		350V. Supply Tube, 5R4GY
V19		550V. Supply Tube, 5R4GY
V20		550V. Supply Tube, 5R4GY

World Radio History

Symbol No.	Dwg. No.	Description
X9		Turret Socket
X10		Turret Socket
X11		Socket
X12		Socket
X13		Socket
X14		Socket
(X15&X16)	D-21627-102	Dual Modulator Tube Socket Assembly (BC-1J/BC-500K)
(X15&X16)	C-19201-102	Dual Modulator Tube Socket Assembly (BC-250L)
X17		Socket
X18		Socket
X19		H.V. Socket
X20		H.V. Socket
X26		Socket, (For Time Delay, E8)

CONTROL PANEL

A1		Filament Pilot Light Assembly (Green)
A2		Plate Pilot Light Assembly (Red)
A8		Pilot Lamp
A9		Pilot Lamp
R1		Power Rheostat, 400 ohms (BC-1J/BC-500K)
R2		Filament Rheostat, 7.5 ohms (BC-1J, BC-500K)
R1		Power Rheostat, 1000 ohms (BC-250L)
R2		Filament Rheostat, 16 ohms (BC-250L)
R95,R96		Resistor, 3000 ohms
S1		Filament Start Pushbutton Switch (Black)
S2		Filament Stop Pushbutton Switch (Red)
S3		Plate Start Pushbutton Switch, (Black)
S4		Plate Stop Pushbutton Switch (Red)
S5		Multi-Meter Switch

METER PANEL

M1		Filament Voltmeter, 0-15 V. A.C.
M2		Modulator Plate Meter, 0-1 amp. in BC-1J, 0-500 MA in BC-500K and BC-250L
M3		Multi-meter, 0-1 MA D.C. Movement with 0-30, 0-300 MA D.C. Scale
M4		P.A. Plate Meter, 0-1 amp. in BC-1J 0-500 MA in BC-500K and BC-250L
M5		P.A. Plate Voltmeter, 0-3000 V. D.C. in BC-1J and BC-500K, 0-2500 V. D.C. in BC-250L
R89	A-10534-101	Multimeter Series Resistor Assembly

World Radio History

RELAY PANEL

Symbol No.	Dwg. No.	Description
E1		Filament Contactor
E2		Plate Contactor
E3		Master Overload Relay
E4		Modulator Overload Relay
E5		P.A. Overload Relay
E6		Grid Undercurrent Relay
E7		Time Delay Relay
F1		Cartridge Fuse, 30 amp.
F2		Cartridge Fuse, 30 amp.
R83		Adjustable Resistor, 5 ohm
R84		Adjustable Resistor, 5 ohm
R85		Resistor, 3000 ohm
TB1		Terminal Studs (Part of Mechanical Ass'y)
X23		Time Delay Relay Socket

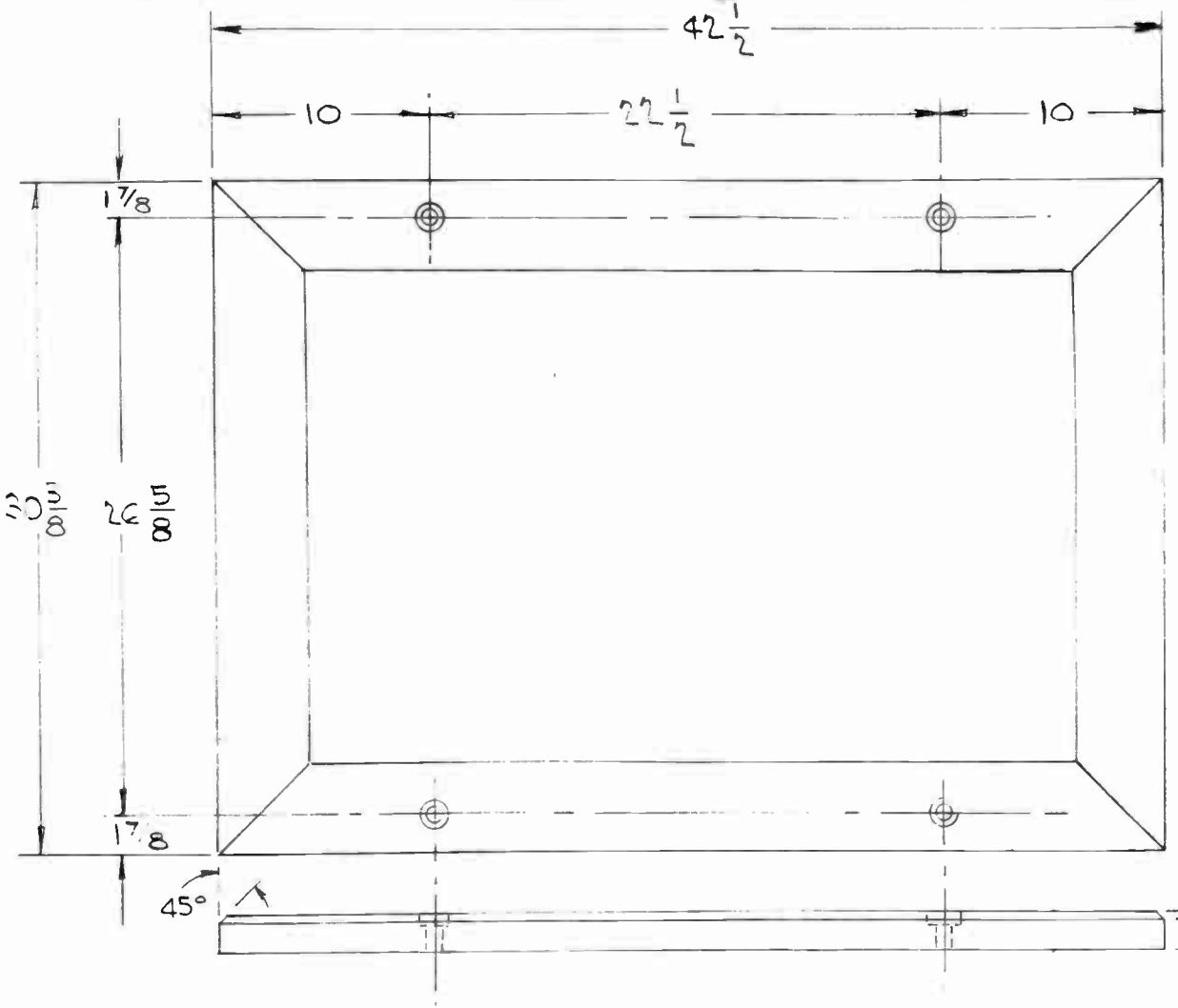
CABINET ASSEMBLY

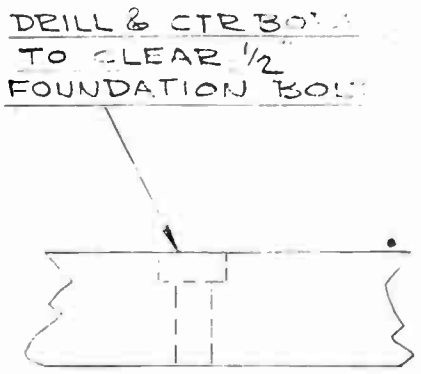
B1		Ventilating Fan
C59		Input Filter Capacitor, 8 mfd.
C60		Output Filter Capacitor, 2 mfd.
L22	AC-10458E	Input Swinging Choke (BC-1J)
L23	AC-10457E	Output Smoothing Choke (BC-1J)
(L22 & L23)	C-19199-101	Filter Choke Ass'y (BC-500K, BC-250L)
R86		Fan Dropping Resistor, 500 ohm
R87		Fan Dropping Resistor, 750 ohm
R88		Bleeder Resistor, 100K ohm
R89,R90		PA Dropping Resistor, 3500 ohm, 160W.
S6		Door Interlock Switch
S8		Door Interlock Switch
T11	AP-10459E	Power Transformer (BC-1J)
T11	AP-10651E	Power Transformer (BC-500K)
T11	AP-7235E	Power Transformer (BC-250L)
T12	AF-10456K	Rectifier Filament Transformer
TB4		Meter Terminal Board
TB5		Control Panel Terminal Board
TB10		Modulation Monitor Terminal Board
V21		Rectifier Tube, 8008
V22		Rectifier Tube, 8008
X21		Rectifier Socket
X22		Rectifier Socket

World Radio History

DRAWING NUMBER

A-10349





BOLT HOLE DETAIL

SCALE 1/8" = 1"

Variations on Finished Dimensions unless otherwise marked		
Basic Dimensions	Fractional Dimensions	Decimal Dimensions
Up to ¼	± 1/128	± .005
Above ¼ to 6	± 1/64	± .005
Above 6 to 24	± 1/32	± .010
Above 24	± 1/16	± .015

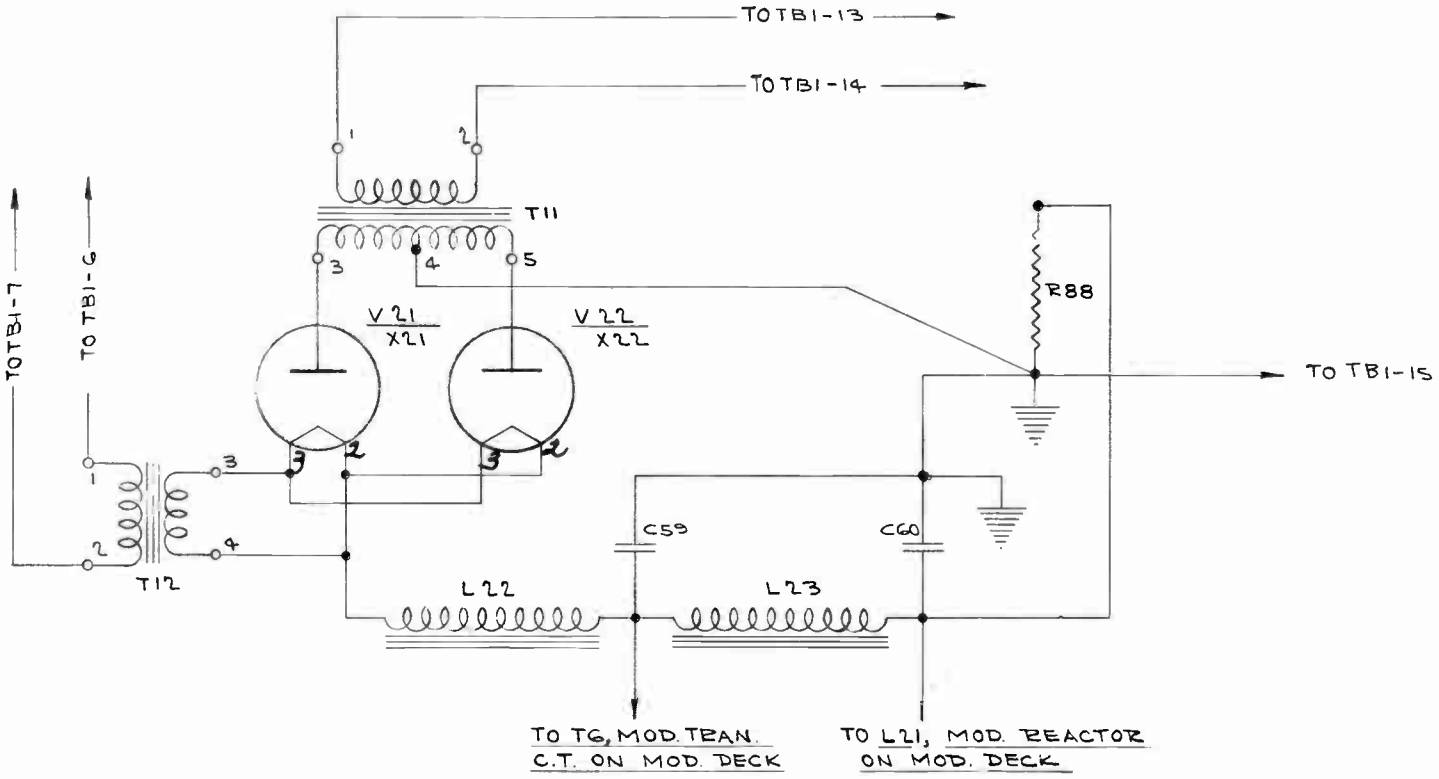
WOOD BASE FOR
BC-1J, BC-500K, BC-250L, HF-1M

MATL. 2"x4" YEL. PINE	FIN. RUBBER BLACK	PART NO. 1
DRAWN BY AWC DATE 1-4-54	.75/0	
CHECKED BY FWW DATE		DWG. NO. A-10349

GATES RADIO COMPANY
QUINCY, ILLINOIS

World Radio History

Drawing Number
B-13342



ECN # 6208 AWC 7-11-54	Variations on Finished Dimensions unless otherwise marked		
	Basic Dimensions	Fractional Dimensions	Decimal Dimensions
	Up to ¼	± 1/128	± .005
	Above ¼ to 6	± 1/64	± .005
	Above 6 to 24	± 1/32	± .010
	Above 24	± 1/16	± .015

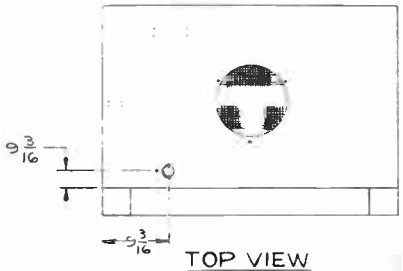
POWER SUPPLY SCHEMATIC
BC-1J, BC-500K & BC-250L, HF-1M

MATL.	FIN.	PART NO.
DRAWN BY AWC DATE 6-1-55	1.5	
CHECKED BY DATE		DWG. NO.
GATES RADIO COMPANY QUINCY, ILLINOIS		B-13342

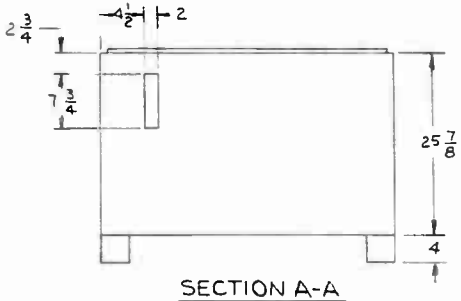
NOTE:- FUSE LOCATED IN RHEOSTAT ON BOTTOM OF XMITTER. (IF BLOWN NO PLATE VOLTAGE)

World Radio History

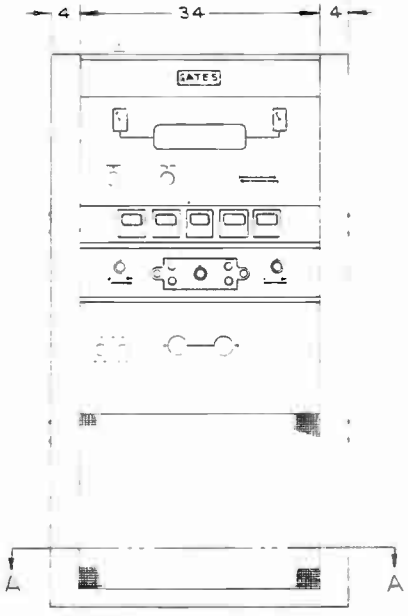
Drawing Number
C-19144



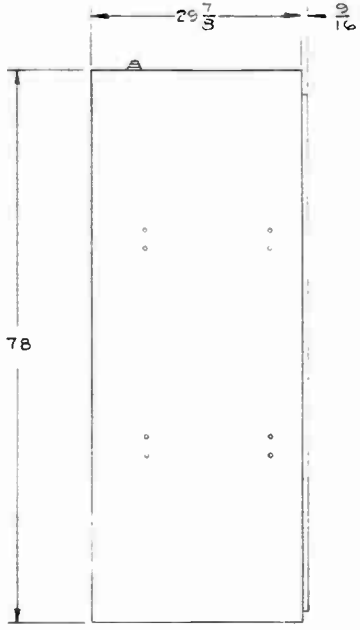
TOP VIEW



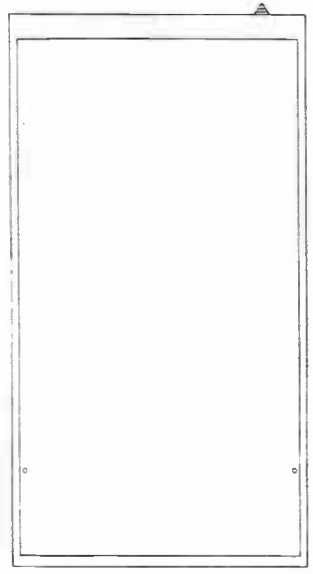
SECTION A-A



FRONT VIEW



SIDE VIEW



REAR VIEW

SCALE 1 = 12

Variations on Finished Dimensions unless otherwise marked		
Basic Dimensions	Fractional Dimensions	Decimal Dimensions
Up to ¼	± 1/128	± .008
Above ¼ to 6	± 1/64	± .015
Above 6 to 24	± 1/32	± .030
Above 24	± 1/16	± .015

OUTLINE DIMENSIONS
BC-1J / BC500K / BC250L / HF-1M

MATL. FIN. PART NO.

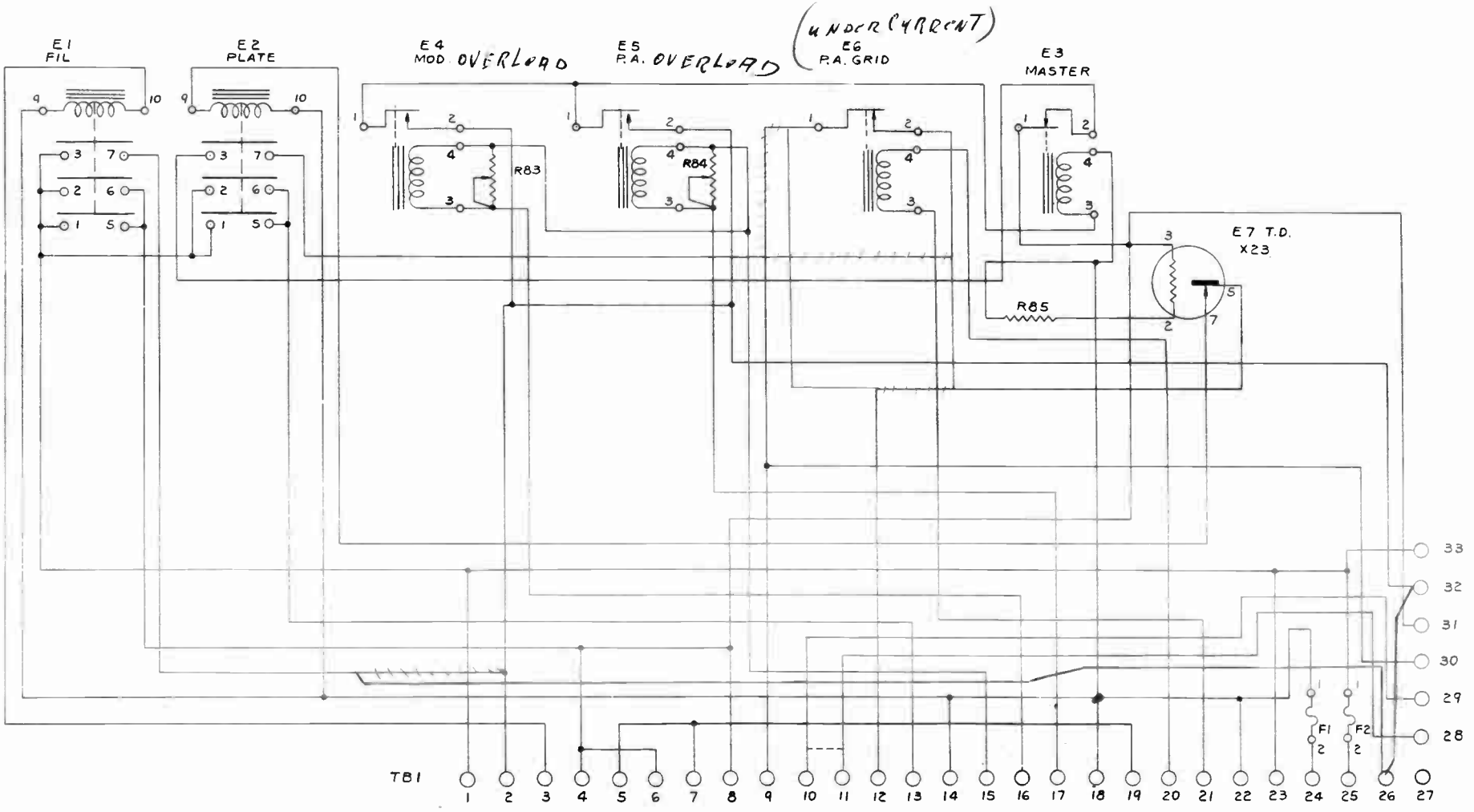
DRAWN BY V.E.K.
DATE 2-55
CHECKED BY F.W.W.
DATE

GATES RADIO COMPANY
QUINCY, ILLINOIS

DWG. NO.
C-19144

World Radio History

Drawing Number
C-19179



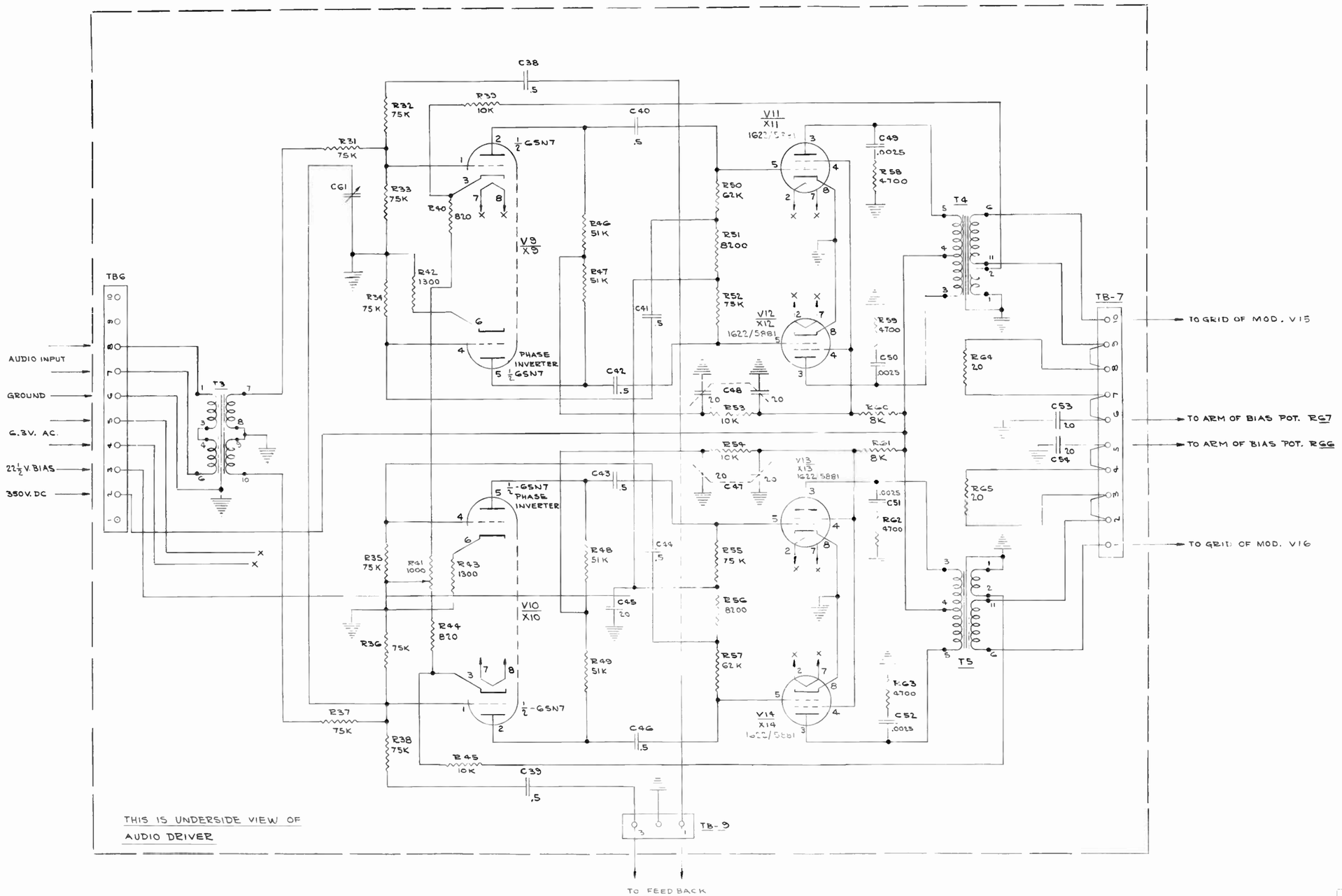
Variations on Finished Dimensions unless otherwise marked		
Basic Dimensions	Fractional Dimensions	Decimal Dimensions
Up to ¼	± 1/128	± .008
Above ¼ to 6	± 1/64	± .016
Above 6 to 24	± 1/32	± .030
Above 24	± 1/16	± .015

RELAY PANEL WIRING
BC-1J / BC500K / BC250L

MATL.	FIN.	PART NO.
DRAWN BY D.L. DATE 3-1-55		
CHECKED BY FWW DATE		DWG. NO. C-19179

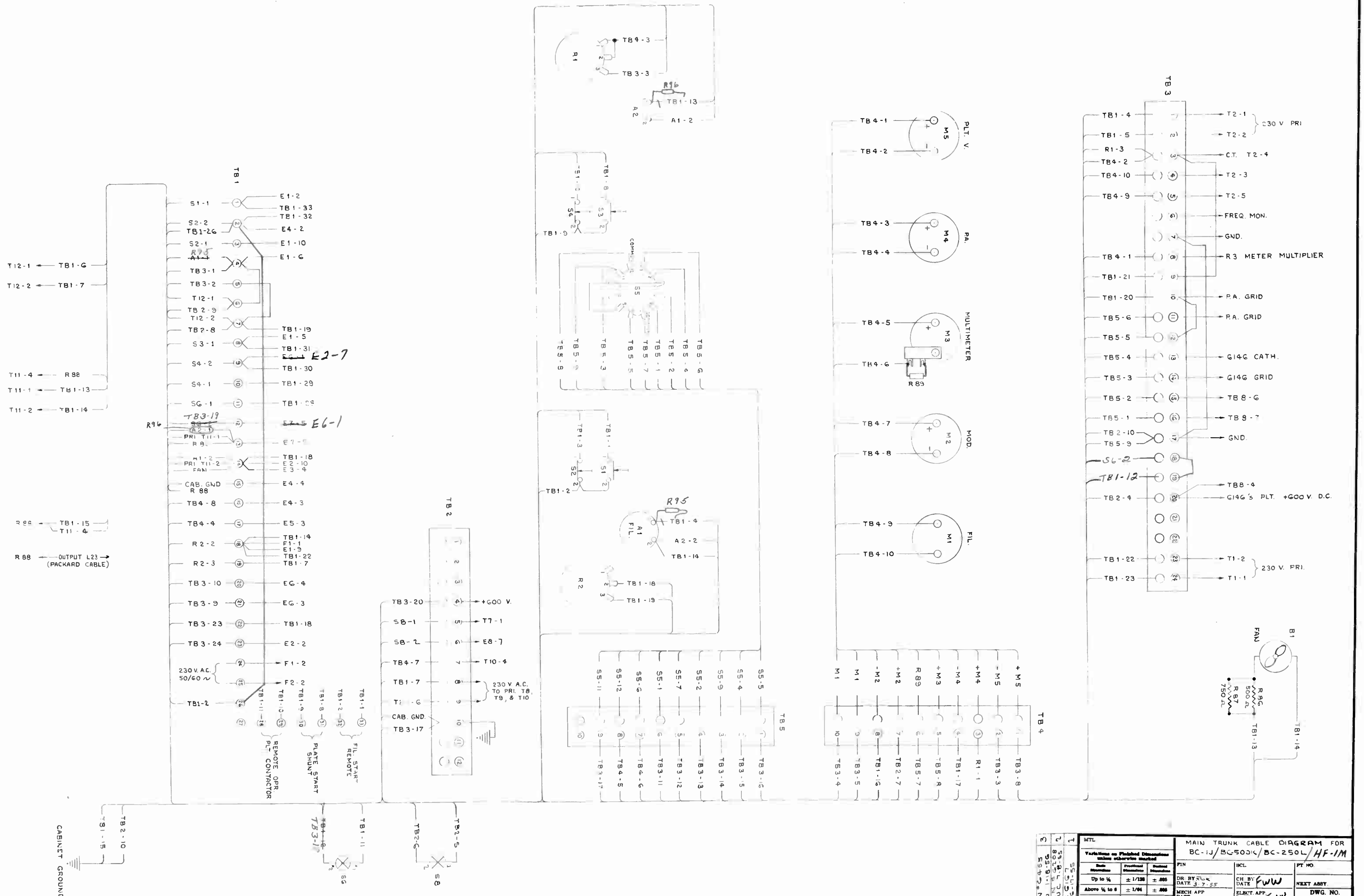
GATES RADIO COMPANY
QUINCY ILLINOIS

World Radio History



SCHEMATIC [illegible] BC-1J / BC-250K/BC250L/HF-1M			
FIN	SCL		FACT NO
DR BY AWC DATE 6-22-55	CH BY		NEAT ASST
MECH APP DATE	ELECT APP DATE FWW		DWG NO D-21646
GATES RADIO COMPANY QUINCY, ILLINOIS			

World Radio History



MTL	
FIN	SCL
DR BY	DATE 3-7-55
CH BY FWW	
MECH APP	ELECT APP FWW

MAIN TRUNK CABLE DIAGRAM FOR BC-1J/BC-500K/BC-250L/HF-1M

GATES RADIO COMPANY
QUINCY, ILLINOIS

DWG. NO. D-21651

World Radio History

RG6 1000Ω
RG7 1000Ω
RG8 250Ω
833 A
V15 X15
V16 X16
833A
T10
CG2 .01
CG3 .01
AUDIO DRIVER
TB7 1 2 3 4 5 6 7 8 9 10
R78 2.2 MEG.
R79 2.2 MEG.
R80 2.2 MEG.
R81 2.2 MEG.
R82 47K
R73 2.2 MEG.
R74 2.2 MEG.
R75 2.2 MEG.
R76 2.2 MEG.
R77 47K
AUDIO DRIVER
(SEE GATES DWG" D-21646 SCHEMATIC)
TB3 1 2 3
SHIELD GROUND
TO L11, C30 ON P.A. DECK
2600V. DC. FROM SWINGING CHOKE L22 (BOTTOM OF CABINET)
C58 1 MFD
TG MOD. TRANS.
L21 MOD. REACTOR
+2600V. DC FROM SMOOTHING CHOKE L23 (BOTTOM OF CABINET)
TB6 1 2 3 4 5 6 7 8 9 10
AUDIO INPUT 500/600Ω
TB2 1 2 3 4 5 6 7 8 9 10 11 12
TB3-10
S8-1
S8-2
TB4-7
TB1-7
TB2-6
CAB. GRID TB5-11
T7
DUAL, LOW VOLTAGE, PLATE TRANS
EG3 62K
R70 100K
R71 75K
R72 27K
L18
C55 20/20 MFD.
T9
E1AS TRANS (PB1.)
L19
C56 20/20 MFD.
T8
DUAL RECT. FIL. TRANS.
L20
C57 10 MFD.
5R4GY V17 X17
5R4GY V18 X18
5R4GY V19 X19
V20 X20
5R4GY
E8 X26
R31 3000Ω
F5 A7
F6 A6

2	ECN 6293 9-7-55	MTL.	MODULATOR DECK BC-1J/BC-500K
1	ECN 6208 AWC 7-8-55	Variations on Finished Dimensions unless otherwise marked	HF-1M
		Decimals: Up to ¼ ± 1/128 ± .005; Above ¼ to 6 ± 1/64 ± .005; Above 6 to 24 ± 1/32 ± .010; Above 24 ± 1/16 ± .015	FIN. SCL. PT. NO.
			DR. BY AWC DATE 5-7-55 CH. BY FWW DATE NEXT ASSY.
			MECH. APP. DATE ELECT. APP. DATE DWG. NO.
			GATES RADIO COMPANY QUINCY, ILLINOIS D-21652

World Radio History

OSCILLATOR, IST. I.P.A. UNIT

TERMINAL #1 ON TB8

C1 .1MFD. A3 X24

V1 X1 6AG7

C9 47MMFD.

C10

R90

C5 150 MMFD

C6 680 MMFD

R7 33K

L2

S7

C7 .005 MFD.

L1

R11 330Ω

C11 .01MFD

R12 10Ω

C66 .01

L3

C2 .1MFD. A4 X25

R4 51K

R5 470Ω

R6 10Ω

C64 .01

C3 20MMFD

C4 20MMFD

C8 .005 MFD.

R9 35K

R10 33K

R14 51K

R13 50K

R26 51K

R15 8K

V2 X2 6AG7

C12 .002 MFD

C13 100MMFD

C16 300 MMFD.

L4

C17 270 MMFD.

L5

V3 X3 6146

L6

R18 47Ω

L7

R19 47Ω

V4 X4 6146

T.C.

C18 .005 MFD.

C19 .005 MFD.

R22 56Ω

R20 1Ω

C67 .01

R21 100K

V5 X5 0B2

R23 20K

R16 27K

R27 27K

R17 10Ω

C66 .01

C20 .01MFD.

V6 X6 6AQ5

C22 .01 MFD.

V7 X7 833A

L16

R29 100Ω

C29 .001 MFD.

L12

L13

L14

L15

R.F. OUTPUT

C31 .00025

C32 .00025

C33 .005

C34 .003

C35 .003

C36 .003

C37 .003

C33 PARALLELED WITH C31 & C32 FOR FREQUENCIES 550 KC THRU 850 KC

TB10

MODULATION MONITOR

C24 470 MMFD.

C25 .002 MFD.

L8

L9

C23 500 MMFD.

C26 NEUT. COND.

SHORT OUT ON FREQUENCY 1200 KC TO 1600 KC

L10

L11

C30 .002 MFD.

R24 5K

R28 5K

C27 .03MFD

C28 .03 MFD.

R25 1Ω

C68 .01

C21 1 MFD.

T2

R3 GATES DWG. A108470-101

FOR 2000 V. OPERATION USE JUMPER AS SHOWN. FOR 3000 V. OPERATION REMOVE JUMPER COMPLETELY.

VOLTMETER MULTIPLIER

R3

+ 2500 V.

FROM V2 PLATE SEE NOTE

TB8 0 1 2 3 4 5 6 7 8 9

TO V3 GRID SEE NOTE

A5 F3

T1

TB3 (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24)

SCHEMATIC, R.F. SECTION, BC 500K M5157

DR. BY: [illegible] DATE 1-21-55 CH. BY. [illegible] DATE

GATES RADIO CO QUINCY, ILLINOIS

E-25408

World Radio History

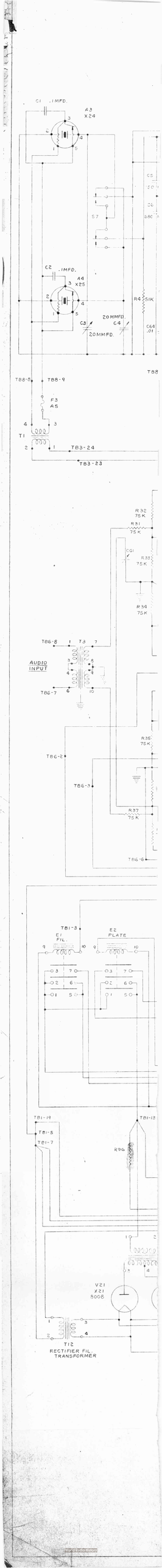
A-10957

FREQ.	C17	C23	C31 & C32	C33	C34	C35	C36	C37	L12 IND. u Hy.	L12 TURNS APPROX.	L13 IND. u Hy.	L13 TURNS APPROX.	L14 IND. u Hy.	L14. TURNS APPROX	P.A. TANK Q.	FREQ.
1600	C17 not used on these Frequencies	C23, Not used on these Frequencies	C31, .00025 & C32, .00025 always connected in Parallel on all frequencies	C33 Not used on these frequencies	C34, .003 used on all frequencies	C35 not used on these frequencies	C36, .003 used on all Frequencies	C37 not used on these Frequencies	21.0	16.6	2.18	8.1	3.3	7.6	25.4	1600
1550									22.2	17.0	2.48	8.65	3.5	7.85	24.6	1550
1500									23.8	17.6	2.59	8.8	3.75	8.1	23.9	1500
1450									24.0	17.8	2.9	9.3	4.0	8.4	23.0	1450
1400									27.2	18.8	3.0	9.5	4.3	8.7	22.2	1400
1350									29.4	19.5	3.26	9.8	4.64	9.0	21.4	1350
1300									31.7	20.4	3.55	10.3	5.0	9.4	20.6	1300
1250									34.2	21.2	3.84	10.7	5.4	9.7	19.9	1250
1200									37.3	22.0	4.25	11.3	5.85	10.2	19.1	1200
1150									40.5	23.0	4.7	11.9	6.4	10.6	18.3	1150
1100									44.5	24.1	5.2	12.5	6.95	11.1	17.5	1100
1050									49.0	25.2	6.0	13.4	7.65	11.6	16.7	1050
1000									54.0	26.6	6.7	14.2	8.45	12.2	15.9	1000
950									60.0	28.0	7.45	14.8	9.3	12.8	15.0	950
900									67.0	29.6	7.1	14.6	10.4	13.6	14.3	900
860									75.0	31.0	10.0	17.0	11.3	14.0	13.6	860
850	C17, .00027 Used on These Frequencies	C23, .0005 Used on These Freq's:		C33, .0005 Connected in Paralled with C31 & C32		C35, .003 Used on these Freqs(Parallel with C34)		C37, .003 used on these freqs (Parallel with C36)	37.0	22.0	3.81	10.7	5.8	10.1	27.0	850
800									41.8	23.4	4.4	11.5	6.6	10.7	25.4	800
750									47.5	24.9	5.0	12.3	7.5	11.5	23.8	750
700									54.5	26.6	6.0	13.4	8.65	12.4	22.1	700
650									63.5	28.8	7.15	14.7	10.0	13.3	20.6	650
600									72.0	30.6	8.6	16.1	11.8	14.4	19.0	600
540									92.0	34.6	10.8	17.9	14.5	15.9	17.2	540

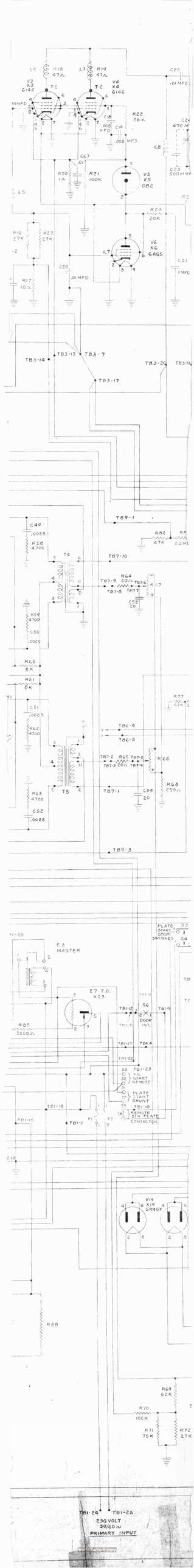
NOTE - "A" - C17, A .00027 Mica used only on Frequencies of 850KC to 540KC.
"B" - C23, A .0005 Mica used only on Frequencies of 800KC to 540KC (Change-Over Broadcasting)
"C" - C31, A .00025 Mica and C32, A .00025 Mica always connected in parallel and used on all Frequencies. C33, A .0005 Mica paralleled with C31 and C32 on Frequencies from 850KC to 540KC.
"D" - C34, .003 Mica and C36, .003 Mica used as Load Condensers, 1600KC to 860KC.
"E" - C34, .003 and C35, .003 used in parallel for Frequencies, 850KC to 540KC.
"F" - C36, .003 and C37, .003 used in parallel for frequencies, 850KC to 540KC.
"G" - Short Out RF Choke L11 on Freq. 1200 KC to 1600 KC between 1200 KC and 540 KC, use both L10 and L11 in series.

TUNING CHART BC-500K
M5157, 50/70 OHM A-10957

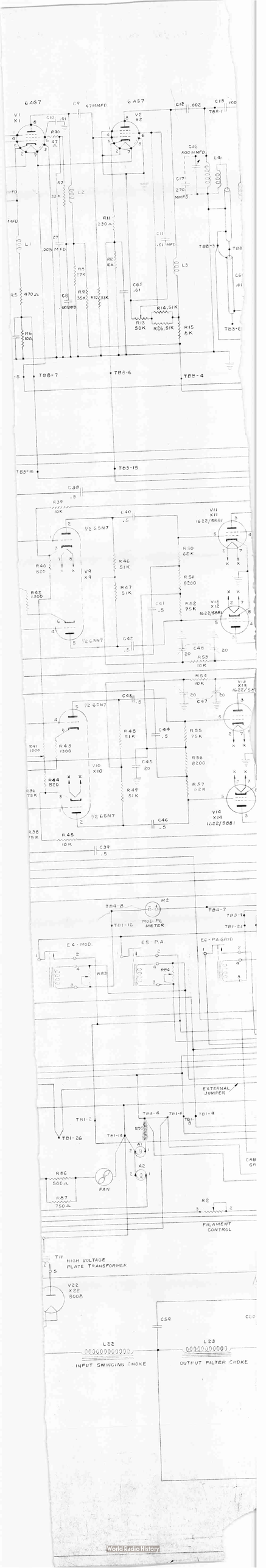
World Radio History


C1 .1MFD.
A3
X24
C5
50
C6
680
S7
C2 .1MFD.
A4
X25
R4 51K
C64
.01
C3
20MMFD.
C4
20MMFD.
T88-5
T88-9
F3
A5
T1
TB3-24
TB3-23
R32
75K
R31
75K
CG1
R33
75K
R34
75K
TB6-8
T3
AUDIO
INPUT
TB6-7
R35
75K
TB6-2
TB6-3
R37
75K
TB6-6
TB1-3
E1
FIL.
E2
PLATE
TB1-19
TB1-13
TB1-5
TB1-7
R96
V21
XZ1
5008
T12
RECTIFIER FIL.
TRANSFORMER


R.F. OUTPUT
C33 PARALLELED WITH
C31 AND C32 FOR FREQUENCIES
550KC THRU 850KC
MODULATION
MONITOR
SHORT OUT ON FREQUENCY
1200KC TO 1600KC
NEUT. COND.
VOLTMETER
MULTIPLIER
P.A. VOLTMETER
FIL. VOLTMETER
MOD. REACTOR
T6
MOD. TRANS.
FILAMENT
START/STOP
SWITCHES
MULTIMETER
COMMON
PLATE
CONTROL
P.A. PLATE
METER
DOOR
INT.
DUAL, LOW VOLTAGE
PLATE TRANS.
DUAL RECT.
FIL. TRANS.
BIAS TRANS.
(PRI)
OVERALL SCHEMATIC
BC500K M5157
DR BY D.L.
DATE 12-15-55
GATES RADIO COMPANY
QUINCY, ILLINOIS
E-25429



World Radio History



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