GATES

GATES

INSTRUCTIONS FOR INSTALLING, OPERATING AND SERVICING

THE GATES' MODEL BC-5P-2, M-5932 TRANSMITTER

IB-894

6/6/58

Gates Radio Company
Quincy, Illinois

ADDENDA SHEET

The high frequency distortion can be improved in some instances by modifying the coupling between the primary and secondary of the modulation transformer. This is done by connecting a capacity of .001 to .003 mfds. between the high side of the secondary and one side of the primary. This is a matter of trial, and generally will be between terminals 3 and 5. When no advantage is gained, the capacity will be omitted.

1/27/59

Gates Radio Company
Quincy, Illinois

ADDENDA SHEET
BC-5P2

ECN-8221, 8645

D-22251 Schematic:

On D-22251 Audio Driver Schematic, C423 and C424 Capacitors .005 mfd., were added between Pin 4 of V404 and V405 respectively to ground.

Add symbol C425, .005 mfd. 1 KV, from pin 4 of tube V403 to ground.

Add symbol C426, .005 mfd., 1 KV, from pin 4 of tube V406, to ground.

ECN-8221, 8769

D-22250 Schematic - - C-78206 Overall Schematic

On D-22250 Frequency Control Unit Schematic and C-78206 Overall Schematic, add R524, Resistor, 22 ohm, 2W. 5% to circuit between pin 6 of XV502 and pin 3 of XV504 to provide surge current limiting protection.

NOTE: To effect BC-5P2 with Serial numbers 64297 and higher.

D-22250 & C-78206

Add Filament Bypass Capacitors C522 and C523 (.01 uf., 1 KV.) from V501, Pins 2 and 7 to ground.

INDEX

	Page
Specifications	1-2
Introduction	3
Preliminary Planning	4
Unattended Operation	5
Ventilation	5
Low Voltage Intercubicle Wiring . . .	7
High Voltage Intercubicle Wiring . . .	8-9
Description	10
Modulator Cubicle	11
Installation	15
External Components	17
Installation Instructions for Remote Control	18
Operation & Adjustments	19
A-12219 Installation Rmt. Ctl.	19a
Holding Relay	23
Power Cubicle	23
Frequency Control Unit	24
R.F. Driver	27
Power Amplifier	28
Tuning Charts	31
Harmonic Reduction	31
Power Reduction 500/1000 Watts	35
Modulation Monitor Pickup	36
Audio Driver	36

Modulators....................................38

Distortion....................................39

Initial Test Procedure........................40

Limits on BC-5P/2 Transmitter.................42

Controls......................................43

Maintenance...................................52

Test Equipment................................53

Tools...54

Spare Parts...................................55

Guarantee.....................................1 - 2

Photographs

Parts List....................................1 - 8

Drawings: A-32022, B-65948, B-65949 Tuning Charts.
C-19628 Floor Plan & Wiring
C-77891 H. V. Wiring (Modulator)
C-77978 Schematic (R. F. Unit)
C-77981 Low Voltage Wiring (Modulator)
D-22251 Schematic, Audio Driver
D-22252 Low Voltage Wiring (Power Amp.)
D-22249 Low Voltage Wiring (R.F. Unit)
D-22253 Line Diagram
D-22250 Schematic, Freq. Control Unit
C-19858 Transformer & Reactor Connections
E-25690 Overall Schematic

M5422 AM Oscillator Instructions

Replacing Components on Chassis.......1 - 4
How Can We Help You?
Service Questionnaire

M-5932, M-5565 BC-5P TRANSMITTER

SPECIFICATIONS

Frequency Range:	535-1620 Kc (as ordered)
Frequency Response:	50-10,000 ± 2 db at 95% Mod.
Frequency Stability:	± 5 cycles
Audio Distortion:	50-7500 3% or less at 95% Mod.
Noise:	5 KW output, 60 db or better below 100% Mod.
Rated Power Output:	5000 watts
Capable Power Output:	5600 watts
Power Reduction:	Carrier reduction to 1KW provided
R.F. Output Impedance:	40-270 ohms (as ordered)
Power Service:	230 V. 3 phase, 50/60 cycle. Other voltages and frequencies on special order
Power Line Demand:	Carrier, 10.2 KW, average program 11.5 KW 100% Mod. 15.0 KW
Power Factor:	90%
Carrier Shift:	50-7500 cycles, 3% or less at 100 % Mod
Audio Input Impedance:	600/150 ohms balanced
Audio Input Level:	100% Mod. -5 dbm ± 2 dbm
Dimensions of Transmitter:	73-3/8" lg. x 39-3/16" dp. x 78" high
Net Weight:	2180 pounds

Tube Complement:

Oscillator	One	6AG7
Buffer	One	6146
R. F. Driver	One	4-250A
Power Amplifier	One	3X2500F3
1 st Audio	One	6SN7
2nd Audio	One	6SN7
Audio Driver	Four	6550
Modulator	Two	3X2500F3
Driver Hold Bias		
P.A. Hold Bias		
Audio Plate		
Modulator Bias		

INTRODUCTION

The Gates' BC-5P, 5 KW broadcast transmitter is designed for continuous duty operation. Many stations find a lucrative market in all night operation and maintain a "24" hour schedule except for brief weekly or semi-weekly shutdown periods for maintenance. Many stations are now being operated by remote control with no direct observation of the transmitting equipment during the majority of the operating time. The Gates' BC-5P, 5 KW broadcast transmitter has been designed with these considerations in mind and every effort has been made to obtain the best quality components and conservative ratings so that this equipment will perform satisfactorily under severe operating conditions. The Gates' BC-5P broadcast transmitter as herein offered is the culmination of a year and a half study by the broadcast section of the Gates Radio Company Engineering Staff. The close contact of the Engineering Department of the Gates Radio Company with those using various radio equipment has provided a guide as to those features that users of broadcast equipment now currently desire incorporated in equipment and as far as practical, these features have been incorporated in the Gates' BC-5P, 5 KW broadcast transmitter.

The Gates' BC-5P, 5 KW broadcast transmitter, is completely self-contained in three cubicles each 24" wide, 36" deep and 78" high. The three units, when joined as a single assembly, with trim, doors, etc., makes a unit 73-3/8 inches long, 39-1/4" deep and 78" high, These three cubicles contain as separate units, a power supply, a modulator, and a radio frequency unit. As there are no mechanical interconnections such as tuning drives, bus-work, supporting frames, etc., the cubicles may be arranged in respect with each other in any sequence as best suits the installation. With additional end bells, the cubicles may be installed as separate units. The inter-wiring requirements is only nine wires from the power cubicle to each of the other cubicles for standard operation. With the isolated unit operation, "High-Voltage ON and OFF" switches would be desirable on each separated cubicle, requiring two additional wires. High voltage wiring is by means of high voltage cable, approximately three per cubicle is required.

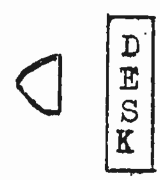
PHASOR	RF	PWR	MOD

MOD	PWR	RF	PHASOR

The arrangement of the cubicles may be in any sequence desired. It is recommended that the Power Cubicle be next to the Radio Frequency Cubicle so the high voltage control will be convenient for tuning adjustments.

MOD	PHASOR	RF	PWR

The Power Cubicle may be placed at the end so the control functions can be reached from the operating desk without additional wiring. As suggested above, the Radio Frequency Cubicle should be adjacent to the Power Cubicle.



Currently, there has been considerable interest in "Conelrad" operation of broadcast transmitters. This is presently being done by (1) an auxiliary transmitter, generally lower power, (2) manually retuning the main transmitter which is the source of income for the broadcasting station and (3) retune the main transmitter to a Conelrad frequency by means of contactors to preset adjustments. The Gates' BC-5P, 5 KW transmitter is so designed that a second radio frequency unit tuned to the Conelrad frequency may be installed and switched into service in place of the standard frequency unit. As the radio unit is reduced to its minimum essentials, the filter, modulation components, etc., being in the Power and Modulator Cubicles, the Conelrad R.F. unit is economically more practical than a complete transmitter of lower power. The regular broadcast frequency unit may be operated at its maximum efficiency for the normal broadcast service, and the Conelrad frequency unit at its maximum efficiency and power. This latter unit will also serve as a spare radio frequency unit which can be tuned to the standard frequency very quickly, or serve as a check on performance, if desired. Also, in the case of remote controlled transmitters, the Conelrad unit may be started, switched in service, or shut down, by the addition of a simple relay system.

PRELIMINARY PLANNING

The initial planning of the transmitter arrangement is most frequently determined by individual conditions and requirements. These fall into five catagories: (1) a completely new installation, (2) replacement of present equipment, (3) increase of power from present equipment and (4) unattended operation, (5) auxiliary or Conelrad transmitter for high power installation. The points brought out in this discussion are to call attention to features which experience has found to obtain the best efficiency of equipment and personnel. With a completely new installation, and due to the mechanical and electrical flexibility of the Gates' BC-5P transmitter, no particular arrangement will be recommended other than have been already indicated. Also such installations might require directional antenna systems with phasors of various sizes and complexities, the possibility of remote control for a portion of the operating time, or perhaps the full operating time; that the station might have or contemplate other broadcast services from the same site, each installation must be considered for its own peculiar conditions.

Should a new building be constructed, whether for attended operation or remote control, consideration should be given for adequate storage space for tubes and spare parts. For attended operation, the room should be well ventilated with windows on all sides, with ventilation provisions during hot rainy weather. The windows and doors should be protected by screens, especially in climates where insects prevail. While the transmitter is well enclosed so insects will not get into the equipment, the operators efficiency and comfort will be greatly improved.

UNATTENDED OPERATION

When a transmitter is to be operated solely be remote control, there is a tendency to make the transmitter building only large enough to house the transmitter and whatever auxiliary equipment is required. It is suggested that consideration be given to allowing for storage facilities for tubes and spare parts, room for a small workbench, and most important of all, some room for permitting the setting up of test equipment as may be required at the original installation, and to make the periodic performance measurements as required by the Federal Communications Commission or other governing body of the country in which the installation is made.

VENTILATION

Ventilating the transmitter building presents a wide range of problems due to the climate, general weather conditions, the particular type of operation, etc. Some localities may be subject to sudden heavy rain storms; other, dry with dust or sand; other cold, and heavy snow during the winter. If the transmitter is located in a fairly large room, the volume will tend to dissipate the heat. If the room is small, ceiling low, the exhaust heat may be trapped and built rather high by the end of the operating period. The heat given off by a radio transmitter is the difference of the power taken from the power lines and that put in the antenna system. The Gates' BC-5P transmitter through careful design has eliminated many sources of power loss and, consequently, heat rise. The designs has been, as in the case of previous Gates transmitters, to allow for unfavorable operating conditions. With previous models of transmitters, many so designed have given very satisfactory performance. A number of these installations have installed ventilating facilities for the building, and without exception, report increased tube life and improved performance of the transmitter.

It is suggested that if a ventilating system is not planned at the time of the transmitter installation, such a possibility be considered, and provisions made at the time of building construction so that a ventilating system might be added at a later date if this seems desirable without extensive remodeling of the building.

Many installations provide ducts from the top of the transmitter to the outside of the building. If this is done, the ducts should go straight up through the roof, and be capped with all-weather ventilators. Some provisions should be made to allow entry of outside air, should the building be sealed tight, efficient air circulation might not be obtained. The exhaust air might be arranged so as to be directed into the building during cold weather. The normal heat dissipation of the transmitter during program operation is six kilowatts.

The exhaust ducts may also be supplied with a booster fan. This fan may be controlled from the transmitter blower or filament circuits, or by a thermostat in the exhaust duct. The rectifier tubes are subject to arc-backs if they are too cold, and the thermostat would allow these tubes to reach the proper temperature. This thermostat can be the type used for furnace control.

If the transmitter is not equipped with exhaust ducts, it is recommended that an attic fan of 2500 c.f.m. or larger be installed. This is most effective if the air flow can be directed as to pull air from across the top of the transmitter. That is, an attic fan in an unceilinged room such as might be used on a remotely controlled installation, would be ineffective if a window directly below it were open. However, if a window on the opposite side of the room were opened, air would be drawn from around the transmitter taking away the exhaust air. With such installation, the exhaust fan should be so mounted as to be operative during inclement weather. This can be done by setting the fan back several feet from the exhaust opening, and building an exhaust tunnel. With louvres across the opening, no rain will be admitted except in the tunnel, and much of this will be deflected away by the air stream during the operating period.

If the room has a ceiling, and the fan installed in the attic, ceiling openings above the transmitter will allow air to be drawn from around the transmitter, regardless of which windows are open.

A practical form of installation is to build the transmitter into a wall. This wall should join the transmitter behind the front corner trim strips (from front edge of the base) so these trim strips may be removed. Doors should be preferably located at each end. Such an installation will then permit the use of a room air conditioner if climatic conditions so warrant.

Some installations have studio and transmitting facilities combined in one building. The question is sometimes asked as to whether a microphone might be used along side the transmitter. If a combined operation is desired, it is recommended that the transmitter be in a separate room, possibly with view windows for the observation of performance. High voltage ON-OFF switches could be readily run to the control desk.

When the transmitter is replacing existing equipment, the installation is complicated in that transmitting facilities must be maintained during the installation. The Gates' BC-5P transmitter is the ideal answer to the problems as the three cubicles may be placed wherever space is available, and connected by temporary wiring. When the transmitter performance has been checked, and the final position cleared, moving the transmitter and restoring it to operation is relatively simple and fast.

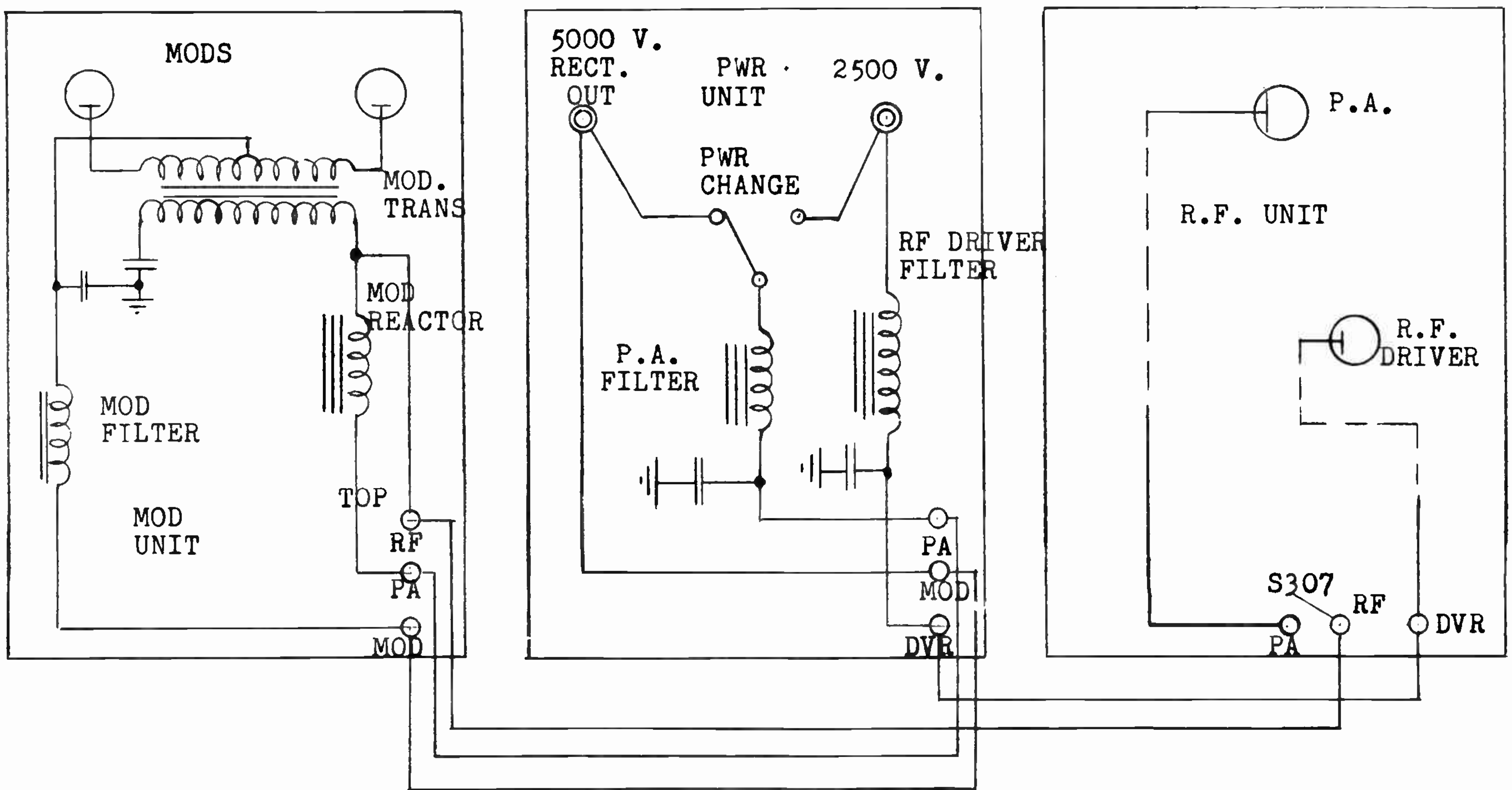
When the transmitter is to be used as an auxiliary or Conelrad transmitter at a high power transmitter site, the installation is dictated by the existent conditions. If the operation is anticipated for short durations, the ventilation considerations may be relaxed. The control circuits in the Gates' BC-5P transmitter are so designed and arranged that interlocking with other facilities may be done without internal wiring changes.

The external wiring may be by means of conduit or wire troughs in the floor. The latter allows for future expansion, but with some floorings is sometimes hard to make a finished appearance. The drawing C-19628 shows the required external wiring and wire sizes. If the cubicles are arranged in a different order, the wiring is varied accordingly. If the cubicles are separated, provisions for inter-cubicle wiring should also be allowed.

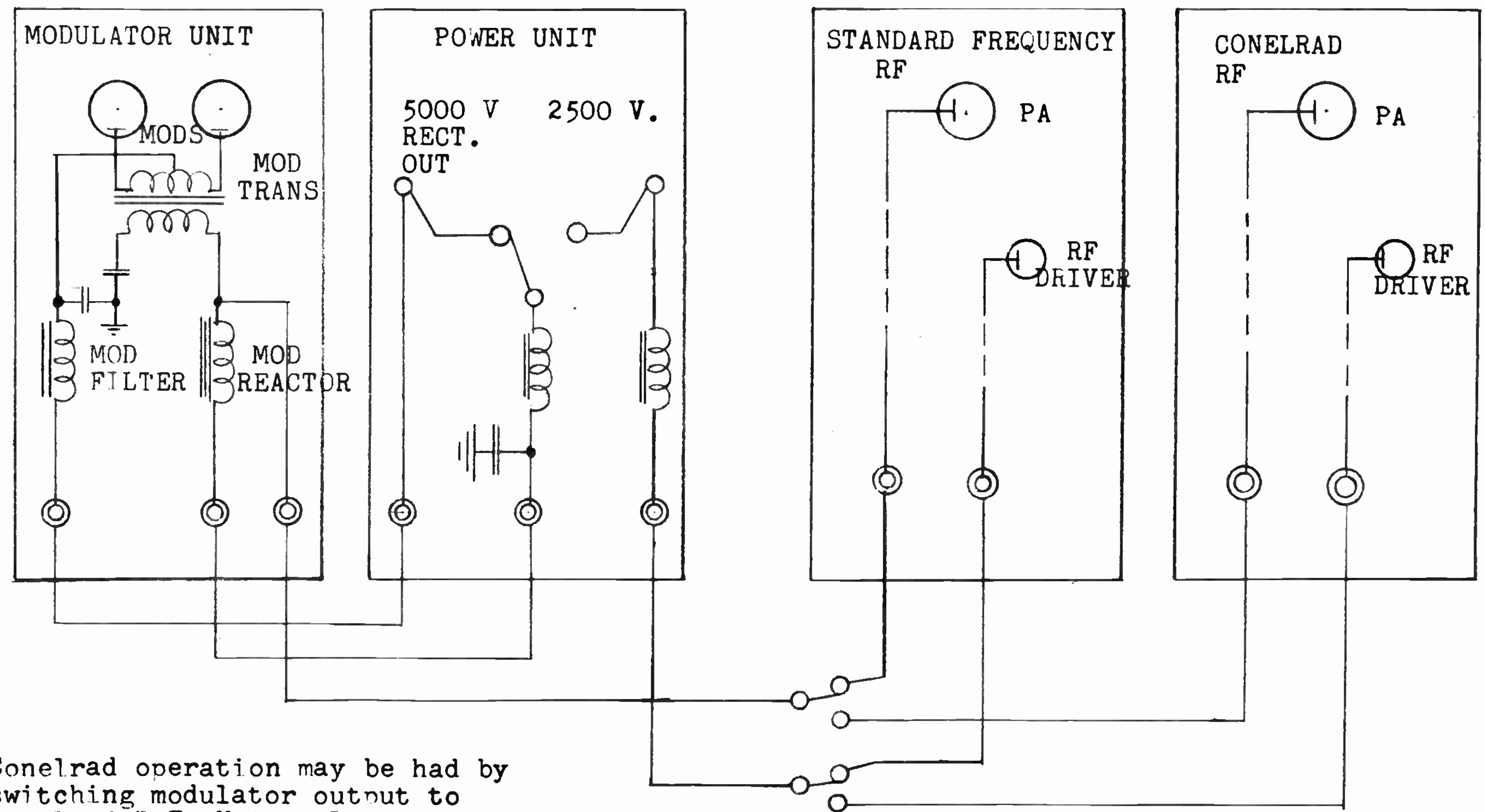
LOW VOLTAGE INTERCUBICLE WIRING

	MODULATOR	POWER	RADIO FREQUENCY
#12	1	1	1
#12	2	2	2
#12	3	3	3
(P.22 Par. 3)	4	4	4
	5	5	9
	9		5
	6	6	6
	7	7	7
	8	8	8
#12	Gnd	Gnd	Gnd

Lines indicated should be #12 wire, others may be #14, but using #12 wire throughout simplifies procurement. Connections between terminals #8 required when audio level and/or monitor switching is used in power change.



HIGH VOLTAGE INTER-CUBICLE WIRING



Conelrad operation may be had by switching modulator output to Conelrad R.F. Unit. Low voltage and control circuits are readily adaptable to addition of second unit.

High Voltage Contactor
May be installed in either RF or Modulator Cubicle

HIGH VOLTAGE INTERCUBICLE WIRING FOR ADDITION OF CONELRAD R.F. UNIT

DESCRIPTION

POWER SUPPLY

This cubicle contains the power supply normally required for the Gates' BC-5P/2 transmitter M-5932 .

This transmitter uses silicon type rectifier in all power supplies. The silicion units will operate within ambient temperature ranges of from -30° to 150° F. and all are hermetically sealed to insure trouble free life in any enviornment.

The low voltage rectifiers are of the plug-in type and are directly equivalent to type 5R4GY and 6W4 rectifier tubes. It should be noted that in an emergency the alternative of tube operation is quickly available in the low voltage supplies since filament connections have been supplied.

The power amplifier plate voltage consists of a three-phase full wave circuit which employs 90 silicon cells rated at 25 ampers and 500 volts peak inverse voltage. The 25 amperes rating is necessary to provide sufficient reserve capabilities to actuate protective circuits without damage to the silicon junction. Inverse voltage division across individual cells in each leg is assured through the use of a resistive voltage divider. Transient peaks are distributed in much the same manner by shunt capacitors . The peak inverse rating is 150% per leg assuring adequate safety factor for handling starting transient surges.

Also located in this cubicle is the central part of the control circuit, the transmitter control switches, the main high voltage contractor, and the rectifier output voltmeter.

The power cubicle has at the top a slanting meter panel for easy meter reading. The meters consist of a line voltage meter with a switch on the panel below it to select the line phase to be read, a voltmeter on the primary of the rectifier filaments to set the rectifier filament voltage, and a plate voltmeter reading the DC output voltage to the power amplifier. The rectifier filament rheostat is on the same panel with the line voltmeter switch. Below this panel is an access door interlocked with the high voltage, and is also provided with a high voltage grounding switch. This door, as are all the doors, is secured at the top by a pawl which pulls the door shut tight. The bottom of the door is pivoted on open slots so the door may be dropped open, or removed entirely, enabling the operating personnel to get close to the transmitter and reach all front components.

Below this door is the control panel with the Star-Stop, High Voltage On-Off and 5KW-1KW power selector switches, and the 5KW-1 kW status lights.

Below the control panel is the access door to the power panel. This is not interlocked, so inspection of the operation can be made at any time.

On the power panel at the top left is the overload lockout relay with adjusting potentiometer in the center, thermal time delays for running the blower two minutes after the filaments have been shut down and a 30 second time delay on the main rectifier filaments.

On the right side on the panel is the terminal board for internal connections. Below the thermal relays is a fuse block with fuses for two circuits. As the transmitter may be operated with various cubicle combinations, and consequently, various loads on the lines, the fuses provide a readily changeable item to meet the individual requirements.

Across the center of the panel are located the filament, blower and high voltage control relays, and the power change control relay whichis a latching type permitting the extension of this switching. Below the relays is the terminal board for external connections. At the bottom of the panel, on both sides are two holes. The high voltage lines are fed through these holes to terminals on the back of the panel. A cover at the bottom over these cables protects the personnel

In the center of the base at the front, and both sides just above the base are holes through which the wiring may be routed. If the cubicles are joined, the low voltage interwiring is formed to the side, down the side so as to be around the end of the shield through the matching holes to the adjoining cubicles. If conduit or wire ducts are desired, the wiring may be run through the hole in the base.

Inside the top access door, on the left facing from the front, is the high voltage contactor. This is shock-mounted to minimize the jar and vibration of its operation. Above this contactor are the two A.C. overload relays. On the right nand side are the voltmeter multiplier resistors and dropping resistor for the unit fan, mounted in the top. Below this is the 5KW-1KW P.A. Voltage change contactor.

On a shelf across the unit towards the front and below the height of the power panel are on the right the power amplifier filter choke and on the left the R.F. driver filter choke. These chokes have more than adequate insulation rating for normal operation, but with overloads particularly as might be encountered with a gassy tube, and extremely high transient voltage might be developed so as an added precaution, the chokes are mounted on insulators.

On the base, on the right side, the P.A. filter condenser sets in a tray and behind it the R.F. driver filter condenser is secured to the floor. The power transformer mounts in the remaining space, the high voltage connections towards the inside.

The air filter retainer is at the bottom rear of the cubicle. The filter may be removed during operation. A screen inside protects the personnel from the high voltage components. This screen may be removed for access to the base components. The rear door sets on a supporting channel which is a part of the filter retainer, and latches at the top.

The filter supplied is non-renewable type. Experience has shown that the renewable or washable type are extremely difficult to properly clean. As the filters are a standard 16" x 20" size, the renewable type may be installed, if so desired.

MODULATOR CUBICLE

The modulator cubicle has at the top a slanting meter panel with individual modulator plate current meters and filament voltmeter. The rheostat for the filament voltage is on the panel directly below. Below this panel is an access door to the audio driver. As there is no voltages appearing in this section, and there is a screen in the rear, this door is not interlocked.

The audio driver panel in height and styling matches the control panel on the power cubicle. The driver panel contains two modulator bias controls, and driver filament and bias lights. On the top front right of the driver chassis is the terminal board for the driver operating service. Underneath, at the rear is the terminal board for the feeds to the modulator grid. This consists of a four terminal board which allows drive balancing adjustment. On the right underneath side of the audio chassis is the feedback terminal board. The audio driver may be completely removed by removing the style strips from the cubicle, the right top door mounting angle. The panel is secured by four bolts, and the chassis itself is supported on side rails, By removing the panel bolts, the chassis can be removed for servicing. The weight of this chassis is 70 pounds.

On the left side of the audio chassis is the audio driver, at the front the input transformer, behind this an amplifier balancing control, and to the left of this control, a balancing control for the feedback. In line are two 6SN7 voltage amplifiers, then the driver consisting of four 6550 tubes in push-pull parallel. Air from the modulator plenum chamber directs air against these tubes. At the center rear of the audio chassis is the driver transformer, and at the right rear the plate transformer. In front of the plate transformer are two S-5019 rectifier tubes for the audio plate voltage. A single S-5019 provides the modulator bias voltage. In front of the rectifier tubes, in the front right corner is the bias plate transformer.

Above the audio chassis on the right side panel of the cubicle are located the modulator overload relays and the filament interlock relay.

Below the audio chassis, is a removable access door.

Across the cubicle, at the lower part of the door, is the cubicle terminal board to which external connections are made. Wiring is brought in, either through the base opening or either side opening, up the side around the end of the shelf mounting the terminal board then terminating at the terminal board.

Beneath this, is the high voltage compartment into which the high voltage connections are made. Space is allowed here to mount a high voltage changeover switch as might be used for a Conelrad radio frequency cubicle.

The modulator tubes are located on a plenum chamber across the rear of the cubicle. The tube connections are inside this plenum chamber. To facilitate servicing , the rear side of the plenum chamber is removable. On the front center is located the air interlock switch. This is a captive plate which under air pressure closes an interlock switch. Above the modulator tubes is a shelf mounting the filament transformer.

Underneath the filament transformer shelf on each side is a triangular air box with a rubber nozzle directing air against the filament seals of the modulator tubes. These boxes obtain air from the main plenum chamber by an enclosure on the outside of the side panels, but staying within the corner post dimensions of the cubicle. The plenum chamber and audio deck with component mounting angles seal off the unit above the tube sockets. The blower mounts on a cross shelf under the plenum chamber and draws air from the intake on the bottom of the rear door, around the modulation transformer and reactor, providing cooling for these components.

On the right side panel are mounted the feedback resistors. Mounting on the base, at the front right is the modulation condenser setting in a retainer, at the front left the modulator filter condenser in a retainer, at the rear right the modulation transformer and at the rear left the modulation reactor.

This cubicle with the M-5533 frequency control unit, provides a complete radio frequency section. This comprises a M-5422 oscillator unit, buffer, driver and power amplifier stages, low voltage supply for the oscillator, buffer and driver screen grid, and holding bias for the driver and power amplifier.

The cubicle has at the top a slanting meter panel which mounts the plate current meter, filament voltmeter and the multimeter.

On the panel below this, on the left side, is located the power amplifier loading control. Space behind this control is allowed for permitting the installation of a power control motor when remote control operation is used. Also on this panel in the center is the filament rheostat for the cubicle, and the R.F. driver tuning control is on the right side. An access door opens to the R.F. driver. This consists of a 4-250A tube, the socket of which is enclosed and obtains air from the power amplifier plenum chamber for tube cooling. The driver tank coil is located on the right side panel and the tuning is by means of a disc which threads into the coil and is directly connected to the panel dial.

Below the R.F. Driver is the M-5533 frequency control unit. The panel of this matches the control panel of the power cubicle and the audio driver panel of the modulator. The controls on this panel are the crystal selector switch, and frequency trimmer condensers behind a door on the panel, the buffer tuning condensers, excitation control and the multimeter switch are directly on the panel.

Below the frequency control unit is a panel mounting the power amplifier tank tuning control. This tuning, like the driver tuning, consists of a disc which is threaded in and out of the tank coil, and is directly connected to the tuning shaft. Below this and access door opens to the unit terminal board located and wired similarly as in the modulator unit.

On the left side panel are located the power amplifier and R.F. driver overload relays, the filament interlock relay, and the driver screen grid relay. On the front of the power amplifier tank enclosure, which forms the rear of this section of the cubicle, is located on the left the adjusting resistors for the overload relays. In the center of this panel is the air switch, operating as described in the modulator description. On the right side panel are the power amplifier grid resistors.

At the bottom front, as in the modulator cubicle, is a high voltage compartment to which the high voltage connections are made, and in which a high voltage switch may be installed. In this compartment is a link in the power amplifier high voltage line so the power amplifier voltage may be removed for tuning and neutralizing. In the rear on the floor is located the blower. Also on the floor is the power amplifier filament transformer and on the right side panel, the power amplifier cathode resistor. The blower is shock mounted and coupled to a plenum chamber by means of a canvas boot. This plenum chamber is of aluminum, and contains the power amplifier tank components. The rear of this chamber is readily removable by pawl fasteners. The bottom edge of the cover has an off-set flange which engages the lower fold of the plenum chamber. In this plenum chamber is the power amplifier tank coil, mounted so as to align with the tuning from the front panel. On the front right upper corner is a fixed vacuum condenser which is a part of the neutralizing circuit. On the right side panel are the plate blocking condensers and one plate choke.

On the base of the plenum chamber at the front is a second plate choke and on the right side, by-pass condensers. On the rear left side is provisions for vacuum condensers as required for the tank capacity. In the upper front left side is the first coupling condenser. The blower inlet is covered by an aluminum screen. The screen serves not only for shielding, but also prevents accidentally dropping materials in the blower. The screen is held in place by a frame so it may be readily be removed for cleaning.

The power amplifier tube retainer mounts on an insulating plate on the top of the tank plenum chamber. In this section are the filament bypass condensers, and grid parasitic suppressor, and filament transformer. This compartment has a removable aluminum shield.

Above the power amplifier tube compartment is the output coupling network. This shelf is perforated so as to allow the air to exhaust.

On the right side panel is the first section coil with fixed taps. Behind this is the coupling condenser. On the left side is the second line inductance which is a continuously variable coil, and is aligned with the power amplifier loading control on the front panel.

On the front center of the divider panel is a cutout behind which a line current meter may be mounted. As this line current meter is generally not required, it is not supplied as standard. At the rear center of the output network shelf in a modulation monitor pickup loop, the connecting terminal block is on the left side panel.

The transmitter output is taken out the top. Connecting across the two side panels and across the top is a ground strap to allow the greatest possible flexibility to grounding the transmission line. This compartment is also closed off with removable aluminum door. It will be seen from the pictures and the description of the power amplifier tank and output circuits, the power amplifier tank and output networks are physically separated and shielded to give the most advantageous suppression of harmonic frequencies, particularly the high order harmonics. If there were inductive or capacitative coupling of the power amplifier tank to the transmitter output circuit, no amount of filtering within the transmitter would give harmonic suppression.

INSTALLATION

The Gates BC-5P transmitter is desmantled for shipment the extent of this will at times be varied dependent upon the manner of shipment.

In the installation the power unit should be placed in position first if the main power supply is to come through a conduit through the floor opening in the cubicle, mainly because this location may be critical. However, if wire ducts are used so the wire entry is not critical, any cubicle might be positioned first. For example; if a wall were on the right or left, this could be the first unit installed.

The primary power supply feed <u>three number four or six wires</u>, are brought into the power cubicle either through the base opening, or fed across from the other units through the side openings. The lines are then formed across the bottom of the cubicle, up the left side to up above the main plate contactor. The leads are then formed back in a loop, 12" - 18", connecting on the power contactor, making sure that these are opposite the load connections. Connections already on the contactor supply the other operations of the transmitter. The cable should be secured. As the contactor is shock mounted, the loops are to maintain the flexibility of the shock mounting.

Removed for shipping are the power transformer, high voltage filter condenser, and both filter reactors. The positions of these have been given in the mechanical description. Contactors, relays, resistors and wiring have been secured for shipment, and all such bondings should be removed.

In the radio frequency cubicle, the blower has been removed. All tuning capacities are generally removed. The two R.F. plate chokes are removed and should be installed with the spaced ends of the winding connecting towards the tube. The plate blocking and vacuum neutralizing condensers are also removed.

The frequency control unit is also removed for safe shipment. The chassis is slid into place on mounting channels, the front panel secured to the corner posts.

The radio frequency cubicle should be thoroughly grounded to the station ground. This is best done by a four inch copper strap brought up either side of the cubicle and bolted to the aluminum plenum chamber. On a strap of this size, it is suggested four 10-32 volts, and that over the copper be placed a stiffening plate so that the whole copper surface may contact with the aluminum. The aluminum is treated with a special conductive lacquer, the same type as is used on the R.F. coils. A strap across the top of the cubicle provides grounding facilities for the transmission line. As there are many variations as to how this might be done, it is essential that this connection be complete and adequate. It may be necessary to drill additional connecting holes through the cubicle top, or to fold a strap through at the grill.

In some cases, it might be desired to take the R.F. output through the bottom of the transmitter, a line, such as RG17U may be brought through the base opening in the front of the transmitter, or a hole may be cut through near the front left corner post. The line is then brought up in the front left corner post and in the R.F. driver, turned to the rear and pass over the top of the divider panel between the driver and output network, terminating as required on line meter or monitor loop. The outer shield should be thoroughly grounded so as not to introduce any R.F. feedback into the low power stages or frequency unit.

The frequency monitor line of the small RG/U type is brought in directly to terminals 517 and 518 on the board underneath rear of the frequency control chassis. The modulation monitor line is brought in, the radio frequency cubicle carried up the left corner post, across the top left corner of the cubicle to the terminal board in the output network compartment.

In the modulator unit, the audio driver chassis is removed, and installs in the same manner as the frequency control unit. The blower likewise is removed.

From the base are removed all components, modulation condenser, filter choke and filter condenser from the front part of the base and consequently the first to be installed. The modulation transformer and reactor are at the rear with the terminals towards th center.

The audio input line is brought in to the modulator cubicle, up the left corner post, to the terminal board on the front left top of the audio chassis.

High voltage connections to the other cubicles are brought in either through the side openings of base opening, through one of the openings at the bottom of the power panel, to the three high voltage terminals on the rear of the power panel at the top right. In the power cubicle a cable cover fits in the bottom over these high voltage cables. The low voltage interwiring should be brought to the left or right, or both, so as to clear the ends of this shield.

All wiring should be secured so there is no possibility of being pushed into high voltage terminals, high voltage grounding switches, or other components.

Provisions are made so that the cubicles can be bolted together by aligning holes in the corner posts. The rear of the radio frequency cubicle, because of the shielding, cannot be bolted. However, bolts may be used on the front and bottom rear. The units should be bolted together so as to maintain a neat appearance.

EXTERNAL POWER COMPONENTS

The Gates BC-5P may be had with oil filled power transformer, a modulation transformer and reactor. When so ordered, connecting terminals are installed as required in the cubicles. See Drawing ES-6134.

The power transformer primary terminal board is installed on the lower left panel of the power cubicle. Terminals for the secondary connections are made on the lower right side.

The modulation transformer connects to a new set of high voltage terminals on the lower right side panel of the modulator.

The balance of the connections are made to terminals already provided. Should additional wire be required more than supplied, automobile ignition cable will be entirely satisfactory.

Then interlock can be provided by removing the jumper between terminals 3 and 5 in the modulator cubicle and connecting the door interlock switch in this circuit.

M-5066 LOAD CONTROL ASSEMBLY

The motor assembly is mounted on the left side of the RF driver compartment. The shaft from the front panel cyclometer to the loading coil is removed. The motor shelf is then mounted in front of the driver filament transformer. Motor mounts on this shelf. The vertical alignment is obtained by slotted holes in the shelf flanges the horizontal alignment by slots in the shelf plate. The motor is connected to the coil by means of a special shaft reduction coupling and shaft. A shield plate fits on the shelf lip, and should be installed to protect the motor from any field from the driver tank coil.

The M-4806 relay assembly mounts behind the cubicle terminal board TB301, to the left of the transformer, T301. The relay unit is connected to the motor according to the diagram A-9392, in the instruction book for the relay assembly. The motor voltage source can be taken from the 115 volt secondary of the transformer, T301. In this way, the system will be completely de-energized during shutdown periods. The motor to relay connecting cable should be formed down the corner post and secured. External connections can be made direct to the terminal board on the relay assembly.

When the motor and relay assembly are interconnected, the motor stops should be adjusted. The motor is equipped with cam stops which permit 22 revolutions. This is not the full length of the coil, but the tuning should always be such as to include some turns in the coil.

Also, in operation the loading variations will be accomplished with relatively few turns, so it is always possible to obtain sufficient variation of the loading. If the operation is so that the slider is near the end of the coil, release the shaft and run the motor in that direction until the stop operates, rotate the coil manually to about two inches from the end of the coil, then fasten the shaft.

M-4720 PLATE CURRENT EXTENSION UNIT

The plate current extension unit mounts to the right of TB301 in the radio frequency unit, and is secured by screws through cleared holes accessible in the high voltage compartment. The power amplifier ground return is from the power amplifier plate current meter, M301, to ground at the terminal board. Two wires connect to this ground, one of them to the meter. This wire is removed, a short length spliced in and connected to the terminal board of the extension unit. The "G" terminal on the extension unit then connects to ground.

M4719 PLATE VOLTAGE EXTENSION UNIT

The plate voltage extension unit mounts in the power cubicle, on the right side panel in front of the fan resistor, R109. Tapped holes are provided for mounting. Screws may be run in from the outside if the units are separated at installation. The insulators mounting the extension unit may be loosened and threaded on the panel screws. If the installation is complete, studs may be cut and the insulators mounted in this manner.

A high voltage lead is then formed around to connect to the high voltage side of the transmitter meter multipliers, R110 and R111. The ground is made to the ground bolt adjacent to the unit mounting. Make sure the ground connection is secure. The meter lead may then be formed down the corner post.

CONTROL CIRCUIT CONNECTIONS BC-5P2 REMOTE CONTROL

Filament holding circuit: The jumper between terminals 104 and 105 on TB101 is removed, opening **the** holding contacts of the start-stop relay, K101. The remote "hold" is then connected to terminals 105 and 110 in TB101.

High voltage Control: Terminals 13 and 14 on TB102 provide the high voltage on circuit. Removal of the high voltage may be accomplished by momentarily opening the "filament hold" circuit. The filament time delay is so arranged the plate voltage may be re-applied immediately if the filaments are re-started before the two minute shutdown period elapses.

If the remote control facilities provide for separate removal of the high voltage, this may be inserted by removing the External connection, to terminal 5 on TB102 and moving this to terminal 9. The remote control "High Voltage Off" is then connected between terminals 5 and 9 on TB102.

OPERATION AND ADJUSTMENTS

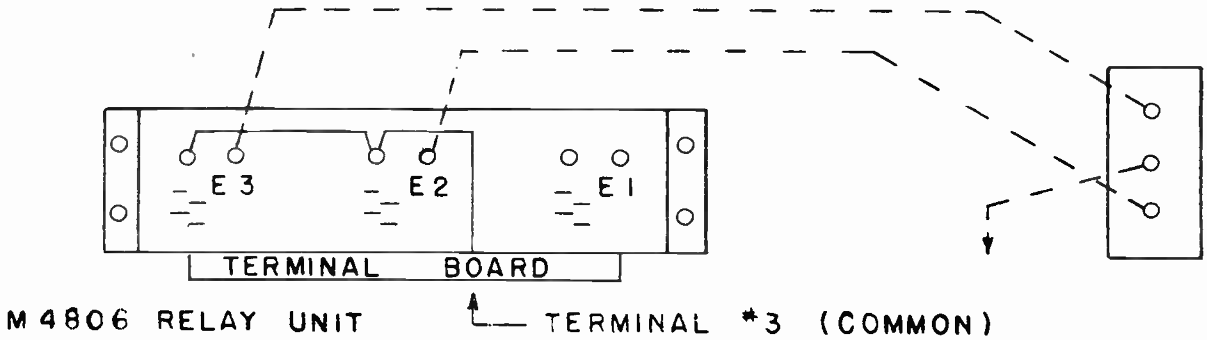
CONTROL CIRCUITS

The operation of the control circuit can best be studied by the line diagram, D-22253. In this diagram, all relays and switches are shown in the de-energized position, that is, as if all power were removed. The coils of the relays and contactors are shown in the diagram to best indicate the relative circuit location. The contacts are connected to the coil by dotted lines and the position of the contacts in the circuit diagram may be considerably removed from the coil as suits the clarity of the diagram. Normally open contacts are shown with the bar spaced away from the contacts, and when the relay is energized this circuit closes. Normally closed contacts are shown with the bar touching the contacts, and when the relay is energized, the circuit opens. Time delay is indicated with an arrow in the direction of the delay.

A-12219

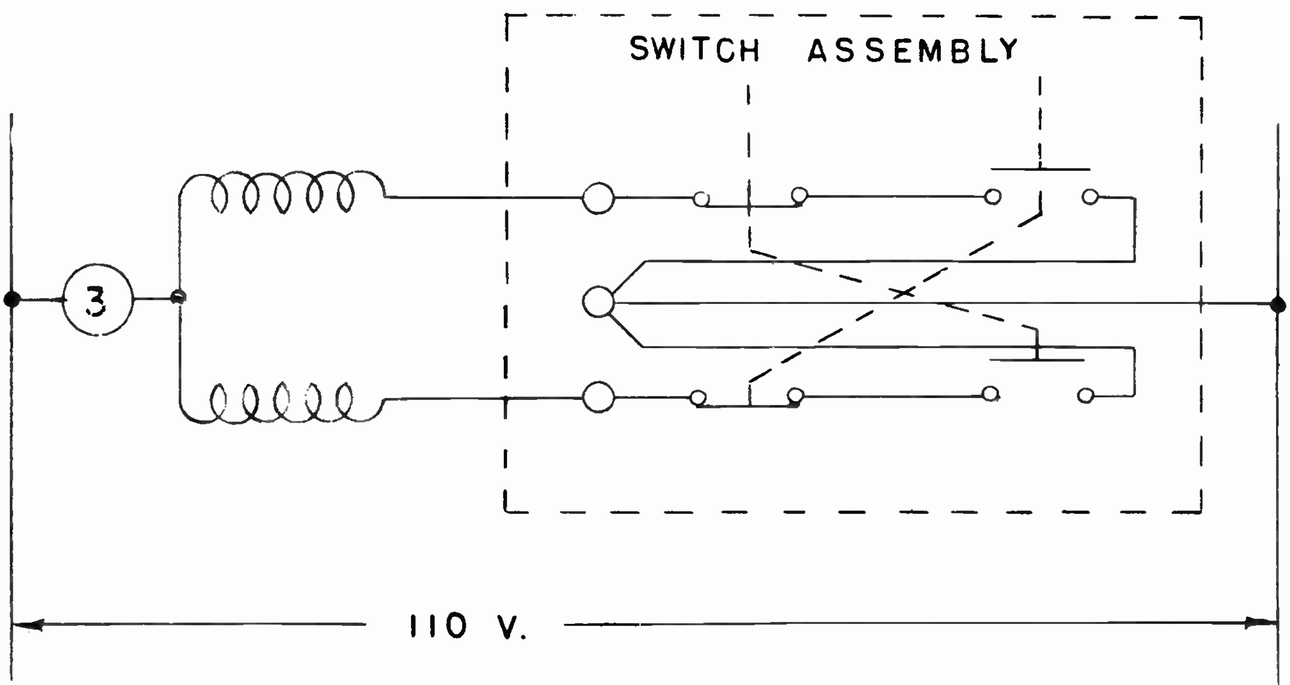
INSTALLATION OF MOTOR CONTROL SWITCH

Remove the top panel mounting the driver tuning, filament rheostat and loading control. Transfer the driver tuning and filament rheostat to the panel provided. The local loading control switch is mounted in the loading turn counter position, being secured by the switch bearings with cover plate on the front. The terminal board should be towards the window.



Solder two leads to A.C. relay terminals opposite common connection, and connect to two outside terminals of motor switch.

The center connection of the switch is taken to the remote control unit and connected to the 110 volt supply opposite the side supplying terminal #3 of the relay unit.



7-2-57

Gates Radio Company
Quincy, Illinois
Drawing No. A-12219

M-4806 RELAY ASSEMBLY

FOR

FIVE WIRE TUNING MOTOR

This unit is supplied as an accessory with Gates' Remote Control Systems where it is necessary to control a 5-wire tuning motor that is either a component part of the station transmitter or is furnished as an accessory with the system. One assembly is required for each motor involved.

To understand the principle of operation, refer to drawing A-9392. Relay, K1, is a six volt relay that is energized when the stepper switch selects the correct position. When K-1's contact close 115V A.C. relays K-2 and K-3 are ready to operate through the remote control increase-decrease circuits.

When increase (or raise) is operated, relay K-2 energizes, and when decrease (or lower) is operated, relay K-3 energizes. The motor voltage source connects to terminals 6 and 7, one side going direct into the field coil of the motor through terminal 12. When either K-2 or K-3 energizes, the other side of the voltage source is connected to the motor field coil through the right hand set of conta[illegible] of either relay.

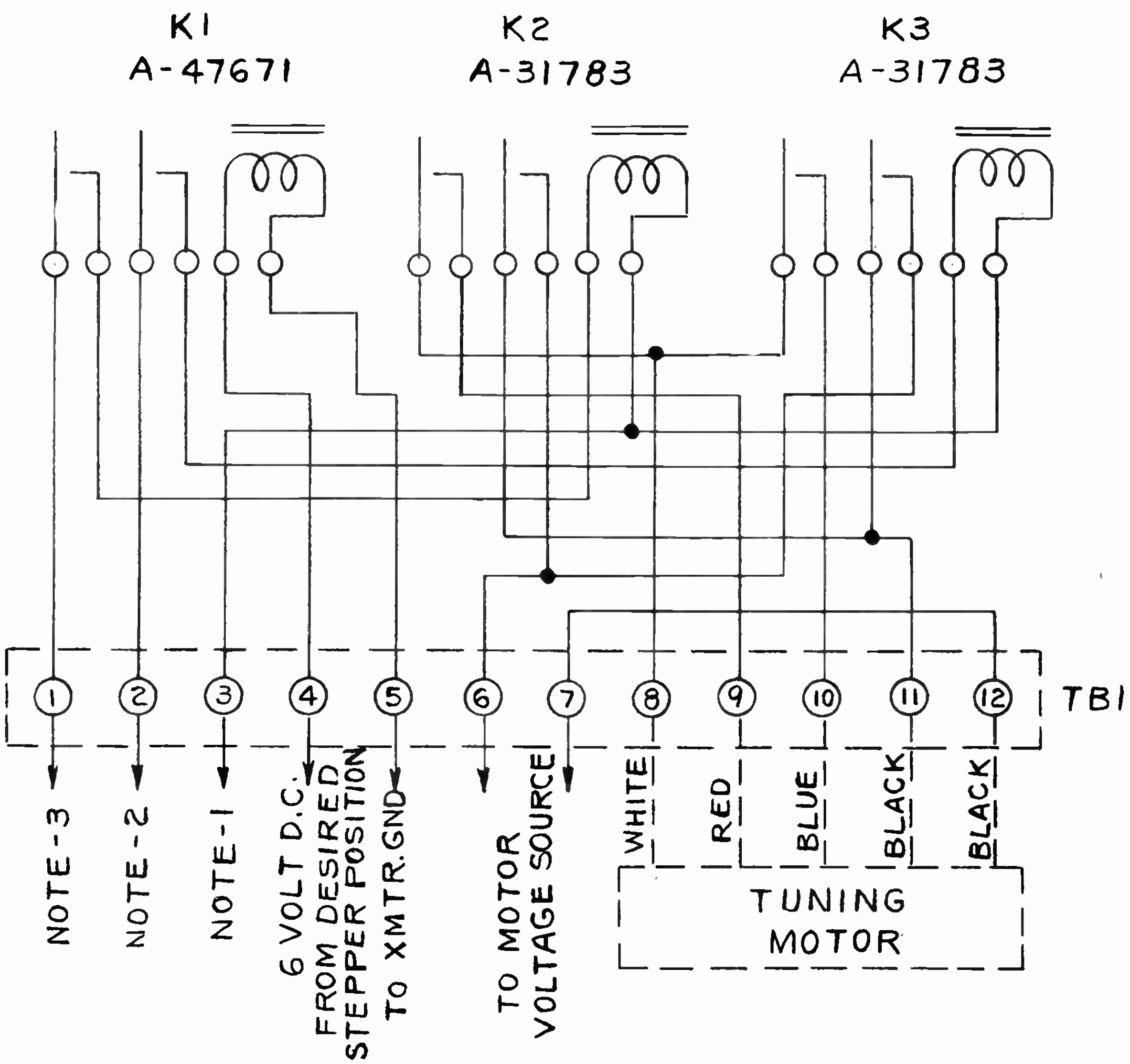
Motor reversing is accomplished by interconnection of the shading poles made through the white, red and blue wires. The left-hand set of contacts on K-2 connect white and red, producing counter-clockwise rotation. K-3 connects white and blue, reversing the direction.

The color coding shown applies to motors manufactured by the Barbe[illegible] Coleman Company, but the method of connection will apply to any ty[illegible] 5-wire motor. It is only necessary to connect the field coil to #[illegible] and #12, the common shading coil terminal to #8, and the reversing shading coil terminals to #9 and #10.

104	103	102	101	GR. NO. / FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS		A - 9392 SCALE

LIST OF PARTS

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



	RCM-20	RDC-10	RDC-200
NOTE 1:	115 A.C. NEUTRAL. (LEG OPPOSITE THE ONE FEEDING TB2-56 AND 58)	115 A.C. NEUTRAL. (LEG OPPOSITE THE ONE FEEDING TB2-27)	TB1-17
NOTE 2:	TB2-59	TB2-28	TB1-18
NOTE 3:	TB2-57	TB2-26	TB1-16

CH. BY	MTL.		TITLE M-4806 RELAY ASSY. FOR FIVE WIRE MOTORS. SCHEMATICS AND INTERCONNECTIONS FOR USE WITH GATES REMOTE CONTROL SYSTEMS	UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC GSM102.
DATE				
DR. BY D.L.	ENG.	FIN.		A - 9392
DATE 3-27-58				

All components within the power unit are of a "100" series: in the modulator, "200" series with the audio driver as a "400" series: and in the radio frequency unit all components are of a "300" series with the frequency control unit a "500" series. Each cubicle has a terminal board for interconnecting with other cubicles, each terminal board being numbered 1, 2, 3, etc. For terminal designations for wiring within a cubicle, these terminals bear designations 101, 102,201, 202, etc. When power is applied to the transmitter, pressing the "Start" switch S101 energizes the Start-Stop relay K101, the A-B contacts seal across the switch S101. The D-C contacts energize the blower contactor K102. The A-B contacts of this contactor across the D-C contacts of K101, seal in the blower contactor, K102. The C-D and E-F contacts of K102 energize terminals 1 and 2. The blower in each cubicle are connected in parallel across these terminals. Terminal 3 is supplied through the H-G contacts of relay, K101, the filaments of each cubicle are paralleled across terminals 2 and 3.

When the "Stop" switch, S103, is pressed the relay, K101, is de-energized, breaking the seal-in. The normally closed E-F contacts then energize the thermal time delay, K113. After 60 seconds, this relay closes, beginning the timing of the second thermal relay, K114. At the end of another 60 second interval, the contacts of this relay open, breaking the seal-in of the blower contactor, K102 causing this to drop off, shutting off the blowers. It will be seen that the filament circuits supplied through the H-G contacts of K101 drop off immediately when S103 is opened, the blower continuing to run until K114 opens. After K114 opens about 20 seconds will be required for this relay to cool and reclose. Pressing the Start switch S101 will close K101, the blower contactor will close as soon as K114 recloses, but this results in burning the contacts of K114 and this procedure is not recommended.

Each cubicle requiring a blower has its individual air pressur switch (S201 & S301) protecting the tubes against insufficient air flow. These switches control the filament circuit through the filament interlock relays K201, K301. The contacts are paralleded for higher current rating.
High voltage may be applied simultaneously with filament voltage with out damage to these tubes, so no time delay is required, but a slight delay is accomplished through the bias interlock circuit.

In the modulator and radio frequency units, all door interlocks except the high voltage compartment in the botton front of these cubicles are connected in the primary supply to the audio driver deck or the frequency control deck, so that opening any of these doors shuts off the respective deck with the attendant power bias supply. A

bias interlock in each deck (K402, K501) prevents the application of high voltage before the protective bias has reached a safe value. Indicating lights on both of these decks shows the status of filament and bias circuits.

The high voltage auxiliary relay K104 controls the operation of the high voltage contactor, K105. The relay is sealed in by one set of contacts when the high voltage on switch, S102, is pressed, the other contact of K104 closes the circuit to the high voltage contactor, K105. In series with the high voltage auxiliary relay, K104, are the a.c. overloads, the door interlocks in the rectifier cubicle, and the interlocks in the high voltage compartments of the modulator and radio frequency cubicles, the bias and filament interlocks of these cubicles. This control line starts with the power cubicle on terminal #5 and connects to terminal #9 of one of the other cubicles, terminal #5 of this then connecting to terminal #9 of the third, and should this be the last cubicle, terminal #5 is then jumpered to terminal #3 of that same cubicle to complete the circuit. This jumper is generally installed in the Modulator Cubicle. As it might be possible to have additional units, such as a second radio frequency cubicle, the series connection would be followed until the last cubicle, in which case the circuit is terminated back to terminal #3 of that cubicle. <u>This is the only series connection required in the transmitter installation</u>.

The two modulator overload relays, K202 and K203, the power amplifier overload relay K304 and the R.F. driver overload relay, K303, all have normally open contacts in parallel. The closing of any one of these will energize the overload auxiliary relay, K103, normally closed contacts of which are in series with the main high voltage contactor, K105, causing the high voltage to drop off. As quick as the overload relay opens, the circuit to the main contactor is again completed, and high voltage is reapplied. Connected across the coil of the overload auxiliary relay, K103, is a small dry rectifier, CR101, this in series with resistors, R106, R107 and R108, and the coil of a memory relay, K106. Connected across the coil of K106, R108 and to the arm of R107, is a large capacity condenser, C103. With each operation of the overload auxiliary relay, K103, the condenser, C103, receives a charge. If the overloads repeat in rapid succession, the charge on the condenser will build sufficiently to operate the relay, K106, a normally closed contact of which opens and drops out the high voltage auxiliary relay, K104, then necessitating manual resetting of the high voltage. In case the overloads do not build sufficient voltage to operate the relay, K106, the charge drains within a second or two, and the recycling is renewed for any subsequent overloads series. The number of overloads before an outage occurs may be set by the adjustable potentiometer, R107, which should be then locked to prevent accidental mis-adjustments.

As already mentioned, the a.c. overloads are in series with the high voltage auxiliary relay, K104, so that any a.c. overload takes off the high voltage which must then be reapplied manually. It is considered that an a.c. overload may be serious, and should have the operator's attention, while a tube overload is in many cases routine, such as a modulation transient.

Connections from the load side of the plate contactor, K105, to terminals #6 and #7 provides a source for closing the driver screen grid relay, K302, when plate voltage is applied.

Power reduction is accomplished by transferring the power amplifier plate supply to the mid-tap of the power transformer, securing half voltage for the power amplifier. This is done by the power change contactor, K108. This is controlled by the latching relay, K107, and the momentary contact high-low power switches, S105 and S106. This latching relay cannot be operated unless the high voltage auxiliary relay, K104, is open and the back contact is closed. That is, before being able to make the power change, the high voltage must be dropped off, then the desired power switch pressed, after which the power may be reapplied. The latching relay holds the required power until intentionally changed, there can be no change in power by relays dropping out due to power failure.

Across the two change solenoids of the power change relay, K108, are two indicating lights to show the position of the power change relay. These lights are supplied on one side from the junction of the time delay contacts of K109 and the high voltage auxiliary relay, K104. Until this time delay closes, there is a circuit complete through both lights so that both lights are on. When the time delay closes, only one light remains on, that one indicating the power position. This gives the indication that the filament time delay, K109, has closed.

From the low power side of the power change relay, K108, a line is brought to terminal #8 which may be carried across to the modulator unit to operate an input level relay, and across to the radio frequency unit to operate a monitor change relay.

Many stations have special control circuit problems. The most common is the use of directional antenna systems. Commonly used is normally closed contacts of the "DAY-NIGHT" switches to break the high voltage while switching. This may be most conveniently inserted in the high voltage auxiliary control line. Terminals #13 and #14 provided for an extension of high voltage on facilities. Power change may be accomplished by paralleling the power switches, S105 and S106, with terminal #114 common, connecting to #113 and #114 respectively. A spare contact arm on the latching relay, K107, may be used to interlock the power with the directional pattern.

Operating facilities may be extended to a control deck similarly as well as filament on by paralleling S101 from terminals #105 and #110, and for filament off by removing the jumper between terminals #104 and #105 and replacing with a normally closed switch.

The transmitter control circuits have been designed for operation with remote control systems with the consideration that many stations will be so operated. The Gates Radio Company provides units for remote control, and such units are being modified and improved as experience shows new desirable features. It is suggested that if remote control is contemplated, the Gates Radio Company be contacted for recommendations as to the latest developments and improvements.

HOLDING RELAY BC-5P

Some stations experience difficulty from momentary power failures dropping off the transmitter. This is generally due to the voltage dropping low enough that the holding contacts of the "ST..RT" relay, K101, opens. If this is unnoticed for a minute or so, as could happen with a remote controlled transmitter, the time delay starting cycle would be required.

By installing a time delay relay which has the time delay on deenergizing, shutdowns from power slumps may be minimized. The available relays are limited, and relatively more expensive than the more common time delay types.

On shutting down the transmitter, the OFF button will have to be held until the time delay operates. Generally, a delay of one or two seconds will be sufficient.

Some remote controlled transmitters cut the high voltage by opening the start circuit momentarily. With a delayed opening, the "OFF" would have to be held until the time delay opened.

POWER CUBICLE

The power transformer, T102 has ± 5% voltage taps. The Primary terminals 7, 8 and 9 are for 5000 volt output with 230 volts on the primary. Taps 4, 5 and 6 will increase the output voltage; 1, 2 and 3 will lower the voltage. The best transmitter operation will be with 5000 to 5200 volts on the plate of the power amplifier tube. Voltages below 5000 generally result in lower efficiency and higher drive requirements. Voltages above 5200 may result in excessive peak voltages generated in the power amplifier.

The incoming line voltage is metered by the top left voltmeter, and is switched between phases by the switch, S110.

The cubicle is cooled by a fan in the top, which runs while the rectifier filaments are on. It is considered that in the greatest majority of installations that the units will not cool during the shut-down period so that the cooling air will cause rectifier arc-backs during the early starting time. Should such a condition exist, such as in an unheated building common with remote control operation, it is suggested that a furnace thermostat be mounted in the cubicle and set to turn the fan on when the temperature reaches 80 to 90 degrees F.

The a.c. overload relays are of the instantaneous type. The tripping value is set by rotating the armature on the threaded shaft; a tab aligns with markers on the armature to indicate the tripping current. The armature is locked in position by a locknut. This should be tight so that the relay holds calibration.

The normal current for 100% modulation at 1000 cycles is approximately 30 amperes per phase, and slightly higher at the high frequency end of the range.

On the low frequency end of the audio range, the relatively long duration of the load cycle may cause the overloads to open. The proper tripping current is just high enough the relays do not trip with modulation. This will be approximately 60-80 amperes.

The voltage change relay, K108, is designed that when the solenoids are fully closed, the arm does not rest against the spacer plates of the switch jaws, but make the electrical contact through the side pressure of the switch jaws. Should the contactor be noisy in either position, examine the closure in this position that the arm is not holding the armature slightly open by pressing against the spacer plate.

Another cuase for noisy operation is that the solenoid is slightly out of alignment, pulling the armature to the side when the solenoid is energized. A light application of grease on the armature will facilitate the movement of the armature, dry metal surfaces at times bind and causes the solenoids to be noisy.

M-5533 FREQUENCY CONTROL UNIT

The M-5533 Frequency Control Unit consists of the M-5422 oscillator unit incorporated in a chassis containing an intermediate power amplifier with plate supply, bias supplies for the power amplifier and driver tubes, and the necessary interlocks.

The M-5533 oscillator unit is located on the front right side of the chassis. Connections are made by a plug cable in the rear of the unit. The unit is removable by removing the cable, and from underneath loosening the four screws on the flange mounting. The crystal change switch and crystal trimmers are behind a hinged door on the front panel so that crystals may be switched or adjusted without shutting down the transmitter.

The oscillator uses a 12BY7A tube in an electron coupled circuit, Due to the low operating voltages and the extremely low crystal current the unit has exceptional frequency stability. A second 12BY7A also operating under conservative conditons acts as an isolation stage between the crystal oscillator and the 1st IPA. The crystals are a low temperature coefficient type which do not need a heated oven to maintain frequency well within FCC limits. Elimination of the oven requirement is desirable for increased reliability as oven thermostats, when they stick or fail to close, can not be repaired by station maintenance personnel. Frequency trimmers C1 and C2 provide a small degree of frequency adjustment which will be required after the crystals have been shipped and during the first several weeks of operation due to ageing. Coil L3 and variable capacitor C9 both in the second 12BY7A plate circuit are adjustable to the stations frequency. The oscillator unit has been thoroughly adjusted and tested on frequency before shipment and only a slight trimming up of capacitor C9 and the frequency adjustment trimmer capacitors, C1 and C2 will be required on installations.

The crystals supplied with the oscillator unit have been made and adjusted in a duplicate oscillator by the manufacturer so as to be within frequency tolerances. The use of any other crystals, or adopting other crystals, may not be satisfactory.

Should a field change of frequency be required, the output coil L3 is at maximum inductance (slug fully in coil) for a range from 540 Kcs to approximately 900 Kcs. With the slug out of the coil for minimum inductance, the range if from approximately 800 Kcs to slightly above 1600 Kcs. With frequencies between 540 and 800 Kcs it would be possible to double in the second stage. If such occurs, it would be apparent by the position of L3, and also in the tuning of the following stage.

Terminals 519 and 520 are in the 6146 cathode, and are provided for carrier suppression and arc-quenching circuits. If such are not used, these terminals should be jumpered together.

Besides the standard rectifier circuit to provide plate power for the oscillator, buffer and R.F. driver screen grid, each side of the power transformer feed to a rectifier tube (6W4) which has half wave rectifiers provide holding bias for the r.f. driver and power amplifier. As soon as these tubes have normal grid drive, this bias voltage is cancelled, and these two holding bias tubes draw no current from the plate transformer. In the holding bias supply for the power amplifier is a bias interlock relay to hold off the high voltage until adequate holding bias is obtained. The front panel

has an indicating light for the filaments, and a second light which is on the bias relay closes.

The power amplifier bias, which may reach considerable voltage, is terminated on a separate terminal to the left of the terminal board under the chassis. As these holding bias supplies work against ground, before excitation is applied, <u>the holding bias current flows through the power amplifier plate meter causing this meter to read reversed</u>, and also through the grid current meter to read up on this meter. These readings serve to indicate the operation of the holding bias before high voltage is applied. These bias currents do not effect the accuracy of the meters during operation. The holding bias on the power amplifier is adjusted so that approximately .2 amperes current flows. This is far within the dissipation rating of the tube, and helps hold the plate voltage from becoming excessive where the tube biased to cutoff.

The 6146 output tank consists of the coil L506 which has a tap for shorting a portion of the end for the high frequency end of the band. The tank will tune 1600 Kc without this short, but by shorting this portion, higher capacity in the tank will be maintained and less critical tuning. This will tune to 1050 Kcs. With the short removed, the tank will tune to 850 Kcs. Connecting the left padder condenser C512 by means of a jumper on the terminal board on the chassis gives tuning to 850 Kcs. The right side condenser of 500 mmfds C511 starts the high frequency end of the range at 850 Kcs, this can be raised by shorting the end portions of the coil providing plenty of overlap.

The lowest frequency with the 500 mmfd padder is 540 Kc. For this low end, both padder condensers may be connected.

On the right side of the panel is a multimeter switch by which currents of the oscillator cathode, buffer grid and cathode, R.F. driver grid and cathode, and power amplifier grid may be measured. The meter is located on the cubicle meter panel on the right.

With the filaments on, the plate supply for the oscillator is on. With the proper buffer tank capacity for the frequency, and with the excitation control at mid-range, switch the multimeter switch to "Driver Grid", and tune for maximum grid current. The amount of pickup will be largely determined by the "Excitation" control which is determined in the final adjustments of the transmitter. The final setting of the "Excitation" control is just past the point at which the power amplifier grid current no longer increases as the excitation is increased.

When the buffer is tuned, grid current should be obtained on the "Driver Grid" position of the multimeter. This will be from <u>20</u> to <u>30 Milliamperes</u> with full excitation.

R.F. DRIVER

The R.F. Driver utilizing a 4-250A tube, is mounted on a chassis on a shelf above the frequency control unit. This chassis with the socket, bypass condensers, grid parasitic and choke, is coupled to the main plenum chamber, thus providing the cooling air as required for the tube. The filament transformer is mounted on the shelf on the left side. The tube is shunt fed, the plate choke on the rear panel on the left, the blocking condenser right of center. The tank coil L303 is mounted on the right side panel, the tuning is by a vane within the coil, and this is directly coupled to a turn counter tuning control on the front panel.

The tank condensers are of the fixed type, mounted on the shelf below the tank coil. The coil is floating, and fed through R.F. choke and a bypass condenser. The power amplifier grid tap is taken from the 4-250A plate end of the coil, the neutralizing tap from the opposite end, the end mounting the tuning vane.

Whenever possible, the radio frequency cubicle has been tuned to the specified frequency. This means that the coil taps are closely to the correct positions, and little if any, coil adjustments will be required.

The stage is tuned by (1) installing the tank condensers C304A & B, setting the coil tap on L303 according to frequency, setting the center-tap L302 to the mid-point of the number of turns of the coil that are used, setting the power amplifier grid and neutralizing taps at 1/2 the turns between the center-tap and the connections of C304A & B, (2) open the power amplifier disconnect switch S307, (3) Turn the "Excitation" control to mid-position, (4) set the multimeter switch to the "Power Amplifier Grid".

Watching the multimeter on the power amplifier grid current position, apply plate voltage. If no current is indicated, cut the plate voltage and tune over a range before re-applying voltage. If an indication of grid current is obtained, it can be quickly determined the direction of tuning, and if the inductance should be changed. <u>The vane moving into the coil decreases inductance, moving out, increases inductance.</u> When the final tuning adjustments have been made, the vane should, if possible, be about opposite the first turn of the coil. In this position, it has no noticeable effect on the neutralizing. It is best to start with the tuning at one end of the range, and in case of excessive tube heating, after cutting the plate voltage, run the tuning to about mid-range and reapply the high voltage, and again to the other end of the range if necessary. The equivalent tuning range is one to two turns variation on the coil, depending on frequency and tank capacity. The L-C ratio of the tank is not critical, except that for high capacity with low inductance, it is difficult to match the tube to the power amplifier **grid,** and the 4-250A tube will run considerably warmer than if lower capacity and more coil were used. A low capacity in this tank might indicate a source of R.F. harmonic generation, but tests show that this has very

little effect. Also the low capacity might indicate the loss of the "flywheel" effect, the carry-over of power during the positive drive cycle. Measurements show the lower capacity tank will actually give better performance due to better matching of the load. However, caution should be observed that the current rating of the tank condensers are not exceeded.

The excitation control should be brought up, the 4-250A grid current will read approximately 20 to 25 milliamperes on the multimeter.

The most desirable setting is found when the transmitter is fully tuned, and is the point just after the power amplifier grid current does not increase with an increase of the "excitation control". Power amplifier grid saturation is obtained for best efficiency and also the noise generated in the radio frequency circuits will be greatly reduced.

The power amplifier grid tap should be adjusted to give a power amplifier grid current reading of approximately 180-220 milliamperes. Increasing the number of turns to the grid tap will eventually reach the point where the grid current will not rise, but the heating of the 4-250A will increase considerably. The tap should be moved back to the maximum most efficient operating point. The 4-250A tube plate will show color. It is normal for these to show a bright cherry red and in many applications are so operated. For the operation in the Gates BC-5P transmitter, the color generally is only a dull red. The plate current as given on the multimeter is between 250-300 milliamperes. If the loading is kept high on the stage, the tube shows slightly more color, but the tank currents are lower because of the lower "Q" and heating of these components will be reduced.

In some instances, increased output from the driver stage may be required. The cathode resistor R308 may be shorted, and/or one or both the plate dropping resistors R115 and R116 may be shorted. Such operation is permissible unless the tube runs more than a dull red, or unless the tank condenser current exceeds the rating. With such operation, the grid and cathode currents may read slightly off-scale.

The driver stage is more easily tuned by reference to the power amplifier grid current rather than the driver cahtode current.

POWER AMPLIFIER

The power amplifier consists of a 3X2500F3 tube. This tube is completely enclosed in a compartment to the rear of the driver stage. The socket assembly mounts on top of a plenum chamber. Inside the plenum chamber is the power amplifier tank. The underneath of the tube socket connects to the plate blocking condensers, C318 and C320. The stage is shunt fed through two radio frequency chokes, L306 and L307, with a bypass condenser at the junction of the two chokes to ground. This effectively keeps radio frequency voltages from feeding back into the modulation components. The tank coil, L308, is tuned

by a movable vane within the coil, and is mounted so that this tuning is in line with a turn counter on the front panel. The tank capacity is from one to four fixed vacuum condensers as required by frequency. These should be installed with outside plates to ground. The neutralizing condenser, C313, is mounted in the front top right hand corner of the chamber. The first coupling condenser C314 mounts in the upper front left corner, a lead from this going up through the tube compartment to the output network in the top compartment.

On the center of the front panel of the chamber is the air switch, the operation of which is described in the "Modulator" section of this instruction book. The plenum chamber must be closed to get this switch to operate. The air intake is at the bottom of the chamber, and is covered by an aluminum screen. This is readily removable, and should be periodically cleaned.

The output line from the power amplifier tank enters the output network compartment in the front left corner, then passed across to connect to the first line coil, L309, then to the variable output coil, L310. A coupling condenser, C316, connects between the two coils to ground. This coupling arrangement is for line impedances up to 100 ohms. When the line impedance is higher, such as 250 ohms, the variable output coil, L310, used as a loading adjustment, will have very little effect on the loading. If the transmitter is to be operated into a high impedance load, a condenser across the load side of the line coil, L310, will allow the loading to be effectively controlled by L310. As an emergency matching, the line from the tank can be moved to L310 with L309 as the output coil. This arrangement results in considerable interaction between the loading and tank tuning. The operation and adjustment will be more critical than the standard low ohmage output circuit.

Whenever possible, the radio frequency section is tuned for the specified frequency and loading. In which case, only minor readjustments may be required.

After the driver stage has been tuned, install the tank and loading condensers, C311,C315 and C316 according to the frequency and load, close the link S307 and put the power switch in the 1 KW position. Apply plate voltage, watching the plate current meter. If this is over 1.2 amperes, cut the plate voltage and tune, turning on the plate voltage momentarily to see if the current is changing, looking for a reduction of plate current. By starting with the tuning vane at one extreme of its travel, the tuning is equivalent to one or two turn changes of the tank coil, depending on frequency and tank capacity. With grid and neutralizing taps set as instructed, there is no tendency for oscillations in the power amplifier. When the power amplifier is tuned and load adjusted, then the final neutralizing adjustments may be made.

In case the transmitter is being tuned to a new frequency, capacities and coil turns will be approximately as shown in the chart.

When the resonance point has been achieved as indicated by minimum plate current, the loading can then be adjusted. This may be accomplished only by the variable coil, L310, or readjustments of L309 may be required. When the final tuning is obtained, the tuning vane in L308 should be about even with the first turn of the coil. The first line coil, L309, will have considerable effect on harmonic radiation, and should have the most number of turns possible, and still be able to control the loading within limits by the coil L310. As L309 is increased, there generally will be reached a point at which the loading goes up rapidly and L310 will be near maximum. Neutralizing may be done "dynamically" by going back and forth through the power amplifier tuning, at the same time watching the power amplifier grid current. When the power amplifier is neutralized, the grid current will drop on both sides of plate resonance. In some instances, the current may not drop immediately, but require a little detuning. Should the grid current increase on either side of resonance, cut the power and move the neutralizing tap on L303 a turn, continuing until the desired effect is achieved. This is usually a turn or two less than the grid tap.

Other means of neutralizing indication may be used. The front bottom of the plenum chamber has several ventilating holes, leads may be brought out through one of these to an oscilloscope from a pick-up loop near the tank. In such cases, the power amplifier disconnect link, S307 should be opened.

<u>The final tuning of the power amplifier should be that the loading is approximately 100 milliamperes below the desired loading, and the tap tuning turned counterclockwise (lower inductance) from resonance until the correct current is obtained</u>. The effect of tuning to both sides of resonance will be quickly noticed on a line current meter, common point meter, or other output indicating device. The explanation is that maximum impedance, as indicated by minimum plate current, is not exactly the same as unity power factor as indicated by increased output current.

The efficiency of the power amplifier stage should be very close to 80%. The unit is factory tested, and the first test is to achieve this efficiency, using a water cooled antenna. By measuring the water flow and the temperature rise of the water, the actual power dissipated in the dummy antenna can be accurately measured. Efficiencies above 85% should be regarded with suspicion, and may be due to defective input current and/or voltage meters, line current meter, or to an error in measuring the radio frequency load at the measuring point. With the transmitter in tune, and reasonably matched to the load, the poorest efficiency is seldom less than 75%. In the case of low efficiency, all power that is not going into the radio frequency load will be dissipated in the tube, tank and coupling components. Thus, one indication of low efficiency is that the tubes and sometimes tank components will show considerable heating. The effect will be most prominent in the heating of the tubes. One check is to set the modulator static current at 250 milliamperes per tube, representing a dissipation of 1250 watts. After running for ten or fifteen minutes with no signal, cut the power, feel the heating on the plates of the modulator tubes and quickly compare with the heating of the power amplifier tube.

In measuring true efficiency, the plate voltage reading should have subtracted from it the voltage drop in the cathode resistor and modulation reactor. These are each 50 ohms, the total is 100 ohms, and if the plate current is 1.25 amperes the voltage drop is 125 volts, which should be subtracted from the meter reading. Thus, if the meter reading is 5125 volts at 1.25 amperes, the actual voltage would be 5125 minus 125, or 5,000 volts.

The meter is connected across the supply so that multiple unit operation may be had without additional meters. If single unit operation is to be used, the voltmeter could be connected directly across the power amplifier by transferring the high voltage lead to the "RF" side of the modulation reactor (using high voltage scale) and the ground side to the center-tap of the P.A. filament transformer, using 600 volt wire.

TUNING CHARTS

The tuning charts for the R.F. driver and power amplifier are given to serve as a guide for tuning the transmitter and are not to be construed as unalterable values. For example, L308 might be indicated to have 20 turns, but at final tuning might have 18 or 22 turns.

The output circuit offers considerable flexibility to values of components, and at times values of capacities might be used other than given in the charts, this being done perhaps as a result of procurement or as the result of additional operational information. Lower capacities will result in a corresponding increase in inductance values to compensate for the changes.

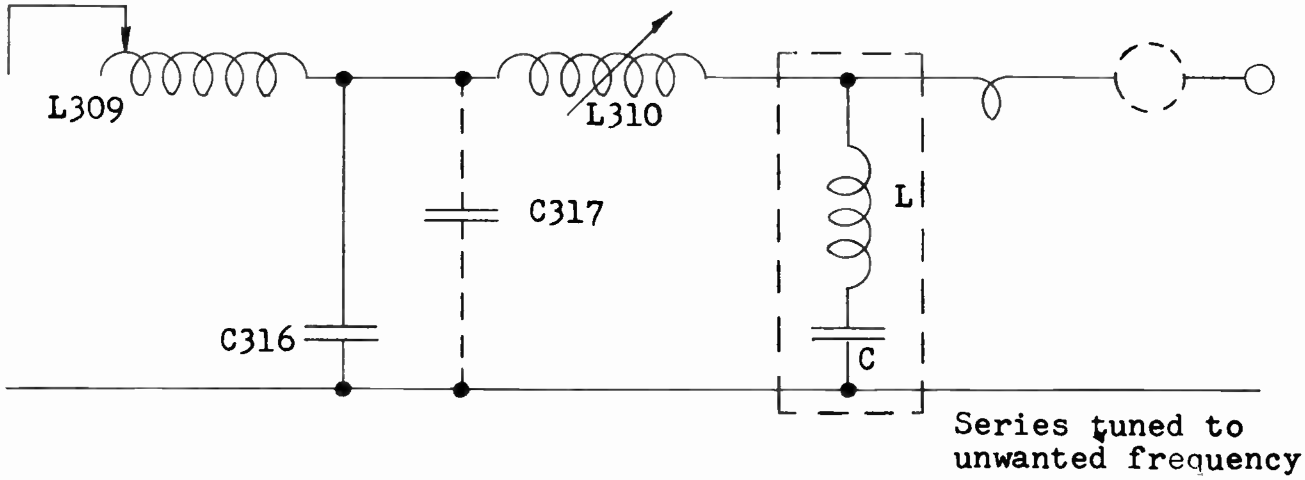
HARMONIC REDUCTION

The Gates BC-5P transmitter has been designed to reduce harmonic radiation as much as possible. High order harmonics may be strongly radiated if there is coupling between the power amplifier tank and the output. The physical arrangement of the BC-5P transmitter eliminates this stray coupling, and actual measurements on several frequencies and operating conditions show that harmonics of the order of the fourth and higher are of very low strength.

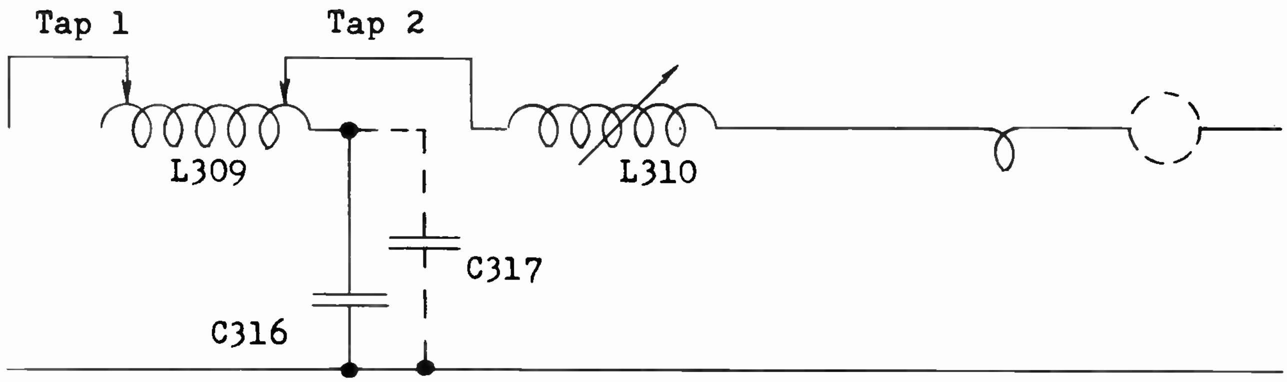
The second and third harmonics are the only harmonics which show signs of reaching objectionable intensity. The strength of these are greatly affected by the tuning. The opinion that increasing all capacity values throughout the power amplifier tank and coupling network to reduce harmonics is fallacious, the best harmonic reduction is obtained by the proper relationship of the various inductive and capacity values. As a general rule, the greater the inductance used in the first coupling coil, L309, the greater the harmonic reduction.

In the case of harmonic trouble, the first step should be to determine whether the harmonic radiation originates in the transmitter or externally such as in the antenna system. Tower guy lines might resonate at some harmonic frequency and be shock excited to radiate an objectionable signal.

Should the harmonic originate in the transmitter, and not adequately respond to normal tuning procedures, circuit revisions may be made. In some instances, a harmonic might be directly on some frequency, such as airways or police, where a very small signal will interfere, and require far more than normal suppression.



The condenser C can be the same type and capacity as at C316/C317. The circuit is tuned to normal loading on the fundamental without L. The coil L is tuned to the unwanted frequency when connected in parallel to C, using a grid dip meter. The coil L should be of 1/4" or 5/16" copper tubing. The mounting should be for minimum coupling to other circuit elements. With careful adjustment 20 to 30 DB attenuation may be obtained.



Tap 2 is adjusted so that the inductance between this tap and the end of the coil connecting to the coupling condensers, with the coupling condensers C316/317 form a series resonance circuit at the unwanted frequency. The position of tap 2 may be critical to 1/4". The normal loading is then adjusted by the position of tap 1. This circuit shows 10 to 20 DB attenuation to the undesired signal.

Should attenuation be required on two frequencies, these two circuits can be both used.

POWER REDUCTION TO 1000 WATTS

Reducing the power amplifier plate voltage to half value also reduces the plate current to half value, giving a power reduction to 1/4 powe or 1250 watts. In most cases, a slight adjustment of loading is satisfactory. Many installations operate full time on 5 kilowatts, the power reduction serves as a tuning convenience. Should an exact power change from the full power value, generally over 5 kilowatts, to allow for antenna losses, to the low power value, installation of three dropping resistors R117, R118 and R119 in the low voltage lead to the voltage changer K108 will drop the plate voltage and, consequently, the current, to a little below the 1 kilowatt value. By using adjustable resistors, the low power level may be set within operating limits without varying the loading.

The three resistors mount below the P.A. voltage changer K108, on insulators. Tapped h les are provided. The resistors are connected in series the "2500 Volt" lead is removed from K108 "B" and connected to one end of the three dropping resistors. The other end connects to the "B" terminal of K108.

POWER REDUCTION TO 500 WATTS

The method is similar to the exact reduction to 1000 watts, except that a higher dropping resistance is used. As considerable heat is developed, these resistors are mounted at the top of the cubicle. To give an adequate wattage, four resistors are used.

ARC QUENCH CIRCUITS

Arc quench circuits operate generally on the principle of a low current supply of 200-300 volts being connected through a suitable radio frequency choke relay to the transmission lines. When an arc occurs, the direct current path is completed, the relay energizes and normally closed contacts open, dropping excitation until the arc is quenched.

It is apparent this system cannot be applied when there is a conductive ground on the transmission line such as might be obtained with grounded phasor tank, or static drain resistors or chokes. Also, in many directional antenna system, lines or towers may be blocked to direct current by series capacitors. To obtain complete and adequate arc protection will in most cases require a study of the parti ular antenna system being used.

FREQUENCY MONITOR

Many stations installing the Gates BC-5P transmitter are replacing old transmitters or increasing power of an existing station. Generally, these have a frequency monitor which is to be used with the BC-5P transmitter. Different makes and models have different requirements for operating power and input impedance. A source for the frequency monitor is provided from terminal 517 which is connected to the tank circuit of the output tube of the oscillator unit

This source is adequate for the Gates M4990 Frequency Monitor. There may be some instances, depending on frequency and transmission line length, that the Gates M2890 Frequency Monitor will not work satisfactorily.

The tap on the IPA tank coil L506 may be utilized for a source for the frequency monitor if this is not shorted out. An excellent and flexible source of power for the frequency monitor is to remove the ground connection from L506, inserting a condenser from .01 to .1 mfd. capacity, preferably equivalent Sangamo type A or H, 600 working volts. The capacity would be a matter of experiment, depending on frequency, transmission line and monitor requirements.

The Gates M4990 may be operated from a modulated radio frequency source. With a suitable power dropping device, this could be paralleled across the modulation monitor input. It will be found preferable to have the monitor pickup from the low power stages as then the frequency can be checked without high voltage. Also, the calibrate adjustment may be maintained more uniformly.

MODULATION MONITOR PICKUP

The modulation monitor pickup, L313, is best adjusted after the installation is complete and the transmitter is tuned. As many variables enter into the adjustment, no effort is made at the factory to set the coil. The line to the modulation monitor should preferably be small size concentric like RG-U. Shielded audio wire introduces severe losses and difficulty will be had getting sufficient pickup to operate the monitor. The amount of pickup can be adjusted by swinging the coil. This should be set for low power. The pickup for full power is then set by the slider on the resistor, R310.

Should the pickup be insufficient, a new coil can be tried. It is suggested that temporary coils be first used, as additional turns on the coil does not always mean more pickup. In some instances, it may be necessary to replace the single turn line coil by a two turn coil. This could be made from #12 bus wire for a trial. Copper tubing, from 3/16" to 5/16" may generally be obtained from auto supply or refrigeration service stores. Of primary importance is that rigility be obtained.

AUDIO DRIVER

The audio driver consists of two 6SN7 voltage amplifiers and four 6550 tubes in push-pull parallel. The audio input is direct to the input transformer, with provisions that a level change relay pad may be installed when it is desired to have automatic level change for 1 KW operation. The cathodes of the first audio stage has a balancing control, R413, in the cathodes. The main feedback is returned to the first stage, and a balancing control, R409, is provided for this. Before starting measurements, both controls should be centered. From the plates of the 6550 driver stage to the cathodes of the second audio stage, is another feedback loop. The driver transformer has 40% voltage taps to which the screens of the tubes are connected. Grids, plates and screens all have parasitic suppressing resistors. The driver stage is cathode biased by the

resistor, R434. On a board on the side of the chassis by the tube sockets is a set of four individual 10 ohm resistors, a voltmeter reading across these will give the individual tube currents. This voltage is normally .65 volts.

The driver transformer secondary has drive balancing taps, on one side plus 5% and on the other minus 5%, enabling the drive to be balanced to 10%. In some cases it may be desirable to reverse these, in which case the main feedback should also be reversed. Normally, the testing can be started with both sides on equivalent voltages, changing the balance if indicated.

The plate supply is self-contained. The rectifiers are two 5R4GY tubes with paralleled plates as a full wave rectifier. The normal voltage is 450 volts, the normal current to the four 6550 tubes is 300 to 325 milliamperes. The supply for the first two audio stages is obtained through a divider and separate filter system eliminating any tendency to motorboat.

A separate rectifier supplies the bias for the modulator tubes. This is well filtered, and the bias controls on the front panel give adequate control of modulator bias. Provided in the bias circuit is the bias interlock relay, K402, which closes the high voltage control circuit when the bias voltage has built to the proper value. A second contact of this relay closes the circuit to the pilot light indicating the bias is applied. A pilot light across a filament circuit indicates the filaments are on.

The power required for the audio chassis is 115 volts, obtained in the transmitter by a step-down transformer, T203. The primary of this transformer is controlled by the door interlock switches, so that opening the doors removed bias voltages. Should it be desired to check the audio deck by itself, the deck can be removed, 115 volts connected to the input supply. The driver transformer secondary should be loaded with 10,000 ohms grid to grid, 50 watt resistor rating should be used. The bias voltage may be blocked off by a 1.0 mfd. 400-600 volt condenser. A vacuum tube voltmeter should be connected from this to ground and a reference level of 150 volts which is the nominal value to obtain 95% modulation with this test, (RMS) should be used for reference.

The overall feedback is removed, and consequently, improvements due to feedback are not obtained. This is particularly noticeable on the low frequency. Some loss of response on low frequency is due to the 1 mfd. blocking condenser used. With these factors in mind, the general performance of the audio driver may be checked external from the transmitter. The signal may require a divider to reduce the level for the distortion meter, for example, 100,000 ohms, 1 watt to the blocking condenser, 25,000 ohms, 1 watt on the ground side, the distortion meter being taken across this.

Typical audio response and distortion of audio driver removed from transmitter with 10,000 ohm "grid to grid load", reference 150 volts RMS, the approximate value required for 95% modulation.

	DIST.	RESPONSE
30	10%	-3
50	3.5	-1.2
100	2.7	-.4
400	2.25	0
1000	2.25	0
2500	2.25	0
5000	2.1	0
7500	2.0	-.8
10000	2.4	-1.2
12000	1.7	-1.7
15000	---	-2.4

MODULATORS

The modulators are operated on both 5 Kw and 1 Kw at full rectifier output voltage of approximately 5000-5200 volts. For 5 kw operation the modulator grid current excursion is very low, permitting the use of a low power driver stage.

During initial test procedures, disconnect the feedback, either by removing the connections at the terminal board, or by removing one resistor on each side of the feedback divider. The resistors removed would be one of the 100,000 ohms on each side. NEVER APPLY HIGH VOLTAGE WITH THE 5000 OHM RESISTORS ON THE GROUND END OF THE DIVIDER REMOVED.

The feedback is supplied by a straight resistor divider network. The feedback signal is reduced to a usable value in the audio deck. The feedback is taken to a terminal board on the right side of the cubicle, directly below the feedback terminals on the audio chassis.

When the audio tone is applied, the input signal level will be about -10 DB. When the operation has been checked, the feedback can be connected, and the input level should be approximately 0 DB for 100% modulation. If the feedback is reversed, the modulator may oscillate. If it does not go into oscillation, the level for modulation will be very low, -20 DB.

The static current on the modulators normally should be 50 milliamperes per tube. However, they can be operated up to 300 milliamperes per tube without damage, but this means that considerable heat will be generated in the modulator unit. Operate the modulators at the lowest static current as is compatible with performance, generally 50 milliamperes.

The driver transformer has balancing taps, one side giving a +2½% boost to one modulator. The other side gives a -2½% drop, so the total correction is 5%. The two center terminals of the output terminal board are marked "200" indicating a normal 200 volt signal. One outside terminal is marked "195" and the other "210" indicating relative voltages from these terminals. Normal testing would begin using the "200" terminals. If better results can be obtained by changing the taps, this should be done. Frequently, the unbalance correction is in the other direction, reversing the grid leads would then require reversing the feedback connections. To have the bias potentiometers regulate the tubes in the same relative position, the bias leads may be reversed on the terminal board by the output transformer. These leads have spade lugs, so the screws do not have to be removed.

After the transmitter has been placed in operating condition, unless the performance is exceptionally good, several checks can be made. The primary of the modulation transformer can be reversed. This frequently has an effect on distortion, mainly on the high frequency end of the range. Also, addition or cancellation of noise usually results from the polarity of the transformer. If the primary lines to the transformer, or connecting on the transformer, are changed, the feedback will be unaffected. The secondary should always have #5 terminal connected to the power amplifier, the #4 terminal to the modulation condenser. With the plate currents statically balanced, when signal is applied it will be noted that frequently the plate currents will differ if the modulation transformer is reversed, it may be noticed that the unbalance is also transferred, indicating that the loading is slightly different between the two halves of the primary. Some balance may be achieved by means of the balance drive taps provided on the driver transformer. The unbalance need not be of great concern if the distortion is within limits. Generally, then the modulation transformer or driver transformer are reversed, the two balancing controls R409 and R413 will generally require changing. Preliminary testing can be done with 50, 1000 and 7500 cycles. The effect of the two controls varies, depending on the type of unbalance, but generally the cathode balance R413 will have the main effect on the low audio frequencies, and the feedback balance R409 on the high frequencies.

DISTORTION

The Gates BC-5P transmitter is tested thoroughly as possible at the factory to assure proper and satisfactory service and performance for the customer. Should the distortion be high, the following items should be checked and tests made.

1. The proper connecting of the feedback, the modulation transformer reactor, condenser, also that the filter condensers are connected on the load side of the filter chokes.

2. Sufficient R.F. drive on the power amplifier. A slight increase in drive may make noticeable improvement.

3. Proper test procedure. The diode may be sensitive to amount of pickup, try varying coupling. The location of pickup may be such that harmonics are also included, or that pickup may be from two sources of different phase. The use of a modulation monitor for modulation reference may result in higher percentage of modulation than desired. An oscilloscope is the best means for obtaining the reference level.

4. Remove or disconnect feedback, use audio divider on modulator grids as described in the audio driver section, determine if the distortion to the modulators is high. This normally will be under 2-3%. The divider might also be applied across the grounded feedback resistors R208 and R209 for measuring modulator output. Also, the divider might be used across the 50 ohm power amplifier cathode resistor, R302, the power amplifier tube acting as the load element on the modulator. This test, however, may not be conclusive, as the power amplifier might not be presenting a linear load to the modulators.

INITIAL TEST PROCEDURE

When the transmitter has been completely installed, all connections made, all blocks and ties removed from the contactors and relays, and to the best knowledge of the installation engineer the transmitter is ready for test, the following outline as developed in the factory for testing is recommended. The engineer should have studied the operation as outlined in this instruction book so that when he begins the initial testing, the proper performance will be recognized He has the assurance that before the trnasmitter was dismantled for shipping, all circuits were functioning properly. Any failure to do so may be due to damage in shipment or minor mechanical failures such as a breaking. Any faults should be corrected before proceeding to the next step.

1. Install tubes.

2. Close the transmitter service switch. Press the "Start" switch. Both power tube blowers should run as well as the rectifier unit fan. The rectifier filaments should be on.

3. Press the "Stop" switch. The blowers should shut down after two minutes.

4. After the thermal time delays have recycled (about 15 seconds), reapply the "Start". Check filament voltages.

5. If the modulator unit is closed, the filament light will show on the audio driver panel and after a few seconds, the bias light. If the power amplifier is closed, the filament light will show on the oscillator panel and after a few seconds the bias light. The multimeter on the "P.A. GRID" will show some current reading. The power amplifier plate current meter will read in a reversed direction due to the holding bias in reversed direction.

6. The first R.F. buffer can be tuned as given in the instructions on this unit.

7. With the high voltage control closed, open various doors and check action of door interlocks.

8. Open the power amplifier disconnect link S307, close the high voltage primary disconnect switch S107, turn the modulator bias controls to the mid-position. Disconnect the modulator feedback. Set up the driver tuning as outlined in the section on this stage. If possible, when tuning the driver check the modulator static current. If this is not possible, it would be well to first disconnect the R.F. driver high voltage line and apply high voltage and set the modulator static current to 100 milliamperes per tube.

9. With the R.F. driver tuned, the power amplifier high voltage can then be applied by closing the link S307, and the power amplifier tuned in accordance with the instructions on this stage.

10. With the transmitter now operating with full power, final tests and adjustments can be made.

11. Open the top modulator panel (not interlocked), and with some insulating material, tap the overload relay armature, checking the action of the overload recycling.

LIMITS ON BC-5P TRANSMITTER

	Minimum	Normal	Maximum
M5422 Plate Voltage	150	180	250
M5422 Plate Current	16	18	20
6146 Plate Voltage	450	490	525
6146 Plate Current	40	50	70
Driver Hold Bias	70	75	80
P.A. Hold Bias	210	230	250
Driver Grid Current	17	20	25
Driver Plate Current	260	280	300
P.A. Grid Current	175	200	230
P.A. Plate Current (Ip)		1.25	
P.A. Plate Volt (Meter) (Eb)	5100	5200	5300
P.A. Input Ip x (Eb-100Ip)		6650W	
P.A. Output		5300W	
P.A. Efficiency	78%	80%	83%
Carrier Shift 100%, 1000 Cy.	2%	3%	4%
6550 Plate Voltage	440	450	460
Modulator Bias	230	240	260
Modulator Plate Current	0.6 @ 1000 cycle 100% Mod.		
Response 50-10000 95%			±2 DB
Distortion 50-7500 95%			3%
Noise 100% Modulation, 1000 Cy.			60

RADIO FREQUENCY CUBICLE

TOP LEFT - Power amplifier loading, indicated as D.C. current to power amplifier on meter directly above this control, or as R.F. output by line meter or common-point current meter. Use to adjust output as required, approximately 1.24 amperes plate current, or R.F. line current as required for specific installation.

TOP CENTER - Filament rheostat for filament voltage in unit. Maintain to read 7.5 volts on filament meter directly above.

TOP RIGHT - R.F. Driver tuning, adjust to maximum multimeter reading when this meter is on "Power Amplifier Grid" position.

OSCILLATOR PANEL RIGHT - Behind small panel door - Crystal selector switch to select crystal to be used. On each side of selector switch is a vernier frequency adjustment for the corresponding crystal.
OSCILLATOR PANEL CENTER - Buffer tuning. Tune for maximum current when multimeter is set on "Driver Grid". Excitation Control-Turn clockwise beyond point P.A. grid current remains constant. Observe distortion measuring equipment on "Noise" position for region of low noise reading.

OSCILLATOR PANEL LEFT - Multimeter selector switch. Most useful indicating position is on "Power Amplifier Grid".

P.A. TUNING PANEL - Power amplifier tuning, tune for minimum current on top left meter (Power Amplifier Plate Current), at 5 KW output, turn counterclockwise to raise the current .1 to .2 amperes above the minimum value, then adjust "Power Amplifier Loading" to give required output.

POWER CUBICLE

TOP LEFT - Line meter switch by which the voltages of the three phase power supply may be read.

TOP RIGHT - Rectifier filament voltmeter, measuring the primary voltage on the filament transformer, to be maintained at a specific value as measured to give 5 volts on the rectifier filaments.

CONTROL PANEL LEFT - Start and stop switches from left to right, to start and shut down transmitter.

CONTROL PANEL CENTER - Low and high power selector switches with lights above, from left to right.

CONTROL PANEL RIGHT - High voltage on and off switches respectively.

MODULATOR CUBICLE

TOP CENTER - Filament rheostat for filament voltage in unit. Maintain to 7.5 volts filament on meter directly above.

AUDIO DRIVER - Two bias controls, adjust to read equally .05 to .1 amperes static current on the two plate current meters on the top panel. Use lowest current to give satisfactory performance.

MAINTENANCE

RELAYS

The RBM contactors used in the control circuits and as power contactors of all but the high voltage, are of the same type and rating, reducing the need of a wide variety or replacement items. Normal expectancy is for long life; the coils are rated 220 volt, 50/60 cycle for continuous operation plus 10% to minus 15% of rated voltage. The contacts operate variously up to 10 amperes and have a 15 ampere rating. The magnet frame and coil assembly are readily removable by two screws. The coil may be replaced by removing the screw which holds the coil retaining clips. No spring adjustments are required for various contact arrangements.

The contacts are of silver-palladium alloy to give long mechanical and electrical life. It is not necessary to clean or file the contact tips at any time during the life of the contacts.

The contacts may be readily reversed by taking off the stationary contacts, then the removable contacts, and re-installing in the opposite position.

Quite frequently extra contactors are desired for auxiliary components at the transmitting station, to be operated by various functions of the transmitter, or to be independent of the transmitter operation. A wide variety of relays and contactors may be obtained from the Gates factory. Specify coil voltage and contacts. In the case of the RBM contactors, the most satisfactory way is to order four pole normally open contacts, which arrangement is a stock item, and alter the contact arrangement as desired.

ADJUSTMENT OF OVERLOADS

The overload relays, with the exception of the a.c. overload relays, are 6 volt D.C. type which pulls in at approximately 4.5 volts. These relays are shunted by appropriate resistances which at the desired overload current will develop the required operating voltage. Decreasing the amount of shunt resistance increases the overload tripping point.

The power amplifier overload may be adjusted by detuning the power amplifier momentarily to 1.5 or 1.6 amperes. If the overload does not trip, then the amount of shunt resistance should be increased. The R.F. driver may be adjusted in a similar manner, detuning until the tube shows more than normal heating, if the current is in excess of the plate current meter reading. The tube need not be left in this operating condition more than a second or so. When this relay is set, the application of high voltage may cause tripping or pumping of the overloads, in which case the overload should be set slightly higher. The modulator overloads may be set by applying 7500 cycle tone, then decreasing bias on one modulator tube until the plate current increases further by .2 or .3 amperes, and setting this relay for tripping. The other modulator tube is adjusted similarly.

With this method of adjustment, the overload need be applied only for a couple of seconds, and as such no damage will be done the tubes. The power amplifier, driver and modulator overload relays, as explained in the control circuit discussion, must close their contacts on an overload to energize the auxiliary control relay, K103, which in turn opens the high voltage control circuit. This prevents chattering on modulation peaks, The rapidity of the operation depends on the rapidity at which the overload occurs. The manner of setting the overloads as described brings the current to the value at a relatively slow rate. An actual overload applies the tripping current suddenly and as such supplies a much heavier closing torque, so that the actual tripping current will be under that as set in the manner prescribed.

Approximate overload tripping currents should be as follows:

Power Amplifier	1.6 Amperes
R.F. Driver	.35
Modulators	1.2

TRANSFORMERS

The power tube filament transformers have voltage range taps. Primary terminal #1 is always connected to one side of the supply line. The other side, connecting to terminal #2 delivers the highest secondary voltage, to terminal #4 the lowest voltage. The voltage range used depends on the line voltage and line voltage variations and the most suitable connection to keep the filament voltages correct by means of the rheostats. When the line voltage is regulated, the taps should be used that allow the rheostats to be operated near the minimum resistance, reducing the heating from these components.

BLOWER

It may be expected that the blower motor will vary from time to time as to details of construction, but will be the proper speed, and power for 230 volt single phase 50 or 60 cycle operation to deliver the required air volume and pressure. It is suggested that the chief engineer, if not thoroughly familiar with motor maintenance, to avail himself of any opportunity to discuss fully such maintenance with any qualified person as may be found in a motor repair shop or electrical shop.

The motor may be equipped with grease cups or oil cups. Grease cups should be given a partial turn every three months, refilling with a good grade of cup grease when necessary. DO NOT use graphite grease. Bearings requiring oil should be oiled lightly when received. As these motors are tested with the equipment, some oil will already be applied, use a good grade of machine oil S.A.E. 10, and oil lightly about every three months.

CE & CY TYPE MOTORS

A capacitor start induction run motor has a condenser in the starting circuit. This starting circuit is opened by a switch or relay when the motor has attained a speed of about 75% of the rated speed which it should do in a few seconds.

TROUBLE CHECK LIST

1. The motor will fail to start if the starting circuit is open which may result from an open condenser or failure of the cut-out device to make contacts. An opening in this circuit can be determined by connecting a test lamp in series with C1 and C2.

2. IF THE MOTOR OVERHEATS: Check the motor speed to see that the motor is not overloaded and operating at reduced speed. Check the line voltage at the motor terminals; it should be within 10% of the name plate voltage. Make sure the cooling air is free to flow through the motor. Check for a shorted stator. Motor usually hotter at one spot or smokes.

3. IF THE MOTOR FAILS TO COME UP TO SPEED: Check load and voltage as above. Condenser may be shorted; if so, replace condenser with one of same rating, voltage and microfarads.

4. MOTOR HUMS OR GROWLS: Probable causes - shorted stator, worn bearings, or excessive end play. Shorted stator will be indicated by high watts and overheating.

AIR PRESSURE SWITCH

The air pressure switch consists of a captive plate, held against the force of the air pressure by the spring tension of the switch. The switch mounting, outside plate and spacer plate are held together by bolts threading through the spacer plate, and held on the inside of the plenum chamber by nuts.

The switch mounting plate is slotted, so the switch may be loosened and by changing the angle of the switch, the switch will operate by the movement of the plate to the pressure position. When the air pressure is released, the switch arm spring presses the plate to the no-pressure position, at the same time opening the circuit.

If the action of the switch becomes erratic, examine the air filters for stoppage due to dirt collection. In the power amplifier, if the screen on the bottom of the plenum chamber becomes clogged, the air switch will fail to operate.

A.C. OVERLOADS

These relays are the instantaneous type. The tripping value is set by rotating the armature on the threaded shaft; a tab aligns with markers on the armature to indicate the value.

To adjust the relay, the cup under the solenoid is unscrewed, the armature and piston removed. The armature is slotted, and inside this slot will be seen a brass shaft with a groove around it. This groove aligns with the tripping current marked on the armature for tripping at that current. A nut on the brass shaft determines the distance the armature sets in the solenoid which establishes the current required to trip the overload.

The overload tripping current should first be set so that the a.c. overloads barely hold in with 100% modulation at 30 cycles. This will generally be between 60 and 80 amperes.

AIR PRESSURE

At times it is desirable to measure the air pressure. Numberous heating companies have inexpensive pressure indicators which are used across the filters. One such is the "VISIFLOAT" by the F. W. Dwyer Company.

A "Manometer" for measuring air pressure may be easily made. Two pieces of glass tubing, about 1/4" diameter and 6 to 10 inches long, and connected together by tubing, rubber or plastic such as spaghetti sleeving, and the two pieces of glass tubing mounted side by side an inch or inch and half apart, making a "U" tube. Clear plastic tubing could be formed in the shape of a "U" for this without requiring glass tubing. The "U" tube is filled with water to about midway on the straight sides. A length of tubing fits on one leg of the "U" and this is then placed inside the chamber under pressure. The air pressure is then measured in inches as the difference in water level in the two legs of the "U" tube.

When making measurements, the U tube should be held vertical. The tube in the plenum chamber should be at right angles to the air stream. Impact of the air will give a higher reading. It is convenient to have some solid tubing on the end of the hose. If this tubing is bent on the end, the end may be very easily turned in the air stream.

AIR FILTERS

The air filters should be examined regularly. The 20" x 20" size is rated for 800 c.f.m., giving over twice the recommended area for the blower capacity. This allows a reasonable amount of dust collection without loss in efficiency. The frequency with which the filters should be changed depends entirely upon the conditions at the transmitter, and with close observation, a replacement schedule can be established. The non-renewable type of filter is furnished, as experience shows that the renewable or cleanable type is generally difficult to clean, and as the dirt becomes deeply imbedded and cannot be removed by the usual available methods, the filtering action is greatly impaired. As the filter is of a standard size, and as such, obtainable from local heating supply firms, either type may be used.

PLEXIGLAS

The plastic windows should have a certain amount of care and there is included a plastic polishing kit shipped with the transmitter. Plastic surfaces attract dust. This is because plastics tend to accumulate electro-static charges that act as a magnet to attract the particles of dust flying constantly in the air.

Dust is not only unsightly, but causes scratches when improperly wiped off. The plastic windows in the BC-5P transmitter have already been waxed and hence, constant dusting is unnecessary.

POWER TUBES

All tubes should be inspected carefully immediately on receipt. Power tubes should be given close attention, particularly to the glass around the plate, filament and grid seals for flaws. Tubes should be tested as soon after receipt as possible, operating first for fifteen minutes at rated filament voltage without plate voltage By testing in the power amplifier, the tube can be operated normall of reduced power for fifteen minutes, and then fifteen minutes at full power. A normal for Class "B" operation, for the absolute minimum of noise and distortion, the tube should be matched, but in practice, random mixture of tubes will not give noise or distortion detectable by aural means.

The tubes should be kept clean, and no foreign matter allowed to collect between the filament terminals. The tube should not be subject to vibration or shock, the 3X2500F3 tubes should be handled by holding to the pins, and supporting the filament leads as much as possible. The best storage is a cabinet not used for storage of other equipment, built with the proper support and cushioning. Such a cabinet may be obtained from the Gates' factory.

The tube locates in the socket with the outside terminal lead away from the filament air seal nozzle. The leads should be formed towards the connectors by holding the top of the tube so as not to place a strain on the glass. The tube is then inserted in the socket, and the leads placed in the terminal clamps. The wing nuts should be firmly tight by hand. The spring clamp on the grid should be loosened so the ring can be turned to allow the grid connection to be made between the two clamping plates. The clamp need not be tightened, as the pressure remains fairly firm.

The filaments should be turned on and off as few times as possible. The delay time of the blower should not be shortened after a sustained period of operation. The operating personnel should familiarize themselves with the tube temperature at normal shutdown, so that on intermittance testing, or filament only, the blowers can be cut when the tubes have cooled sufficiently.

The tube life of a thoriated tungsten filament tube cannot be extended by reduction of filament voltage as with bright tungsten filament tubes, as actual filament evaporation is negligible. During operation, emission is obtained from the thorium coating of the tungsten filament. To maintain balance of the coating of thorium, the filament should be operated close to specified voltage, that is plus or minus 5%. Filament voltage should be measured on each tube, and the voltage balanced by the primary taps on the transformer if necessary. This normally should not be required, The ranges of the taps are given in the information on transformers. When tubes are changed, the filament voltage should be checked as soon after as possible. The operation range is not materially narrower than bright tungsten filaments, as this latter cannot be operated over-voltage without great loss of life, and with under-voltage, the emission may not be sufficient for satisfactory operation.

Filament operation plus or minus 10% is occasionally permissible for periods of short duration, but for all intent and purpose, the filament should be operated at rated voltage. The tube life is not materially affected by filament operation within this range, if the periods of such operation are of relatively short and infrequent duration.

The thoriated tungsten filament normally holds emission throughout life, and very close to the end of life, the emission starts to fall off rapidly. This gives the station personnel a chance to anticipate the end of life and to replace the tube without suffering transmitter outages. Once the emission has started to go, it is only a matter of a few days until the tube will be completely unsatisfactory.

The loss of emission will be indicated the same as with any other type of filament. One of the earliest indications is the falling off of grid current in the case of a power amplifier tube. This results from the fact that a very small reduction in output power

and consequent reduction in R.F. voltage developed in the plate circuit causes a drop in control grid current. In fact, the control grid current acts as a monitoring vacuum tube voltmeter for the developed R.F. plate voltage. By referring to constant current curves and noticing that as the operating line fails to push into the region of equal grid and plate voltages, the grid current falls off rapidly.

Other indications are failure to hit the modulation peaks on both the positive and negative. The positive peaks are not reached because there is a lack of space current, and the negative peaks are not developed because there is insufficient grid current to develop the necessary variations in grid leak bias to drop the output power momentarily to zero.

In the modulators, failure of emmision of one of the tubes may result in unbalance of the modulation peaks. Loss of emission by the modulator supplying the positive modulation peak would show as failure to attain full modulation on the positive peaks; where failure of the modulator supplying the negative peak would give a similar indication for this modulation cycle. There may also be present a quality breaking, or oscillating, during the peak of the cycle. Suspicious modulator tubes could be checked in the power amplifier position and the results compared with a known good tube. In the case of unbalance of modulation peaks, the performance should be checked that there is not some fault existent in the audio driver giving unbalanced drive. A modulation monitor which is picking up radio frequency harmonics will show unbalance on the modulation peaks, although the transmitter has been adjusted and performing normally with no indication of change, this possibility does still exist. As the tubes are easily changed, it can be noted if the condition changes with a replacement, or rearrangement, of tubes.

It is suggested that no tube remain idle more than three months. One procedure is to rotate tubes, placing spare tubes in service, and more or less equalizing the usage of the tubes.

An alternate method is given, that is to place the spare tubes in service only for a day or so at three or four month intervals. Thus, tubes are kept conditioned, and when tube trouble or loss of emission is suspected, a practically new set of conditioned tubes will be available for comparison.

3X2500F3

Filament Voltage	7.5
Filament Current	48
Maximum Start Current	100
Amp. Factor	20
Interelectrode Capacity:	
Grid-plate	20 mmfd.
Grid-Fil.	48 mmfd.
Plate-Fil.	1.2 mmfd.
Transconductance	20,000 mmhos. (3000V. - .83A)
Net Weight	7.5 lbs.
Maximum Rating:	
DC Plate Voltage	5500
DC Plate Current	2.0
Plate Dissipation	2500 Watts (1) 1670 Watts (2)
Plate Cooler Core Temp.	150° C.
Grid Dissipation	150 watts

HIGH VOLTAGE SUPPLY

Some of the outstanding advantages of semi-conductor rectifiers are their long life and low maintenance costs. However; when continuity of services is of primary concern, a few simple periodic preventative maintenance measures may eliminate an eventual unexpected equipment shutdown.

After the first 500 to 1000 hours of operation, it is suggested that a simple ohmmeter check on individual rectifier cells be performed to locate any possible shorted cells that need replacement. There after, this check need not be repeated at intervals less than 5,000 to 10,000 hours. More critical tests can be made on individual cells by applying rated inverse voltage and displaying the cell reverse characteristic on a scope. Circuits for performing this test can be found in any good text on semi-conductors.

Unless exceptionally clean filtered air is available for rectifer cooling, dust will in time deposit on rectifer surfaces and reduce the effectiveness of heat dissipation. The rectifer assemblies should be cleaned on a regular maintenance basis, the interval between cleaning depending on the particular enviornmental conditions of the installation.

RATINGS:

SILICON CELL

Audio Devices type 50K7N

Standard Rectifier type S1081

Negative base type;

Peak inverse voltage..............500 Volts

Current.......................... 25 Amperes

Reverse current................... 25 MA

Instantaneous forward drop

@ 25 Amps. & 25°C. Junction temp.....1.5 Volts

These cells are rated by the manufacture to carry 100 amperes for one second before reaching dangerous junction temperature.

MAINTENANCE SCHEDULE

A hard and fast maintenance schedule cannot be set up in this instruction book. Each installation will have its own problems and conditions which effect the schedule. Thus, a location which is dusty, where mud is tracked in during inclement weather to become dust on drying, will require more often cleaning of the air filters and this dust and mud may be carried inside the transmitter by the personnel to require more frequent cleaning of components.

After each signoff, the personnel should give the transmitter an inspection. This inspection should include:

1. All condensers in power amplifier and R.F. Driver.
2. All coils in the power amplifier tank and coupling circuits for undue heating, also the slips on the coils for heating.
3. Components of phasor (if used).
4. Filament connections of power tubes for heating.
5. Bearings of blowers. Note if any vibration is present in blower as might indicate a loose wheel.

This inspection will only take a few minutes, and may anticipate a failure which would lose valuable program time. The BC-5P transmitter is like any machine, for the best performance it should be properly maintained.

The following are given to serve as guide in planning maintenance. Each installation may require modiviation to suit the local conditions. A transmitter weekly maintenance schedule is suggest as follows:

1. Inspect all relays and clean contacts as required.
2. Clean internally all part of the transmitter, including insulators.
3. Inspect power amplifier tank coils, connections, etc.
4. Inspect blowers for vibration.
5. Test operation of overload relays.
6. Test door interlocks.
7. Inspect sliding contacts of variable coils.

A monthly maintenance routine is suggest as follows:

1. Clean with crocus cloth low power and rectifier contacts.
2. Clean all socket and tube prong contacts.
3. Check all filters, and clean if required.
4. Tube rotation according to schedule.
5. Give a general detailed close inspection of each unit in the transmitter with whatever test of components seems advisable.
6. Check all connections for tightness and heating.
7. Check tube radiators and clean any dust accumulation.
8. Test air pressure switch.

TEST EQUIPMENT

The operating performance of broadcasting equipment may be kept to high standards by having and using certain items of test equipment. It is impossible to say which should be had in preference to others, but the utility of each will be pointed out.

PORTABLE VOLT-OHMMETER to use for quick checking of voltage, continuity and resistance. The self-contained type is preferable for convenience.

VACUUM TUBE VOLTMETER to use for checking audio signal voltages and d.c. voltage where low current drain of the meter is essential. At least one meter either VTVM or volt-ohmmeter should be available which would read 3000 volts d.c.

AUDIO OSCILLATOR to use to obtain a signal source for checking audio equipment.

VU METER AND PAD to obtain input level readings for frequency response measurements.

NOISE AND DISTORTION ANALYZER to use for checking both radio frequency and audio units for distortion and noise. If the unit does not contain a diode, a diode unit will be required.

OSCILLOSCOPE to use for observing wave shapes, calibrating modulation monitor, etc.

This test equipment can be used not only for transmitter maintenance but also in keeping the studio equipment at peak of performance. Most of these items are listed in the GATES RADIO COMPANY catalog and all are obtainable through this company. Where test equipment is available, a regular check should be made of the equipment as a part of the maintenance schedule.

TOOLS

A list of desirable tools would probably include everything on the store counter. Where station personnel build part of the station equipment, or construction equipment for home or amateur use, the tool rack will usually be found to be well equipped. Where tools are used strictly for maintenance, the tool supply is too frequently lacking important tools. The design and construction of the transmitter has been to use "standard" parts where possible, and no special tools are required.

The recommended tool list is as follows:

1. Screwdrivers - 5 or 6 ranging from 1/16" bit to 7/16". An offset screwdriver is frequently time saving. A full set of Phillips screwdrivers should also be included.
2. Wrenches - 3 or 4 from 4" to 10" adjustable. These can well be augmented by sets of open end box wrenches and socket sets.
3. Spintite wrenches are exceedingly convenient in working close quarters, such as transformer terminal boards.
4. Soldering irons - 2, one small, fairly rapid heating, the other, heavy duty for soldering tubing, large lugs, etc.
5. Pliers - needle nose medium and heavy duty side cutters, Bernard and vise grip types are frequently very useful. Also, one or two sizes of cutters should be included.
6. Electric drill - the 1/4" medium duty is probably the best for general use. A light duty drill may fail at an inopportune time; a heavy duty drill is generally too heavy and cumbersome for average station use.
7. Among the miscellaneous tools, at least standard hacksaw should be included, as well as tin shears, vise, hammer, etc.
8. Allen wrenches from 6-32 to 1/4-20 sizes.

To complete the workshop an assortment of nuts, bolts, lockwashers and washers, some wire, #12 and #14 flameproof, hookup wire, bus wire #8, #12 and #16, some high voltage cable, an assortment of soldering lugs should be on hand. Many other items suggest themselves.

SPARE PARTS

Except for tubes, frequently a station has no spare parts. The Gates' BC-5P has been designed with the intention that there should be no part failures. This of course, must be qualified "in normal operation". The most common sources of damage are perhaps electrical storms which may damage condensers in the antenna system, power amplifier tank and coupling and the R.F. meters. Accidental short circuits are damaging to switch and relay contacts. Breakage may occur to resistors especially of the ferrule type.

The location would also be a determining factor. Near large cities many substitute parts may be obtained should such be required. Stations located near smaller cities often do not have access to substitute replacement parts.

The problem then reserves itself to one of individual conditions. The Gates' BC-5P transmitter has been designed as far as practical for the duplication of parts. The Engineering Department of Gates Radio Company will be glad to cooperate to work out a spare parts inventory to meet the customer's requirements and desires.

SAFETY PRECAUTIONS

Rigid rules for safety should be established and enforced.

The rectifier filters are equipped with grounding relays, which normally give protection from high voltage, but even then enough voltage may be passed to give a severe shock. Condensers in the BC-5P have been so arranged that they are shorted by the grounding switches or have some form of drain. However, in event of a fault, or some phase of maintenance, a condenser might be left with a dangerous charge. Always test the high voltage condensers with a grounding stick before handling components.

Do not try to make repairs on a "hot" circuit. The accidental slip of a tool might cause far more damage than to shut completely down in the first place, or result in physical harm to the operator.

A good many times an operator will be working alone. This calls for continuous caution on his part, that he use tools sensibly, that if he needs to reach the top part of the transmitter he have a safe step-ladder, that if he has to move a heavy unit he has the work so organized to require the minimum of physical strain such as having blocks and rest positions ready.

Extreme care should be used around the power tubes. In working around them, if there is any possibility that a tool may slip and hit the tube, remove it to a safe place. Such a blow may shatter the glass and cause severe injuries to face and eyes.

When more than one operator is working on the transmitter, make sure that everyone is clear before applying any voltages. The best way is to get verbal clearance from everyone, then announce the voltage is being applied.

Do not short out door interlocks to get inside of a unit in operation.

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

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

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

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

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

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

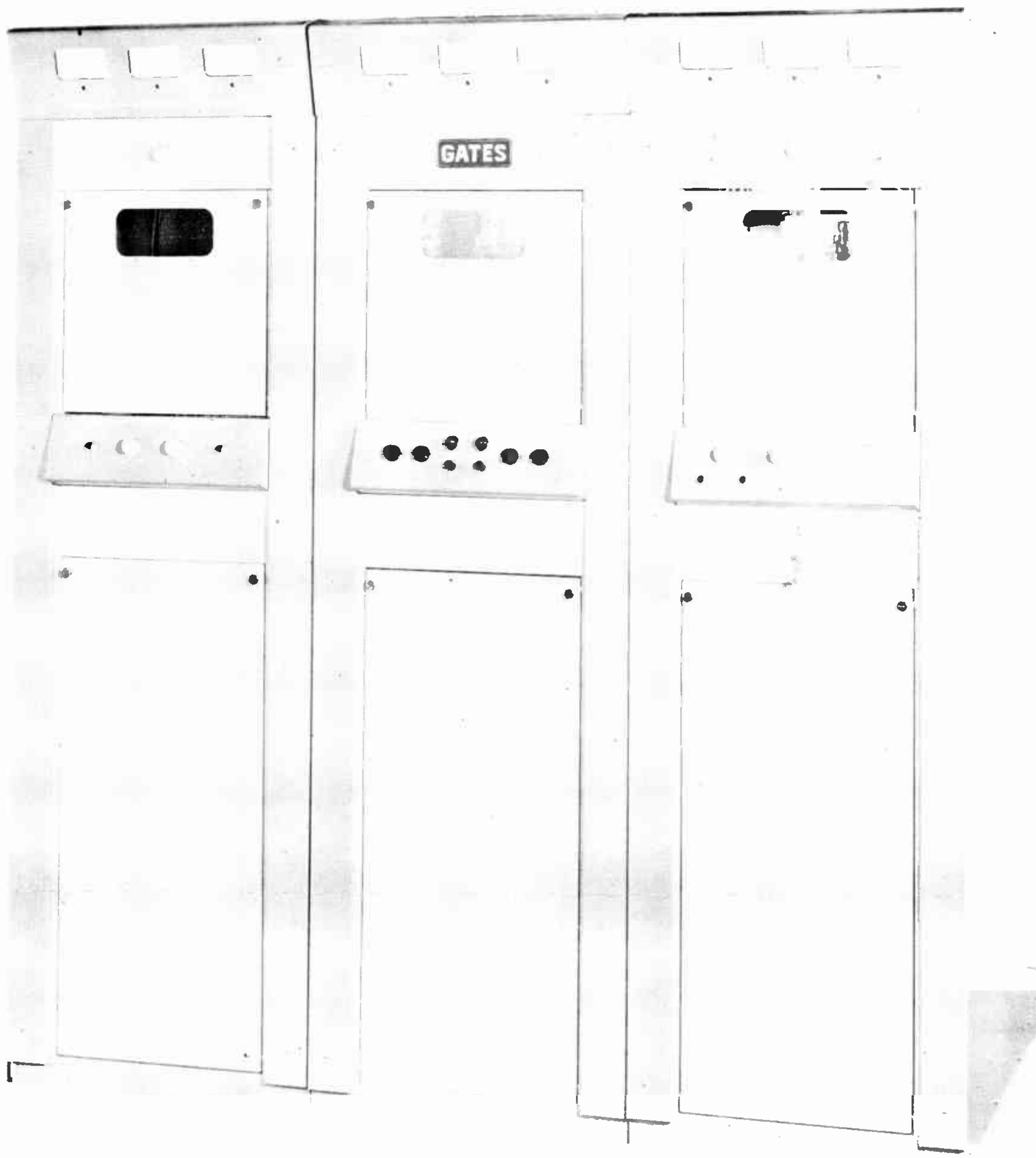
9. This warranty may not be transferred by the original purchaser and no party, except the original purchaser, whether by operation of law or otherwise, shall have or acquire any rights against Gates Radio Company by virtue of this warranty.

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

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

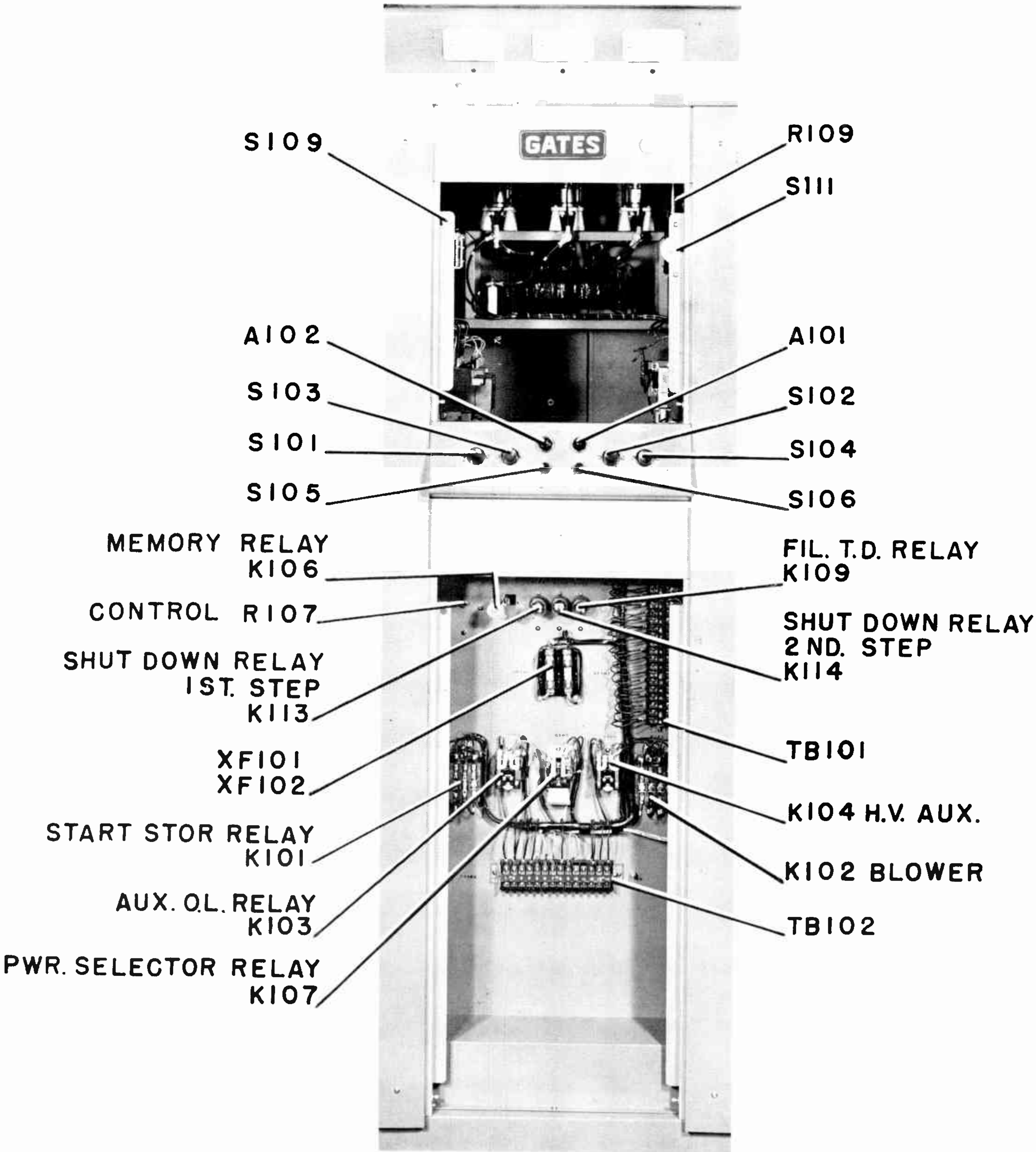
Gates Radio Company
Quincy, Illinois

1/6/60



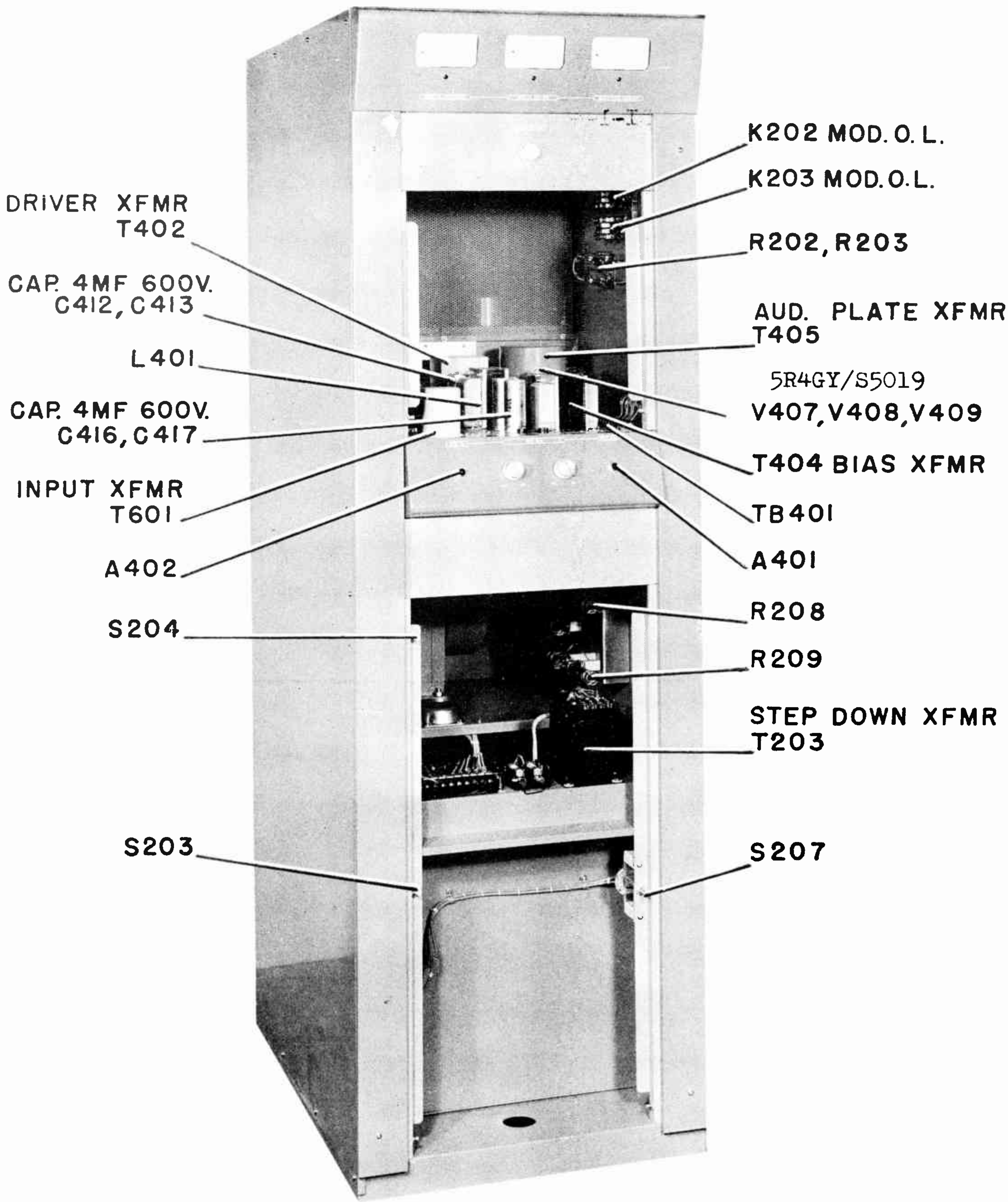
GATES
BC-5P
BROADCAST
TRANSMITTER

DI-136



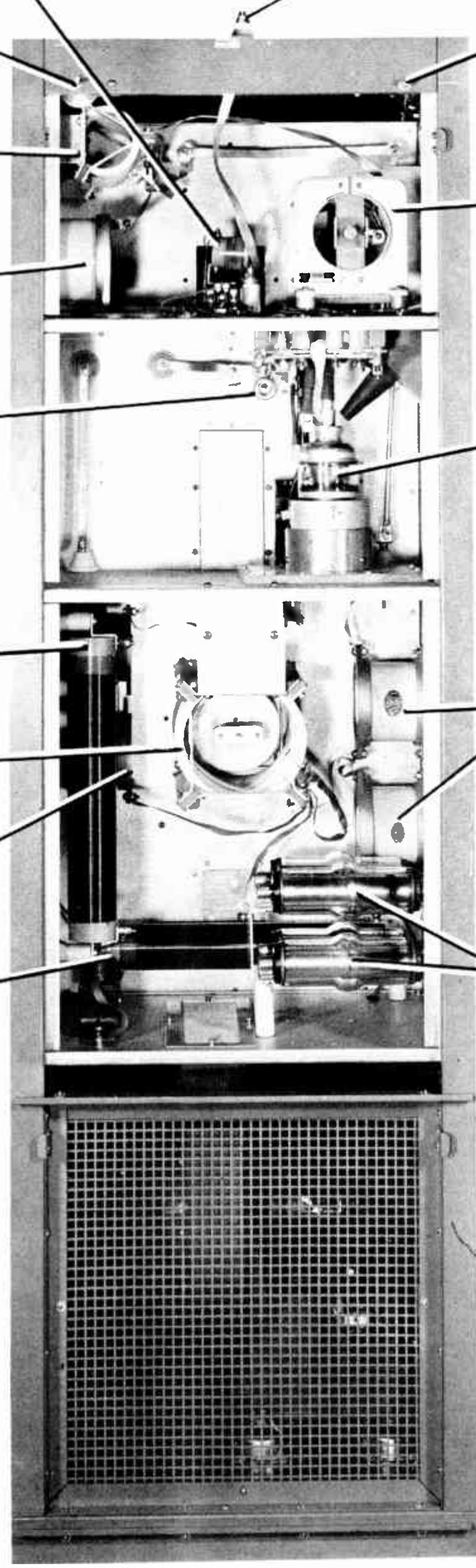
FRONT VIEW POWER CUBICLE
BC5P/BC10P

DI 1 4 3.

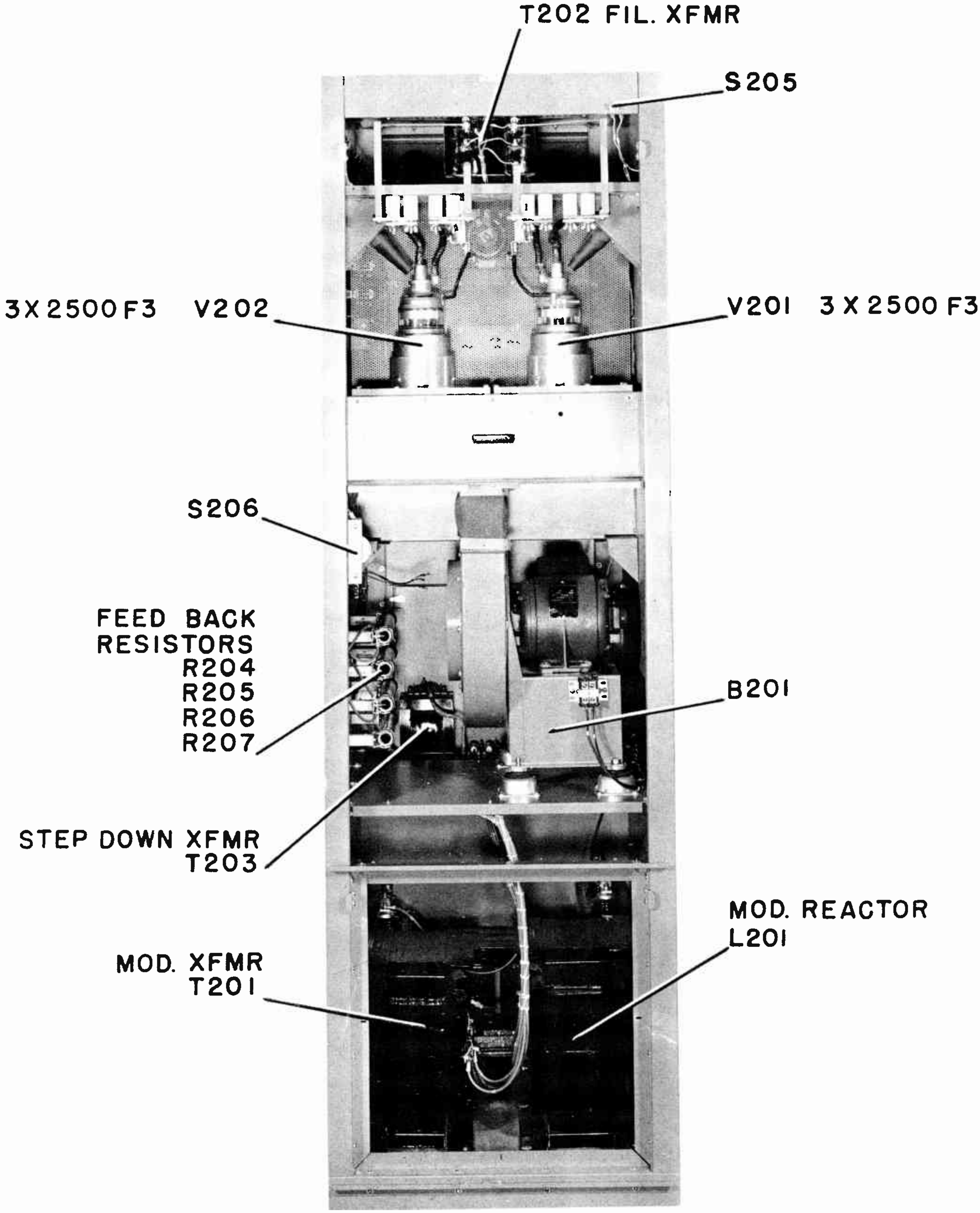


FRONT VIEW MODULATOR CUBICLE
BC5P

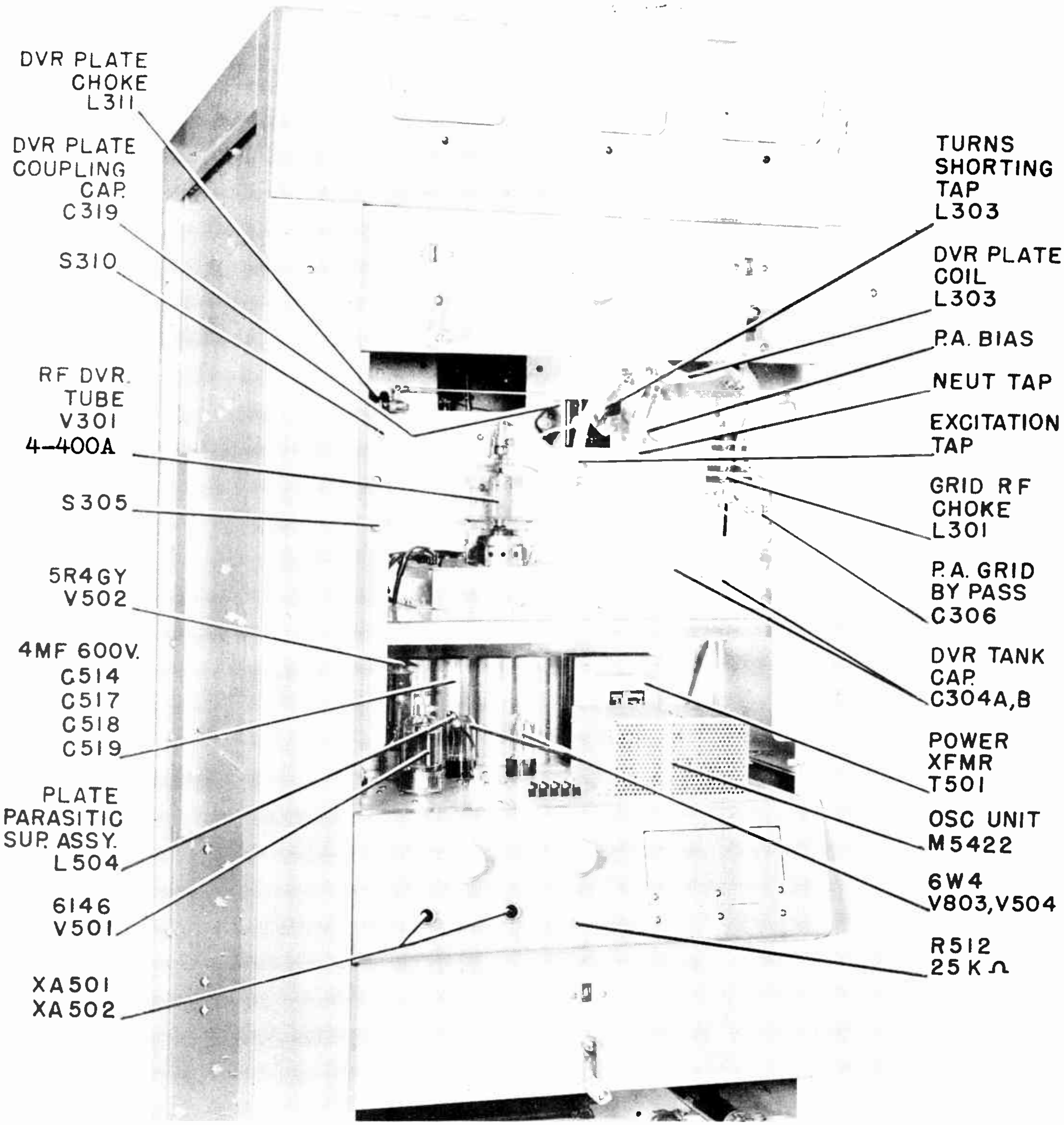
DI-144



REAR VIEW P.A. CUBICLE
BC5P

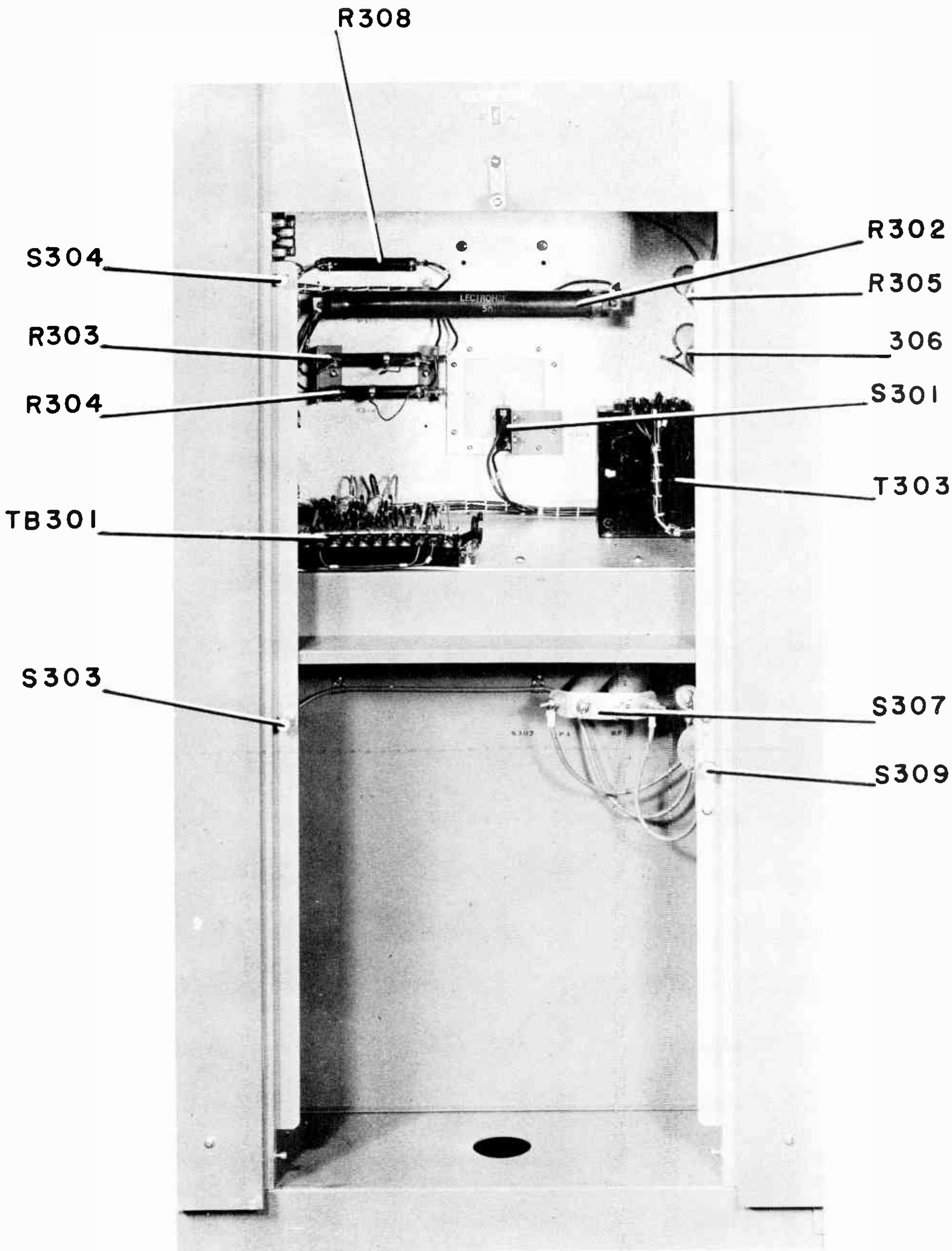


REAR VIEW MODULATOR CUBICLE
BC5P



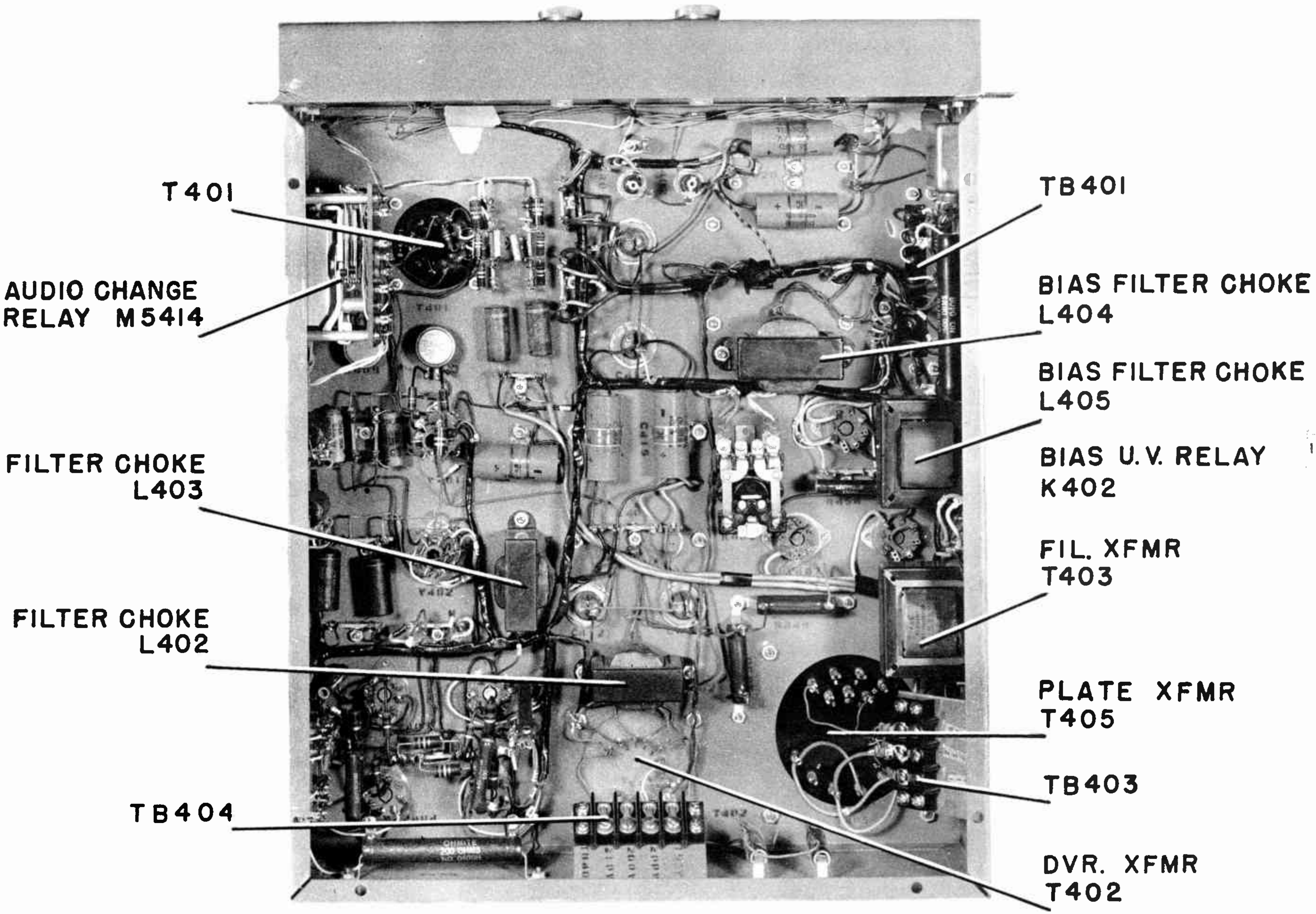
FRONT VIEW TOP SECTION PA CUBICLE
BC5P/BC10P

DI-148

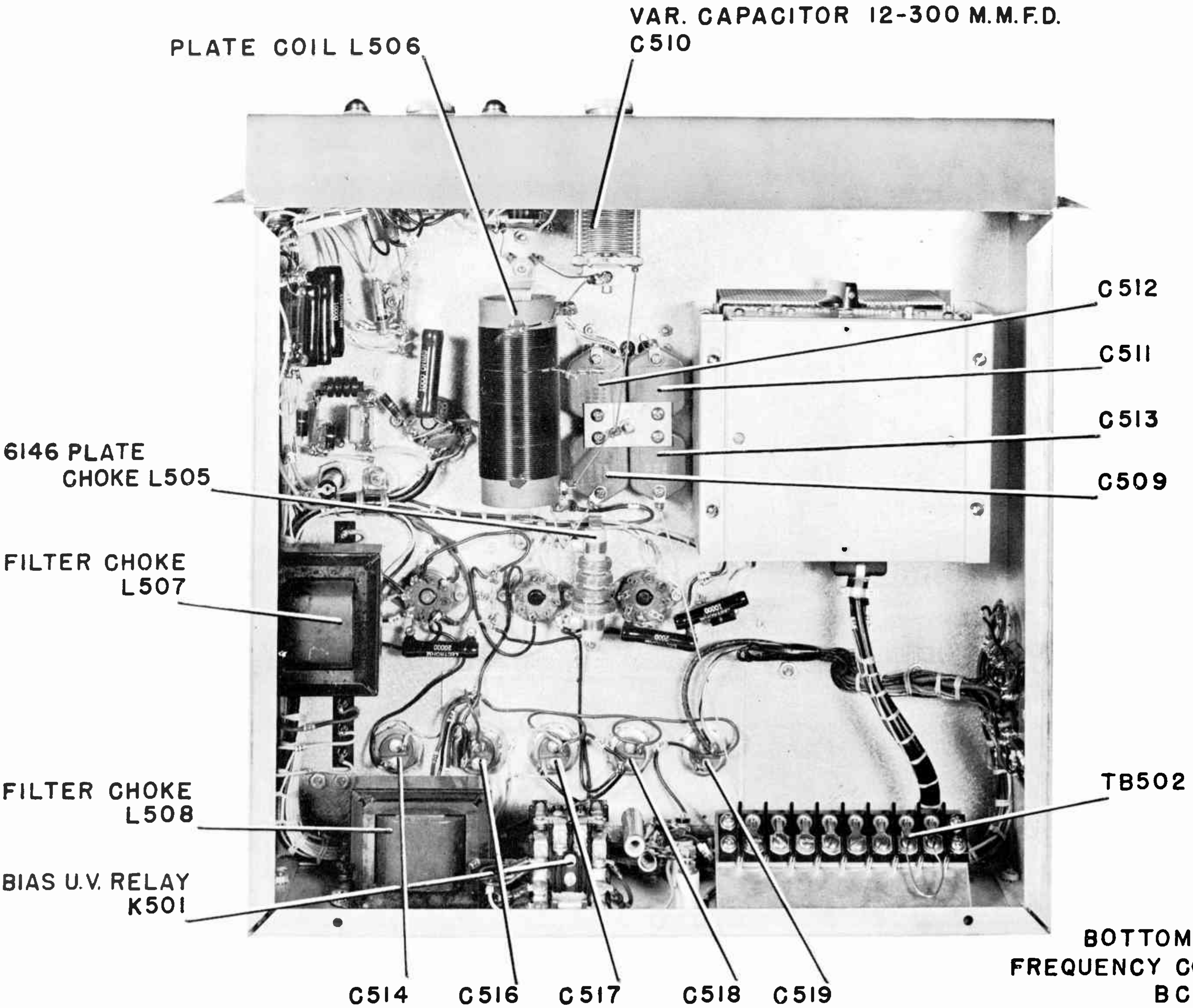


LOWER SECTION P.A. CUBICLE

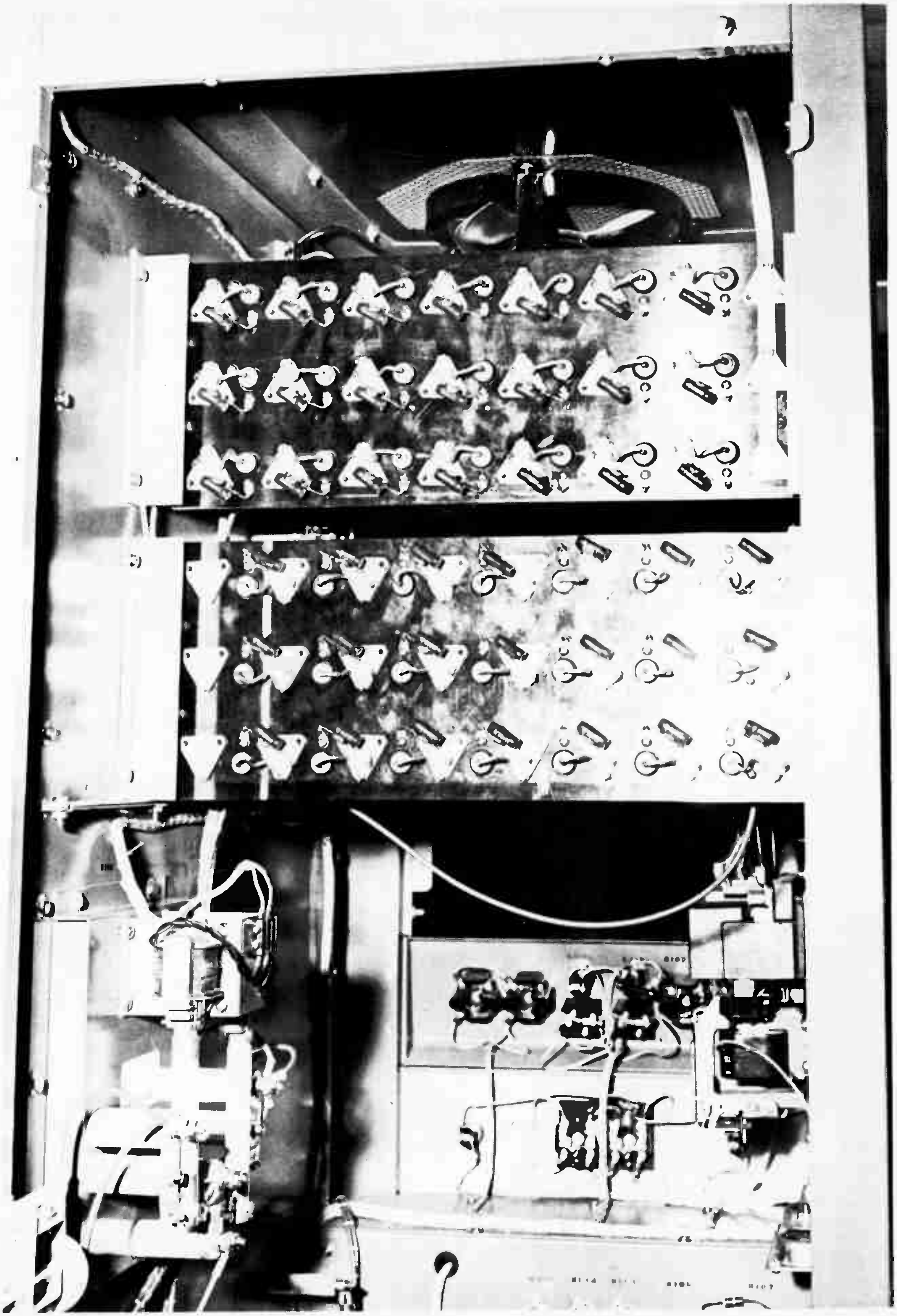
BC5P

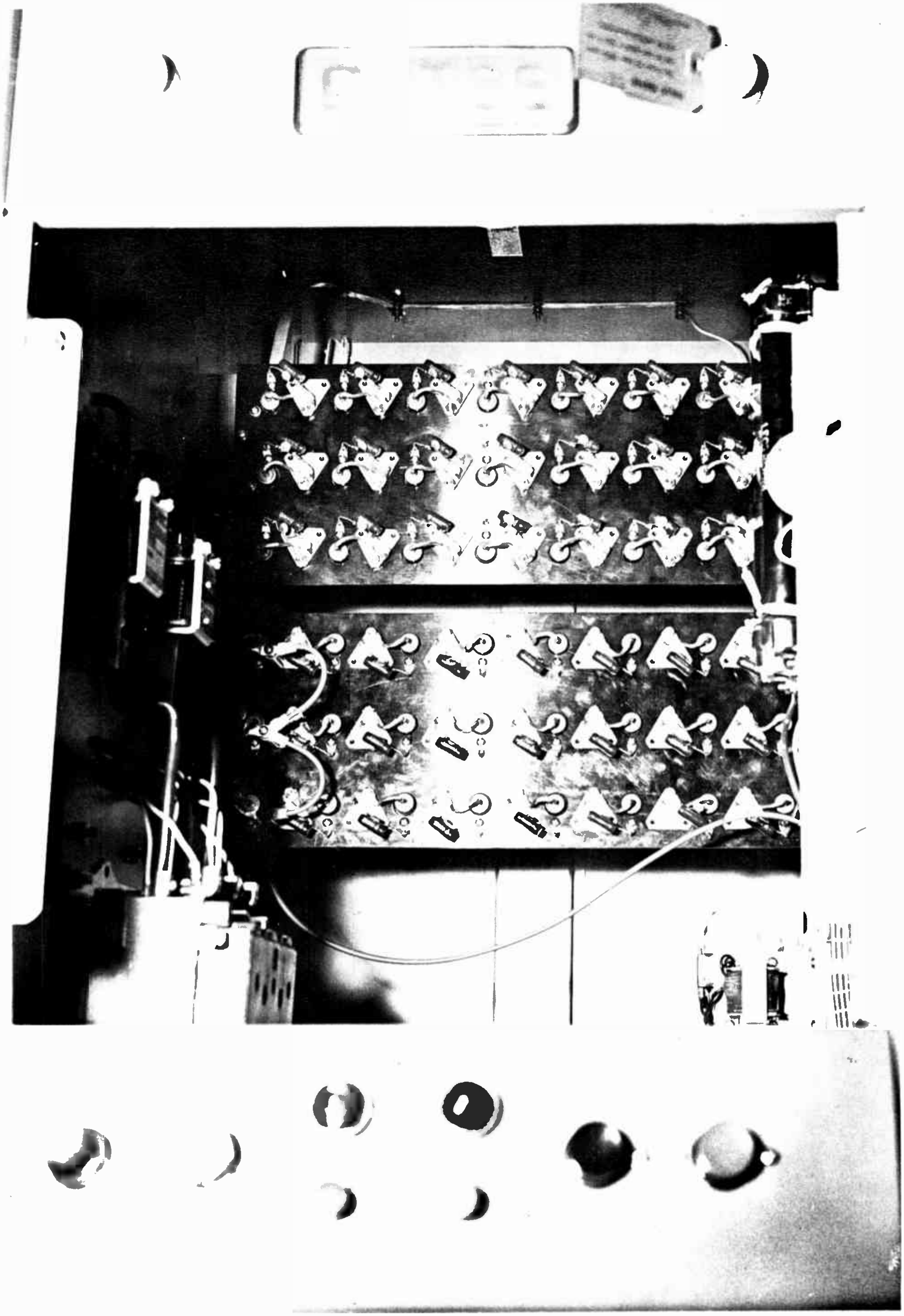


BOTTOM VIEW AUDIO DRIVER CHASSIS
BC5P



BOTTOM VIEW
FREQUENCY CONTROL UNIT
BC5P/BC10P





BC-5P2 TRANSMITTER

POWER SUPPLY SECTION, M5667 — PARTS LIST

Symbol No.	Gates Part No.	Description
A101,A102	396 0016 000	Lamp, 10 W., 230 V. Screw Base
B101	430 0002 000	Fan, 115 V., 50/60 Cy., 1450 RPM, 6 W.
C101	510 0209 000	Cap., 8 mfd., 3000 V.
C102	510 0312 000	Cap., 4 mfd., 7500 V.
C103	522 0031 000	Cap., 16 mfd., 450 V.
CR101	384 0044 000	Selenium Rectifier, 25 MA DC
F101,F102	398 0138 000	Cartridge Fuse, 10 amp., 250 V.
K101,K102	570 0050 000	Start-Stop & Blower Contactor, 220 V. 50/60 cy.
K103,K104	574 0034 000	O.L. & H.V. Aux. Contactor, 230 V., 50/60 Cy.
K105	570 0034 000	H.V. Contactor, 220 V., 50 amps, with coil for 50 cycles
K106	574 0034 000	Relay, 1-B, 230 V DC
K107	574 0038 000	Latching Relay, both coils 230 V., 50/60 cy. DPDT
K108	942 0133 003	Voltage Change Relay
K109	576 0022 000	Time Delay Relay
K111,K112	582 0003 000	A.C. Overload Time Limit Relay, 60-120 amps., Contact N.C.
K113	576 0024 000	Time Delay Relay
K114	576 0039 000	Time Delay Relay
L101	476 0166 000	Filter Reactor
L102	476 0104 000	Filter Reactor, 8 hy., 600 MA
M101,M103	630 0048 000	A.C. Line & Rect. Fil. Voltmeter, 0-300 V. AC.(cal. for .0598" steel panel)
M102	632 0150 000	P.A. Plate Voltmeter, 0-1 MA, DC movement with 0-6000 V. scale. (cal. for .0598" steel panel)
R101	552 0381 000	Filament Voltage Rheostat, 16 ohm, 100 W.
R102	542 0084 000	Res., 3000 ohm, 10 W.
R106	540 0481 000	Res., 12K ohm, 1 W., 10%
R107	550 0065 000	Control, 5K ohm
R108	540 0748 000	Res., 4700 ohm, 2 W., 10%

Symbol No.	Gates Part No.	Description
R109	542 0518 000	Res., 200 ohm, 160 W. ferrule type
R110,R111	548 0016 000	Meter Multiplier, 3 megohm, 3 KV, 1 MA
R112,R113,R114	542 0089 000	Res., 6000 ohm, 10 W.
R115,R116	542 0549 000	Res., 1000 ohm, 190 W. ferrule type
S101,S102	604 0070 000	Fil & H.V. ON Pushbutton Switch, Black
S103,S104	604 0071 000	Fil. & H.V. OFF Pushbutton Switch, Red
S105	604 0067 000	Switch, Low Power Pushbutton, Black
S106	604 0142 000	Switch, High Power Pushbutton, Red
S108,S109	604 0061 000	Switch, Door Interlock
S110	600 0052 000	Switch, Line Voltmeter Tap, two in tandem
S111,S112	991 2230 001	High Voltage Grounding Switch Assy.
T101	472 0175 000	Fil. Transformer
T102	472 0242 000	Power Transformer
TB101	614 0239 000	Terminal Board
TB102	614 0235 000	Terminal Board
TB103	614 0092 000	Terminal Board, Fan
TB104	614 0093 000	Terminal Board, Line Meter
	384 0052 000	Silicon Rect, 25 amp, 500 PIV
XA101	406 0073 000	Low Power Pilot Light Assy, Green
XA102	406 0072 000	High Power Pilot Light Assy, Red
(XF101 & XF102)	402 0014 000	Dual Fuseblock
XK109,XK113, XK114	404 0016 000	Socket
XV101,XV102, XV103,XV104, XV105,XV106	404 0052 000	Socket

MODULATOR SECTION, M5668

B201	432 0001 000	Blower, CW rotation, 1/4 H.P., 1450/1750 RPM, 115/230 V. single phase, 50/60 cycle, cont. duty oiler, non-sealed bearing, 270 CFM at 1.4" static pressure, upblast.
C201	510 0272 000	Mod. Cap., 2 mfd., 7500 V.
C202	510 0312 000	Filter Cap., 4 mfd., 7500 V.

Symbol No.	Gates Part No.	Description
F201,F202	398 0138 000	Cartridge Fuse, 10 amp., 250 V.
K201	574 0034 000	Filter Interlock Contactor, 230 V. 50/60 cycle
K202,K203	574 0033 000	Overload Contactor, 6 V. D.C.
L201	482 0013 000	Mod. Reactor
L202	476 0166 000	Mod. Filter Choke
M201,M203	632 0033 000	Mod. 1 & 2 Plate Current Meter, 0-2 amp., D.C. (cal for .0598" steel panel)
M202	630 0032 000	Mod. Fil. Voltmeter, 0-10 V. AC (cal. for .0598" steel panel)
R201	552 0403 000	Fil. Voltage Rheostat, 7.5 ohm, 150 W.
R202,R203	552 0082 000	Adj. Res., 5 ohm, 50 W.
R204,R205, R206,R207	542 0539 000	Res., 100K ohm, 160 W. ferrule type
R208,R209	542 0461 000	Res., 5000 ohm, 38 W. ferrule type
S201	604 0050 000	Air Switch, N.O.
S203,S204,S205	604 0061 000	Door Interlock Switch
S206,S207	991 2230 001	High Voltage Grounding Switch Assy.
T201	478 0080 000	Mod. Transformer
T202	472 0180 000	Fil. Transformer
T203	472 0304 000	Stepdown Transformer
TB201	614 0233 000	Terminal Board
TB202	614 0223 000	Blower Terminal Board
TB203	614 0093 000	Terminal Board
V201,V202	374 0004 000	Mod. Tube, 3X2500F3
(XF201,XF202)	402 0014 000	Dual Fuseblock
XV201,XV202	991 2749 001	Tube Socket Assembly

R. F. SECTION, M5669

B301	432 0001 000	Blower, CW roation, 1/4 H.P., 1450/1750 RPM, 115/230 V. 1 phase, 50/60 cy., cont. duty oiler, non-sealed bearing 270 CFM at 1.4" static pressure, upblast
C301,C302,C303	500 0320 000	Cap., .01 mfd., 600 (W) V.
C304A,C304B		Cap., Driver Tank,(det. by oper. freq.)

Symbol No.	Gates Part No.	Description
C306	500 0477 000	Cap., .01 mfd., 2500(W) V.
C307,C308	504 0023 000	Cap., .02 mfd., 1000(W) V.
C309,C310		Cap., P.A. Tank Vacuum (det. by operating freq.)
C313	512 0103 000	Cap., Vacuum, 25 mmfd., 20 KV
C314,C315, C316,C317		Cap., Coupling, (det. by operating freq.)
C318,C319, C320	504 0152 000	Cap., .002 mfd., 12.5 KV
C321,C322, C323	500 0202 000	Cap., .006 mfd., 500 (W) V.
C324,C325	504 0090 000	Cap., .002 mfd.
F301,F302	398 0182 000	Cartridge Fuse, 10 amp., 250 V.
K301,K302, K305	574 0034 000	Fil. & SG Contactor, 230 V., 50/60 cy.,
K303,K304	574 0033 000	Driver & P.A. O.L. Contactor
L301	494 0076 000	R.F. Choke, 2.5 MH
L302		Choke
L303	931 6138 010	Driver Plate Coil
L305	911 1358 001	P.A. Grid Parasitic Suppressor
L306,L307	931 9560 002	P.A. Plate Choke Assembly
L308	931 6138 030	P.A. Tuning Coil Assembly
L309	931 6138 047	Loading Coil Assembly
L310	931 6583 002	Variable Loading Coil Assembly
L311	494 0101 000	R.F. Choke
L312	811 1792 001	Mod. Mon. Loop
L313	911 1790 001	Mod. Mon. Coil Assy.
L315	911 1358 002	P.A. Plate Parasitic Suppressor Assembly
M301	632 0033 000	P.A. Plate Current Meter, 0-2 amp. D.C.(cal. for .0598" steel panel)
M302	630 0043 000	P.A. Fil. Voltmeter, 0-10 V, A.C. (cal. for .0598" steel panel)
M303	632 0206 000	Multi-Meter, 0-1 MA D.C. movement with 0-30 and 0-300 MA D.C. scale, (cal. for .0598" steel panel)
R301	552 0405 000	Rheostat, 15 ohm, 150 W.
R302	542 0542 000	Res., Ferrule, 50 ohm, 190 W.
R303,R310	552 0085 000	Res., Adj., 50 ohm, 50 W.
R304	552 0082 000	Res., P.A., O.L., Adj., 5 ohm, 50W
R305,R306	542 0525 000	Res., Ferrule, 2000 ohm,160 W.
R308	542 0210 000	Res., 250 ohm, 50 W
R307	542 0060 000	Res., 100 ohm, 10 W.

Symbol No.	Gates Part No.	Description
S301	604 0050 000	Air Switch, N.O.
S303,S304, S305,S306	604 0061 000	Door Interlock Switch
S307	810 8060 001	P.A. Disconnect Switch Blade
S308,S310	991 2231 001	H.V. Grounding Switch
S309	991 2230 001	H.V. Grounding Switch
T301	472 0202 000	P.A. Fil. Transformer
T302	472 0111 000	Driver Fil. Transformer
T303	472 0304 000	Step-Down Transformer
TB301	614 0233 000	Terminal Board
TB302	614 0094 000	Terminal Board
TB303	614 0223 000	Blower Terminal Board
TB304	614 0114 000	Terminal Board
V301	374 0009 000	Tube, 4-250A
V302	374 0004 000	Tube, P.A., 3X2500F3
(XF301 & XF302)	402 0014 000	Dual Fuseholder
XV301	404 0055 000	Socket
XV302	991 2749 001	P.A. Tube Socket Assembly

AUDIO DRIVER UNIT (MODULATOR SECTION) M5366

Symbol No.	Gates Part No.	Description
A401,A402	396 0045 000	Lamp, 6-8 V.
C401,C402	506 0016 000	Cap., .5 mfd., 400(W) V.
C403,C414, C415,C419, C420	522 0133 000	Cap., 16 mfd., 450 V.
C404,C405	506 0013 000	Cap., .05 mfd., 400(W) V.
C406,C407, C408,C409	506 0024 000	Cap., .5 mfd., 600 (W) V.
C412,C413, C416,C417	510 0360 000	Cap., 4 mfd., 600 V.
C418	510 0317 000	Cap., 1 mfd., 600 (W) V.
C421,C422	500 0043 000	Cap., .0005 mfd., 500 (W) V.
C423,C424, C425,C426	516 0075 000	Cap., .005 mfd., 1 KV
F401,F402	398 0020 000	Fuse, 3 amp., 250 V, 3 AG
K401	572 0028 000	Relay
K402	574 0032 000	Relay, Bias U.V., DPDT, 115 V. DC

Symbol No.	Gates Part No.	Description
L401	476 0027 000	Filter Choke
L402,L403	476 0007 000	Filter Choke
L404,L405	476 0013 000	Bias Filter Choke
R401,R402	540 0335 000	Res., 1300 ohm, 1 W., 5%
R403,R404	540 0316 000	Res., 220 oh, 1 W., 5%
R405,R406	540 0373 000	Res., 51K ohm, 1 W., 5%
R407,R408, R424,R425	540 0645 000	Res., 27K ohm, 2 W., 5%
R409	550 0065 000	Control, 5000 ohm
R410,R411	540 0501 000	Res., 560K ohm, 1 W., 10%
R412,R414, R419,R420	540 0339 000	Res., 2000 ohm, 1 W., 5%
R413	550 0061 000	Potentiometer, 1000 ohm, 2 W.
R415,R416, R422,R423	540 0758 000	Res., 33K ohm, 2 W., 10%
R417,R418	540 0380 000	Res., 100K ohm, 1 W., 5%
R426,R427, R428,R429	540 0468 000	Res., 1000 ohm, 1 W., 10%
R430,R431, R432,R433	540 0284 000	Res., 10 ohm, 1 W., 5%
R434	542 0209 000	Res., 200 ohm, 50 W.
R435,R436, R437,R438	540 0728 000	Res., 100 ohm, 2 W., 10%
R439,R440, R441,R442	542 0060 000	Res., 100 ohm, 10 W.
R443,R444	540 0377 000	Res., 75K ohm, 1 W., 5%
R449	542 0140 000	Res., 5000 ohm, 20 W.
R447,R448	552 0321 000	Rheostat, 1500 ohm, 25 W.
R450	542 0147 000	Res., 15K ohm, 20 W.
R451	540 0756 000	Res., 22K ohm, 2 W., 10%
R453	542 0216 000	Res., 2500 ohm, 50 W.
R454	542 0099 000	Res., 15K ohm, 10 W.
R455,R456	540 0495 000	Res., 180K ohm, 1 W., 10%
T401	478 0142 000	Transformer, Audio Input
T402	478 0054 000	Transformer, Driver
T403	472 0085 000	Transformer, Rect. Fil.
T404	472 0248 000	Transformer, Bias Power
T405	472 0035 000	Transformer, Rect. Plate
TB401	614 0115 000	Terminal Board
TB402	614 0111 000	Terminal Board, Audio Input
TB403	614 0110 000	Terminal Board, Feedback
TB404	614 0112 000	Terminal Board
TB405	614 0046 000	Terminal Board

Symbol No.	Gates Part No.	Description
V401,V402 V403,V404,	370 0097 000	Tube, 6SN7GTA
V405,V406 V407,V408,	370 0214 000	Tube, 6550
V409	374 0020 000	Tube, 5R4GY
XA401,XA402	406 0144 000	Fil. & Bias Pilot Light Assy., Green
XF401,XF402	402 0021 000	Fuseholder Assembly
XV401,XV402 XV403,XV404, XV405,XV406, XV407,XV408,	404 0064 000	Turret Socket
XV409	404 0016 000	Socket

FREQUENCY CONTROL UNIT (R.F. SECTION) M5533

Symbol No.	Gates Part No.	Description
A501,A502	396 0045 000	Lamp, 6-8 V.
C507	500 0187 000	Cap., .002 mfd., 500 V. (W)
C508,C521, C522,C523	516 0082 000	Cap., .01 uf., 1 KV
C509,C513	500 0336 000	Cap., .002 mfd., 1200 V. (W)
C510	520 0211 000	Cap., Variable, 12-300 mmfd.
C511	500 0333 000	Cap., .0005 mfd., 1200 (W) V.
C512	500 0447 000	Cap., .0002 mfd., 1200 (W) V.
C517,C518, C519	510 0360 000	Cap., 4 mfd., 600 (W) V.
C516	510 0362 000	Cap., 2 mfd., 1000 (W) V.
C520	516 0075 000	Cap., .005 mfd., 1 KV, disc hi-kap
C514	510 0359 000	Cap., 2 mfd., 600 V. (W)
F501	398 0020 000	Fuse, 3 amp., 250 V, 3 AG
K501	574 0032 000	Relay, 115 V., D.C., D.P.D.T.
L503	494 0033 000	R.F. Choke, 2.5 mh
L504	911 1371 001	Plate Parasitic Suppressor Assy.
L505	494 0070 000	R.F. Choke, 2 mh.
L506	913 0857 000	Oscillator Coil Assembly
L507,L508	476 0016 000	Filter Choke, 6 henry
P501		Plug, 8 pin
R501	542 0105 000	Res., 25K ohm, 10 W.
R503	552 0079 000	Res., Adj. 15K ohm, 25 W.
R504	542 0145 000	Res., 10K ohm, 20 W.

Symbol No.	Gates Part No.	Description
R505	540 0308 000	Res., 100 ohm, 1 W., 5%
R507	540 0482 000	Res., 15K ohm, 1 W., 10%
R508,R518	540 0284 000	Res., 10 ohm, 1 W., 5%
R509	542 0132 000	Res., 1000 ohm, 20 W.
R510,R514, R515	542 0703 000	Res., 1 ohm, 1 W., 5%
R512	552 0258 000	Control, 25K ohm
R513	540 0317 000	Res., 240 ohm, 1 W., 5%
R516	542 0081 000	Res., 2000 ohm, 10 W.
R517	542 0095 000	Res., 10K ohm, 10 W.
R522	542 0148 000	Res., 20K ohm, 20 W.
R519	542 0099 000	Res., 15K ohm, 10 W.
R523	542 0410 000	Res., 3500 ohm, 20 W.
R524	540 0571 000	Res., 22 ohm, 2 W., 5%
S502	600 0160 000	Switch
T501	472 0069 000	Transformer, Power
TB501	614 0118 000	Terminal Board
TB502	614 0116 000	Terminal Board
TB503	614 0070 000	Terminal Board
V501	374 0051 000	Tube, 6146
V502	374 0020 000	Tube, 5R4GY
V503,V504	370 0103 000	Tube, 6W4GT
XA501,XA502	406 0144 000	Pilot Light Assembly, Green
XF501	402 0021 000	Fuseholder
XV501,XV502, XV503,XV504	404 0016 000	Socket

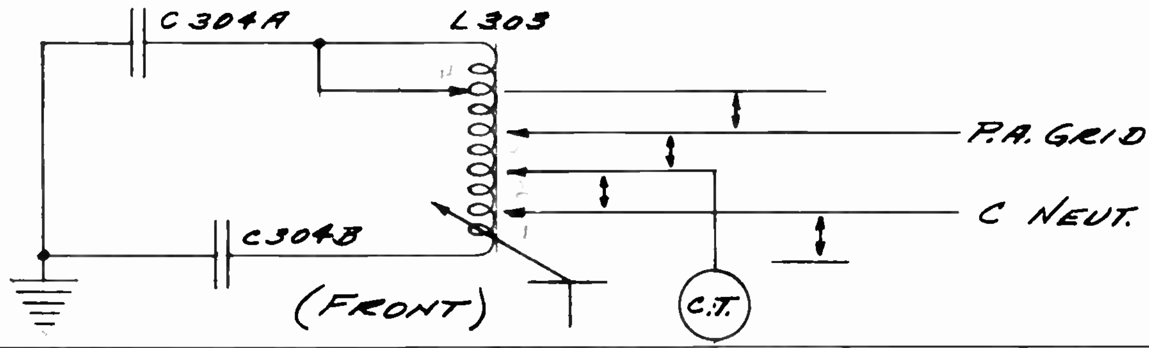
M5422 OSCILLATOR UNIT FOR AM TRANSMITTERS

C1,C2	520 0116 000	Cap., Variable, 3.9-50 mmfd.
C3	502 0008 000	Cap., 24 mmfd., 500 (W) V.
C4	502 0094 000	Cap., 800 mmfd. 500 (W) V.
C5,C7,C8	508 0061 000	Cap., .01 mfd., 600 V.
C6,C11	502 0024 000	Cap., 100 mmfd., 500 (W) V.
C9	520 0119 000	Cap., Variable, 6.7-140 mmfd.
C10	502 0024 000	Cap., 100 mmfd., 500 (W) V.
J1	610 0047 000	Receptacle
L1,L2	494 0033 000	R.F. Choke, 2.5 mh
L3	492 0019 000	Variable Coil, 105-200 uh

Symbol No.	Gates Part No.	Description
R1,R6	540 0764 000	Res., 100K ohm, 2 W., 10%
R2	540 0740 000	Res., 1000 ohm, 2 W., 10%
R3,R9, R10,R11	540 0757 000	Res., 27K ohm, 2 W., 10%
R4	540 0754 000	Res., 15K ohm, 2 W., 10%
R5,R8	540 0752 000	Res., 10K ohm, 2 W., 10%
R7	540 0730 000	Res., 150 ohm, 2 W., 10%
R12	540 0740 000	Res., 1000 ohm, 2 W., 10%
R13	540 0760 000	Res., 47K ohm, 2 W., 10%
R14	540 0284 000	Res., 10 ohm, 1 W., 5%
S1	913 0316 001	Rotary Switch
V1,V2	370 0123 000	Tube, 12BY7A
XV1,XV2	404 0059 000	Socket, Noval
XY1,XY2	404 0016 000	Socket, Crystal
Y1,Y2		Vacuum Crystal (det. by freq.)

104	103	102	101	GR. NO. FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS		A-32022 SCALE
QTY.	QTY.	QTY.	QTY.	ITEM	LIST OF PARTS		

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



FREQ.	C304A-B (Each)		1	2	3	4
540	.003	G1	8	12	14	5
600	.003	G1	8	8	9	6
650	.002	G1	6	13	15	5
700	.002	G1	6	11	17	3
750	.0015	G1	5	14	16	2
800	.0015	G1	5	12	15	2
850	.0015	G1	5	11	13	2
900	.0015	G1	5 4	10 11	13 12	3 3
950	.001	G1	6	11	16	2
1000	.001	G1	6	10	15	1
1050	.001	G1	6	10	14	1
1100	.001	G1	6	8	12	2
1150	.001	G1	5	9	12	1
1200	.0005	G2	13	10	11	10
1250	.0005	G2	10	10	15	5
1300	.0005	G2	8	10	15	4
1350	.0005	G2	8	9	12	5
1400	.0005	G2	8	8	11	5
1450	.0005	G2	7	9	11	4
1500	.0005	G2	6	9	12	2
1550	.0005	G2	6	8	11	2
1600	.0005	G2	5	8	12	1

STATUS	
DEVELOPMENT	PRODUCTION
MECH. CHK.	
PROJ. ENG.	
APPROV. PRODUCTION BY	

NOTE: In ranges where capacity changes, use capacity value of lower frequency.

CH. BY	MTL.		TITLE DRIVER TUNING CHART - BC5P-2 M5565	UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC 65M1D2.
DATE				
DR. BY DRA DATE 3-19-59	ENG. L.P.	FIN.		A-32022

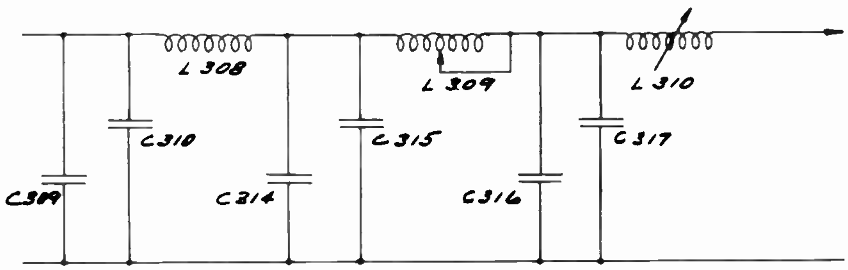
GATES RADIO COMPANY
QUINCY, ILLINOIS

B-65948

TITLE: TUNING CHART BC5P-2 XMTR M-5565

ENG. L.B.P.

APPROXIMATE SETTINGS - 50 - 70 OHM OUTPUT



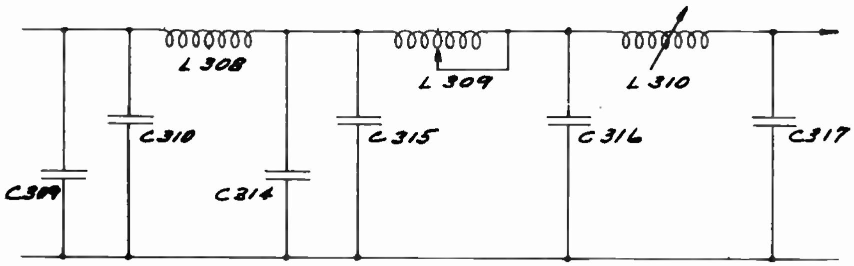
NOTE: In ranges where capacity changes, use capacity value of lower frequency.

FREQ. KC	15 KV TANK CAP JENNINGS M		L308 TURNS	LOAD CAP. G3		L309 TURNS	OUTPUT CAP. G3		L310 TURNS	
	C309	C310		C314	C315		C316	C317		
1600	500		13	.002		7	.002		4.7	
1550	500		14	.002		7	.002		4.6	
1500	500		15	.002		7	.002		4.9	
1450	500		15	.003		9	.002		3.4	
1400	500		16	.003		9	.002		2.8	
1350	500		17	.003		9	.002		2.1	
1300	500		18	.003		11	.002		3.8	
1250	500		19	.003		14	.002		5.8	
1200	500		21	.003		17	.002		6.8	
1150	500		22	.003		17	.002		3.0	
1100	750		19	.003		10	.002		13.4	
1050	750		20	.003		10	.002		12.4	
1000	750		21	.003		10	.002		11.9	
950	750		23	.003		10	.002		11.6	
900	750		25	.003		10	.002		11.4	
850	1000		23	.004		15	.003		8.7	
800	1000		25	.004		15	.003		10.4	
750	1000		27	.004		15	.003		9.5	
700	750	750	24	.004		13	.004		16.5	
650	750	750	25	.006		13	.006		10.5	
600	1000	1000	23	.006		14	.006		16.2	
540	1000	1000	28	.006		14	.006		15.4	

GATES RADIO COMPANY
QUINCY, ILLINOIS

B-65949

APPROXIMATE SETTINGS - 250 OHMS OUTPUT



NOTE: In ranges where capacity changes, use capacity value of lower frequency.

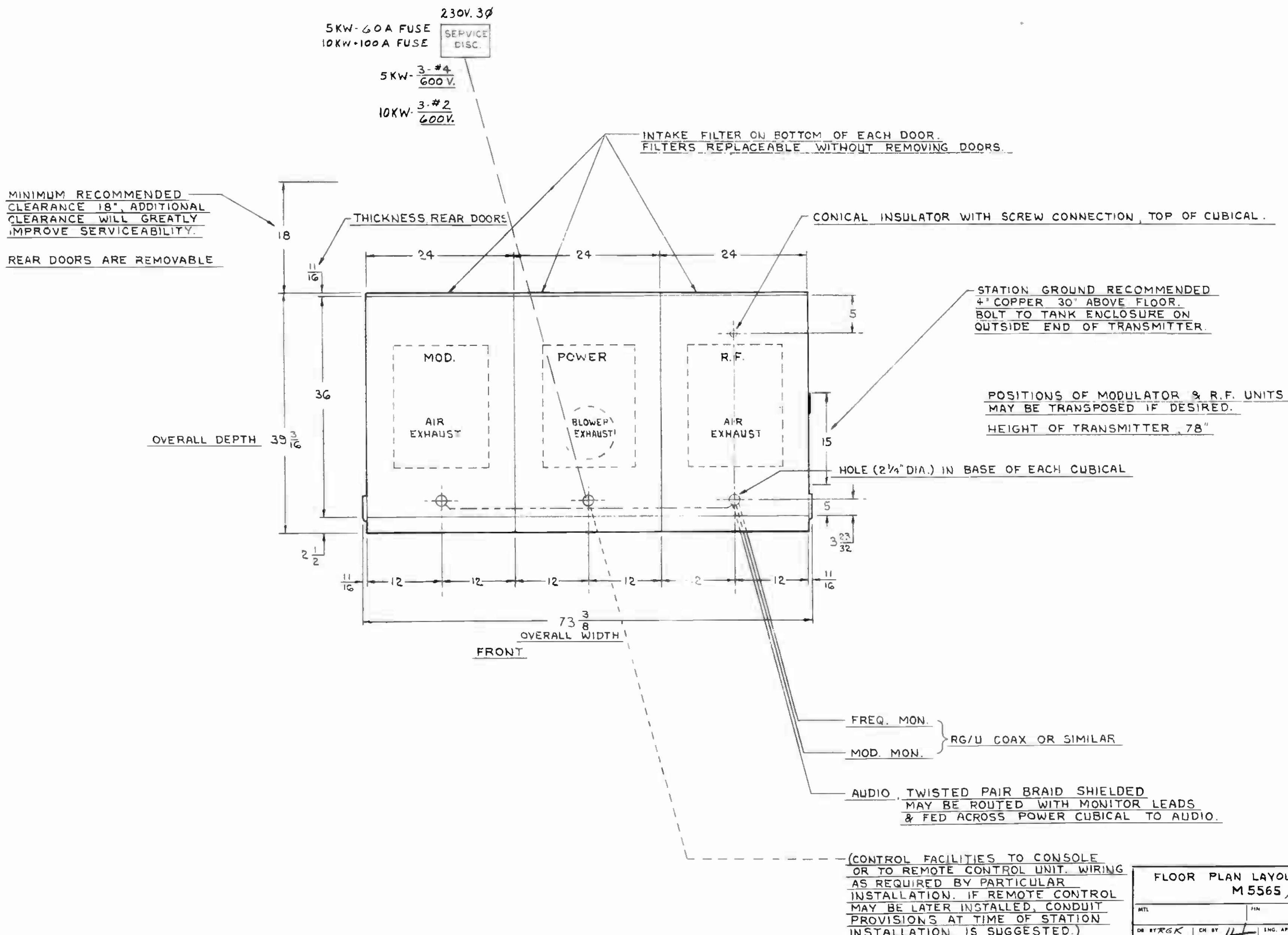
FREQ. KC	TANK CAP. JENNINGS M		L308 TURNS	LOAD CAP. G3		L309 TURNS	MID CAP. G3	L310 TURNS	OUTPUT CAP. G3
	C309	C310		C314	C315		C316		C317
1600	500	-	12	.002	-	8	.002	6.3	.0005
1550	500	-	12	.002	-	9	.002	3.5	.0005
1500	500	-	13	.002	-	9	.002	6.1	.0005
1450	500	-	14	.002	-	9	.002	8.1	.0005
1400	500	-	15	.002	-	9	.002	9.6	.0006
1350	500	-	16	.002	-	9	.002	11.4	.0006
1300	500	-	18	.002	-	10	.002	11.7	.0006
1250	500	-	19	.002	-	10	.002	17.6	.0006
1200	500	-	20	.002	-	11	.002	11.3	.0008
1150	500	-	21	.002	-	11	.002	15.2	.0008
1100	750	-	18	.003	-	8	.002	12.6	.0008
1050	750	-	19	.003	-	8	.002	16.6	.0008
1000	750	-	20	.003	-	9	.002	15.7	.0008
950	750	-	21	.003	-	11	.002	15.4	.0008
900	750	-	23	.003	-	11	.002	15.4	.001
850	1000	-	22	.003	-	11	.002	13.6	.001
800	1000	-	25	.003	-	11	.002	17.3	.001
750	1000	-	27	.003	-	14	.002	17.1	.001
700	750	750	24	.003	-	11	.002	7.7	.001
650	750	750	27	.003	-	11	.002	12.9	.001
600	1000	1000	26	.004	-	11	.003	13.5	.001
540	1000	1000	28	.004	-	14	.003	13.4	.0015

TITLE: TUNING CHART BC5P-2 XMTR M-5565

ENG. L.B.P.

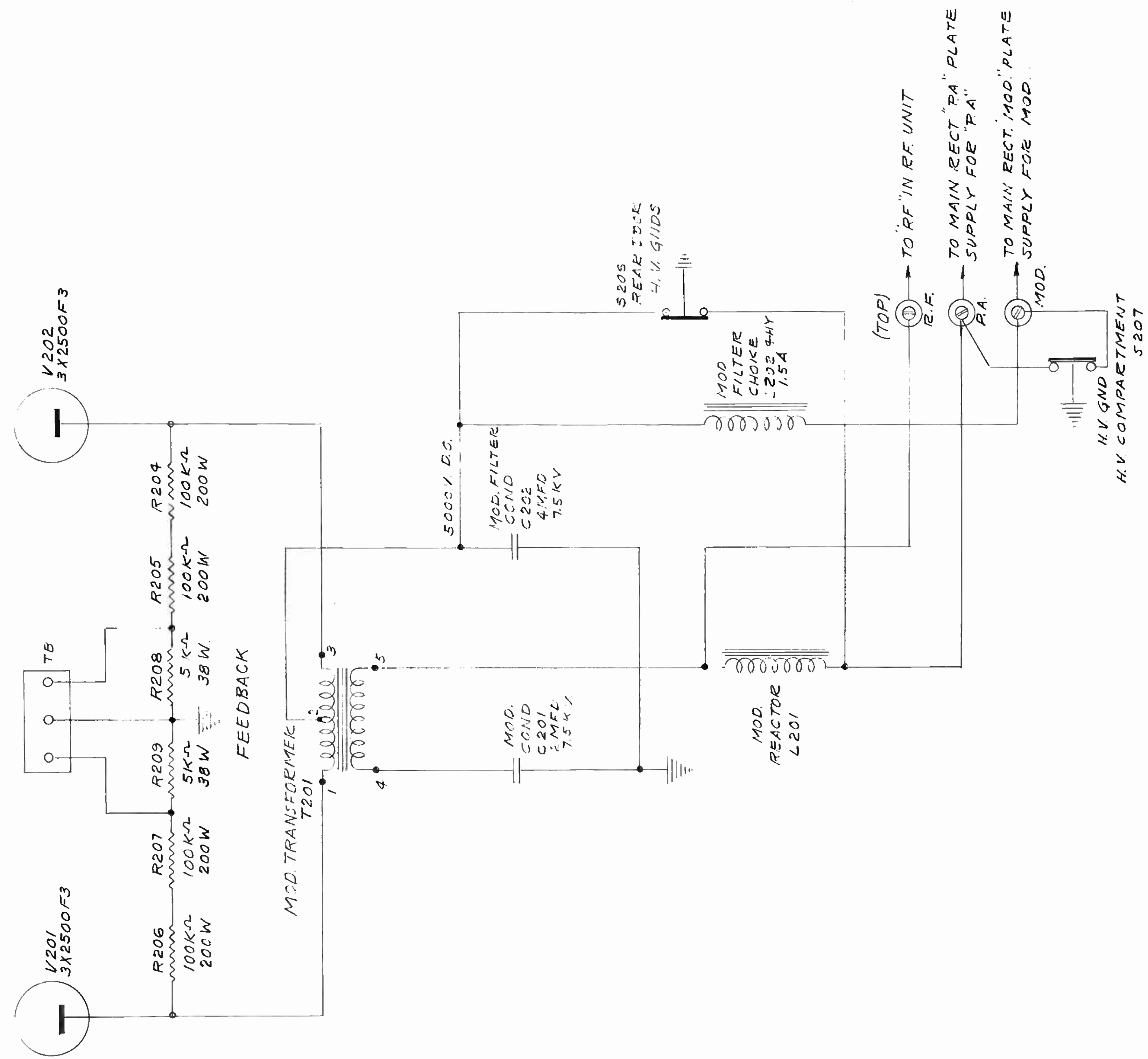
B-65949

C-19628



FLOOR PLAN LAYOUT, 5/10 KW XMTR M5565 / M5383	UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC GSM107.
DR BY RGK DATE 2-24-56	DRAWING NUMBER
GATES RADIO COMPANY QUINCY, ILLINOIS	C-19628

						FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS		C-77891 SCALE
106	105	104	103	102	101	GR. NO	LIST OF PARTS		
QTY.	QTY.	QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE / PT. OR G.N. / FIN.	DESCRIPTION	MATERIAL

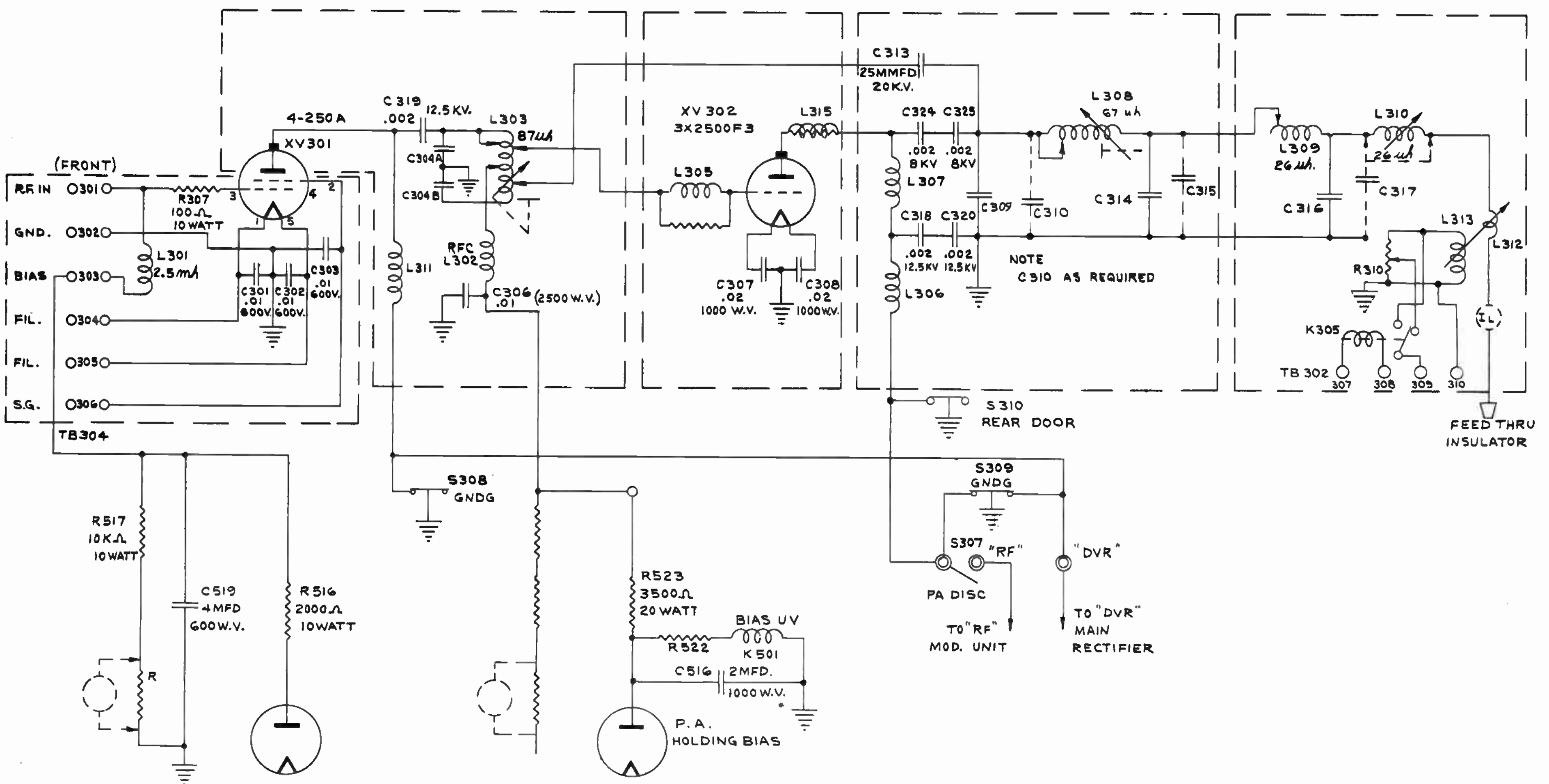


TITLE

HIGH VOLTAGE WIRING FOR
MODULATOR MS184A, BC5P M5565

MTL	FIN.	UNLESS OTHERWISE SPECIFIED, ALL TOLERANCES PER GATES SPEC.
DR. BY / DATE	CH. BY / DATE	ENG. / DATE	C-77891

						FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS				C-77978 SCALE
106	105	104	103	102	101		LIST OF PARTS				
QTY.	QTY.	QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N.	FIN.	DESCRIPTION	MATERIAL

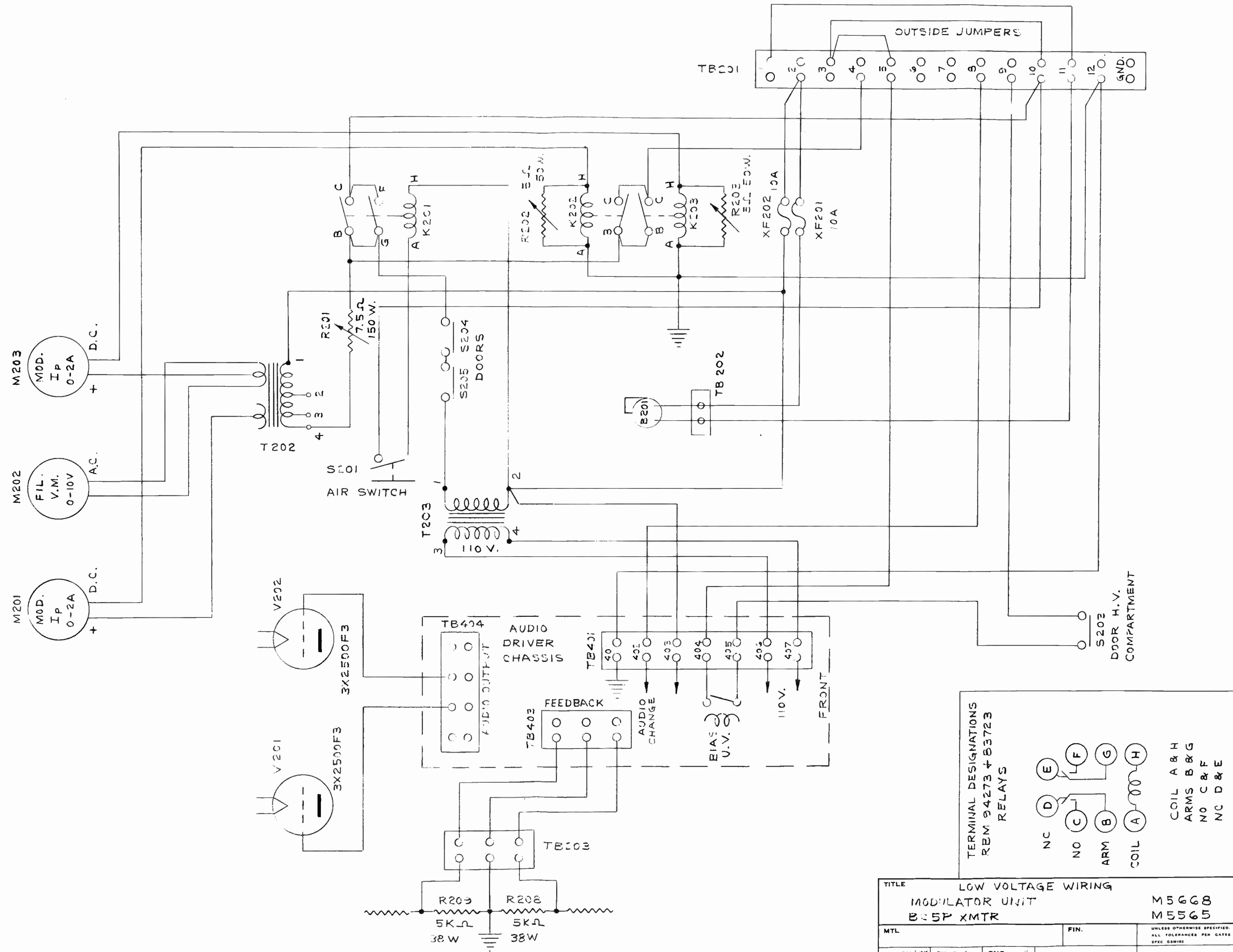


TITLE	SCHEMATIC FOR R.F. UNIT BC5P-M5669
MTL	FIN.
DR. BY DATE 12/20/57	CH. BY DATE	ENG. DATE

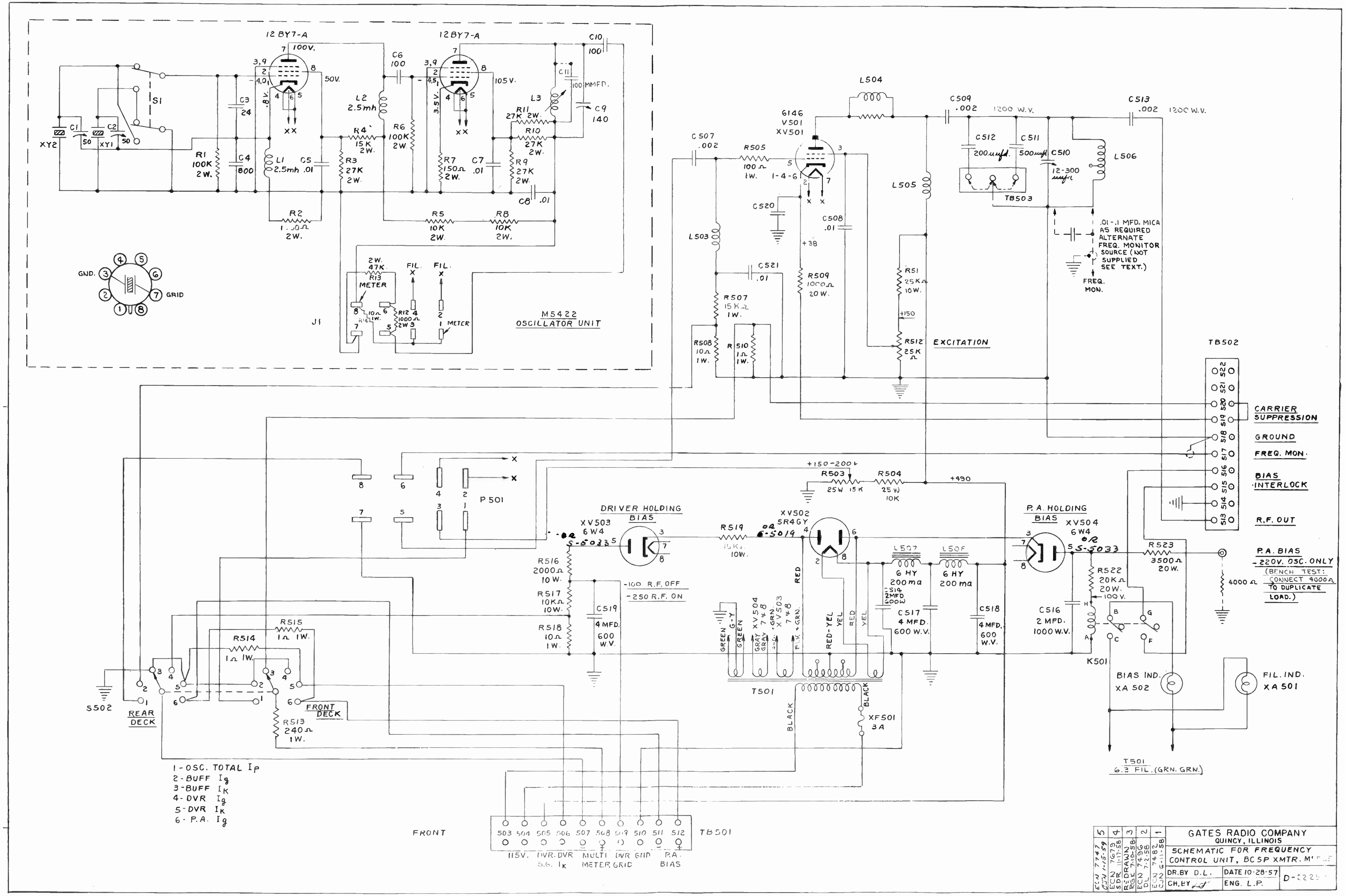
ECN 7725 CTN 12-18-58

C-77978

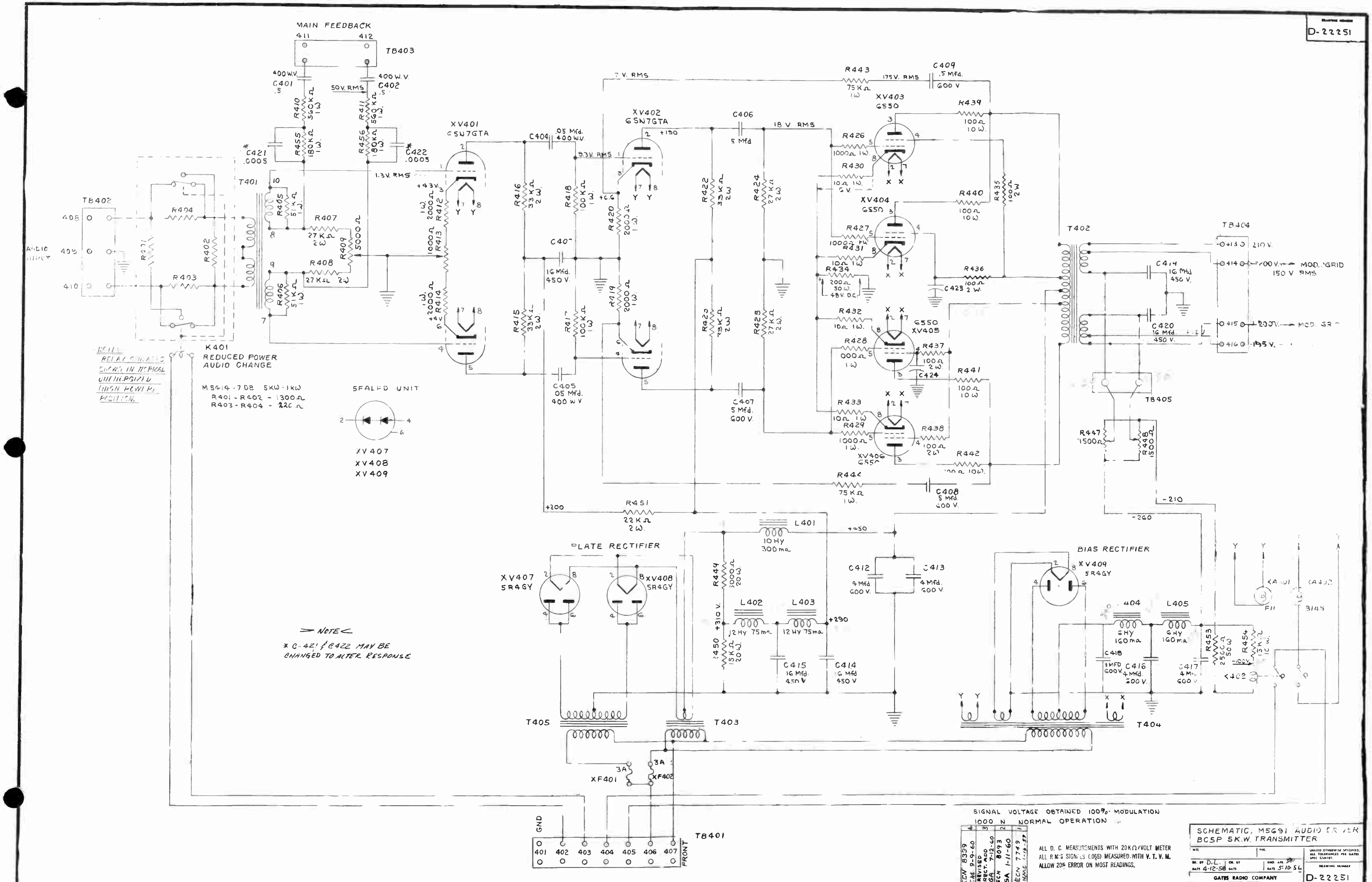
						FIRST MADE FOR	GATES RADIO COMPANY QUINCY, ILLINOIS		C-77981 SCALE
106	105	104	103	102	101	GR NO	LIST OF PARTS		
QTY.	QTY.	QTY.	QTY.	QTY.	QTY.	ITEM	REFERENCE	PT. OR G.N. / FIN. / DESCRIPTION	MATERIAL

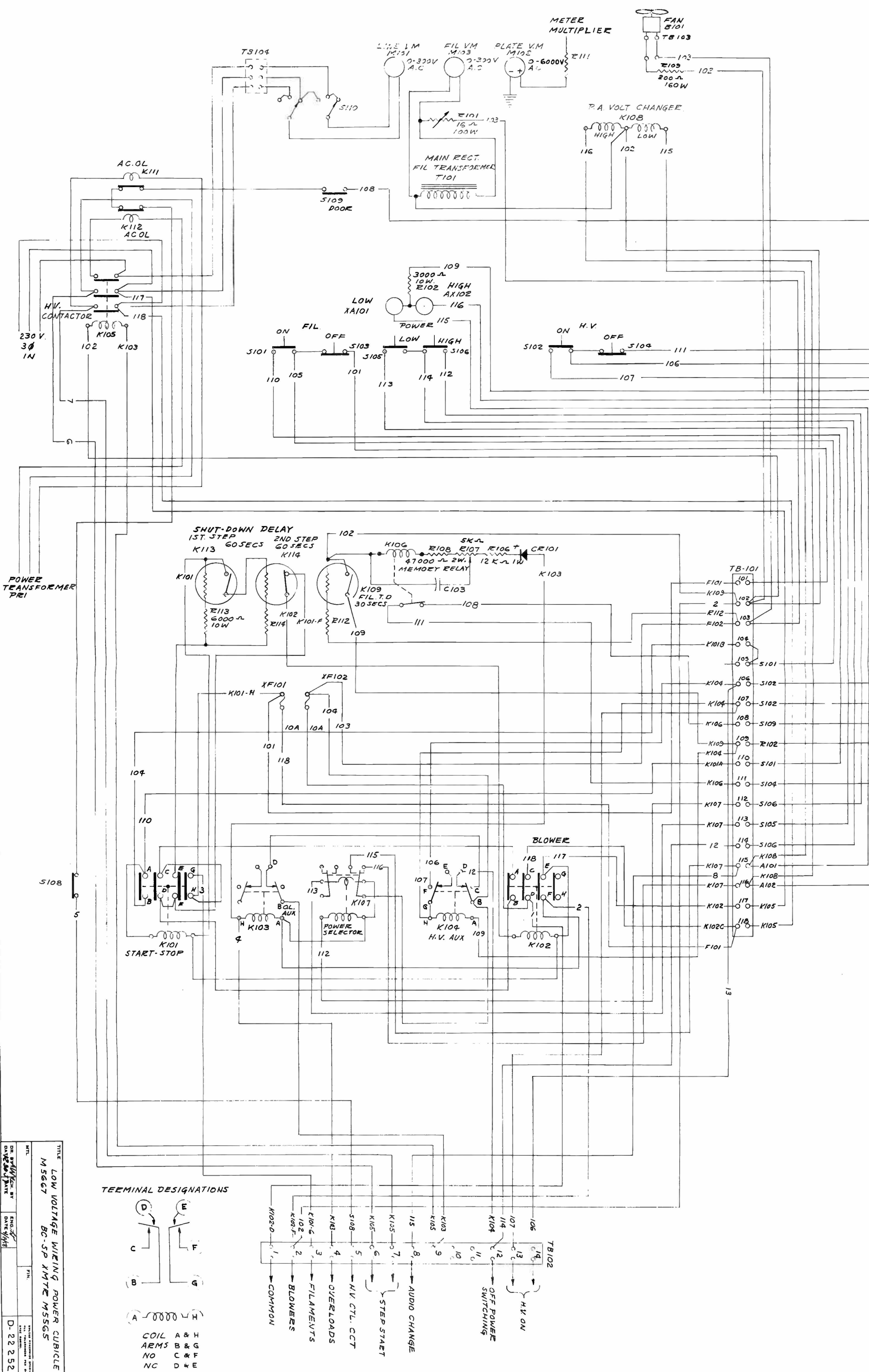


TITLE	LOW VOLTAGE WIRING MODULATOR UNIT BC-5P XMTR	M5668 M5565
MTL	FIN.	UNLESS OTHERWISE SPECIFIED ALL TOLERANCES PER GATES SPEC
DR. BY: DATE	CH. BY: DATE / ENG. DATE	C-77981



12BY7-A
12BY7-A
100V.
50V.
105V.
S1
XY2
XY1
C1 50
C2 50
C3 24
C4 800
R1 100K 2W.
L1 2.5mh
C5 .01
R2 1500Ω 2W.
L2 2.5mh
C6 100
R3 27K 2W.
R4 15K 2W.
R6 100K 2W.
R7 150Ω 2W.
C7 .01
R5 10K 2W.
R8 10K 2W.
R9 27K 2W.
R10 27K 2W.
R11 27K 2W.
L3
C8 .01
C9 140
C10 100
C11 100 MMFD.
GND.
GRID
R13 47K 2W.
METER
R12 1000Ω 2W
FIL.
FIL.
METER
J1
M5422
OSCILLATOR UNIT
6146 V501 XV501
C507 .002
R505 100Ω 1W.
L504
C509 .002 1200 W.V.
C513 .002 1200 W.V.
C512 200μμfd.
C511 500μμf
C510 12-300 μμf
L506
L505
TB503
C520
C508 .01
+38
L503
C521 .01
R509 1000Ω 20W.
R507 15KΩ 1W.
R51 25KΩ 10W.
+150
R512 25KΩ
EXCITATION
R508 10Ω 1W.
R510 1Ω 1W.
.01-.1 MFD. MICA AS REQUIRED ALTERNATE FREQ. MONITOR SOURCE (NOT SUPPLIED SEE TEXT.)
FREQ. MON.
TB502
CARRIER SUPPRESSION
GROUND
FREQ. MON.
BIAS INTERLOCK
R.F. OUT
P501
+150-200V
R503 25W 15K
R504 25W 10K
+490
DRIVER HOLDING BIAS
XV503 6W4 OR S-5033
XV502 5R4GY OR S-5019
R519 15K 10W.
L507 6 HY 200ma
L508 6 HY 200ma
C514 2MFD 600W
C517 4 MFD. 600 W.V.
C518 4 MFD. 600 W.V.
P.A. HOLDING BIAS
XV504 6W4 OR S-5033
R523 3500Ω 20W.
R522 20KΩ 20W.
-100 V.
C516 2 MFD. 1000 W.V.
K501
P.A. BIAS
-220V. OSC. ONLY
(BENCH TEST: CONNECT 4000Ω TO DUPLICATE LOAD.)
4000Ω
R516 2000Ω 10W.
R517 10KΩ 10W.
R518 10Ω 1W.
C519 4 MFD. 600 W.V.
-100 R.F. OFF
-250 R.F. ON
GREEN G-Y GREEN
GRAY GRAY XV504 7 & 8
G-Y GRN XV503 7 & 8
RED
RED-YEL
YEL
RED
YEL
BLACK
BLACK
T501
XF501 3A
BIAS IND. XA502
FIL. IND. XA501
T501 6.3 FIL. (GRN. GRN.)
R515 1Ω 1W.
R514 1Ω 1W.
R513 240Ω 1W.
S502
REAR DECK
FRONT DECK
1-OSC. TOTAL I_P
2-BUFF I_g
3-BUFF I_K
4-DVR I_g
5-DVR I_K
6-P.A. I_g
FRONT
TB501
503 504 505 506 507 508 509 510 511 512
115V. DVR. S.G. DVR I_K MULTI METER GRID DVR GRID P.A. BIAS
GATES RADIO COMPANY
QUINCY, ILLINOIS
SCHEMATIC FOR FREQUENCY CONTROL UNIT, BC5P XMTR.
DR.BY D.L.
DATE 10-28-57
CH.BY
ENG. L.P.
ECN 7747
ECN 7679
SDR 11-17-58
REDRAWN
ECN 7482


D-22251
MAIN FEEDBACK
TB403
TB402
AUDIO INPUT
T401
K401
REDUCED POWER
AUDIO CHANGE
NOTE:
RELAY CONTACTS
SHOWN IN NORMAL
UNENERGIZED
(HIGH POWER)
POSITION.
M5414-7DB 5KW-1KW
R401-R402 - 1300Ω
R403-R404 - 220Ω
SEALED UNIT
XV407
XV408
XV409
XV401
6SN7GTA
XV402
6SN7GTA
XV403
6550
XV404
6550
XV405
6550
XV406
6550
T402
TB404
MOD. GRID
150 V RMS
TB405
PLATE RECTIFIER
XV407
5R4GY
XV408
5R4GY
BIAS RECTIFIER
XV409
5R4GY
T405
T403
T404
XF401
XF402
TB401
GND
FRONT
NOTE
* C-421 & C422 MAY BE
CHANGED TO ALTER RESPONSE
SIGNAL VOLTAGE OBTAINED 100% MODULATION
1000 N NORMAL OPERATION
ALL D. C. MEASUREMENTS WITH 20KΩ/VOLT METER
ALL R.M.S SIGNALS (.065) MEASURED WITH V. T. V. M.
ALLOW 20% ERROR ON MOST READINGS.
SCHEMATIC, M5691 AUDIO DRIVER
BC5P 5K.W. TRANSMITTER
GATES RADIO COMPANY
QUINCY, ILLINOIS
D-22251



TITLE LOW VOLTAGE WIRING POWER CUBICLE M5667 BC-5P XMTR M5565

MTL.

D-22252

GATES RADIO COMPANY
QUINCY, ILLINOIS

LIST OF PARTS

D-22252

NOTE:

L302	540-1000 K.C. USE 2 M.H.
L302	1000-1600 K.C. USE 7 M.H.

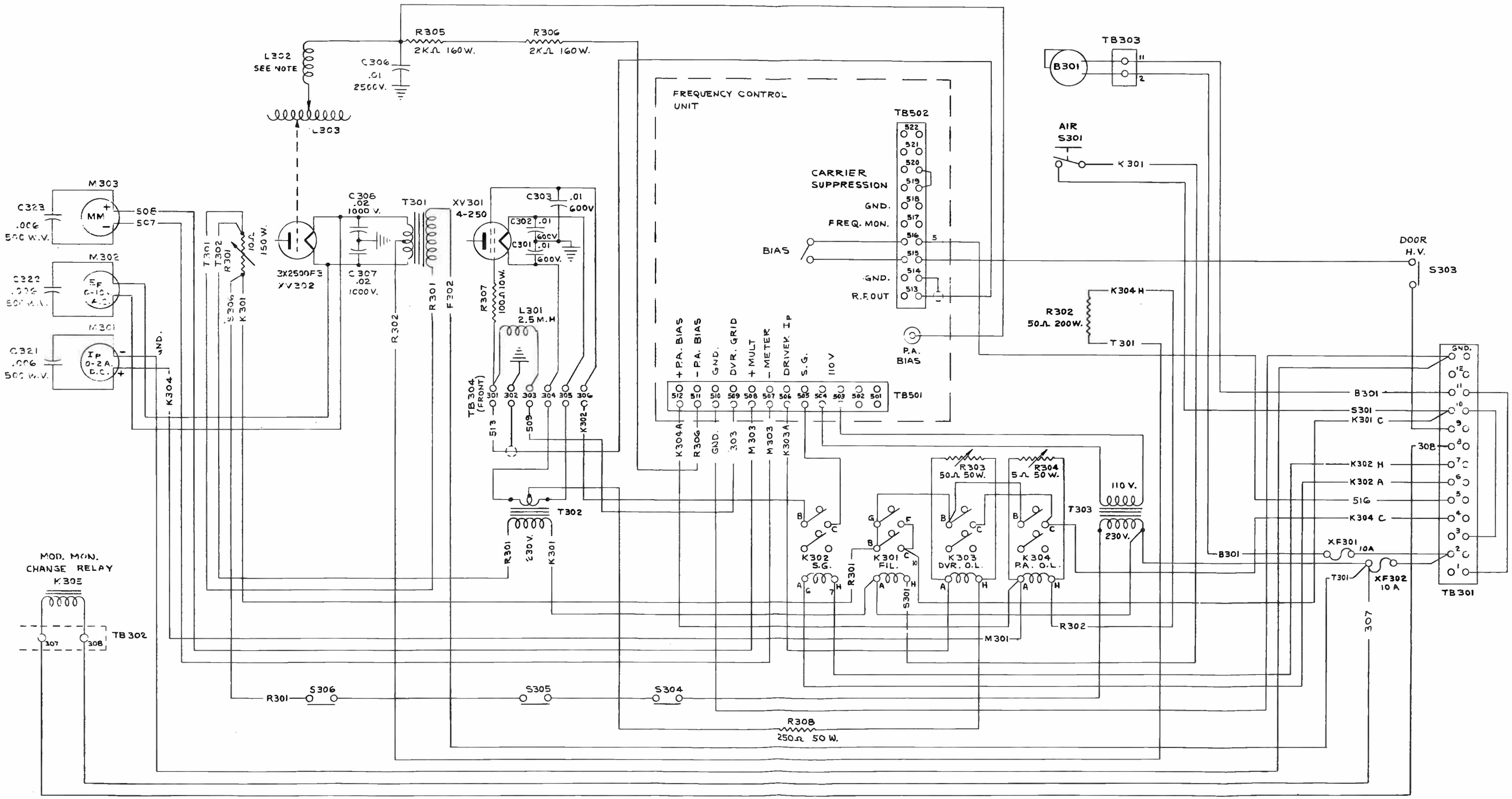
GATES RADIO COMPANY
QUINCY, ILLINOIS

D-22249

SCALE

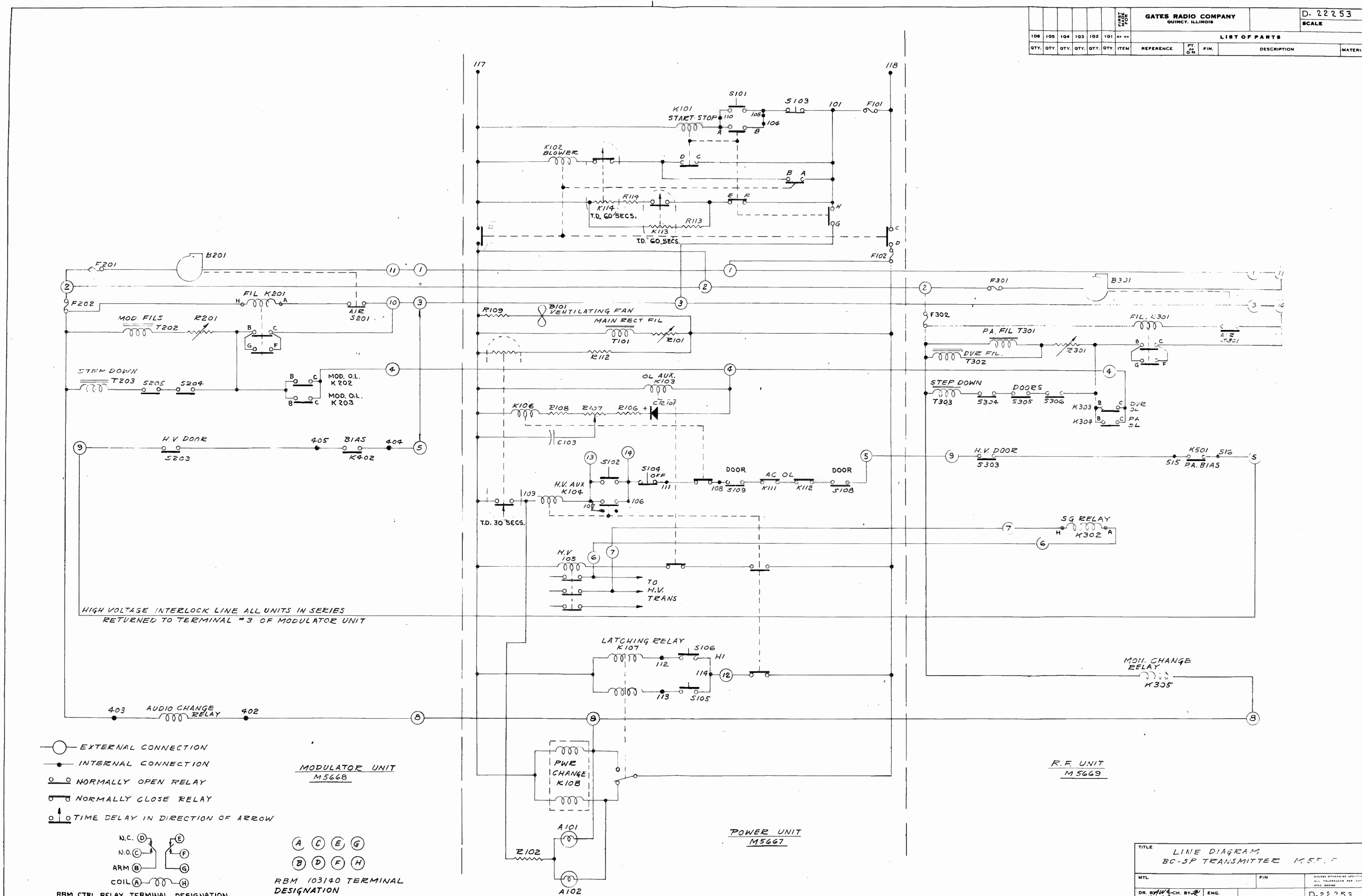
LIST OF PARTS

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

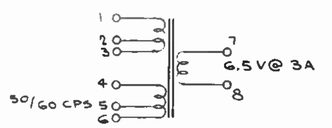


TITLE	LOW VOLTAGE WIRING R.F. UNIT BC5P XMTR.
	M5665 M5565
DR. BY / DATE 12/18/57	CH. BY / DATE
ENG. / DATE	
	D-22249

ECN 8082 / ECN 7795 / HMC 3-9-59

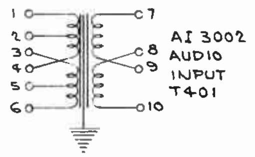

GATES RADIO COMPANY
QUINCY, ILLINOIS
D-22253
SCALE
LIST OF PARTS
REFERENCE
DESCRIPTION
MATERIAL
K101 START-STOP
S101
S103
F101
K102 BLOWER
K114 T.D. 60 SECS.
K113 T.D. 60 SECS.
R119
R113
F102
B201
F201
F202
FIL K201
AIR S201
MOD. FILS T202
R201
STEP DOWN T203
S205
S204
MOD. O.L. K202
MOD. O.L. K203
H.V DOOR S203
BIAS K402
B101 VENTILATING FAN
R109
MAIN RECT FIL T101
R101
R112
OL AUX. K103
K106
R108
R107
R106
CR101
C103
S102
S104 OFF
H.V. AUX K104
T.D. 30 SECS.
DOOR S109
AC OL K111
K112
DOOR S108
H.V 105
TO H.V. TRANS
HIGH VOLTAGE INTERLOCK LINE ALL UNITS IN SERIES
RETURNED TO TERMINAL #3 OF MODULATOR UNIT
LATCHING RELAY K107
S106
S105
AUDIO CHANGE RELAY
PWR CHANGE K108
A101
A102
R102
B301
F301
F302
FIL. K301
AIR S301
PA. FIL T301
DVR FIL. T302
R301
STEP DOWN T303
S304
DOORS S305
S306
K303
K304
DVR OL
PA OL
H.V. DOOR S303
K501 PA. BIAS
SG RELAY K302
MOD. CHANGE RELAY K305
EXTERNAL CONNECTION
INTERNAL CONNECTION
NORMALLY OPEN RELAY
NORMALLY CLOSE RELAY
TIME DELAY IN DIRECTION OF ARROW
N.C.
N.O.
ARM
COIL
RBM CTRL. RELAY TERMINAL DESIGNATION
RBM 103140 TERMINAL DESIGNATION
MODULATOR UNIT M5668
POWER UNIT M5667
R.F. UNIT M5669
TITLE LINE DIAGRAM BC-5P TRANSMITTER
D-22253

C-19558

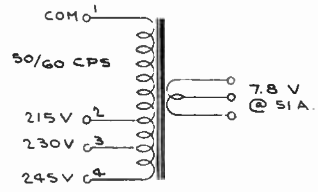


LINE	CONNECT TO	JOIN
115 V.	1 + 3	1+4, 3+6
210 V.	1 + 5	2 + 4
220 V.	1 + 5	3 + 4
230 V	1 + 6	3 + 4

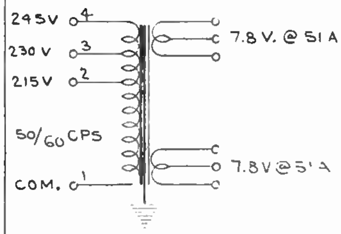
UT.C - CG33
T502 - CRYSTAL HEATER



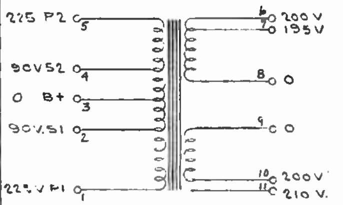
INPUT Z	CONNECT TO	JOIN
500 OHMS	1 + 6	3 TO 4
333 OHMS	1 + 5	3 TO 4
250 OHMS	1 + 6	2 TO 3
200 OHMS	2 + 5	3 TO 4
125 OHMS	1 + 4	1 TO 3 + 4 TO 6
50 OHMS	2 + 4	2 TO 3 + 4 TO 5



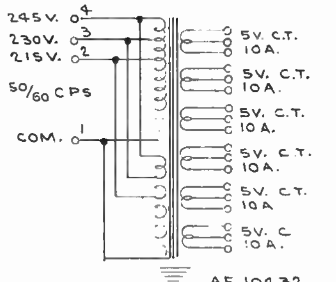
AF 7782
T301 POWER AMP. FILAMENT



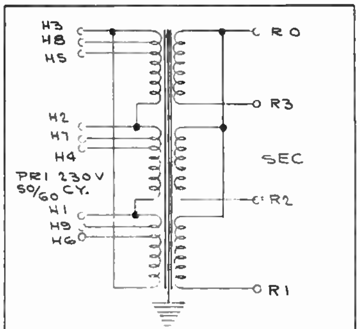
AF-10546
T202 - MODULATOR FILAMENT



AD 11770
T402 AUDIO DRIVER

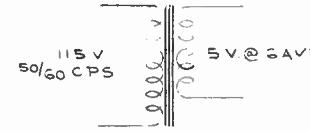


T101 AF 10432
MAIN. RECT. FIL.

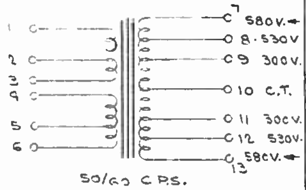


AP 8000 T102 MAIN POWER

CONNECT TO 7, 8, 9 NOMINAL 5000 VDC
CONNECT TO 1, 2, 3 - 5% D.C. VOLTAGE
CONNECT TO 4, 5, 6 + 5% D.C. VOLTAGE

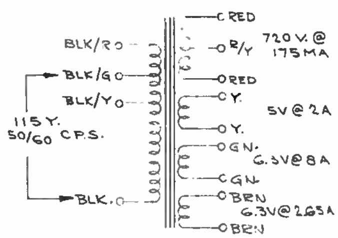


T403
TRIAD F8X
AUDIO RECTIFIER FILAMENT

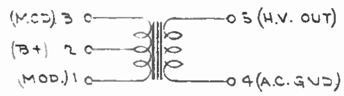


PRI. VOLT	CONNECT	JOIN
105	1 + 2	1+4; 2+5
115	1 + 6	1+4; 2+5

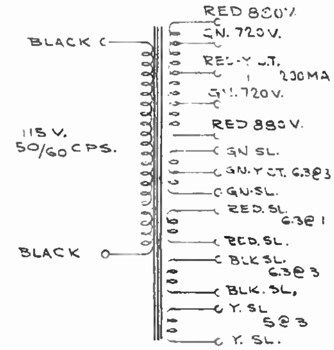
UTC - CG301
T405 AUDIO PLATE



AP 9653
T404 MODULATOR BIAS AND
AUDIO FILAMENT



AM 7718
MOD. TRANS.



T501
TRIAD R26A
FREQ. CTL. SUPPLY

BLACK + BLACK PRIMARY

GN. SL
GN. Y - C.T. } 6.3 @ 3 AMPS
GN SL

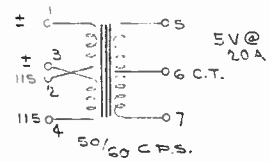
BLK SL
BLK. SL } 6.3 @ 3 AMPS

RED SL
RED SL } 6.3 @ 1 AMP

YELLOW SL
YELLOW SL } 5V @ 3 AMPS

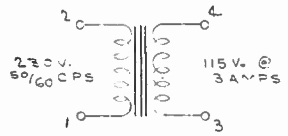
H. V

RED TO RED 880 V. @ 200 MA
GN. TO GN. 720 V @ 200 MA
RED + YELLOW C.T.

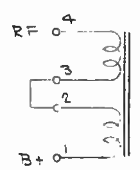


LINE	CONNECT	JOIN
115 V.	1 + 2	1+3; 2+4
230 V	1 + 4	2 + 3

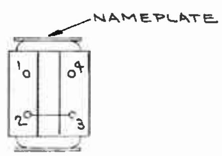
F 516
T302 DRIVER FILAMENT



STEPDOWN TRANSFORMER
AS 11278
T203, T303



AC 7719E
MOD REACTOR
30 HENRIES



FILTER REACTORS				
SYMBOL	NUMBER	INDUCTANCE	CURRENT	INSULATION (RMS TEST)
L101 / L202	AC 3143	4 HY	1.5 A.	8000 V.
L102	EG422	8 HY	600 MA.	4000 W.V.
L401	C19A	10 HY	300 MA.	3000 V
L402 / L403	C5X	12 HY	75 MA.	1500 V.
L404 / L405	C12X	6 HY	160 MA.	1500 V.
L507	AC 3123	8 HY	200 MA.	1500 V.

TRANSFORMER + REACTOR
CONNECTIONS + DATA
BC5P M5349

1	ADDED T... NUMBER T402 4-1-57
2	T405, CHANGED CONNECT TO FOR 1+5 TO 1+6 12-2-57

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 crystals 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.

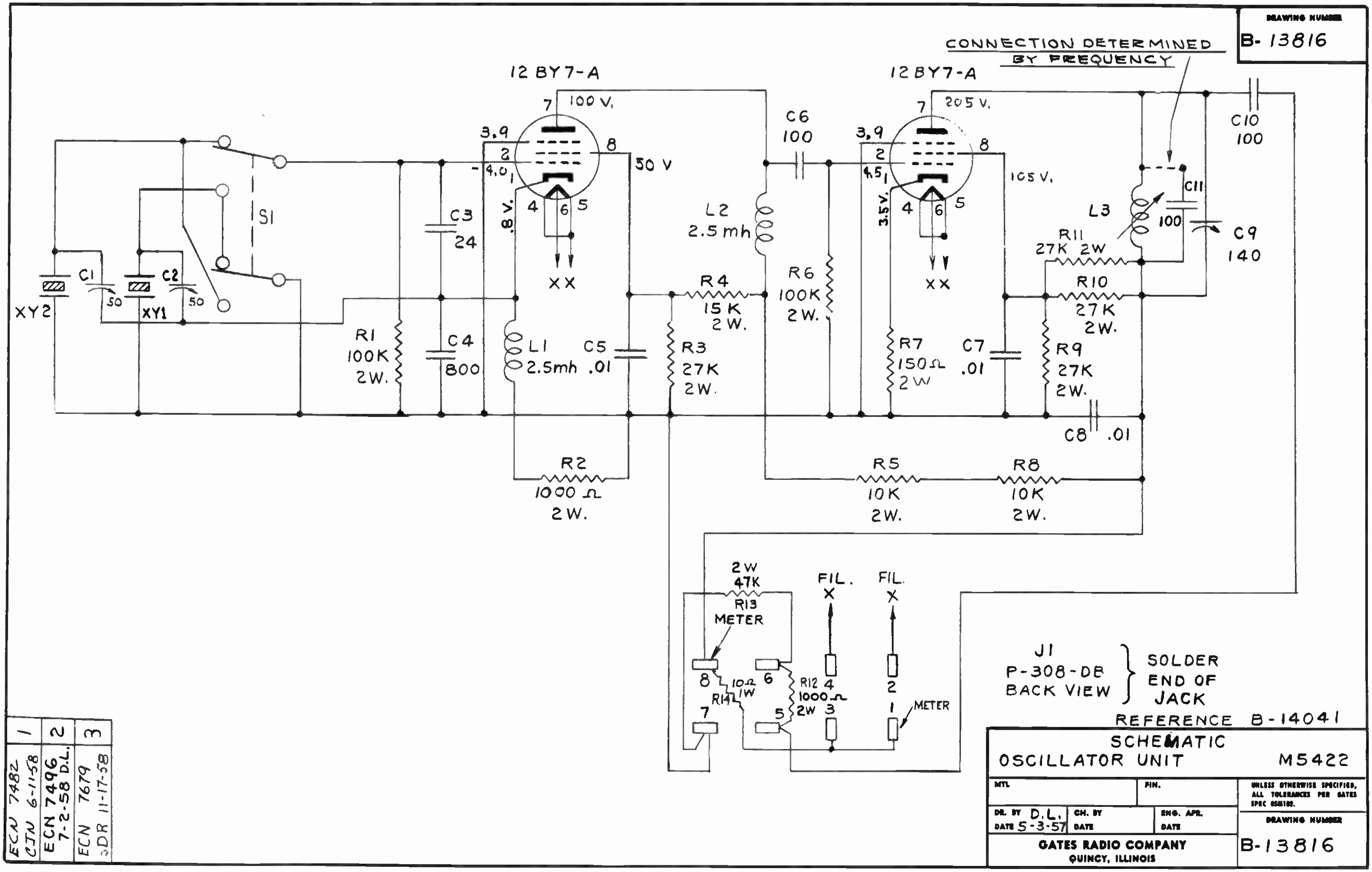
2. Slug on L3 should be screwed down 14 turns.

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).

<u>CAUTION</u> - 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.


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

REPLACING COMPONENTS ON THE PRINTED CHASSIS

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

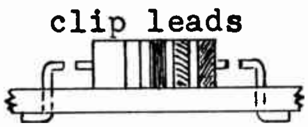
<u>WARNING:</u> The copper conductors are only .0027" thick on the printed chassis. They are easily damaged! Do not attempt to pull one component lead loose to check the component. Use only the approved procedure as outlined in the sketches and the sub-paragraphs listed below.

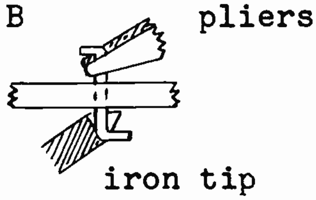
Use a small electric soldering iron (60 watts or less) and allow it to come up to full heat before starting the repair job. The tip must be clean and well tinned.

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

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

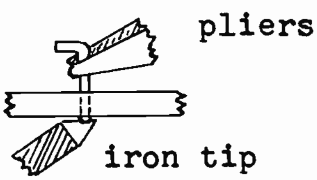
1. REMOVING PARALLEL MOUNTED COMPONENTS WITH AXIAL LEADS:

A


B


push wire through hole until hook can be clipped off.

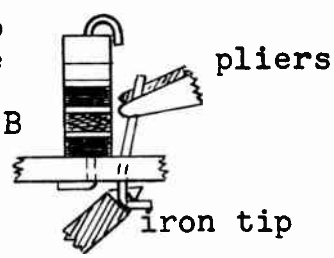
clip off hook that was soldered to chassis.

C


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

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

A

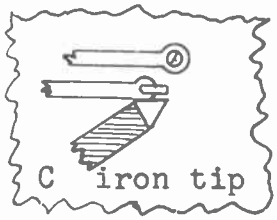

B


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

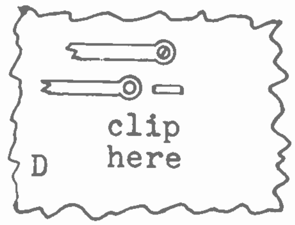
clip off hook that was soldered to chassis.

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

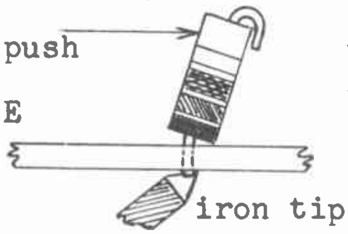
2. (continued)



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

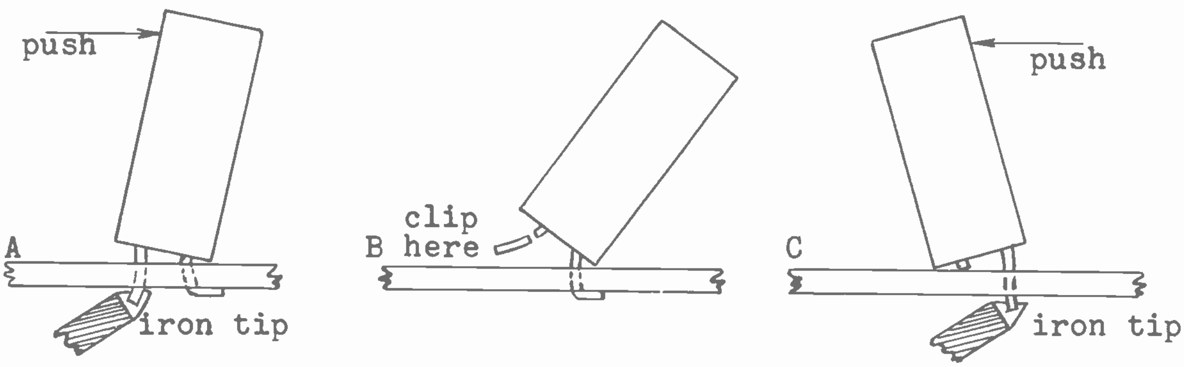


cut the wire as near the chassis as possible after removing as much excess solder as possible. Remove solder by carrying it away with the iron tip and wiping the tip on a clean cloth. Repeat until the hook can be clipped with small sharp diagonal cutters, illustrated in (2-D).



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

3. REMOVING PRINTED WIRING TYPE CAPACITORS:

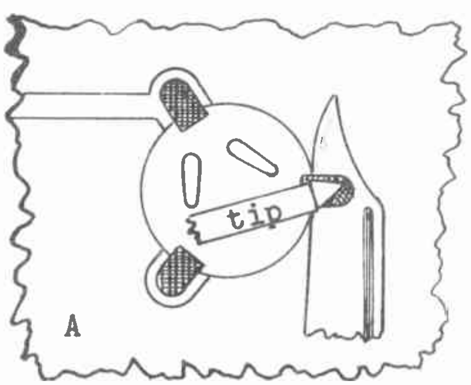


(A) hold iron tip on one of the folded leads, as soon as the solder melts - push gently but firmly on the side that will lift this lead. The capacitor should be pushed over just far enough to clear the lead from the hole.

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

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

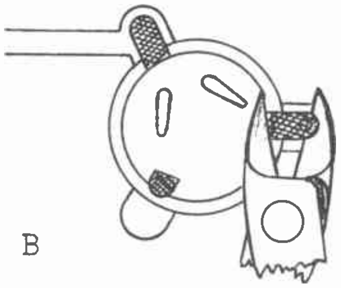
4. REMOVING SADDLE TYPE ELECTROLYTIC CAPACITORS:



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

Repeat on other two mounting ears.

4. (continued)

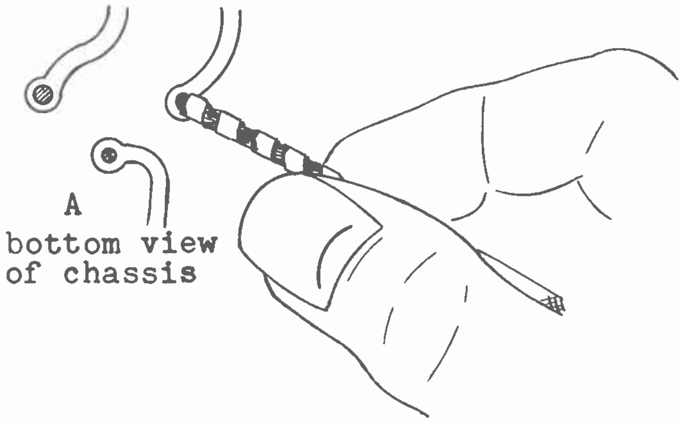


B

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

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

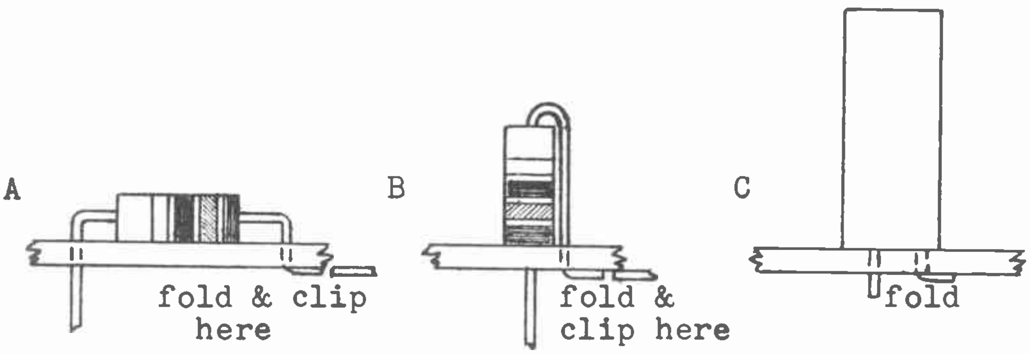
5. PREPARING THE HOLES FOR THE REPLACEMENT COMPONENT:



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

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

6. REPLACING THE COMPONENTS:



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

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

7. REPLACING TUBE SOCKETS:

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

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

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

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

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

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

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

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

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

HOW CAN WE HELP YOU?

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

- In extremely cold weather if you blow a fuse at morning turn-on, it is a safe bet the temperature of the room has gone very low and the mercury in your rectifiers has collected, causing an arc-back. You can correct this by placing a light bulb or small heating element next to the rectifiers which turns on when the transmitter is turned off.
- Dirt or scum is the evil of all transmitters. Enough will cause arc-overs that will blow fuses.
- Look for cable abrasions.

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

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

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

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

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

20. It is well to remember that one bad connection in the radiating system can cause outages. Several years ago an engineer solved weeks of investigation by stepping on a poorly brazed connection at the base of the tower. When he did so, he noted the antenna current increase nearly ½ ampere. So don't assume. Be sure the entire chain is well connected. Carelessness around the base of the tower, where wires are brazed and at which point is the hub of the entire ground system, has caused many problems.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SERVICE QUESTIONNAIRE

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

Radio Station ____________________ City ____________________

Street Address ____________________ Office Phone __________ Xmitter Phone __________

Chief Engineer ____________________ Home Address ____________________

Number of years with Station ____________________

Make of transmitter ____________________ Model ____________________

) Date placed in service ____________________

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

(8) Height of tower ____________________ Tower resistance ____________________

Date resistance measured ____________________

Reactance (indicate plus or minus) ____________________

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

☐ transmission line ☐ direct coupled

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

☐ If transmission line employed, please state following:

____________________ Type __________ Impedance __________

Length __________

(10) No. of ground radials ____________________ Length ____________________

Do you use ground screen? ____________________ Size ____________________

(11) State method of connecting ground system to main ground of transmitter ____________________

____

____

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

Make ____________________ Age ____________________

State antenna current (meter connecting to tower) ____________________ Amps.

State line current at transmitter ____________________ at coupler ____________________

(13) If transmitter feeds directional antenna system, please state whether all monitor points checked or measured daily____, weekly____, other____________________.

(14) Number of towers____. When installed?____________________.

ROYAL

(15) Your transmitter

Plate voltage at: no modulation ________ 90% modulation ________

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

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

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

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

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

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

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

Date proof of performance made ________

By whom ________

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

1000 cycles ________ 2500 cycles ________ 5000 cycles ________

7500 cycles ________ 10,000 cycles ________

—Distortion: 50 cycles ________ 100 cycles ________

1000 cycles ________ 5000 cycles ________

—Noise: Db. reduction below 100% modulation ________

(18) Have you experienced part failures? ________

If so, state what: ________

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

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

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

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

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

P.A. tube No. 1__________hours

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

Mod. tube No. 1__________hours

Mod. tube No. 2__________hours

Main rectifiers__________hours

SPEECH INPUT EQUIPMENT:

(24) Make of speech equipment__________Model__________

When purchased__________

(25) Make of transcription turntables__________

Model__________When purchased__________

(26) State make of pickup as follows:

Arm__________

Head__________

Filter or equalizer__________

Preamplifier__________

Styli: ☐ diamond ☐ sapphire

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

(28) Make of limiter__________Model__________

When purchased__________

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

(30) Are studios separate from transmitter?__________

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

How is it?__________

(32) DO YOU OPERATE BY REMOTE CONTROL?_____ INDICATE PART TIME_____ FULL TIME_____

(33) Type of Remote Control System, DC_____, Tone Operated_____ Other_____ Make__________

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

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

(36) Is transmitter building heated in winter?_____

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

THE OVERALL SYSTEM

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

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

What is it? ______

What happens when you add it? ______

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

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

SUMMARY

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

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

Subsidiary of Harris-Intertype Corporation

* C421 & C422 MAY BE CHANGED TO ALTER RESPONSE
K401
REDUCED POWER
AUDIO CHANGE
M5414 - 7DB 5KW-1KW
R401-R402 - 1300Ω
R403-R404 - 220Ω
RELAY CONTACTS SHOWN IN NORMAL UNENERGIZED (HIGH-POWER) POSITION.
RELAY SHOWN IN UNENERGIZED (HIGH-POWER) POSITION
SHUTDOWN TIME DELAY
PLATE RECTIFIER
BIAS RECTIFIER
PA VOLTAGE CHANGER