FIGURE 1. MODEL 6100-B AMATEUR RADIO TRANSMITTER WITH MODEL SIDEBAND GENERATOR ATTACHED

I MODEL 5100-B AMATEUR RADIO TRANSMITTER

A. INTRODUCTION

1. General Description

The B&W Model 5100-B Amateur Radio Transmitter is a completely self-contained transmitter designed for multiband operation. It is housed in a handsomely styled cabinet measuring 22 inches wide by 11½ inches high by 14 3/4 inches deep and weighs 88 pounds (see Figure 1). Terminals and an RF connector are provided at the rear of the equipment for making the necessary AC power, antenna, and control connections.

A hinged top cabinet cover permits easy access to the inside for replacement of tubes. For servicing, the equipment may be removed from the cabinet and disassembled into five basic units; the Main Chassis Unit, the VFO and Dial Assembly, the Crystal Oscillator and Buffer Unit, the Multiplier and Final Amplifier Unit, and the Speech Amplifier and Modulator Unit. The Main Chassis Unit consists of the front panel and the main chassis which contains all power supplies, the receptacles for plugging in the other units, and the terminals for making the necessary connections to the equipment. All operating controls are located on the front panel. Those controls requiring infrequent adjustment are located within the cabinet.

CAUTION: DO NOT ATTEMPT TO OPERATE THE TRANSMITTER UNLESS THE RF OUTPUT IS CONNECTED TO A DUMMY LOAD OR TO AN ANTENNA. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN DAMAGE TO THE INTEGRAL LOW PASS FILTER.

2. Function of the Equipment

The Model 5100-B has been designed for amateur communications service for the 10, 11, 15, 20, 40 and 80 meter amateur bands. Provision is made for either AM radiotelephony or CW radiotelegraphy. Also, when paired with B&W's 51SB-B, it provides the added advantages of single sideband transmission without any internal changes whatsoever. The equipment may also be used to drive a higher powered RF amplifier, and provision is also made whereby a high powered class B audio modulator may be driven by the 5100-B modulator. The transmitter as shipped from the factory is complete with tubes and is ready for operation. The only additional items required are a microphone, key, antenna, and crystals, if crystal controlled operation is desired.

3. Electrical Specifications

a. Power Source
117 V.A.C., 50/60 cps

b. Frequency coverage
The Model 5100-B is completely bandswitched and is designed for operation in the following amateur bands:

80 Meter Band	-	3,500 Kcps.	to 4,000 Kcps.
40 Meter Band	-	7,000 Kcps.	to 7,300 Kcps.
20 Meter Band	-	14,000 Kcps.	to 14,350 Kcps.
15 Meter Band	-	21,000 Kcps.	to 21,450 Kcps.
11 Meter Band	-	26,960 Kcps.	to 27,230 Kcps.
10 Meter Band	-	28,000 Kcps.	to 29,700 Kcps.

c. Emission
CW or AM telephony (SSB with the addition of the 51SB-B)

d. Frequency control
Crystal or VFO (crystals not supplied

e. D.C. Power Input to final amplifier
CW - 180 watts (with the 51SB - 180 watts on SSB)
AM telephony - 140 watts

f. R.F. Output Circuit
Pi-Network - 75 ohms unbalanced output impedance with internal low pass filter. Available with 52 ohm output impedance at no extra cost.

g. Audio Input
Crystal or dynamic microphone, Amphenol 80-PC2F two contact connector.

h. Tube Complement
VFO - 1 type 6BH6
Crystal oscillator & Buffer Unit - 2 type 6BJ6.
Multiplier - 4 type 6AQ5.
Final Amplifier - 2 type 6146.
Speech Amplifier - 1 type 6U8 and 1 type 6AQ5
Modulator - 2 type 6146
H.V. Rectifier - 2 type 5R4G-Y
L.V. Rectifier - 1 type 5U4-GB
Voltage Regulator - type OD3/VR-150

B. INSTALLATION AND OPERATION

The B&W Model 5100-B Amateur Radio Transmitter is shipped complete with tubes and instruction manual in a cardboard container, baffled and pudded to prevent damage in transit. After the equipment has been removed from its container, it should be inspected for any damage it any have suffered in transit. Make sure that all tubes are intact and properly seated in their respective sockets. Unshielded tubes are separately packed and should be inserted in their respective sockets. (See Figure 2)

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1. Installing and connecting the equipment.

The 5100-B has been designed for table-top operation and should be located in a convenient position on the operating table. Before plugging in the AC line cord, make all the other necessary connections to the transmitter and check to see that all power switches are in their "OFF" positions. Connections should be made in accordance with Figure 4. CHECK and DOUBLE-CHECK all leads to make certain that no errors have been made.

a. Antenna Systems

The Model 5100-B may be used with a variety of antenna systems. However, since the transmitter is designed to feed into a 75 ohm unbalanced line, the antenna feed system should be arranged accordingly.

(1) Single band half wave folded dipole antenna.
This is illustrated in Figure 6. Here the antenna feed line is a 300 ohm

balanced line. The transformation from 75 to 300 ohms and from unbalanced line to balanced line is accomplished by means of a balun made up of two B&W type 3975 bifilar coils.

(2) Multiband antenna for 80, 40, 20, and 10 meter bands.
This antenna is shown in Figure 7. It provides the operator with a radiating system for each of the bands indicated. This antenna is, of course, not as effective as a half wave antenna designed for single band operation. It does, however, represent a good compromise where conditions do not permit the erection of a separate antenna for each band. Here again the transformation from the transmitter output to the antenna feed line is accomplished by means of the balun described above.

(3) Beam Antennas for 10, 15, and 20 meter bands.
Here a separate beam antenna is used for each band. As shown in Figure 8, the antenna is connected to the transmitter through a beam balun and a 75 ohm coaxial line. A separate balun is required for each band, and these are listed in the figure. Note that the balun is mounted right at the beam.

(4) Half wave split dipole.
This is illustrated in Figure 9. The performance of this system is similar to the folded dipole of Figure 6. The two systems are identical except that the feed line for the split dipole is a 75 ohm balanced line. The transformation is accomplished by two B&W Type 3975 Bifilar coils. These are connected to provide a 75 ohm unbalanced to a 75 ohm balanced transformation. Instructions for doing this are provided with each set of balun coils.

(5) Half wave split dipole and end fed Zepp antennas using open wire feed line system.
From the operational standpoint, these antennas are basically similar to those of Figures 6 and 9. However, as shown in Figures 10 and 11, the transformation from unbalanced line to balanced line is accomplished by means of an antenna coupler circuit. The antenna coupler consists of a B&W antenna coupler coil with a fixed link and a B&W JCX100E split stator variable capacitor equipped with a jack bar and mounting brackets. This provides a compact assembly without leads.

Feed line impedance matching is obtained by placing the feed line across appropriate taps on the coupler coil. The loading is accomplished by adjustments of the "AMP. LOADING" and "AMP. TUNING" controls together with coupler capacitor, C1. While this coupler is very flexible in that it permits matching a wide range of impedances, it has the objectionable feature of adding another tuning control to the transmitter.

Although the coupler is shown here as used with half wave antennas, it can be used with longer antennas such as the odd or even half wave multiple types as well as the rhombic and "V" type high gain antennas. As a matter of fact, it can be used with any antenna when a resonant or non-resonant feed line system is used.

To adjust the coupler when used with the 5100-B, proceed as follows;

(a) With the "AMP. LOADING" control fully clockwise, place the transmitter into CW operation with key down and the "TUNE-OPER." switch in the "TUNE" position.

(b) Place a short across C1 of the coupler and then adjust the "AMP. TUNING" control for minimum plate current dip.

(c) Remove the short across C1 and adjust C1 for maximum loading.

(d) Tap the antenna feeders on L1 starting at the ends. Locate correct taps by moving line feeders in toward the center of the coil. Select those taps that provide maximum loading with C1 set as in step (c) above.

(e) Place the "TUNE-OPER." switch in the "OPER." position and tune and load the final to maximum with C1 shorted as in step (b).

(f) Remove the short from C1 and adjust C1 as in step (c) above. If the setting of C1 is the same as in step (c), the VSWR is satisfactory. If C1 has increased, the line is inductively reactive, if C1 has decreased, the line is capacitively reactive.

(g) Repeat the above steps until a minimum VSWR is obtained.

Obtaining a minimum VSWR is best accomplished by placing a VSWR indicator in the coaxial line between the coupler and the transmitter. Here the B&W Matchmaster is a valuable instrument for this purpose.

For considerably more information on antennas, couplers, and feed systems, the reader is referred to the ARRL Antenna Handbook.

2. Functions of Controls

All operating controls of the 5100-B are located on the front panel and perform the following functions:

"AUDIO GAIN" control - varies overall gain of the speech amplifier and modulator and hence the per cent modulation.

"A.C. LINE" switch - controls total AC power to the transmitter.

"TUNE-OPER." switch - places a resistor in series with primary of plate transformer to reduce the output of the high voltage power supply for tuning purposes.

"FUNCTION SWITCH"
"SSB/CW" - selects the mode of transmission. SSB functions only when 51SB-B Single Sideband Generator is added.
"VFO" - closes keying circuit and removes high voltage from final amplifier. Used to zero beat the transmitter with another station on the receiver.
"PH" - sets the transmitter up for AM radiotelephone operation.

"EXCITATION CONTROL" - varies screen voltages on first and third multiplier tubes and hence the drive to the final amplifier.

"H.V." switch - controls primary voltage to plate transformer.

"METER SWITCH" - selects function of front panel meter.
"EXC." - indicates final amplifier screen current. (Inoperative on SSB).
"MOD." - indicates modulator plate current.
"AMP." - indicates final amplifier plate current.

"FREQUENCY SELECTOR" - adjusts the variable capacitor in the VFO.

"BAND SELECTOR" - changes taps on the final amplifier plate tank coil and selects proper output from the multiplier to drive the fianl.

"NORM-SSB" switch - this switch is used only when the Model 51SB-B is connected to the 5100-B. In the "SSB" position, it feeds the necessary dc voltage for operation of the 51SB-B as well as connecting the output of the multiplier section to the 51SB-B input. It also connects the 51SB-B output to the grids of the Final Amplifier. Other functions of this switch can best be understood from the schematic diagram.

"AMP. LOADING" control - adjusts loading capacitor of the fianl pi-network plate tank circuit. Setting of this control determines the degree of loading of the final amplifier.

"AMP. TUNING" control - adjusts the plate tuning capacitor of the final pi-network plate tank circuit. This capacitor is adjusted for minimum final plate current dip.

"MULTIPLIER TUNING" control - gang tunes plate inductors in the multiplier section. This control is adjusted for maximum excitation current for the particular operating frequency as indicated by front panel meter when set to "EXC." position.

"MIC" jack - Amphenol type 80-PC2F two contact connector. No. 1 contact connected to speech amplifier input. No. 2 contact connected to 5100-B control relay for push-to-talk operation.

"KEY" jack - normally open telephone type jack. Closing of circuit by means of the key removes blocking bias from the tubes in the crystal oscillator and buffer unit and at the same time reduces the fixed grid bias on the fianl grids from beyond cutoff to that required for proper operation. This circuit is closed when "FUNCTION SWITCH" is in the "VFO" or "PH" position.

3. Operation

With all of the connections completed and <u>with an antenna or dummy load connected to transmitter output, proceed as directed below:</u>

a. CW Operation

(1) Before plugging in the AC line plug, set the 5100-B controls as follows:
"AUDIO GAIN" control - completely counter-clockwise.
"A.C. LINE" switch - "OFF" position
"TUNE-OPER." switch - "TUNE" position
"FUNCTION" switch - "SSB/CW" position
"EXC. CONTROL" - completely clockwise
"H.V." switch - "OFF" position
"METER SWITCH" - "EXC." position
"FREQUENCY SELECTOR" - desired frequency of operation
"BAND SELECTOR" - desired band of operation
"NORM-SSB" switch - "NORM" position
"AMP. LOADING" control - completely clockwise
"AMP. TUNING" control - completely clockwise
"MULTIPLIER TUNING" control - may position
"VFO-XTAL" switch - located on the crystal oscillator and buffer unit chassis. For VFO operation set this switch in the "VFO" position. For Crystal controlled operation set this switch in the "XTAL" position and insert the proper crystal in the crystal socket. <u>Use only 80 meter crystals.</u> (See section 0-3)

(2) Plug in the AC line cord and place the "AC LINE" switch in the "ON" position. Note: The "117V-107V" switch located at the rear of the transmitter should be set at "117V" if the line voltage is noranl (117V) or higher. or at "107V" if lower than normal.

(3) After allowing about thirty secoads warm-up time, place the "H.V." switch in the "ON" position.

(4) With the key plugged in aad held down, adjust the "MULTIPLIER TUNING" control for maximum meter iadication. ("METER SWITCH" in "EXC." position). Keep meter on scale by reducing "EXC. CONTROL" as this adjustment is ande.

(5) Keeping key depressed, tune the Final Plate to roeonance by ndjusting the "AMP. TUNING" control for minimum meter reading. ("METER SWITCH" in "AMP." position).

(6) Place the "TUNE-OPER." switch in the "OPER." position.

(7) Load the final amplifier by rotating the "AMP. LOADING" control counter-clockwise ons to two divisions at a time. Each time this is done, retune the "AMP." tuning control for a minimum plate current dip. Repeat until the final is loaded to a plate current of 300 me.

(8) Again adjust the "MULTIPLIER TUNING" control for maximun excitation as indicated by the meter with the "METER SWITCH" in the "EXC." position. Adjust the "EXC. CONTROL" for a final screen current of 20 to 25 ma. (Meter Switch in "EXC." position).

(9) The transmitter is now completely tuned and if connected to an antenaa, needs only to be keyed to be put "on the air". If connected to a dummy load, throw the "H.V." switch off before connecting the antenna.

The following chart shows the approximate dial settings for a typical transmitter en set up for CW operation. In each case, the final amplifier is loaded for a plate rrent of 300 ma.

APPROXIMATE DIAL SETTING

FREQUENCY SELECTOR	AMP LOADING	MULTIPLIER TUNING	AMP TUNING
3500	1.5	10	7.7
4000	3.2	1	6.2
7000	4	10	4.8
7300	4	9.4	4.4
14000	4.2	10	3.9
14350	4.6	9.5	3.7
21000	4	10	3.9
21450	3.6	9.5	3.6
27100	4.2	10	2.5
28000	5	10	5
29700	5.3	9.1	1.9

b. AM Radiotelephone Operation

With the transmitter adjusted for CW operation and loaded to 225 ma., place "HV" switch in the "OFF" position and proceed as follows:

(1) Place the "FUNCTION SWITCH" in the "PH" position.
CAUTION: WHEN SWITCHING THE "FUNCTION SWITCH" MAKE SURE THAT THE "AUDIO GAIN" CONTROL IS IN THE EXTREME COUNTER-CLOCKWISE POSITION.

(2) Connect the microphone to the "MIC" jack and then place the "HV" switch in the "ON" position. Place the "METER SWITCH" in the "MOD" position and note the modulator resting plate current which should be approximately 55 ma.

(3) Speaking into the microphone in a normal manner, advance the "AUDIO GAIN" control to the point where the modulator plate current reaches 70-80 ma. on voice peaks. Under these conditions, the final is being modulated just under 100 per cent on the voice peaks.

For push-to-talk operation, place the "HV" switch in the "OFF" position. The push-to-talk switch on the microphone can now be used to take over the function of the "H.V." switch, pressing the switch when transmitting and releasing it when receiving.

Note: The B&W MATCHMASTER* is strongly recommended to check tuning and operation of the transmitter. More important, the instrument can be used to check the VSWR of the antenna feed line and for making antenna coupler adjustments.

C. CIRCUIT DESCRIPTION

1. Main Chassis Unit

The Main Chassis Unit consists of the front panel assembly (less VFO and dial assembly) and the receptacles for plugging in the other units as well as mounting the low pass filter, power supplies, and associated circuits.

Referring to the schematic wiring diagram of Figure 13, the low voltage power supply is a conventional full wave circuit utilizing a type 5U4-GB high vacuum rectifier. The rectifier output is filtered by a two section choke input filter composed of CH-2, CH-3, C520A and C520B. This power supply furnishes the 275 V.D.C. required by the multiplier section, the speech amplifier, the final screen grids, and the 51SB-B when used. The regulated 150 V.D.C. required by the VFO and the Crystal Oscillator and Buffer Unit is also obtained from this supply through R512 and V501.

Negative bias voltage is obtained from the low voltage power supply through an additional tap on the high voltage secondary of T4. The AC voltage at this tap is rectified by SR501 and filtered by the RC filter shown. Adjustable bias for the modulator tubes is obtained through the voltage divider consisting of R509, R510, and R511. Bias for the final amplifier tubes is obtained from the voltage divider composed of R513, R514, R515 and R516. Blocking bias for the crystal oscillator and buffer unit is taken from the junction of R515 and R516. This blocking bias is removed by shorting this junction to ground which occurs when the transmitter is keyed or when the "FUNCTION SWITCH" is set at the "VFO" or "PH" positions. When the junction of R515 and R516 is not shorted to ground, the final grid is biased beyond cutoff. However, when this point is shorted to ground, the final grid bias is restored to normal as determined by the setting of R514. R517 together with C517 serve as a keying filter

* Model 650 - 52 ohms
Model 651 - 73 ohms

The bias supply also furnishes the DC voltages required for the operation of the control relay, K504. This relay performs the following functions:

Contacts 1 and 2 control the 275 V.D.C. to the multiplier and the final screen grids.

Contacts 3 and 4 control the AC voltage to the primary of the plate transformer, T3.

Contacts 5 and 6 are normally closed and used to mute the station receiver when transmitting.

Contacts 7 and 8 together with S501-T control any external antenna changeover circuit.

Receptacle J506 is provided for connecting the Model 5100-B to the 51SB-B. Terminal board TB501, located on the rear chassis apron, provides for making various connections to the transmitter. All leads are filtered to minimize conduction of RF energy through the leads.

Meter, M501, together with SW502 provides for metering the final screen and plate currents and the modulator plate current. It should be pointed out that when the 51SB-B is used with the 5100-B, final screen current is not indicated by M501 when SW302 is in the "SSB" position. The final grid current is always indicated by the 51SB-B panel meter with its "METER" switch in the 'GRID' position.

All controls of the 5100-B Main Chassis Unit are clearly marked on the schematic diagram and their functions can be easily traced.

2. Variable Frequency Oscillator and Dial Assembly

The Variable Frequency Oscillator employs a type 6ER6 tube in a modified Hartley circuit. The oscillator range when properly adjusted, is from 1680 to 2005 Kcps. The oscillator frequency is determined by the parallel combination of L101, C101, C102, and C103. L101 and C102 are used to adjust tracking of oscillator with the dial while C101 is the oscillator tuning capacitor (marked 'FREQUENCY SELECTOR' on the front panel). The plate circuit of the oscillator is tuned to the oscillator frequency so that the signal fed to the buffer amplifier is within the range of 1680 to 2005 Kcps. The output of the oscillator is fed to the crystal oscillator and buffer unit through a shielded lead terminated in plug P101. Plate and filament voltages are obtained through P102 which plugs into J502 on the main chassis.

The dial assembly is a gear driven unit that provides a drive ratio of 64 to 1. The dial indicator is of the slide rule type whose pointer is driven through a cord and pulley arrangement. A slip clutch is provided to prevent damage to the VFO tuning capacitor when the dial knob is driven beyond either extreme position. An incremental indicator is provided on the drive knob, each major division of which represents one Kcps. on the 80 meter band. Thus, on 40 and 20 meters each major division represents 2 Kcps. and 4 Kcps. respectively, and so on down to 10 meters. Figure 12 shows how to replace a broken dial cord.

3. Crystal Oscillator and Buffer Unit

When the Transmitter is set up for VFO operation, this unit serves to isolate the VFO from the multiplier. The first tube, V201, operates as a class A amplifier while V202 is driven beyond saturation to provide a signal of constant level to the multiplier.

These tubes also serve as keying tubes. Thus, under key-up conditions, a negative bias of about 125 volts is applied to each grid thereby cutting them off so that no signal is fed to the multiplier.

When crystal controlled operation is desired, switch SW201, which is located on the anit, is placed in the "XTAL" position. This removes plate voltage from the VFO thereby disabling it. Placing a crystal in the crystal socket then sets the transmitter up for crystal controlled operation. Crystals for all bands must be fundamental 80 mater crystals. To determine the proper crystal frequency for a particular output frequency, we can use the relationship

$$\text{Crystal frequency (Kcps)} = \frac{\text{output frequeany (Kcps.)}}{n}$$

Where n represents the number of times the oscillator frequency is anltiplied in the multiplier section. The value of n differs for each band as follows:

Band	n
80M	1
40M	2
20M	4
15M	6
10 & 11M	8

Connactions to the Crystal Oscillator and Buffer Unit are made by plugging P202 into J501 on the main chessis.

CAUTION: WHEN ON VFO OPERATION, REMOVE THE CRYSTAL FROM ITS SOCKET.

4. Multiplier and Fianl Amplifier Unit

The multiplier section of this unit consists of four stages. These are tuned by means of slug tuned inductors which are ganged acd brought out to the "MULTIPLIER TUNING" control on the front panel. Selection of the proper output from the multiplier is accomplished by means of switch sections SW301 A to D inclusive.

In normal operation, the multiplier output is fed to the final grids through SW302 A and C. However, when using a Model 51SB-B for SSB operation, SW302 is placed in the "SSB" position. The multiplier then feeds the 51SB-B input whose output in turn, drives the fianl grids.

The final power amplifier consists of a pair of 6146 tubes, V305 and V306 connacted in parallel. The final plate tank circuit is a pi-network consisting of C334, L308, L309, and C335. The proper taning range of the pi-network is selected by means of SW301F and taps on L309. The output of the pi-network feeds the low pass filter which is mounted under the main chessis.

Capacitor C333 is a piston type trimmer capacitor which is used to neutralize the final amplifier when the transmitter is set up for normal CW or AM operation. When set up for SSB operation, neutralization is not required and C333 is disconnected from the circuit by SW302H.

5. Speech Amplifier and Modulation Unit

This anit is constructed on a separate sub-chassis and is counected to the rest of the transmitter through P401 and J401. The microphone output is coacected to the grid

of the 6U8 triode section V401-A whose output feeds the "AUDIO GAIN" control, R502. The output of the gain control is further amplified by the 6U8 pentode section, V401-B, and by the modulator driver V402. V402 drives V403 and V404 in push-pull through T1. The push-pull modulators are operated class AS2 and deliver adequate power to modulate the final amplifier 100 per cent. The modulators are coupled to the final amplifier through modulation transformer T2. Note the tapped secondary on T2. This provides a 500 ohm output from the modulator in the event that it is desired to drive a higher power modulator at a later date. The 500 ohm connection is brought out to terminals 4 and 5 of TB501.

D. MAINTENANCE AND TROUBLE SHOOTING

1. General

The Model 5100-B Amateur Radio Transmitter has been designed to require a minimum of servicing. In most cases of faulty operation, the cause can usually be traced to a bad tube. It will therefore be a good idea to keep spare tubes on hand, one for each type used in the equipment. If trouble still persists after all tubes have been checked, the trouble should then be localized to a particular unit.

In order to minimize the need for repairs, the equipment should be checked periodically for faulty electrical and mechanical parts. This should also include keeping the equipment free of dust and other foreign matter. Cleaning of switch wafers periodically with a soft bristled brush and carbon tetrachloride is recommended. Under no circumstances should the plastic supported coils be cleaned with acetone or other plastic solvent.

In the course of servicing, it may be necessary to remove the equipment from the cabinet and to remove a unit from the equipment. The instructions for doing so are listed below:

a. Removing the equipment from the cabinet.
Disconnect all leads to the rear terminal strip and remove the connection to the R.F. output connector. Remove all retaining screws, six on the front panel, three at the rear of the cabinet, and four on the underside. The equipment may now be removed from the cabinet.

b. Removing the Crystal Oscillator and Buffer Unit.
Remove the equipment from the cabinet, then remove J501 from P202 on the underside of the chassis. Disconnect the R.F. connections to the unit and remove the four screws holding it to the top of the chassis. The unit may now be removed from the equipment.

c. Removing the VFO and Dial Assembly.
If it is desired to remove the VFO unit only, leaving the dial assembly intact, it will not be necessary to remove the equipment from the cabinet. Disconnect the VFO from the equipment. Turn the "FREQUENCY SELECTOR" dial counter clockwise so that the dial indicator is on the extreme left side of the dial. Then loosen the VFO flexible coupling set screws and remove the four screws securing the VFO unit to the dial assembly. When replacing, check with section 2 below for alignment and tracking.

To remove the VFO and Dial Assembly as a unit, the equipment must be removed from the cabinet and the Crystal Oscillator and Buffer Unit removed. Remove the two dial light assemblies from the dial and disconnect the VFO from the equipment. Remove the "FREQUENCY SELECTOR" knob from its shaft. Then remove the five screws securing the dial assembly to the front panel. The VFO and Dial Assembly can now be maneuvered and removed from the equipment.

d. Removing the Multiplier and Final Amplifier Unit.
Remove the equipment from its cabinet, then remove the front panel knobs for this unit from their shafts. Disconnect the RF output cable from the low pass filter on the underside of the chassis and remove P301 from J505. Remove the three screws securing the unit to the chassis. The Multiplier and Final Amplifier Unit can now be removed from the equipment.

e. Removing the Speech Amplifier and Modulator Unit.
Remove the equipment from its cabinet. Disconnect the connectors on the unit on the underside of the chassis and remove the four screws securing it to the top of the chassis. The unit can now be removed from the equipment.

2. Alignment

a. VFO Alignment and Dial Calibration

(1) VFO Alignment

The VFO Unit as shipped from the factory is completely aligned. Realignment is necessary only in those cases where the oscillator tube is replaced, the dial cord requires replacement, or when the oscillator has been separated from the dial assembly.

(a) When the oscillator tube is replaced.
i. A signal source of exactly 3.6 Mcps. is tuned in on a communications receiver.
ii. After the VFO unit has been allowed to warm up, set the "FREQUENCY SELECTOR" to 3.6 Mcps.
iii. Adjust the trimmer capacitor, C102 (located on the rear of the VFO chassis) until the VFO zero beats exactly with the standard 3.6 Mcps. on the receiver. This completes the alignment.

(b) Aligning VFO after replacing dial cord.
i. After the dial has been restrung with a new cord, tune in a signal of known frequency on the receiver. This frequency can also be 3.6 Mcps.
ii. Adjust the "FREQUENCY SELECTOR" control until the VFO signal zero beats exactly with the test signal on the receiver.
iii. Slide the dial pointer assembly along the cord, without in any way altering the frequency of the VFO signal, until the dial pointer position corresponds with the test signal. This completes the alignment procedure when dial cord has been replaced.

(c) Aligning after VFO unit has been separated from the dial assembly.
i. Tune in a signal of known frequency on the receiver. Here again we can use 3.6 Mcps.
ii. With the flexible coupling loose on the dial shaft, rotate the tuning capacitor by means of the coupling until the VFO signal zero beats exactly with the test signal on the receiver.
iii. Without disturbing the VFO signal frequency, rotate the "FREQUENCY SELECTOR" control so that the dial reading corresponds to the test signal.
iv. Tighten the set screws on the flexible coupling without disturbing the VFO signal frequency. This completes the alignment procedure when VFO unit and dial assembly have been separated.

(d) Tracking the VFO with the dial scale.
Scale tracking adjustments are required only when the inductance of the

oscillator coil, L101, has been changed.

i. With the flexible coupling loose on the dial shaft, rotate the tuning capacitor fully counter-clockwise against the stop.
ii. Set the "FREQUENCY SELECTOR" control to 3.355 Mcps.
iii. Tighten the set screws on the flexible coupling.
iv. Set the "FREQUENCY SELECTOR" control to 3.6 Mcps.
v. Using a frequency standard of 3.6 Mcps., adjust the trimmer capacitor, C102, to zero beat with the 3.6 Mcps. standard on the receiver.
vi. Check the tracking at 4.0 Mcps. by setting the "FREQUENCY SELECTOR" so that the VFO signal zero beats with a 4.0 Mcps. standard signal on the receiver. Tracking is complete if the dial reading is on 4.0 Mcps.
vii. If the pointer reading is high on the scale, the coil inductance is too low. Increase the inductance by turning the core screw of L101 clockwise (approximately ½ turn to start).
viii. Repeat steps iv, v, and vi above until the dial tracks properly at 3.6 and 4.0 Mcps.
ix. If the pointer reading is low for 4.0 Mcps., the coil inductance is too high. Decrease the inductance by turning the core screw of L101 counter-clockwise (approximately ½ turn to start).
x. Repeat steps iv, v, and vi above until the dial tracks properly at 3.6 and 4.0 Mcps.

b. Aligning the Multiplier Section

(1) Remove the Multiplier and Final Amplifier Unit from the equipment as indicated in section D-1-d.
(2) Provide a suitable extension power cable with the appropriate plug and receptacle to connect P301 with J505 permitting operation of the unit external to the chassis. Also provide a suitable extension to connect P201 to J301.
(3) Set the "FUNCTION SWITCH" to the "VFO" position. THIS IS IMPORTANT!
(4) Connect a 20,000 ohms per volt voltmeter across the 3300 ohm final amplifier grid resistor, R318, located on the back of the amplifier chassis. Set the voltmeter range to 50 V.D.C. and observe proper polarity.
(5) With the "A.C. LINE" and "H.V." switches in the "OFF" positions, connect the transmitter to the A.C. line. Place the "A.C. LINE" switch in the "ON" position and proceed as indicated below.
(6) 80 METER BAND
  (a) Set "BAND SELECTOR" to 80M.
  (b) Set "FREQUENCY SELECTOR" to 3.4 Mcps.
  (c) Pre-set "MULTIPLIER TUNING" control fully counter-clockwise, then back off clockwise one turn.
  (d) Adjust the core screw of L301, (See Figure 5 for location) to obtain maximum deflection on the meter.
(7) 40 METER BAND
  (a) Set "BAND SELECTOR" to 80M.
  (b) Set "FREQUENCY SELECTOR" to 3.4 Mcps.
  (c) Adjust "MULTIPLIER TUNING" control for maximum deflection on the meter.
  (d) Set "BAND SELECTOR" to 40M.
  (e) Adjust the core screw of L302 to obtain maximum deflection on the meter.

(f) Set the "BAND SELECTOR" again to 80M.
(g) Set "FREQUENCY SELECTOR" to 3.7 Mcps.
(h) Adjust "MULTIPLIER TUNING" control for maximum deflection on the meter.
(i) Set "BAND SELECTOR" again to 40 M.
(j) Adjust trimmer capacitor, C310, for maximum meter deflection.
(k) Repeat steps (a) through (j) above until L302 and C310 are peaked for 3.4 Mcps. and 3.7 Mcps. respectively.

(8) 20 METER BAND
(a) Set "BAND SELECTOR" to 80M.
(b) Set "FREQUENCY SELECTOR" to 3.4 Mcps.
(c) Adjust "MULTIPLIER TUNING" control for maximum meter deflection.
(d) Set "BAND SELECTOR" to 20M.
(e) Adjust the core screw of L 303 for maximum meter deflection.
(f) Set "BAND SELECTOR" again to 80M.
(g) Set "FREQUENCY SELECTOR" to 3.7 Mcps.
(h) Adjust the "MULTIPLIER TUNING" control for meximum meter deflection.
(i) Set "BAND SELECTOR" again to 20M.
(j) Adjust trimmer capacitor, C314, for maximum meter deflection.
(k) Repeat steps (a) through (j) above until L303 and C314 are peaked for 3.4 Mcps. and 3.7 Mcps. respectively.

15 METER BAND
(a) Set "BAND SELECTOR" to 80M.
(b) Set "FREQUENCY SELECTOR" to 3.53 Mcps.
(c) Adjust "MULTIPLIER TUNING" control for maximum meter deflection.
(d) Set "BAND SELECTOR" to 15M.
(e) Adjust the core screw of L304 to obtain maximum deflection on the meter.

10-11 METER BAND
(a) Set "BAND SELECTOR" to 80M.
(b) Set "FREQUENCY SELECTOR" to 3.4 Mcps.
(c) Adjmet "MULTIPLIER TUNING" control for maximum meter deflection
(d) Set "BAND SELECTOR" to 10M.
(e) Adjust the core screw of L305 to obtain maximum meter deflection and note the reading.
(f) Set "BAND SELECTOR" again to 80M.
(g) Set "FREQUENCY SELECTOR" to 3.7 Mcps.
(h) Adjust "MULTIPLIER TUNING" control for maximum deflection on the meter.
(i) Set "BAND SELECTOR" to 10M.
(j) Adjust the core screw of L305 to obtain a deflection on the meter.
(k) Repeat steps (a) through (j) above until eqnml readings on steps (e) and (j) are obtained.
(l) C322 is set near meximum, and it is usually not necessary to change its setting.

c. Adjusting Final Amplifier and Modulator Bias Voltages

The final amplifier and modulator bias voltages are controlled by R514 and R510 respectively. These potentiometers are located on the top of the Main Chassis just under the final amplifier plate tuning capacitor, R514 being the one nearest the front panel. With the transmitter set up for CW operation, remove the excitation lead from the ultiplier by pulling P201 from J301. Then adjust R514 for a resting "AMP" current of 55 ma. and with the "EXC." control turned one third clockwise,

adjust R510 for a resting "MOD" current of 75 ma. When the high voltage power supply is normally loaded by the final amplifier, the resting "MOD" current will be a normal 55 ma.

d. Neutralizing the Final Amplifier

The adjustable piston capacitor, C333, has been included to prevent self-oscillation of the final amplifier when the transmitter is used for CW or AM operation. The capacity of C333 is adjusted to lie within a range where self-oscillation is not present on any of the bands.

3. Trouble Symptoms, Possible Causes and Remedies

The following is a list of trouble symptoms that may be encountered, together with their possible causes and remedies. The list, however, is not intended to be all inclusive, but is intended rather as a guide to help the trouble shooter to localize troubles that may arise.

a. Transmitter completely inoperative, dial lights do not light.
No AC line voltage - check voltage across AC Line terminals. Blown fuse - check fuse. Short in one of the units causing fuse to blow - pull all unit plugs and insert ones by one until faulty unit is located. If no faulty unit is found, trouble may lie in main chassis.

b. Final plate current goes off scale.
No bias voltage on final tubes - check grid bias which should normally be from 55 to 65 volts. Defective final tube - check 6146 tubes.

c. No final plate current - plate voltage normal.
Excessive grid bias - check bias voltage. Check filaments on final tubes.

d. Basey Modulation
Improper modulator static plate current which should be about 55 ma. - check bias voltage. R405, R407, or C405 defective. Modulation transformer T-2 defective. Defective microphone.

e. Cracking, frying or buzzing noise in chassis.
Can be caused by expansion and contraction of R525, the AC line voltage dropping resistor. This is normal.

f. Erratic operation.
Intermittant tube or component - try to localize to a particular unit. Tap tubes and components in faulty unit to pinpoint trouble.

g. Hum and scratchy voice quality on AM operation.
Defective VFO Tube, V101 - check and replace if necessary. Defective VR tube, V501, which may be oscillating. Check C522.

h. Rough note on CW operation
Defective VR tube, V501, which may be oscillating - check and replace if necessary.

As a guide in trouble shooting, nominal voltages of various points in the transmitter are indicated on the schematic diagram of Figure 13.

A. INTRODUCTION

1. General Description

The B&W Model 51SB-B Single Sideband Generator has been designed as a companion unit for the B&W Model 5100-B Amateur Radio Transmitter. It is contained in an attractive matching cabinet measuring 10 inches wide by 11½ inches high by 14 3/4 inches deep and weighs 27 pounds (see Figure 1). The unit is bolted to the right side of the Model 5100-B to form one integral assembly. Connections between the two equipments are made through holes located on the sides that are bolted together. The terminals at the rear of the Model 51SB-B provide for making connections to the voice operated relay circuits.

A hinged cover at the top of the cabinet permits easy access to the inside for replacement of tubes. For servicing, the equipment may be removed from the cabinet and disassembled into three basic units, the RF unit, the Audio Unit, and the Main Chassis Unit (see Figure 14). The latter unit consists of the front panel and the main chassis which contains the receptacles for plugging in the other units, and terminals for making the necessary connections to the equipment. All operating controls are located on the front panel. Those controls requiring infrequent adjustments are located within the cabinet. The equipment has been designed with an eye toward ease and simplicity of operation.

2. Function of the Equipment

The B&W Model 51SB-B Single Sideband Generator is designed to connect directly to the Model 5100-B to convert it to a bandswitching single sideband suppressed carrier transmitter but still retaining all of the normal AM and CW features. Connections are made in such a way that the output of the 5100-B multiplier section feeds the RF input to the Model 51SB-B whose output, in turn, drives the final grids of the 5100-B. The 51SB-B combines its RF input with the audio input to its microphone jack to produce a single sideband suppressed carrier signal. Either the upper or the lower sideband may be selected by means of a switch on the front panel. The SSSC signal output of the Model 51SB-B drives the final amplifier of the Model 5100-B as a class AB_1 amplifier. RF connections between the two equipments are made by means of two RG-62/U cables located on the 5100-B which plug into the RF section of the 51SB-B. Filament and D.C. voltages are supplied through a cable located on the 51SB-B which plugs into receptacle J506 on the 5100-B chassis.

3. Electrical Specifications

a. Power Source
   6.3 V.A.C. 3.2 A.
   250 V.D.C. 130 MA.

These voltages are obtained from the 5100-B.

b. Frequency Coverage
   The Model 51SB-B is completely bandswitched and is designed for operation in the following amateur radiotelephone bands:

   80 Meter Band – 3800 Kcps. to 4000 Kcps.
   40 Meter Band – 7200 Kcps. to 7300 Kcps.
   20 Meter Band – 14200 Kcps. to 14300 Kcps.
   15 Meter Band – 21250 Kcps. to 21450 Kcps.
   11 Meter Band – 26930 Kcps. to 27230 Kcps.
   10 Meter Band – 28500 Kcps. to 29700 Kcps.

c. RF Input characteristics
Frequency - same as the desired output frequency.
Input impedance - 50 ohms resistive on all bands.
Input voltage required - 1.5 to 2.0 VRMS on all bands.

d. RF Output characteristics
Frequency - same as input frequency. Peak output voltage is approximately 75 volts when driving a class AB1 stage.

e. Audio Input
Crystal or dynamic microphone, Amphenol 80-PC2F two contact connector.

f. Tube complement
(1) RF Unit
Balanced Modulator 2 - Type 12AT7
First driver 1 - Type 6CL6
Second driver 1 - Type 6V6

(2) Audio Unit
Voltage amplifiers - 3½ Type 12AT7
Voice operated relay tube - ½ - Type 12AT7
Rectifier - 1 - Type 6AL5

B. INSTALLATION AND OPERATION

The B&W Model 51SB-B Single Sideband Generator is shipped, complete with tubes, in a cardboard container, properly baffled and padded to prevent damage in transit. After the equipment has been removed from its container, inspect it to ascertain if it has suffered any damage in transit. Make sure that all tubes are intact and properly seated in their respective sockets.

1. Installing and Connecting the Equipments

Remove the Model 51SB-B from its cabinet after removing the eight retaining screws, six on the front panel and two on the bottom rear of the cabinet. The equipment can now be more thoroughly inspected for damage. After disconnecting the power line, remove the two plug buttons from the right side of the 5100-B cabinet, then bolt the 51SB-B cabinet to it with the four bolts, flatwashers, and lockwashers provided. The bolts are threaded into the four tapped inserts on the right side of the 5100-B. The flatwashers are used as spacers between the two cabinets while the lockwashers are placed under the heads of the bolts. The 51SB-B may now be replaced in its cabinet and secured with the screws previously removed.

Connect the two equipments together by passing P301 of the 51SB-B through the rear opening common to the two cabinets and plugging it into J506 of the 5100-B. Pass X304 of the 5100-B through this same opening and plug it into J101 of the 51SB-B. J101 is located on the rear of the 51SB-B RF unit. Pass X305 of the 5100-B through the forward hole common to the two cabinets and plug it into J103 of the 51SB-B. J103 is located on the top front of the 51SB-B RF unit.

Remove the cover at the rear of the 51SB-B so that the terminal board TB301 is accessible. Connections to TB301 are made as follows:

Terminal No. 1 - connect to station grounding bus.
Terminals Nos. 4, 5 & 6 - these terminals are connected to SPDT contacts of the Voice Operated Relay and are utilized in such a fashion that the receiver is disabled when the VOR is energized.

Terminnls Nos. 7 & 8 - connect in series with the actenna relay circuit.
Termimals Nos. 9 & 10 - connect across the receiver speaker voice coil. This connection together with the VOR deactivating circuit in the audio nnit provides for preventing the loudspeaker output from operating the VOR.

The above connections are shown in Figure 15.

2. Preliminary Adjustments

All operating controls for the 51SB-B are located on the front panel acd perform the following functions:

"BAND SELECTOR" switch - Selects the desired band of operation.
"BAL. MOD. TUNING" control - Tunes the plate tank circuit of the belanced modulator etage.
"DRIVER TUNING" control - Gang tunes plate tank circuits of first and second driver stnges.
"AUDIO GAIN" control - Controls overall gain of the speech amplifier or the levels of the audio signals fed to the balanced modulator and hence the SSB power output.
"BALANCE" controls - Used in balancing out the carrier from the balanced modulator stnge.
"BALANCE-UNBALANCE" switch - Used for nnbalancing the balanced modulator stnge without necessitating disturbing the balaccing controls. This is done when the equipment is being tuned.
"METER" switch - Used in conjnnction with the front panel neter.
"GRID" position - Indicates the grid current of the 5100-B final amplifier tubes.
"OUTPUT" position - Indicates relative level of RF cutput of the 51SB-B. This indication is used when balancing out the carrier from the balanced modulator stage.
"TUNE-OPER." switch - In the "TUNE" position, this switch places a short across the normally open key jack of the 5100-B acd also energizes the voice operated relay. In the "OPER." position. this short is removed and the VOR is operated either by the voice output of the microphone or by the push-to-talk switch on the microphone.
"SIDEBAND" selector - the position of this switch determines whether the output of the 51SB-B is an upper or a lower sideband signal.
"MIC." jack - Termianl No. 1 is the microphone input. Terminnl No. 2 provides connection for push-to-talk microphone switch. Grounding this terminel through the microphone switch causes the voice operated relay to become energized.

With the 51SB-B connections completed, connect the 5100-B to the A.C. line. Also connect the RF cutput to a ben meter antennn or a dummy load and place it into normnl CW operation at 29,600 Kcps. Tune acd load the final for a DC plate current of 300 ma. Note that with the 51SB-B "METER" switch in the "GRID" position, the 51SB-B panel neter reads the grid current of the 5100-B finnl tubes. Making sure that the "MULTIPLIER TUNING" control is properly peaked, set the 5100-B "EXC. CONTROL" for a grid current of .5 to 1.5 mm. Place the 5100-B "H.V." switch in the "OFF position and proceed as follows:

a. Place the 5100-B "NORM-SSB" switch in the "SSB position. Do not disturb any of the other controls.
b. Place the 51SB-B controls as follows:
"BALANCE-UNBALANCE" switch - "UNBALANCE" position
"AUDIO GAIN" control - complete counter-clockwise position
"BAND SELECTOR" - 10 meter band.
"METER" switch - "OUTPUT" position
"TUNE-OPER." switch - "TUNE" position.
"SIDEBAND" selector - either position

c. Place the 5100-B "HV" switch in the "ON" position. The 51SB-B panel meter should now show a reading.

d. Lift the top cover of the 5100-B and peak this meter reading by adjusting C326 with an insulated tool. C326 is located at the rear of the 5100-B R.F. section near the "NORM-SSB" switch.

e. Further peak this meter reading by the "BAL. MOD. TUNING" and the "DRIVER TUNING" controls.

f. Lift the top cover of the 51SB-B and further peak the meter reading by adjusting C122 located inside near V103. Each time C122 is adjusted, "rock" the "DRIVER TUNING" control for maximum meter reading. Repeat this until no further increase in the meter reading can be obtained. If the meter needle goes off scale, keep it on scale by backing down on the 5100-B "EXC. CONTROL". Repeat the above steps d to f, this time using the grid current as an indication. Note: C326 and C122 will require no further adjustments after this.

g. Place the 51SB "BALANCE-UNBALANCE" switch in the "BALANCE" position and balance out the carrier by means of the two balancing controls at the top of the 51SB-B panel. These controls must be adjusted alternately so that the meter reading (switch in "OUTPUT" Position) is reduced to zero. The equipment is now adjusted and ready to be put into SSB operation.

Note: If a dummy load or a 10 meter antenna is not available, the above adjustments can be performed at the high end of the 15, 20, or 40 meter bands.

Operation

With the 5100-B "NORM-SSB" switch in the "NORM" position, place the 5100-B into normal CW operation at the desired operating frequency and load the final to 300 ma. The appropriate antenna will, of course, have to be connected to the transmitter. With the 5100-B "HV" switch in the "OFF" position, place the "NORM-SSB" switch in the "SSB" position. Return the "HV" switch to the "ON" position and proceed as follows:

a. Place the 51SB-B controls as described in section 2b. above except for the "BAND SELECTOR" which should be set to correspond to setting of the 5100-B "BAND SELECTOR".

b. Tune the "BAL. MOD. TUNING" and the "DRIVER TUNING" controls for maximum output as indicated on the 51SB-B panel meter. A sharper indication of maximum is obtained by observing the grid current. However, it should be noted that grid current does not flow until the peak driving voltage at the grids of the 5100-B final exceeds the grid bias.

c. Set the 5100-B "EXC. CONTROL" for a grid current of .5 to 1.5 ma.

d. Place the "BALANCE-UNBALANCE" switch in the "BALANCE" position and balance out the carrier by alternately adjusting the balancing controls. These controls are adjusted until the output meter reads zero. A course indication of balance is obtained by adjusting for minimum final amplifier plate current and then using the 51SB-B output indication to reduce the carrier level to zero.
Note: Do not readjust the 5100-B "EXC. CONTROL" and the "MULTIPLIER TUNING" control after the carrier has been balanced out as this may cause a slight shift in the balance. Shifting the operating frequency by more than about 50 Kcps. may also cause the balance to shift, in which case, balance can be restored by repeaking the "MULTIPLIER TUNING" control.

e. Connect the microphone to the "MIC" jack.* Speaking into the microphone in a normal manner, advance the 51SB-B "AUDIO GAIN" control clockwise until the grid current barely "kicks up" on voice peaks. The 5100-B is now being driven to full class AB_1 output.

* B&W will have available, shortly, a microphone adaptor, Type 51 MCA. This adaptor will permit the use of one microphone with the 5100-B & 51SB-B combination without the need for switching microphones when going from AM to SSB operation.

For voice-break-in operation, place the "TUNE-OPER." switch in the "OPER." position. Speaking into the microphone in a normal manner, adjust the "VOR SENS." control (located near the front of the Audio Unit chassis) so that the voice operated relay operates positively. The hold in time for the relay is adjusted by the "VOR-DEL" control (also located on the Audio Unit chassis) Advancing this control clockwise increases the hold-in time which is set to suit the operator. *

For push-to-talk operation, turn the "VOR SENS." control completely counter clockwise. The relay is then energized, by means of the push-to-talk switch on the microphone.

When voice-break-in operation is employed, it may be dasirable to use a loudspeaker on the receiver, in which case, provision is made to prevent the londspeaker output from operating the VOR. This is dome by feeding the voltage developed across the speaker voice coil to terminals 9 and 10, at the rear of the 51SB-B. With the receiver gain set at a comfortable hearing level, advance the "VOR ELACT. SENS." control clockwise, from its extreme counterclockwise position, until the speaker output ceases to operate the VOR.

Note: WHEN BREAK-IN OPERATION WITH LOUDSPEAKER IS EMPLOYED, THE RECEIVER MUST BE DISABLED DURING TRANSMISSION PERIODS. This can be accomplished by the SPDT VOR contacts that are brought out to terminals 4, 5, and 6 at the rear of the 51SB-B as shown in Figure 15

The Audio Unit chassis has two other controls, the "BAL." control and the "PHASE ADJ." control. <u>These are adjusted at the factory and locked in place. They should not be disturbed unless they are out of adjustment for some reason.</u> The RF phase shift network adjustments (C101 to C106 and L101 to L106) located at the rear of the RF Unit chassis, are factory adjustments. These too will not normally require adjusting when installing. In the vent that any of these controls do require adjustment, the procedures for doing so are given in the section under "Maintenance and Trouble Shooting".

C. CIRCUIT DESCRIPTION

The B&W Model 51SB-B Single Sidaband Generator utilizes the phasing principle of generating a single sideband suppressed carrier radiotelephone signal. The circuits are designed so that the single sidabaad signal is generated at the operating frequency which obviates the necessity for hetrodyning stages. The result is an equipment that is very simple to operate and adjust.

The equipment is made up of three major subassemblies, the RF Unit, the Audio Unit, and the Main Chassis Unit. These are interconnected by means of cable and plug assemblies and can be easily disassembled for servicing.

1. Main Chassis Unit

The Main Chassis Unit consists of the front panel assembly and the chassis for mounting the RF and audio units. (See Figure 14). The front panel mounts all of the necessary operating controls as well as the meter and microphone jack. The chassis contains the necessary wiring and receptacles for interconnecting the RF and Audio Units. It also contains the cable and plug assembly for connecting the equipment to the 5100-B. This cable provides for feeding the necessary voltages to the 51SB-B, for metering the 5100-B final grid current by means of the 51SB-B panel meter, and for connecting the 5100-B keying circuit to the circuits of the 51SB-B. The terminal board on the rear apron of the chassis

* If the operator wishes to "talk himself" on frequency, he should disable the receiver mating circuit by opening the SPST switch shown in Figure 15, Then by listening to himself on the receiver headphones, he can adjust the transmitter frequency until his voice sounds natural.

provides for making connections to the voice operated relay contacts and to the speaker deactivating circuit. All of these terminals are filtered to minimize conduction of RF energy through external leads.

2. R.F. Unit

The R.F. Unit is contained in a separate chassis measuring 12 inches long by 3 7/8 inches wide by 3½ inches high. (see Figure 14). Referring to the schematic diagram (Figure 16) of the 51SE-B, the R.F. Unit is shown at the top. It consists simply of a 90 degree R.F. phase shift network, a double balanced modulator stage, and two Class-A R.F. voltage amplifiers. All stages are band switched for operating convenience.

The R.F. excitation voltage from the Model 5100-B Transmitter is fed to the R.F. input receptmele, J101, which is connected to the input of the 90 degree R.F. phase shift network. This network splits the R.F. voltage into two equal amplitude components that are 90 degrees out of phase with respect to each other. These two voltages are then fed to the input of the double balanced modulator stage where they are combined with equal amplitude audio voltages, also 90 degrees out of phase with respect to each other, to produce a single sideband suppressed carrier signal.

The double balanced modulator consists of two single balanced modulators with separate input circuits and a common output circuit. If we consider the single balanced modulator, V101, we see that the plates are connected in push-pull through the tank circuit, L111 and C116. (C115 is connected in parallel with L111 and C116 for all bands except 10 and 11 meters). The grids are connected in parallel for the R.F. signal through C107 and C108, and in push-pull for the audio signal through L107 and L108. R108 is the carrier balancing control which varies the gain of V101-A and V101-B differentially. Thus, in the absence of an audio signal and with equal in-phase R.F. voltages on the grids, R108 is adjusted so that the output of V101-A is just equal to that of V101-B. Since these two grid voltages are equal and in phase, there is no net output voltage at the link of L111, and hence the carrier is balanced out.

If we now apply a push-pull audio tone to the grids of V101 through L107 and L108, they are alternately biased negative and positive with respect to ground. Thus when grid No. 2 is positive with respect to ground, grid No. 7 is negative with respect to ground, and vice-versa. We then have each triode conducting more heavily than the other on alternate half cycles of the applied audio tone. The net output at the link of L111 is then as shown in Figure 17a. This is a double sideband suppressed carrier signal. These two side frequencies are of equal amplitudes, spaced twice the audio frequency, and are centered about the carrier frequency.

If now, we apply the same R.F. and audio voltages but each shifted in phase by 90 degrees, to the grids of V102, the output at the link of L111 due to V102 is also as shown in Figure 17a, but with one important difference, one side frequency is exactly 180 degrees out of phase with the corresponding side frequency output of V101, the other two side frequencies being exactly in phase. The out-of-phase components cancel each other in the common output circuit while the in-phase components add together and the result is a single sideband signal.

In the above example, let us assume that the two upper side frequencies cancel each other producing a lower single sideband signal. If now, we reverse the phase of one of the audio signals, the two lower side frequencies become exactly 180 degrees out of phase, resulting in an upper single sideband signal. In this particular case, phase reversal of one of the audio signals is accomplished by S301.

If the audio signal is a single audio tone, the output of the double balanced modulator is a single R.F. signal whose frequency is displaced from the suppressed carrier by an amount equal to the audio frequency. Since it is impossible to obtain complete carrier and unwanted sideband suppression, this R.F. signal will appear to have a small amount of amplitude modulation as shown in Figure 17b. This waveform represents a good single tone, single sideband signal. Lack of a small amount of modulation on the R.F. envelope is an indication of excessive audio or R.F. drive causing a stage to be overdriven. When the audio signal is speech, the R.F. envelope is of the form of Figure 17c.

The output of the balanced modulator is link coupled to the grid of V103. This is a conventional Class-A, R.F. voltage amplifier utilizing a type 6CL6 pentode. Its output drives V104, a 6V6 which is also operated as a Class-A voltage amplifier. Both of these amplifier stages have identical plate tank circuits so that they may be readily ganged tuned. The trimmer capacitor C122 is adjusted so that the total shunt capacity across the first driver plate circuit is equal to that across the second driver plate circuit when the latter is connected to the grids of the 5100-B final.

C129 couples a small portion of the 6V6 output to the germanium crystal rectifier circuit. The d.c. output current of this circuit is indicated on the panel meter M301. This indication is used when balancing out the carrier.

The output of the 6V6 is coupled to the 6146 grids through C128, a short length of RG-62/U cable, and S302-C of the 5100-B, when S302 is in the "SSB " position. Also, with S302 in the "SSB" position, the output of the 5100-B multiplier section (arm of S302-A) is coupled through S302-A, C326, C327 and a short length of RG-62/U cable to the R.F. input of the 51SB-B. Here, C326 and C327, together with the 51SB-B input circuit, provide for lowering the multiplier output voltage to the level required at the input of the 51SB B.

3. Audio Unit

The Audio Unit is contained in a chassis measuring 12 inches long by 3 1/8 inches wide by 2 inches high (See Figure 14). The schematic diagram for the unit is shown at the bottom left of the 51SB-B schematic of Figure 16. The microphone output connects to terminal No. 1 of J302 and is amplified by V201-A and V201-B. The output of V201-B is fed to R208, the "AUDIO GAIN" control which controls the voltage level at the grid of V202-A. The audio signal is further amplified by V202-A whose output is transformer coupled to the low-pass filter composed of L201, C204 and C205. This filter has a cutoff frequency of approximately 3500 cps. and is provided to attenuate those audio frequencies lying above 3000 cps. This is done since these frequencies are beyond the operating range of the B&W Model 350, Type 2Q4, 90 Degree Audio Phase Shift Network.

The output of the low-pass filter feeds the parallel combination of R210 and Z201. R210 is adjusted so that at 1000 cps., the two output voltages of Z201 (pins 2 and 6) are equal and exactly 90 degrees out of phase with respect to each other. This phase angle is then maintained to within 1.5 degrees of 90 degrees as the frequency is varied from 300 to 3000 cps., and the relative amplitudes are held constant.

The two output voltages of Z201 are then separately amplified by V203-A and V203-B. The "AUDIO BALANCE CONT." provides for varying the gains of these two stages differentially to compensate for slight differences in tube characteristics so that the two output voltages are exactly equal. The outputs of V203-A and V203-B are then transformer coupled to the grids of V101 and V102 respectively.

Connected in parallel with the "AUDIO GAIN" control is the "VOR SENSITIVITY CONTROL", R219. This controls the audio signal level at the grid of V205-A. The signal is then

amplified by V205-A, and rectified by V204-B. The positive d.c. voltage thereby developed across the series combination of R224 and R225 in parallel with C209 is applied to the grid of V205-B. This tube is normally cut off by the positive voltage applied to its cathode through R226. The relay, K201, in the plate circuit is therefore normally denergized. Application of sufficient positive voltage to the grid causes V205-B to conduct and thereby energize K201. The sensitivity control, R219, is set so that the relay operates readily when one speaks into the microphone in a normal manner.

The setting of the "VOR DELAY CONTROL", R225, determines how long the relay remains energized after the operator stops talking. With R225 shorted out completely, K201 operates at a syllabic rate. However, when R225 is set at the other extream, K201 remains energized for more than five seconds or so after the operator stops talking. This control, is of course, set to suit the operator.

Relay K201 can also be energized by placing R228 in parallel with R227. This reduces the positive bias on the cathode of V205-B sufficiently to allow enough plate current to flow to energize K201. R228 can be placed in parallel with R227 by the push-to-talk switch on the microphone or by the "TUNE-OPERATE" switch, S303.

Contacts 2 and 3 of K201 are utilized for the antenna relay circuit. As indicated previously, these are placed in series with the antenna relay coil and the antenna change-over terminals, of the 5100-B. Contacts 4, 5 and 6 are brought out to the rear terminal strip for use as desired. Contacts 8 and 9 are utilized for keying the buffer stage of the 5100-B When these contacts are closed, blocking bias is removed from V201 and V202 of the 5100-B Crystal Oscillator and Buffer Unit. Thus, R.F. excitation is applied to the R.F. input of the 51SB-B only when K201 is energized or when the key is closed.

When voice-break-in with loudspeaker operation is desired, the VOR deactivating circuit is provided to prevent the speaker output from actuating K201. This is accomplished by feeding the signal developed across the speaker voice coil to the input of T201. This signal is amplified by V202-B and then rectified by V204-A which develops a negative voltage across the parallel combination of R218 and C207. This negative voltage is used to bias the diode V204-B through R223, and it is this bias that prevents the microphone output due to the speaker output from developing sufficient positive bias across C209 to energize K201. With the loudspeaker output set at a comfortable hearing level, the "VOR DEACT SENS." control is advanced clockwise until the speaker output ceases to actuate the VOR.

D. MAINTENANCE AND TROUBLE SHOOTING

1. General

The Model 51SB-B Single Sideband Generator has been designed so as to require a minimum of servicing. It will be found that faulty operation of the equipment can usually be attributed to a faulty tube. For this reason, it will be good practice to maintain spare tubes on hand, one of each type used in the equipment. Once having established that all tubes are in satisfactory condition, one can proceed to localize the trouble to a particular stage.

Any program of equipment maintenance should include a program of preventive maintenance. This includes a periodic check on the functioning of mechanical parts and keeping the equipment free of dust and other foreign matter. A periodic inspection and cleaning of switch wafers will also go a long way in preventing troubles from developing. Such cleaning should be done with a small soft bristled brush and a clean solution of carbon tetrachloride. Under no circumstances should an attempt be made to clean the plastic supports

coils with acetone or other plastic solvent. This may result in deforming the coil causing short-circuiting of adjacent turns.

In the course of servicing, it may be necessary to remove the equipment from the cabinet. This will require the removal of eight retaining screws, six on the front panel and two on the bottom rear of the cabinet. Before removing the equipment, however, pull out plugs P301 of the 51SB-B and X304 and X305 of the 5100-B. Before disassembling any further, a complete visual inspection of the front panel and main chassis wiring may reveal the source of trouble. If no trouble is apparent visually, check to make sure that the R.F. and Audio Units are receiving filament and d.c. voltages. These may be measured at the tube sockets referring to the schematic wiring diagram. If the proper voltages are present, the next step is to localize the trouble to either the R.F. Unit or the Audio Unit, then to a particular stage of the unit.

The R.F. Unit may be removed from the Main Chassis by removing the three front panel control knobs, and the #6-32 self-tapping screws on the underside of the Main Chassis. The R.F. Unit can then be pulled out toward the rear. The R.F. Unit wiring should then be thoroughly visually inspected. If this does not reveal the cause of the trouble, proceed to make resistance measurements of the unit in accordance with Table I. The inside of the R.F. Unit can be made more accessible by removing the two side cover plates.

If it is apparent that the trouble is in the Audio Unit, it can be removed by taking off the single front-panel control knob, unsoldering the microphone input connection at the junction of L301 and C301 and removing the #6-32 self-tapping screws on the underside of the Main Chassis. Then removing P201 from its receptacle, the Audio Unit can be pulled out toward the rear. The Audio Unit should then be thoroughly visually inspected, removing the two side cover plates if necessary. If found necessary, make resistance measurements as indicated in Table II.

When the trouble has been traced to a faulty component, it should be removed and replaced with one known to be good. In doing this, however, care should be exercised so as not to disturb other parts of the circuit. In time, the operator will find that he can usually localize most troubles without removing the equipment from the cabinet. The ability to do this, of course, comes from a thorough working knowledge of the circuits and their operation.

2. Alignment

Under normal conditions of use and operation, the Model 51SB-B will not require alignment. However, in the event that those circuits affecting sideband suppression are out of alignment for some reason, they must be readjusted if the equipment is to provide the maximum performance for which it was designed. These circuits include the 90 degree R.F. phase shift network, and the 90 degree audio phase shift circuit. These adjustments will require a 1000 cps. low distortion (less than 1%) audio signal source and an oscilloscope for observing the R.F. output of the 5100-B Transmitter.

The R.F. phase shift network has a different L-C combination for each band. Each of these combinations must be adjusted at the center frequency of the corresponding amateur radiotelephone band. These frequencies are as follows:

Band	Center Frequency	L	C
80	3900 Kcps.	L106	C106
40	7250 Kcps.	L105	C105
20	14250 Kcps.	L104	C104

Band	Center Freqnancy	L	C
15	21350 Kcps.	L103	C103
11	27095 Kcps.	L102	C102
10	29100 Kcps.	L101	C101

Ths "AUDIO PHASE ADJ." control, R210, and the "AUDIO BALANCE CONT." R212, need be adjusted at only ona of the above freqnancies. The adjustment is then good for all other bands.

Proceed as follows for aligning the 51SB-B:

a. With the 5100-B Transmitter set up for SSB operation, tune the equipment to one of the above freqnancies following the procedure given in the section on operation. The 5100-B should, of course, be connected to an antenna or a dummy load.

b. Make up an R.F. pick-up assembly as shown in Figure 18, and couple the loop lightly to the output tank coil of the 5100 Transmitter. The inductance of the coil L, is made to series resonate with the capacity C. The coupling should be such as to produce a vertical deflection of about one inch or so on the oscilloscope. Adjnat the horizontal sweep speed to about 200 cps.

c. With the carrier balanced out, apply the 1000 cps. signal to the microphone input terminal of J302. The level of this signal should be about .003 to .03 volts R.M.S. This voltage should not exceed .05 volts R.M.S. since this may cause the audio input stages to be overdriven and distort the signal. Under these conditions it will be impossible to properly adjust the equipment.

d. Advance the "AUDIO GAIN" control clockwise until the final plate current meter reads about 100 ma. If the equipment is properly adjusted, the oscilloscope presentation will be as shown in Figure 17b. The presence of more modulation on the signal indicates that adjnatments will be required.

e. Adjust L and C of the R.F. phase shift network corresponding to the band of operation for minimum ripple on the signal. The capacitors are made available for adjusting by removing the cover plate on the rear side of the 51SB-B.

f. Adjnat the "AUDIO PHASE ADJ." and the "AUDIO BALANCE" controls of the Audio Unit for minimum ripple on the signal. Try to minimize the ripple further by again adjusting the L and C of the R.F. Phase Shift Network. Each time an adjustment is made, turn the "AUDIO GAIN" control completely counter-clockwise, then check to make sure that the carrier is properly balanced out.

g. Next, place the sideband selector switch in its other position, and note whether or not the amount of ripple is the same for both positions. If it is not, adjust the "AUDIO PHASE ADJ." control slightly until the ripple is the same for either upper or lower sideband operation.

h. With the adjnatments complete, lock the "AUDIO PHASE ADJ." and the "AUDIO BALANCE" controls in position. Make surn that the adjustments

are not disturbed when locking. These controls will not require further adjusting when aligning the equipment on the other bands.

i. The equipment may now be aligned on the other bands as was done above. Keep in mind that no further adjustments on the Audio Unit will be required.

Note: If either balanced modulator tube V101 or V102 is replaced, it may be necessary to readjust the RF Phase Shift Network for each band; however, if a number of 12AT7 tubes are available, it may be possible to select one that will not require these readjustments.

3. Trouble Symptoms, Possible Causes and Remedies

The following is a list of trouble symptoms that may be encountered, together with their possible causes and remedies. However, before attempting to localize the trouble in the 51SB-B, check the operation of the 5100-B as an AM or CW transmitter to make sure that the fault does not lie there.

a. Equipment tunes properly, but delivers no output when microphone is driven: This indicates no output from the Audio Unit. If the VOX operates normally, check tubes V202-A and V203. If tubes are good, check for bad component in these stages.

b. If in addition to the above, the VOX is inoperative, check V201. If V201 is satisfactory, check the components associated with this tube.

c. VOX Inoperative:
Check V204-B and V205. If VOX operates by means of push-to-talk or "TUNE-OPERATE" switches, check stages preceding V205-B.

d. VOX Deactivating Circuit Inoperative:
Check V202-B and V204-A. If tubes check ok, check components in circuit.

e. Impossible to balance out carrier:
Check V101 and V102. Check connections to P102 and components in balanced modulator stage. Check DC supply voltage. High hum level output from the power supply will cause hum signal to be fed to balanced modulator stage.

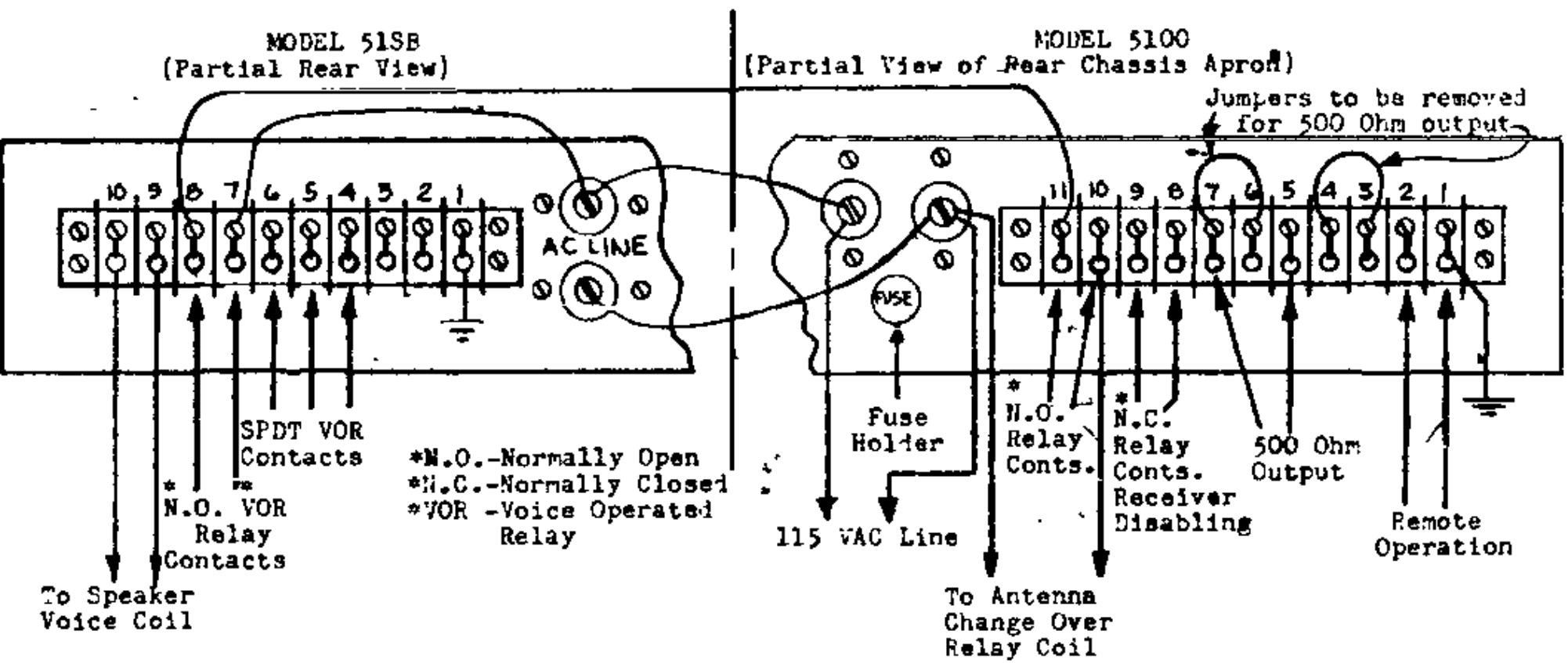
f. No R.F. Drive to 51SB:
Faulty VOX operation. Close 5100-B Keying Circuit. If this restores R.F. drive, check operation of VOX contacts.

g. Insufficient R.F. drive to 5100-B from the 51SB-B:
Check V103 and V104 and components associated with same. Check d.c. supply voltage.

h. Transmitting a double sideband signal:
One half of V203 defective - check and replace if necessary. V101 or V102 defective - check and replace if necessary. Check T202 or T203. Check balanced modulator grid resistors.

REAR TERMINAL CONNECTIONS FOR MODEL 5100 AND MODEL 51SB COMBINATION

NOTE: When 5100 Transmitter is used as a conventional AM or CW Transmitter, the "Meter-Function" switch on 51SB must be in "Normal" position, this places a short across terminals 7 and 8 of 51SB so that antenna-relay is completely controlled by the 5100.



TABLES OF D. C. RESISTANCE MEASUREMENTS

The measurements indicated below are in ohms and are taken between ground and the point indicated. All measurements are taken with all unit plugs and tubes removed from their sockets.

T A B L E - I

R.F. UNIT

PIN NO'S.	1	2	3	4	5	6	7	8	9
CONNECTOR									
V101	∞	15K	∞	0	0	∞	15K	∞	∞
V102	∞	15K	∞	0	0	∞	15K	∞	∞
V103	82	∞	∞	∞	0	∞	82	∞	0
V104	—	0	∞	∞	3.3K	—	∞	270	—
P101	15K	15K	15K	15K	0	∞	∞	2K	—
J102	∞	∞	∞	∞	0	—	—	—	—

T A B L E II

AUDIO UNIT

PIN NO'S.	1	2	3	4	5	6	7	8	9	14	10 To 13 15 To 16
CONNECTOR											
V201	163K	100K	1K	0	0	163K	470K	1K	∞	—	—
V202	48.5K	0-50K	680	0	0	148.5K	0-25K	1K	∞	—	—
V203	48.5K	770K	500	0	0	48.5K	198K	500	∞	—	—
V204	100K	1.3M	0	∞	1-11M	—	1.2M	—	—	—	—
V205	148.5K	2.2M	1K	0	0	58.5K	1-11M	1500	∞	—	—
P201	∞	∞	0	∞	—	2K	∞	∞	∞	48.5K	∞

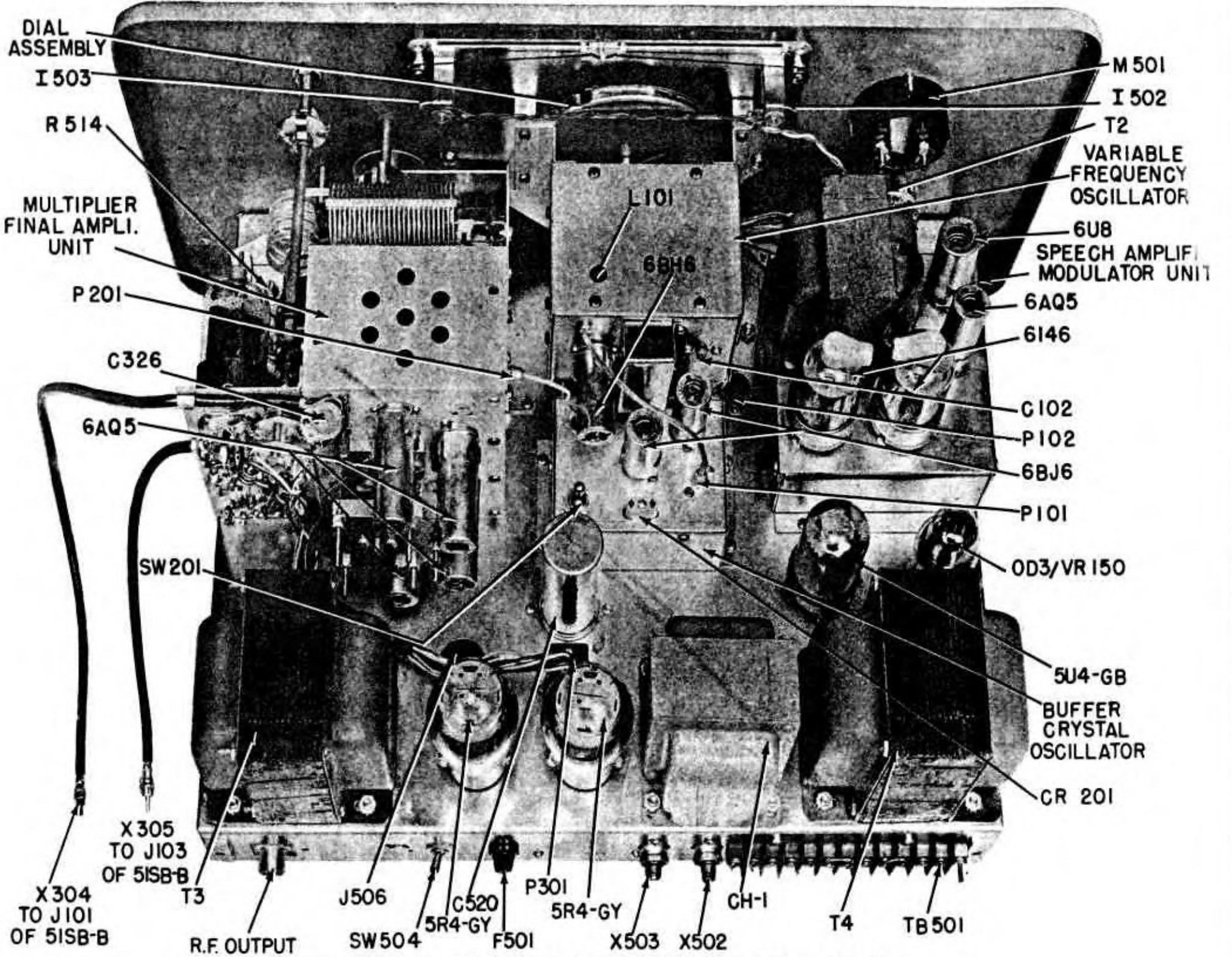


FIGURE 2. MODEL 5100-B TRANSMITTE , WITH CABINET REMOVED.

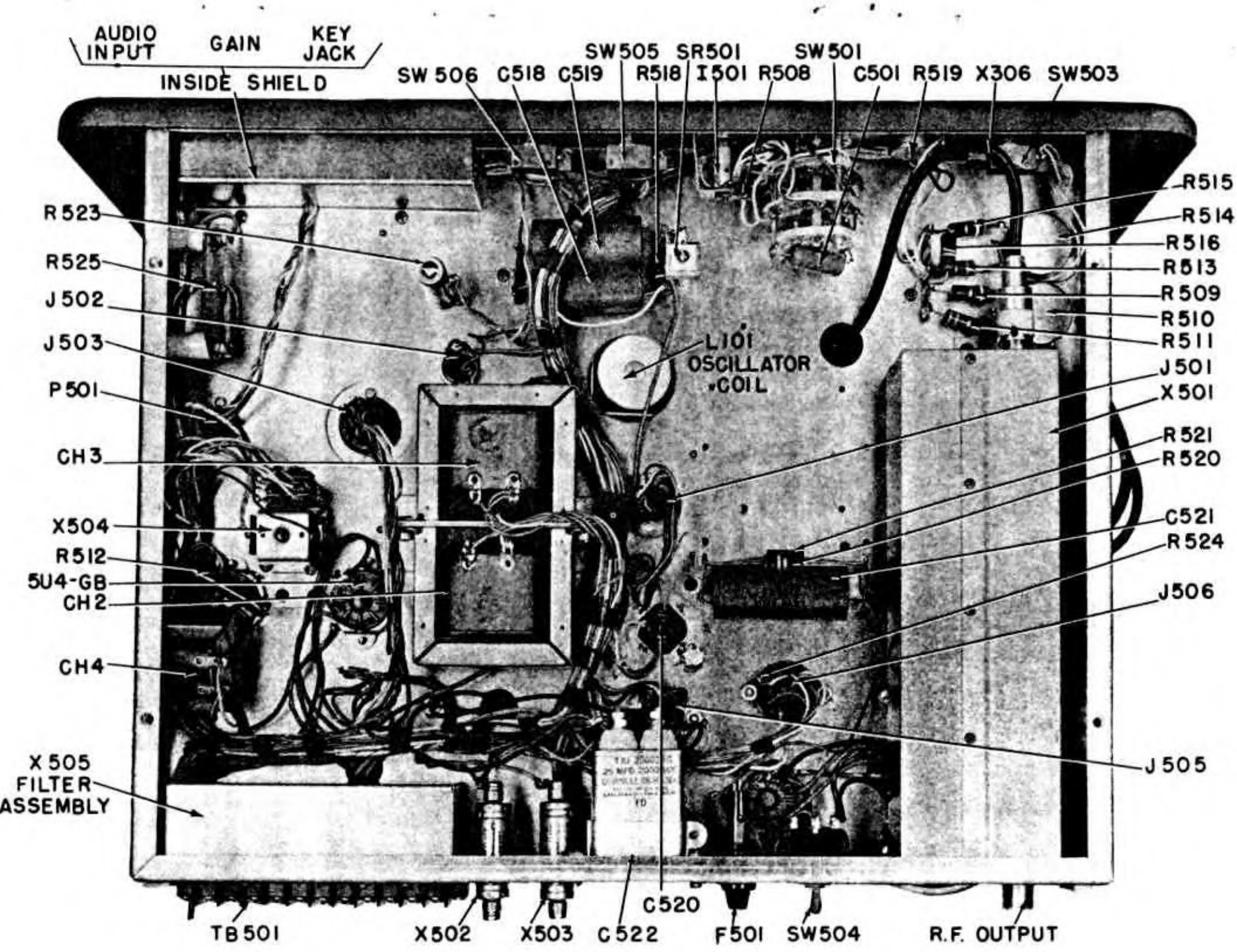


FIGURE 3. MODEL 5100-B, UNL R CHASSIS VIEW.

NOTE: TO DRIVE A HIGHER POWERED MODULATOR BY THE 5100-B SPEECH AMPLIFIER-MODULATOR UNIT, DISCONNECT JUMPERS ACROSS TERMINALS 3 & 4 AND ACROSS TERMINALS 6 & 7 OF TB501. A 500 OHM DRIVER SOURCE FOR MODULATOR IS THEN AVAILABLE AT TERMINALS 4 & 5. PLACE A JUMPER ACROSS TERMINALS 3 & 6 SO THAT THE FINAL AMPLIFIER CAN BE USED TO DRIVE A HIGH POWERED AMPLIFIER.

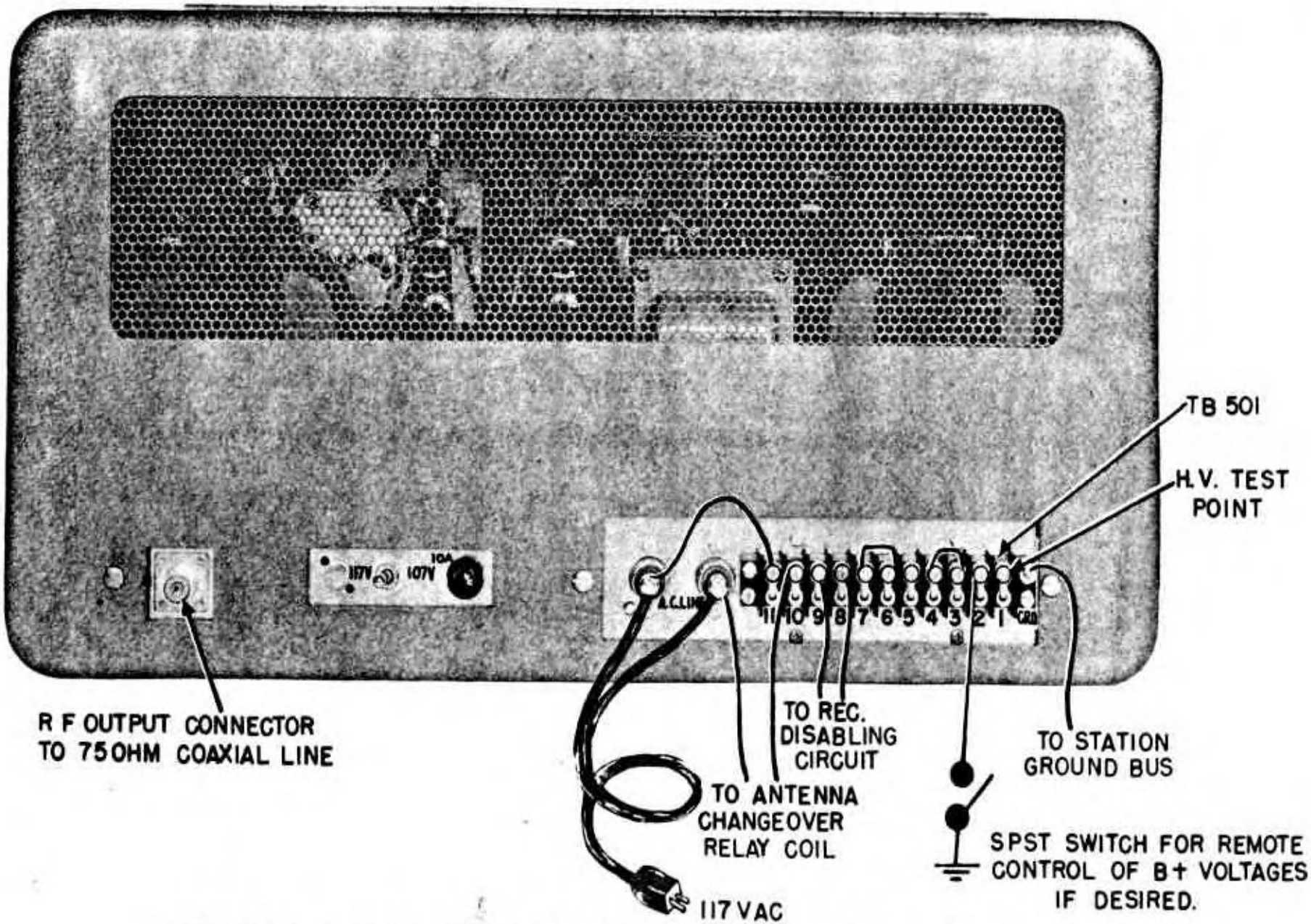


FIGURE 4. REAR VIEW OF MODEL 5100-B, SHOWING CONNECTIONS

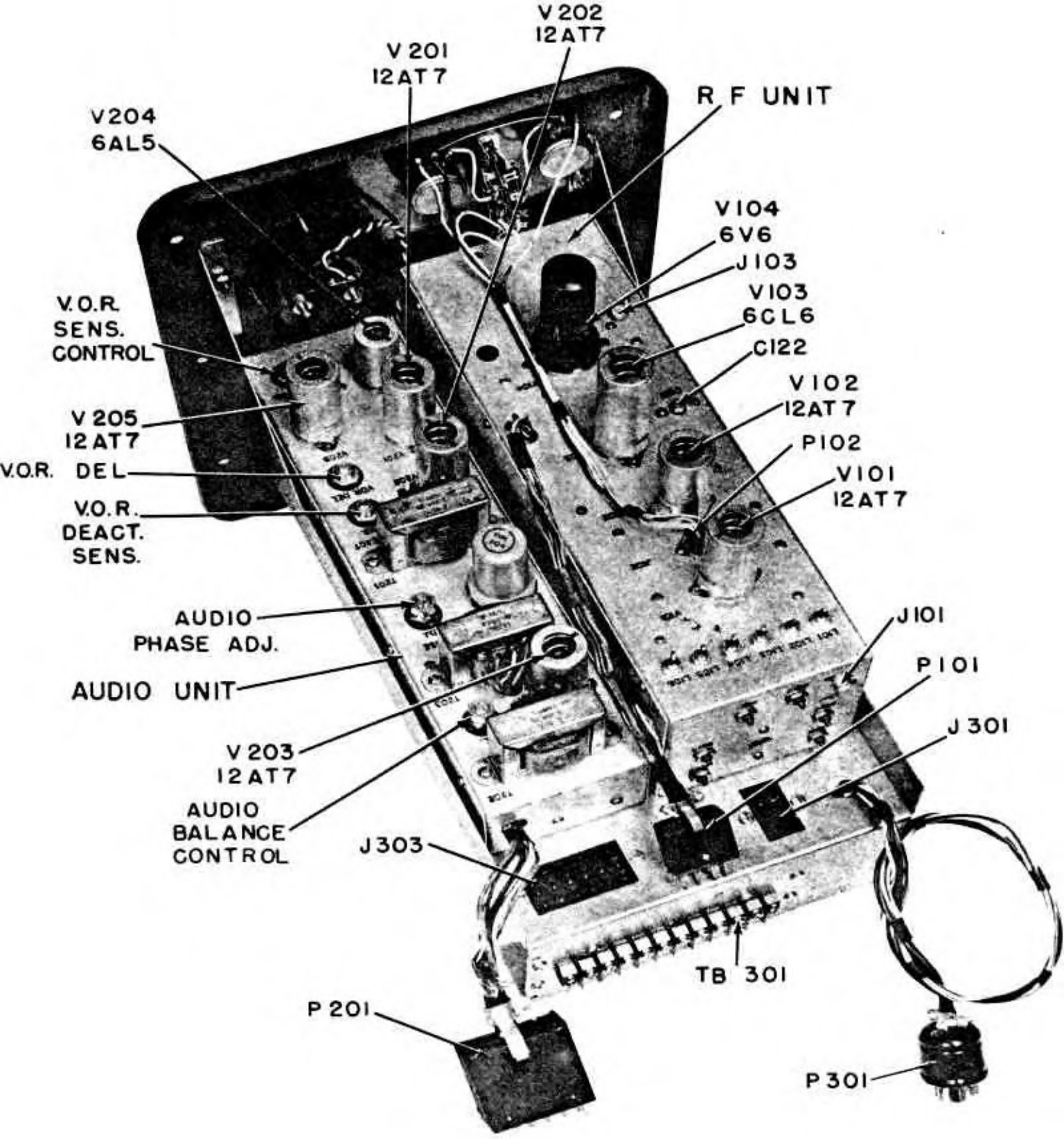


FIGURE 14. MODEL 51SB-B (WITH CABINET REMOVED)

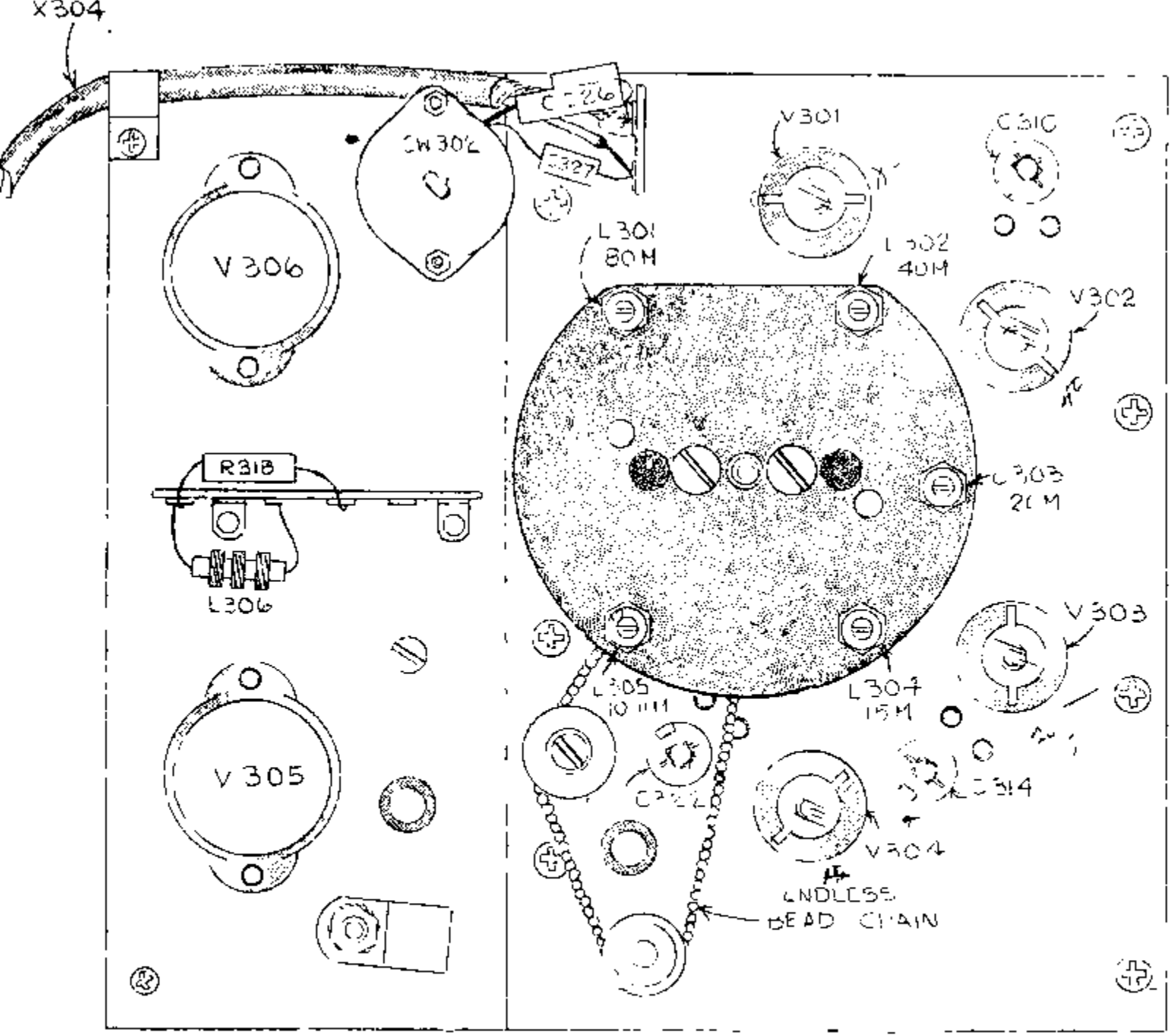


FIGURE 5 - REAR VIEW OF MULTIPLIER AND FINAL AMPLIFIER UNIT.

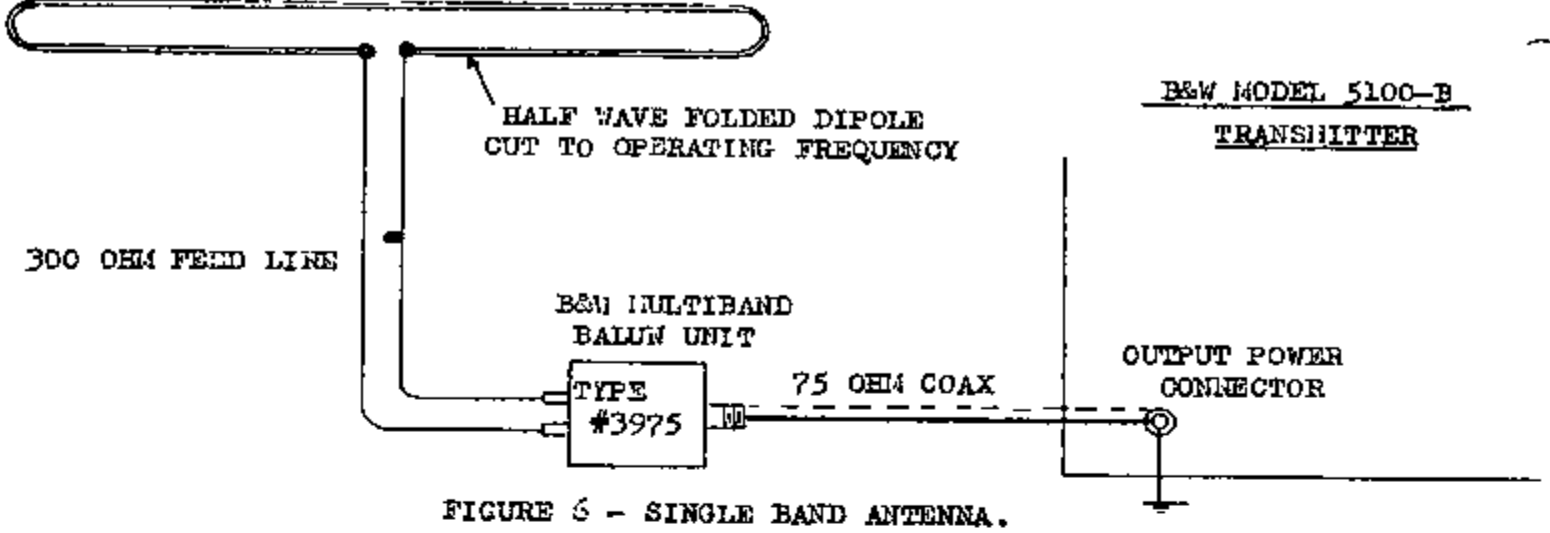


FIGURE 6 - SINGLE BAND ANTENNA.

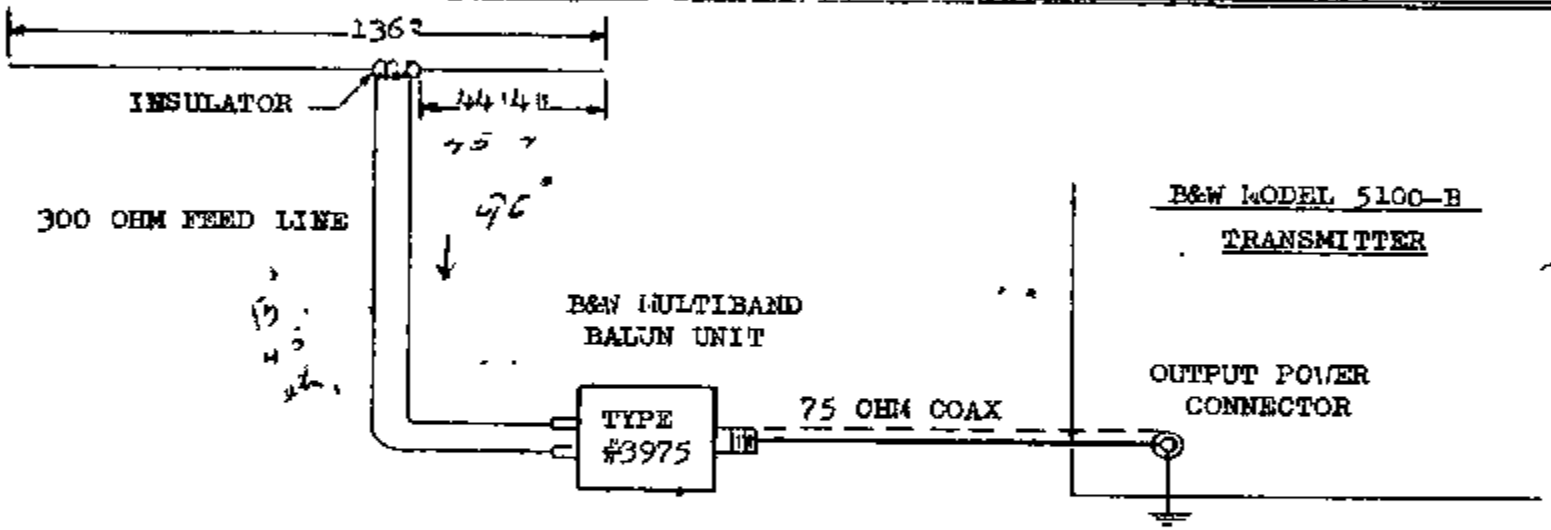


FIGURE 7 - MULTIBAND ANTENNA COVERS, 80, 40, 20 AND 10 METERS.

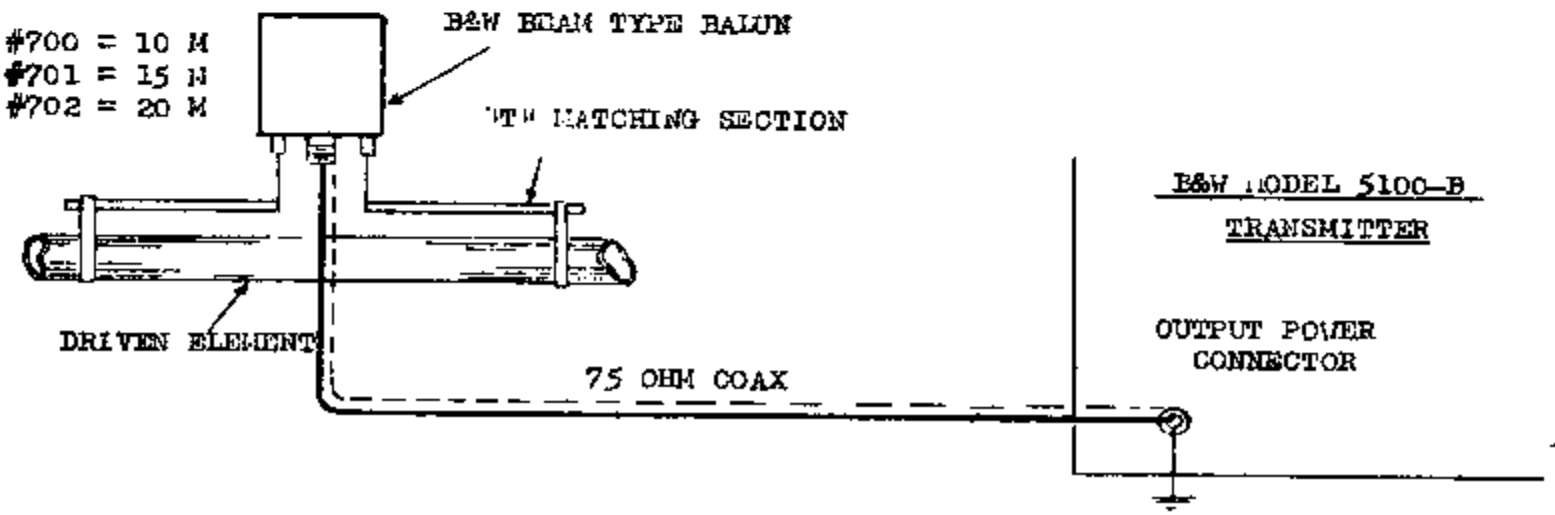


FIGURE 8 - BEAM ANTENNAS FOR EITHER 10, 15 OR 20 METERS.

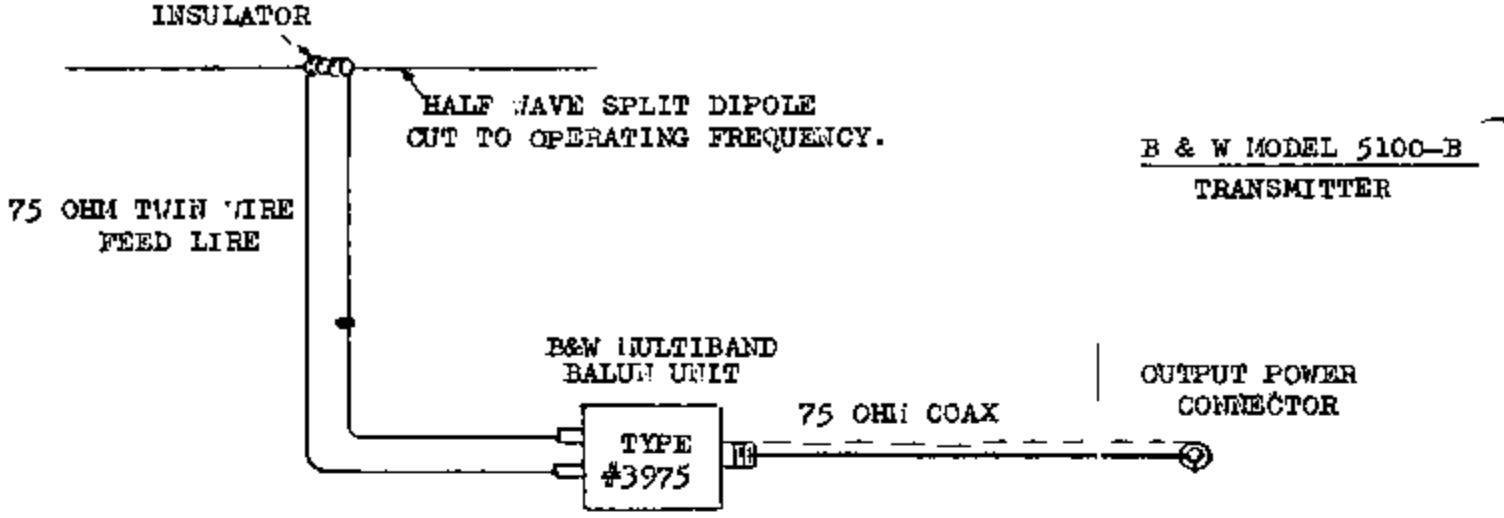


FIGURE 9 - SINGLE BAND ANTENNA

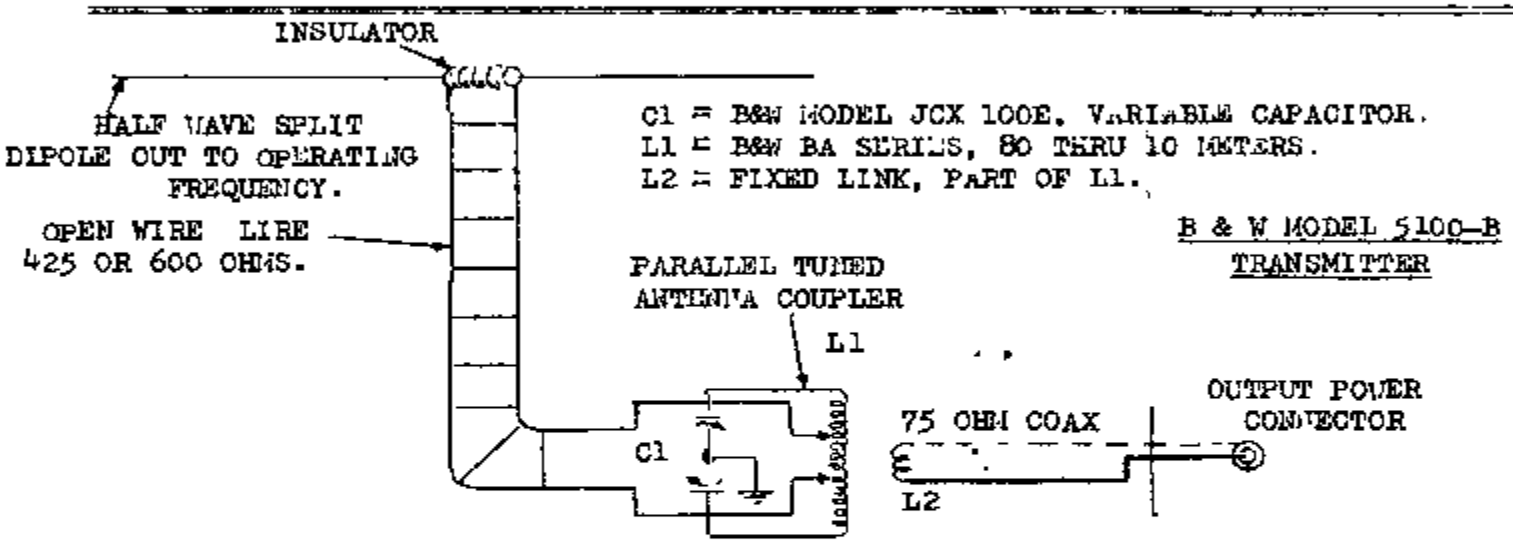


FIGURE 10 - CENTER FED, HALF WAVE SPLIT DIPOLE.

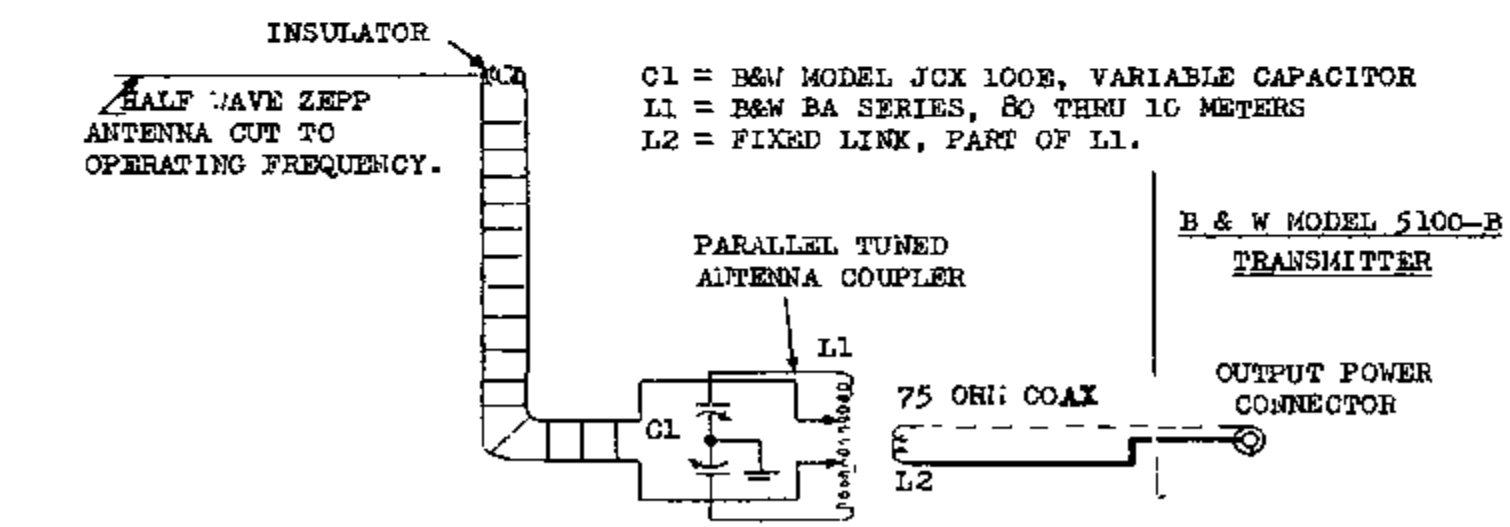
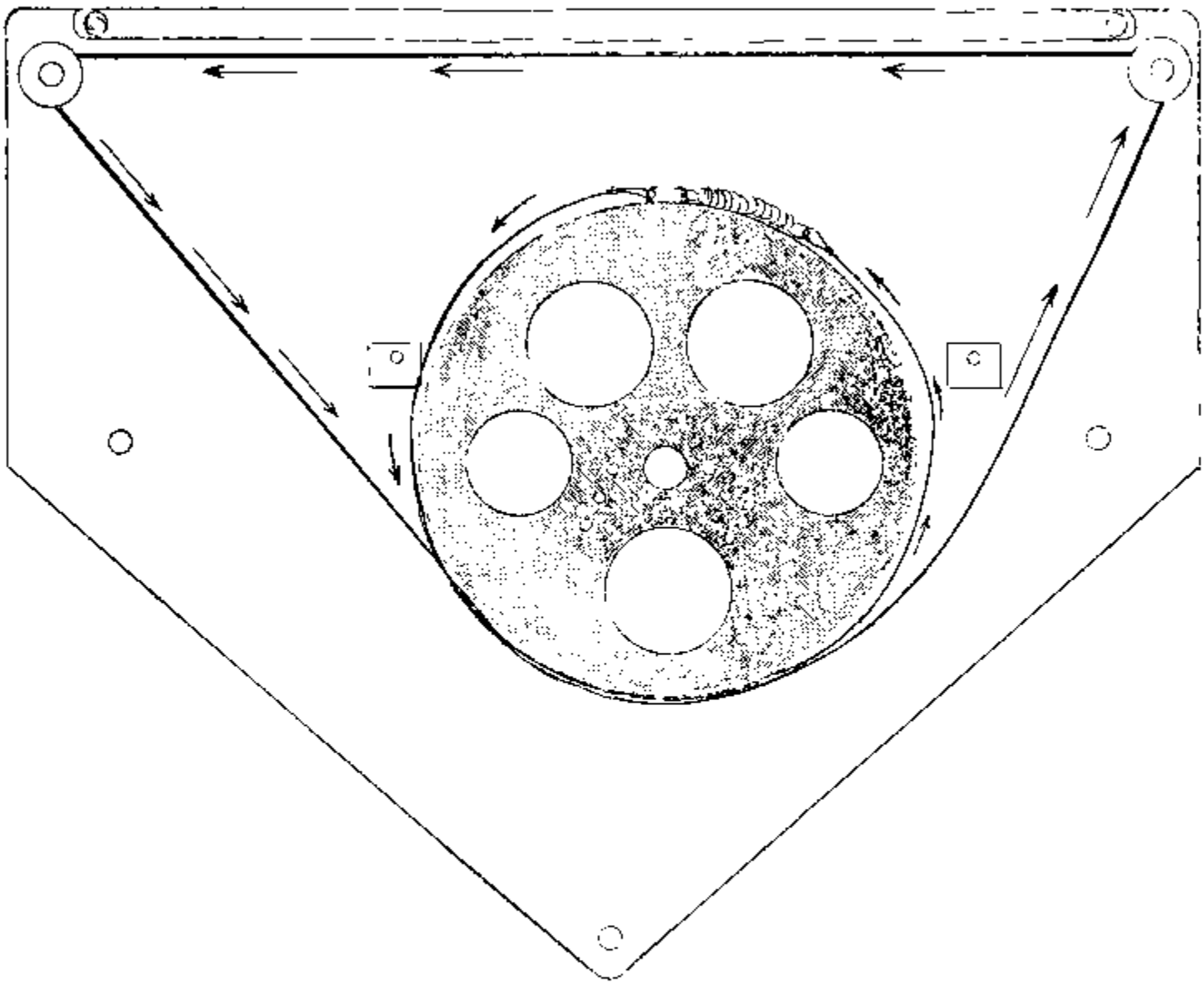


FIGURE 11 - END FED, HALF WAVE ZEPP.



Loop one end of cord over left side of cord retaining hook, then wind cord around large pulley as shown by arrows. Loop cord over the two corner pulleys as shown and then follow around large pulley to right side of cord retaining hook. Use tension spring as shown to keep the cord taught. Make sure that the cord does not cross over itself at any point on the large pulley.

FIGURE 12 - INSTRUCTIONS FOR STRINGING TO DIAL.

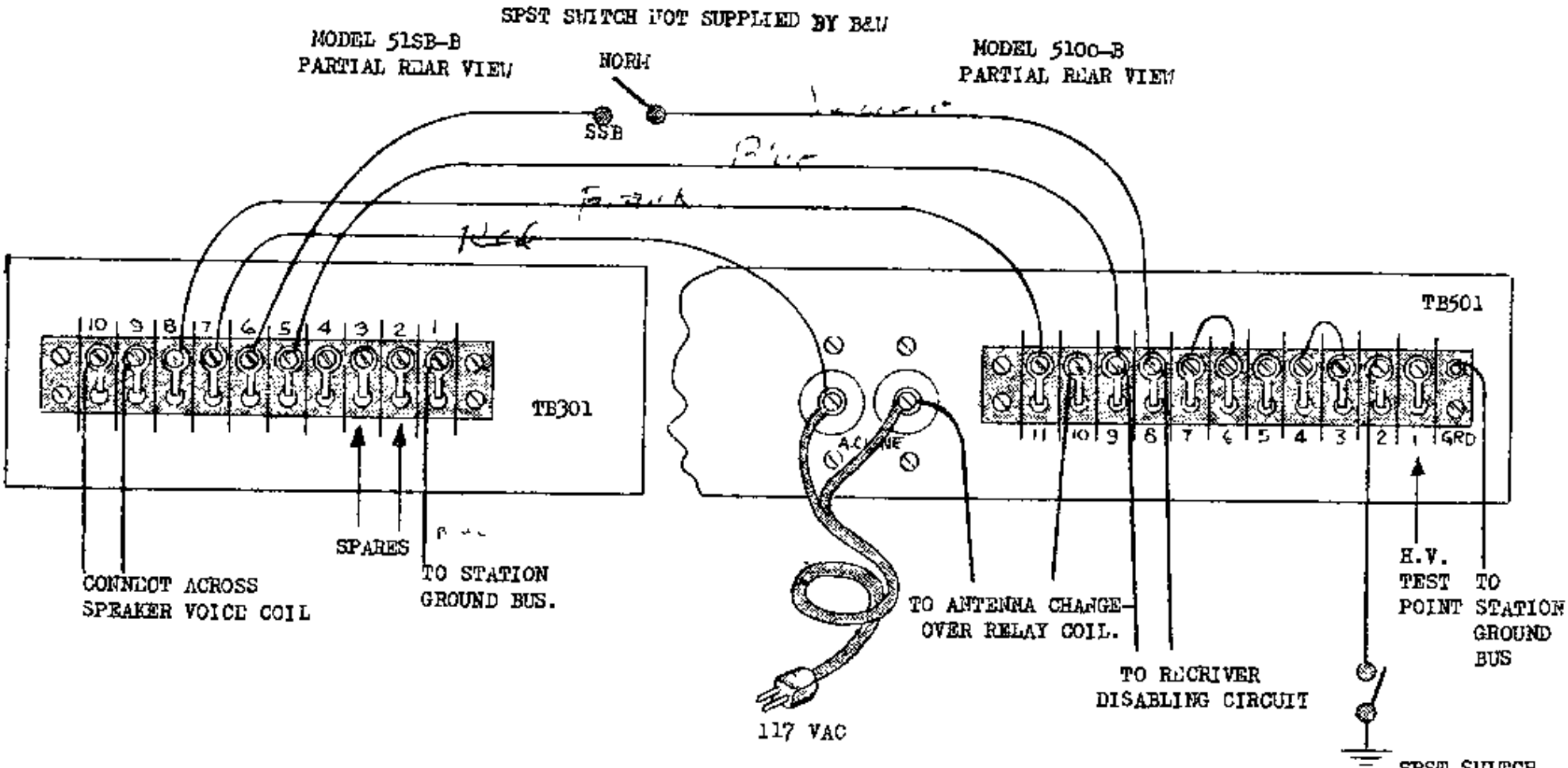
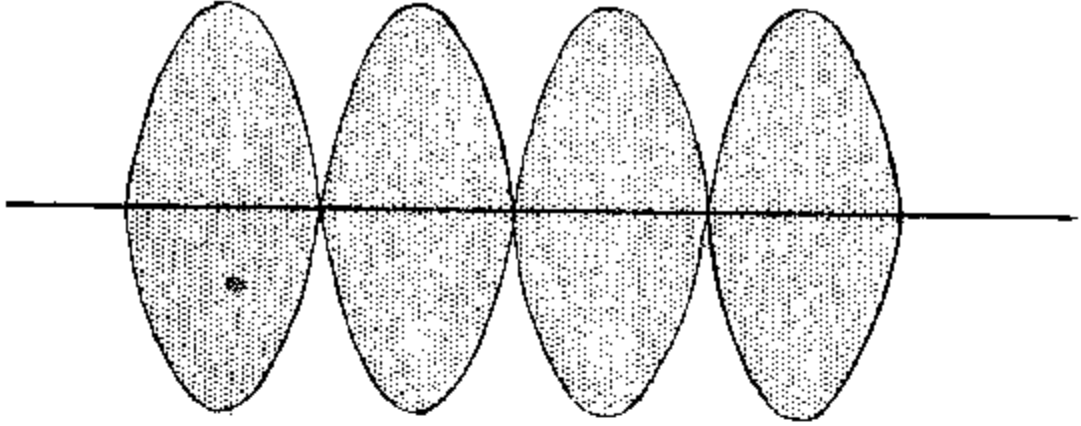
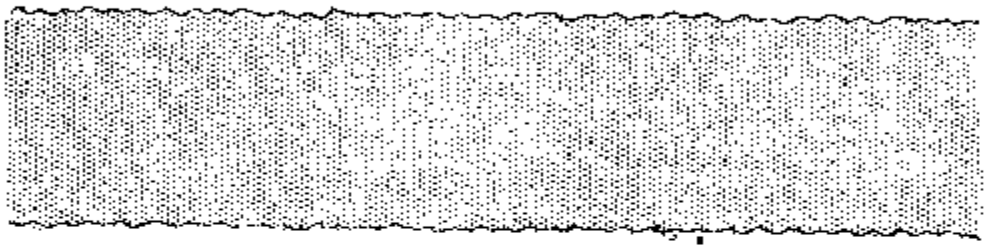


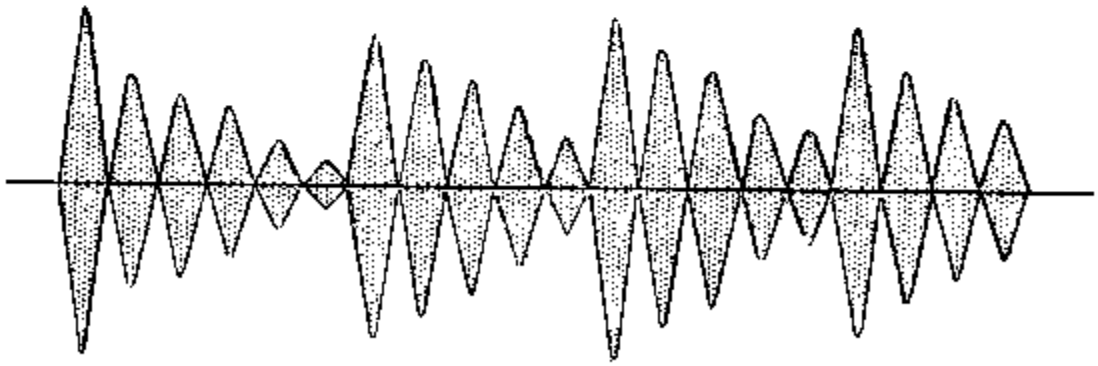
FIGURE 15 - REAR VIEW OF MODELS 5100-B and 51SB-B
SHOWING CONNECTIONS.



(a) DOUBLE SIDEBAND SUPPRESSED CARRIER SIGNAL



(b) SINGLE SIDEBAND SUPPRESSED CARRIER SIGNAL WITH SINGLE AUDIO TONE MODULATION



(c) SINGLE SIDEBAND SUPPRESSED CARRIER SIGNAL WITH VOICE MODULATION

FIGURE 17 - MODEL 51SB-B SINGLE SIDEBAND GENERATOR OUTPUT WAVEFORMS.

Circuit Symbol	Description	B & W Part No.
	VFO	
C101	Capacitor, Variable Special	T-620
C102	Capacitor, APC Trimmer 20 MMF	T-314
C103	Capacitor, Special Compensating Group	
C104	Capacitor, Ceramic Tubular 100 MMF	T-646
C105	Capacitor, Disc .01 MF	T-607
C106	Capacitor, Ceramic Tubular 75 MMF ± 10%	T-647
C107	Capacitor, Disc .01 MF	T-607
C108	Capacitor, Disc .01 MF	T-607
C109	Capacitor, Disc .01 MF	T-607
C110	Capacitor, Disc .01 MF	T-607
C111	Capacitor, Disc .01 MF	T-607
C112	Capacitor, Disc .01 MF	T-607
C113	Capacitor, Ceramic Tubular 200 MMF ± 10%	T-1200
L101	Oscillator Coil Assembly	X-333
L102	Choke, R-F Plate	T-712
L103	Choke, R-F	T-359
L104	Choke, R-F Iron Core	T-1107
P101	Phono Plug	T-288-1
P102	Plug, 3 Pin EBY	T-1041
R101	Resistor, 100K ½W 10%	R-116
R102	Resistor, 560Ω ½W 10%	T-244
R103	Resistor, 1 K ½W 10%	R-65
R104	Resistor, 6.8 K ½W 10%	R-162
V101	Tube, 6BH6	T-1080
	BUFFER - XTAL OSCILLATOR	
C201	Capacitor, Ceramic Tubular 50 MMF ± 10%	T-616
C202	Capacitor, Ceramic Tubular 95 MMF ± 10%	T-643
C203	Capacitor, Disc .01 MF	T-607
C204	Capacitor, Disc .01 MF	T-607
C205	Capacitor, Disc .01 MF	T-607
C206	Capacitor, Ceramic Tubular 50 MMF ± 10%	T-616
C207	Capacitor, Disc .01 MF	T-607
C208	Capacitor, Disc .01 MF	T-607
C209	Capacitor, Ceramic Tubular 95 MMF ± 10%	T-643
C210	Capacitor, Disc .01 MF	T-607
C211	Capacitor, Ceramic Tubular 20 MMF ± 10%	T-644
C212	Capacitor, Disc .01 MF	T-607
C213	Capacitor, Disc .01 MF	T-607
C214	Capacitor, Disc .01 MF	T-607
C215	Capacitor, Ceramic Tubular 300 MMF ± 10%	T-1201
CR201	Socket Crystal	T-361

Circuit Symbol	Description	B & W Part No.
J201	Phono Jack	T-288
L201	Choke, R-F Grid	T-712
L202	Choke, R-F Screen	T-713
P201	Phono Plug	T-288-1
P202	Plug, 5 Pin EBY	T-1069
R201	Resistor, 150 Ω ½W ± 10%	R-62
R202	Resistor, 5.6 K ½W ± 10%	R-63
R203	Resistor, 220 Ω ½W ± 10%	R-131
R204	Resistor, 3.3K ½W ± 10%	R-148
R205	Resistor, 100 K ½W ± 10%	R-116
R206	Resistor, 150 Ω ½W ± 10%	R-62
R207	Resistor, 1 K ½W ± 10%	R-65
R208	Resistor, 5.6 K ½W ± 10%	R-63
R209	Resistor, 220 Ω ½W ± 10%	R-131
SW201	Switch, Toggle SPST	T-537
V201	Tube, 6BJ6	T-645
V202	Tube, 6BJ6	T-645
	MULTIPLIER - FINAL AMPLIFIER	
C301	Capacitor, Disc .001 MF	T-509
C302	Capacitor, Disc .001 MF	T-509
C303	Capacitor, Disc .001 MF	T-509
C304	Capacitor, Ceramic Tubular 20 MMF ± 5%	T-1030
C305	Capacitor, Mica 510 MMF ± 5%	T-SP-224
C306	Capacitor, Disc 100 MMF	T-940
C307	Capacitor, Ceramic Tubular 30 MMF ± 5%	T-1031
C308	Capacitor, Disc .001 MF	T-509
C309	Capacitor, Disc .001 MF	T-509
C310	Capacitor, Ceramic Trimmer 8-50 MMF	T-941
C311	Capacitor, Mica 510 MMF ± 5%	T-SP-224
C312	Capacitor, Disc 100 MMF	T-940
C313	Capacitor, Ceramic Tubular 33 MMF ± 5%	T-1032
C314	Capacitor, Ceramic Trimmer 8-50 MMF	T-941
C315	Capacitor, Disc .001 MF	T-509
C316	Capacitor, Disc .001 MF	T-509
C317	Capacitor, Mica 510 MMF ± 5%	T-SP-224
C318	Capacitor, Disc 100 MMF	T-940
C319	Capacitor, Ceramic Tubular 28 MMF ± 5%	T-1033
C320	Capacitor, Disc .001 MF	T-509
C321	Capacitor, Disc .001 MF	T-509
C322	Capacitor, Ceramic Trimmer 8-50 MMF	T-941
C323	Capacitor, Mica 510 MMF ± 5%	T-SP-224
C324	Capacitor, Disc 100 MMF	T-940
C325	Capacitor, Disc .001 MF	T-509
C326	Capacitor, Ceramic Trimmer 8-50 MMF	T-854
C327	Capacitor, Ceramic Tubular 30 MMF ± 5%	T-1031
C328	Capacitor, Disc .001 MF	T-509

Circuit Symbol	Description	B & W Part No.
C329	Capacitor, Disc .001 MF	T-509
C330	Capacitor, Disc .001 MF	T-509
C331	Capacitor, Ceramic .001 MF 5000 Volts	T-944
C332	Capacitor, Ceramic .001 MF 5000 Volts	T-944
C333	Capacitor, Piston Trimmer 1-10 MMF	T-1034
C334	Capacitor, Variable Air 325 MMF	T-SP-163
C335-A-B	Capacitor, Variable Air Dual 530 MMF	T-656
J301	Phono Jack	T-288
L301	80 Meter Coil Assembly	11511
L302	40 Meter Coil Assembly	11512
L303	20 Meter Coil Assembly	11513
L304	15 Meter Coil Assembly	11513
L305	10-11 Meter Coil Assembly	11514
L306	Choke, R-F Grid	T-1156
L307	Choke, R-F Plate	T-710
L308	High Frequency Coil	X-329
L309	Low Frequency Coil Pi-Network	X-328
P301	Plug, 12 Pin Jones	T-554
R301	Resistor, 100K ½W ± 10%	R-116
R302	Resistor, 1.5K 1W ± 10%	R-124
R303	Resistor, 820Ω ½W ± 10%	R-158
R304	Resistor, 4.7K 2W ± 10%	R-160
R305	Resistor, 100K ½W ± 10%	R-116
R306	Resistor, 1K 1W ± 10%	R-269
R307	Resistor, 68K ½W ± 10%	R-5
R308	Resistor, 27K 2W ± 10%	R-171
R309	Resistor, 4.7K 2W ± 10%	R-160
R310	Resistor, 47K ½W ± 10%	R-147
R311	Resistor, 820Ω 1W ± 10%	R-142
R312	Resistor, 820Ω ½W ± 10%	R-158
R313	Resistor, 4.7K 2W ± 10%	R-160
R314	Resistor, 100K ½W ± 10%	R-116
R315	Resistor, 1.5K 1W ± 10%	R-124
R316	Resistor, 820Ω ½W ± 10%	R-158
R317	Resistor, 4.7K 2W ± 10%	R-160
R318	Resistor, 3.3K 1W ± 10%	R-115
R319	Resistor, 100Ω 1W ± 10%	R-58
R320	Resistor, 100Ω 1W ± 10%	R-58
SW301-A-B-C-D-E	Switch, Miniature Ceramic 3 Wafers 5 Poles 5 Positions	T-1038
SW301-F	Switch, Ceramic Single Wafer with Detent 1 Pole 5 Positions	T-1093
SW302-A-B-C-D-E-F-G	Switch, Miniature Ceramic 2 Wafers 7 Poles 2 Positions	T-1039
SW302-H	Switch, Special 1 Pole 1 Position	X-357
V301	Tube, 6AQ5	T-284
V302	Tube, 6AQ5	T-284
V303	Tube, 6AQ5	T-284
V304	Tube, 6AQ5	T-284

Circuit Symbol	Description	B & W Part No.
V305	Tube, 6146	T-553
V306	Tube, 6146	T-553
X301	Choke, Parasitic	T-714
X302	Choke, Parasitic	T-714
X303	Choke, Parasitic	T-714
X304	Multiplier Output Cable Assembly	X-322-2
X305	Final Input Cable Assembly	X-322-1
X306	Final Output Cable Assembly	X-321
	Endless Bead Chain 44 Beads	T-1121
	Endless Bead Chain 77 Beads	T-1122

POWER SUPPLY CHASSIS

C501	Capacitor, Paper .1MF 200 VDCW	T-1051
C502	Capacitor, Disc .001 MF 1500 VDCW	T-679
C503	Capacitor, Disc .001 MF 1500 VDCW	T-679
C504	Capacitor, Disc .01 MF 1500 VDCW	T-607
C505	Capacitor, Disc .001 MF 1500 VDCW	T-679
C506	Capacitor, Disc .001 MF 1500 VDCW	T-679
C507	Capacitor, Disc .001 MF 1500 VDCW	T-679
C508	Capacitor, Disc .001 MF 1500 VDCW	T-679
C509	Capacitor, Disc .001 MF 1500 VDCW	T-679
C510	Capacitor, Disc .001 MF 1500 VDCW	T-679
C511	Capacitor, Disc .001 MF 1500 VDCW	T-679
C512	Capacitor, Disc .001 MF 1500 VDCW	T-679
C513	Capacitor, Disc .001 MF 1500 VDCW	T-679
C514	Capacitor, Disc .001 MF 1500 VDCW	T-679
C515	Capacitor, Disc .001 MF 1500 VDCW	T-679
C516	Capacitor, Disc .01 MF 1500 VDCW	T-1046
C517	Capacitor, Electrolytic 4MF 150 VDCW	T-1050
C518	Capacitor, Electrolytic 60MF 150 VDCW	T-1047
C519	Capacitor, Electrolytic 60MF 150 VDCW	T-1047
C520-A-B-C	Capacitor, Electrolytic 40-40-40MF 450 VDCW	T-1049
C521	Capacitor, Electrolytic 40MF 450 VDCW	T-1048
C522	Capacitor, Oil Filled Paper .25MF 2000 VDCW	T-580
CH-1	Choke, Filter	T-1053
CH-2	Choke, Filter	T-1054
CH-3	Choke, Filter	T-1054
CH-4	Choke, Screen	T-1055
F501	Fuse 3AG-10A. 125 VAC	
I501	Lamp, Neon NE-51	T-597
I502	Lamp, Pilot #47	T-703
I503	Lamp, Pilot #47	T-703
J501	Receptacle, 5 Contact EBY	T-1068
J502	Receptacle, 3 Contact EBY	T-1066
J503	Receptacle, 11 Contact EBY	T-1158
J504	Receptacle, Microphone 2 Contact	T-611

Circuit Symbol	Description	B & W Part No.
J505	Receptacle, 12 Contact EBY	T-590
J506	Receptacle, 11 Contact Amphenol	T-SP-251
J507	Key Jack	T-1058
L501	Choke, R-F	T-359
L502	Choke, R-F	T-359
L503	Choke, R-F	T-359
L504	Choke, R-F	T-359
L505	Choke, R-F	T-359
L506	Choke, R-F	T-359
L507	Choke, R-F	T-359
L508	Choke, R-F	T-359
L509	Choke, R-F	T-359
L510	Choke, R-F	T-359
L511	Choke, R-F	T-359
L512	Choke, R-F	T-359
L513	Choke, R-F	T-359
	Meter, 0-1 MA. Special Scale	T-1073
	Plug, 4 Pin EBY	T-1067
R501	Resistor, 22K 1W ± 10%	R-59
R502	Potentiometer, Composition 500K	T-612
R503	Resistor, 10K ½W ± 10%	R-136
R504	Resistor, Wire Wound 7.5 ½W ± 5%	T-1186
R505	Resistor, Wire Wound 0.75 ½W ± 5%	T-1185
R506	Resistor, Wire Wound 0.75 ½W ± 5%	T-1185
R507	Resistor, Wire Wound 240 ½W ± 5%	T-1187
R508	Resistor, 33K ½W ± 10%	T-598
R509	Resistor, 3.9K 2W ±10%	R-109
R510	Potentiometer, Wire Wound 5K	T-801
R511	Resistor, 3.3K 2W ± 10%	R-167
R512	Resistor, Wire Wound 2.5K 10W	T-112
R513	Resistor, 3.3K 2W ± 10%	R-167
R514	Potentiometer, Wire Wound 5K	T-801
R515	Resistor, 3.9K 2W ± 10%	R-109
R516	Resistor, 68K 2W ± 10%	R-165
R517	Resistor, 100Ω ½W ± 10%	R-159
R518	Resistor, 470Ω 1W ± 10%	R-125
R519	Potentiometer, Composition 100K	R-164
R520	Resistor, 68K 2W ± 10%	R-165
R521	Resistor, 68K 2W ± 10%	R-165
R522	Resistor 33Ω ½W ± 10%	R-166
R523	Resistor, Wire Wound 350 20W	R-163
R524	Resistor, 470Ω ½W ± 10%	R-146
R525	Resistor, Wire Wound Special Heater	T-588
R526	Resistor, 560K ½W ± 10%	T-493
SR501	Rectifier, Selenium 65MA.	T-1057
SW501-A-B-C-D-E-F-G	Switch, Ceramic 3 Wafers 9 Poles 3 Positions	T-1060
SW502	Switch, Ceramic 1 Wafer 3 Poles 3 Positions	T-595
SW503	Switch, Toggle SPST	T-592

Symbol	Description	Part No.
SW504	Switch, Toggle DPDT	T-1059
SW505	Switch, Toggle SPST	T-592
SW506	Switch, Toggle SPST	T-592
T3	Transformer, Plate	T-1062
T4	Transformer, Filament and Low Voltage	T-1061
TB501	Terminal Board	T-638
V501	Tube, OD3/VR150	T-128
V502	Tube, 5R4-GY	T-605
V503	Tube, 5R4-GY	T-605
V504	Tube, 5U4-GB	T-1063
X501	Filter, TVI	Model 426
X502	Filter, Line	T-680
X503	Filter, Line	T-680
X504	Relay	T-1052
X505	Filter Assembly, includes L503 through L513 and C505 through C515	X-312

MODULATOR

C401	Capacitor, Disc .001 MF	T-509
C402	Capacitor, Ceramic Tubular 50MMF	T-616
C403A-B	Capacitor, Electrolytic Dual 8MF 450V	T-1020
C404	Capacitor, Disc .001 MF	T-509
C405	Capacitor, Electrolytic 20MF 450V	T-907
C406	Capacitor, Paper .0033 MF 200V ± 10%	T-1022
C407	Capacitor, Paper .0033 MF 200V ± 10%	T-1022
C408	Capacitor, Disc .001 MF	T-509
C409	Capacitor, Disc .001 MF	T-509
C410	Capacitor, Disc .001 MF	T-509
CP401	Interstage Coupling Network	T-966
J401	Receptacle, 4 Contact EBY	T-1025
P401	Plug, 11 PIN EBY	T-1026
R401	Resistor, 10 Meg, ½W ± 10%	R-38
R402	Resistor, 270 K ½W ± 10%	R-49
R403	Resistor, 15 K ½W ± 10%	R-154
R404	Resistor, 820 Ω ½W ± 10%	R-158
R405	Resistor, 220 K ½W ± 10%	R-4
R406	Resistor, 15 K ½W ± 10%	R-154
R407	Resistor, 470 Ω 1W ± 10%	R-125
R408	Resistor, 1.5 K ½W ± 10%	R-132
R409	Resistor, 1 K ½W ± 10%	R-65
R410	Resistor, 1.5 K ½W ± 10%	R-132
R411	Resistor, 1 K ½W ± 10%	R-65
R412	Resistor, 100 Ω ½W ± 10%	R-159
R413	Resistor, 100 Ω ½W ± 10%	R-159
R414	Resistor, Wire Wound 5 K 10 W	R-113
R415	Resistor, 4.7 Ω 1 W ± 10%	R-70
T1	Transformer, Driver	T-1023
T2	Transformer, Modulation	T-1045
V401A-B	Tube, 6U8	T-635
V402	Tube, 6AQ5	T-284
V403	Tube, 6146	T-555
V404	Tube, 6146	T-553

FREQUENCY SELECTOR

C101 117μμf

C102 20μμf

C103 235μμf MICA

L101

C104 100μμf

R101 100K

R102 560

V101 6BH6

L102 17μH

C106 75μμf

C113 200μμf

R103 1K

C107 .01μf

C105 .01μf

L103 RFC

C108 .01μf

L104 RFC

C110 .01μf

C111 .01μf

R104 6.8K

C109 .01μf

C112 .01μf

VARIABLE FREQUENCY OSCILLATOR

P101

J201

C201 50μμf

C206 50μμf

XTAL SOCKET CR201

-8V

V201 6BJ6

R202 5.6K

V202 6BJ6

R205 100K

L201 17μH

C202 95μμf

C215 300μμf

R201 150

C204 .01μf

R206 150

C210 .01μf

R203 220

C205 .01μf

C208 .01μf

R204 33K

C203 .01μf

C207 .01μf

BUFFER-CRYSTAL

R405 220K

T1

BLU

GRN

BLK

YEL

R408 1.5K

R409 1K

C406 .0033μf

R410 1.5K

R411 1K

C407 .0033μf

V403 6146

V404 6146

R412 100

C408 .001μf

C409 .001μf

C410 .001μf

R413 100

R414 5K-10W

R407 470

V402 6AQ5

RED

C405 20μf 450V

CP-401

.005

.01

100

500K

27M

500K

V401-A ½ 6U8

V401-B ½ 6U8

C401 .001μf

R401 10 Meg

C402 50μμf

C404 .001μf

R402 270K

C405A 8μf 450V

R403 15K

R404 820

R406 15K

C403-B 8μf 450V

TWISTED TRIPLET

SPEECH AMPLIFIER-MODULATOR

BUFFER-CRYSTAL OSCILLATOR

ALL VOLTAGES ARE MEASURED WITH A 20,000 OHMS PER VOLT METER WITH THE TRANSMITTER OPERATING UNDER THE FOLLOWING CONDITIONS:
1. 117 VOLT LINE VOLTAGE
2. BAND - 80 METERS
3. FUNCTION - MODE WITH AUDIO GAIN MINIMUM
4. AMP - LOADED TO 225 MA WITH DUMMY LOAD
5. MOD - 55 MA RESTING CURRENT
6. EXC - 65 MA

CAUTION: BE EXTREMELY CAREFUL SINCE ALL CIRCUITS ARE LIVE.

MULTIPLIER- FINAL AMPLIFIER

BAND SELECTOR
SW 301-A
SW 301-B
SW 301-C
SW 301-D
MULTIPLIER TUNING
L301 90M
L302 40M
L304 15M
L305 10-11M
1ST MULTI V301 6AQ5
2ND MULTI V302 6AQ5
3RD MULTI V303 6AQ5
4TH MULTI V304 6AQ5
C301 .001μf
C305 510μμf
C306 100μμf
C310 8-50μμf
C311 510μμf
C312 100μμf
C317 510μμf
C318 100μμf
C322 8-50μμf
C324 100μμf
R301 100K
R302 1.5K 1W
C302 .001μf
C303 .001μf
R304 4.7K 2W
C307 50μμf
R305 100K
R306 1K 1W
C308 .001μf
C309 .001μf
R307 68K
R309 4.7K 2W
C313 50μμf
R310 47K
R311 820 1W
C315 .001μf
C316 .001μf
R313 4.7K 2W
C319 25μμf
R314 100K
R315 1.5K 1W
C320 .001μf
C321 .001μf
R316 820
R317 4.7K 2W
R308 27K 2W
R312 820
P303 820
P301
J305
J501
J502
J503
J504
J507
KEY
L501 RFC
C502 .001μf
L502 RFC
C503 .001μf
C501 .1μf
R501 22K 1W
R503 10K
R502 500K
R586 560K
AUDIO GAIN
MIC.
H.V. SW 503
METER SWITCH
SW 502
1- XC.
2- MOD.
3- AMP.
C504 .01μf
M501
R507 240 5%
EXC. +270V
MOD. +635V
AMP. +635V
R504 .5WW, 5%
R505 0.75WW, 5%
R506 0.75WW, 5%
CHC 20H
FUNCTION SWITCH
SW 501
1- SSB-CW
2- VFO
3- PH
V501 0D3 VR 150
R515 8.5K 10W
R509 5.5K 2W
R510 5K
+150V
6.3VAC
+180V
-4V
6.3V AC
+270V
+635V
+630V
+615V
-65V
WITH A 20,000
THE TRANSMITTER
VING CONDITIONS.
NO GAIN MINIMUM
WITH DUMMY LOAD
ENT.
AREFUL SINCE
LIVE.
L503 RFC C505
L504 RFC C506
L505 RFC C507
L506 RFC C508
L507 RFC C509
L508 RFC C510
L509 RFC C511
L510 RFC C512
L511 RFC C513
L512 RFC C514
L513 RFC C515
C516 .001μf 1500V
X 505
FILTER ASSEMBLY
ALL CAPACITORS
THIS ASSEMBLY A
.001μf, 1500V EXC
C516.
TB 501
+635V
0
+615V
+630V
+635V

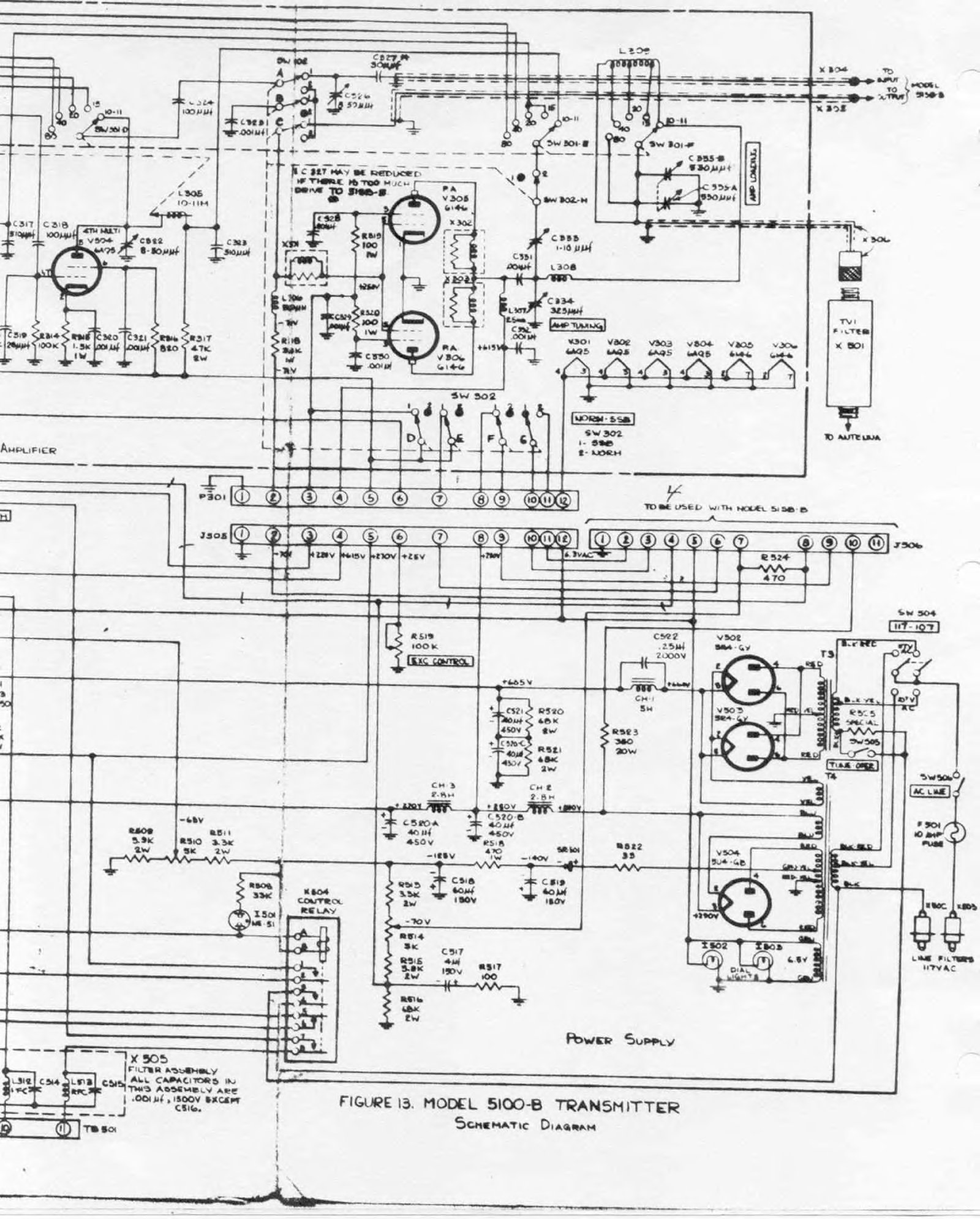


FIGURE 13. MODEL 5100-B TRANSMITTER

Schematic Diagram