switch position when operating SSB to monitor the SSB transmissions. The microphone gain control setting will be found to be less critical because of the compression action of the AALC circuitry; however, the actual control setting still depends upon the type of microphone, the operator's voice characteristics, and his operating habits. Sufficient microphone gain has been built into the Model SR-2000 Transceiver to handle the usual range of levels associated with communications type microphones.

E. Release the microphone switch button. The transceiver returns to the receive function and the plate current drops to zero. The meter on the transceiver now monitors the strength of the incoming signals in the usual "S" units of measurement; S-9 represents approximately a 50-microvolt signal.

F. HIGH POWER SSB OPERATION. When operating single sideband, two power input levels are available. The tune-up and low power sideband operation are carried out with the High Power/Low Power switch on the Model P-2000 Power Supply set at SSB LOW POWER-CW-TUNE (1700 VDC supply voltage). When operating with single sideband phone transmissions the operator may use the SSB HIGH POWER position (2700 VDC supply voltage), after he has determined that the low power operation is performing to his satisfaction. Do not tune-up or transmit continuous carrier signals (CW) in the SSB HIGH POWER switch position. There are no final amplifier loading tests or adjustments required when switching from low power to high power operation. The only change in control setting that may be required is an increase in the AF control setting to accommodate the higher plate voltage. Again adjust for the AALC meter deflection on voice peaks. Always switch to SSB LOW POWER-CW-TUNE to make any tuning adjustments.

5-7. VOICE CONTROLLED SSB OPERATION.

The operating procedures outlined for basic transmitter tune-up (paragraph 5-4) and push-to-talk sideband operation (paragraph 5-6) also apply for voice controlled single sideband operation. The following adjustments, therefore, are intended to apply only to the adjustment of the VOX control system.

To avoid unintentional transmission while adjusting the VOX system controls, set the AF (transmitter group) control at zero (Full CCW) and press the HIGH VOLTAGE OFF button to disable the final amplifier plate supply.

A. Turn the four transceiver cabinet cover screws 1/4 turn to loosen the fasteners and lift the top cover clear to gain access to the VOX controls.

B. Initially set the VOX, DELAY and ANTI-TRIP controls fully counterclockwise.

C. Set the OPERATION control at VOX and the FUNCTION control at either the USB or LSB position.

D. Turn the VOX control clockwise, while talking into the microphone, until the VOX control relay closes on the first syllable of speech. The transceiver will transfer from receive mode to transmit mode when the relay closes. Use just enough VOX gain to accomplish the desired results, too much gain will make the system over sensitive to speaker feedback and too little sensitivity will place a relatively high signal level at the antenna change-over relay contacts at the time it switches over to transmit.

E. Adjust the DELAY control for the desired drop-out delay. The delay period increases as the DELAY control is turned clockwise. The delay period should be long enough to prevent change-over between words but not long enough to miss the other operator's quick reply.

F. Set the receiver AF control for the desired listening level and advance the ANTI-TRIP control (clockwise) until the received signals do not actuate the VOX control relay. Excessive anti-trip gain or a major increase in the established listening level may lock out the voice control system.

G. With the VOX controls adjusted, either method of control may be selected by setting the OPERATION control at MOX for manual control or at VOX for voice control. To place the transmitter in operation, restore the high voltage and reset the transmitter AF gain control watching the AALC metering as you speak into the microphone.

H. Replace the cabinet cover and turn the screws 1/4 turn clockwise to lock the cover in place.

NOTE

Some microphones, equipped for push-to-talk control, have shorting contacts in the switch to disable the microphone element when the push button is released. VOX operation will not be feasible unless this circuitry is disconnected within the microphone.

SECTION VI
THEORY OF OPERATION

6-1. GENERAL.

The Model SR-2000 Transceiver consists of a double conversion receiver and double conversion transmitter. To achieve true on frequency transceiver operation, the VFO, heterodyne crystal oscillator, and carrier frequency oscillators all contribute to the transmit and receive functions. In addition, the 6.0 — 6.5 MC IF amplifier and 1650 KC IF amplifier stage associated with the crystal lattice filter all function for both modes.

Circuitry that would be compromised, performance wise, to accomplish common usage between the transmit and receive function is avoided in the design of the Model SR-2000 Transceiver.

Refer to figure 9 for the block diagram of the system and to figures 21 and 22 for schematic details.

6-2. RECEIVER SECTION.

The signal (f1) at the antenna connector is fed to the receiver RF amplifier stage (V1) through the antenna change-over relay (K1) located in the transmitter final amplifier section. The signal is amplified and passed on to the first receiver mixer (V2A), where it is heterodyned to frequency (f2) which is the difference between the heterodyne crystal oscillator (V12) frequency (X1) and the signal frequency (f1). The resulting variable IF signal (f2) falls between 6.0 MC and 6.5 MC. The RF amplifier and first receiver mixer tuned circuits are selected by the BAND SELECTOR switch and tuned by the PRESELECTOR control capacitor.

The variable IF signal (f2) is amplified by a broad band IF amplifier (V3A) and then heterodyned to the second IF frequency of 1650 KC (f3) by mixing with the VFO (variable frequency oscillator) (V13 and V4B) in the second receiver mixer (V4A).

With the NOISE BLANKER control set at OFF, the second IF signal (f3) is amplified by the first 1650 KC IF amplifier and blanker stage (V6) in a conventional manner. When the NOISE BLANKER control is adjusted for maximum noise rejection, the noise amplifier stage (V5A) samples and amplifies the 6.0 to 6.5 MC noise and signal (f2). The signal and noise pulses in this path are then detected and shaped into positive going pulses with diode CR7. The detected signal, which is now predominantly noise pulses, is amplified by the pulse amplifier stage (V5B). The negative going pulses are then fed to grid No. 3 of the pentagrid type first 1650 KC IF amplifier and blanker tube (V6) with diode CR6 acting as a steering diode to prevent positive pulses from reaching grid No. 3. Pulse modulation of the IF amplifier and blanker stage, momentarily interrupts the second IF signal (f3) during noise bursts with no apparent discontinuity of reception because of the relatively short pulse duration.

The 1650 KC IF signal (f3) now passes through the crystal lattice filter (FL1) to further reject the unwanted signals on either side of the desired signal and is again amplified by the second 1650 KC IF amplifier (V7A). At this stage the signal path is split, one path feeds the signal to the product detector (V9A), the other path feeds the signal to the AGC amplifier stage (V8A).

The product detector stage (V9A) heterodynes the 1650 KC signal (f3) with one of the two carrier oscillator frequencies (X3) to shift the signal frequency to the audio frequency range. The choice of carrier oscillator frequency (X3) determines whether the upper sideband or lower sideband group of frequencies are detected, since the crystal lattice filter response relative to the carrier frequency (X3) causes the unwanted sideband group of frequencies in each case to be rejected before reaching the product detector.

Normally, shifting the carrier oscillator frequency (X3) to obtain upper and lower sideband reception would also entail shifting the receiver dial setting to receive the opposite sideband of a signal frequency (f1) at the antenna input.

The Model SR-2000 system shifts the VFO frequency (X2) electrically with varicap CR13 when the 1651.550 KC carrier oscillator frequency is switched on for upper sideband reception (or transmission). Shifting the VFO frequency by an amount equal to the difference between the two carrier oscillator frequencies (X3), or 3 KC, the received suppressed carrier frequency (f1) is received at the same dial setting for both upper and lower sidebands.

The 1650 KC IF signal (f3) fed to the AGC amplifier stage (V8A) is amplified and detected to supply the negative DC bias voltage (AGC) used

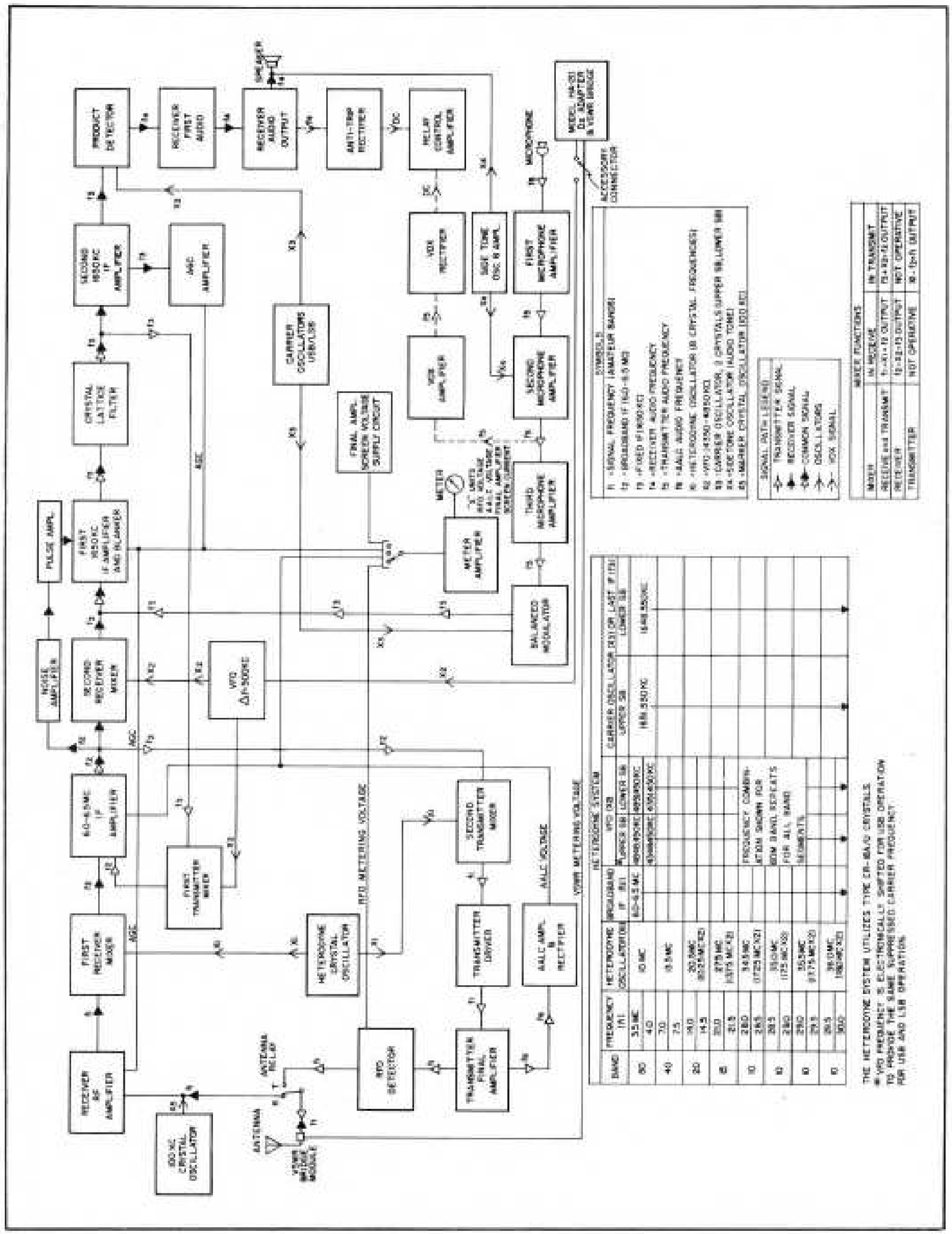

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Figure 9. Block Diagram of Transceiver.

to control the gain of the receiver RF amplifier stage (V1) and first 1650 KC IF amplifier and blanker stage (V6). The signal level at which gain control takes effect is controlled by the AGC THRESHOLD control R46.

The detected audio frequency signal amplitude is controlled by the AF gain control, R4B, and amplified to speaker level by the first audio amplifier stage (V9B) and audio output stage (V15). Two audio output impedances are available for external use; 500 ohms at the phono jack at the rear apron or 3.2 ohms at the PHONES jack on the front panel.

6-3. TRANSMITTER SECTION

The audio frequency signal (f5) generated by the microphone is amplified with a three stage audio amplifier (V19A, V19B and V14B). The audio frequency signal (f5) then modulates the selected (USB/LSB) carrier oscillator signal (X3) in the balanced modulator stage (CR19 and CR20) to produce a double sideband suppressed carrier signal (f3) near 1650 KC. The double sideband signal (f3) is then amplified by the first 1650 KC IF amplifier and blanker stage (V6) with the blanker system disabled during the transmit function.

The unwanted sideband of the double sideband signal is attenuated by more than 50 DB as the signal passes through the crystal lattice filter (FL1) and a single sideband suppressed carrier signal results. The signal is blocked for the transmit function at the second 1650 KC IF amplifier stage (V7A) with bias voltage switching and the signal proceeds on to the first transmitter mixer stage (V2B).

At the first transmitter mixer stage the signal (f3) is heterodyned with the VFO carrier frequency (X2) to produce a signal frequency (f2) in the 6.0 to 6.5 MC frequency range. The signal frequency filters through the bandpass circuits of the 6.0 — 6.5 MC IF amplifier (V3A) and on to the second transmitter mixer (V11A) because in the transmit mode it is blocked at the second receiver mixer (V4A).

The intermediate frequency signal (f2) is again heterodyned with the heterodyne crystal oscillator frequency (X1) to produce the final transmitter output signal frequency (f1). The signal at output frequency (f1) is amplified by the transmitter driver stage (V18) and final amplifier stage (V16 and V17) to the desired power level.

The output signal is fed through the PI network in the final stage to transform its impedance to the antenna transmission line impedance (50 ohms nominal), and from the output of the PI network it is conducted through the antenna change-over relay (K1) to the common antenna connector.

6-4. RIT CONTROL.

Receiver Incremental Tuning is applied at the VFO stage since this stage is one of the three frequency determining elements in the system for both the transmit and receive function.

The varicap (CR13) in the VFO stage is a solid state device whose effective capacity varies with the DC bias potential applied across its terminals. By carefully regulating the bias supply potential with the zener diode (CR14) to obtain frequency stability, the VFO frequency may be varied a small amount with a potentiometer type control.

For normal operation as a transceiver system, the CAL ADJ. potentiometer (R90) is used to set the VFO frequency as a dial calibration control. When Receiver Incremental Tuning (RIT) is desired, the VFO frequency is controlled by setting the varicap bias with the RIT panel control (R91). The varicap bias voltage is switched by the VOX relay (K2) so that the CAL ADJ. potentiometer (dial calibration) sets the VFO frequency when transmitting, regardless of the RIT ON/OFF panel switch (S7) setting. This, of course, keeps the transmitter at the dial frequency and allows independent tuning of the receiver for a few kilocycles either side of the dial frequency when desired.

6-5. METERING.

The transceiver circuits are metered by three meters, one multipurpose meter in the Model SR-2000 unit and two meters in the Model P-2000 Power Supply unit. The two meters in the power supply unit monitor the final amplifier plate voltage (0-5 kilovolts DC) and the plate current (0-1 Ampere). The meters are connected into their respective circuits at a low potential point to avoid an operational shock hazard.

The multipurpose meter (M1) in the Model SR-2000 Transceiver unit has a three-position selector switch (S2) which provides for metering the system as follows:

In positions No. 1 and No. 2 the meter is connected into a bridge circuit with the meter amplifier tube (V6B) forming one arm of the bridge and the METER ZERO control R120 providing the meter zero adjustment arm for bridge balance.

When the transceiver is in the receive mode, the AGC voltage developed on signal is fed to the meter amplifier tube grid to unbalance the bridge and provide a log scale deflection for metering antenna signal levels. The meter is calibrated in the customary "S" units up to S-9 and in DB over S-9 with S-9 representing approximately 50 microvolts at the antenna terminals.

When the transceiver is in the transmit mode, switch position No. 1 connects the meter amplifier tube grid to the diode detector (CR16) circuit in the output of the final amplifier stage which rectifies a portion of the RF voltage developed across the antenna transmission line. (Diode CR17 in this circuit is a directional gate to keep the resistor R103 from loading the AGC buss.) The meter scale is not calibrated in volts RMS for this application since the tune-up procedure requires only that the operator know when he has obtained maximum RF voltage across the antenna terminals.

When the transceiver is in the transmit mode, switch position No. 2 connects the meter amplifier tube grid to the AALC control grid voltage buss. The meter then measures the AALC grid voltage developed when the final amplifier stage is driven into the grid current levels during SSB operation. No calibrated meter scale is required to monitor the AALC action since the meter deflection obtained is used only to indicate the presence and not the value of grid current on voice peaks.

In switch position No. 3 the meter circuit is active only in the transmit mode. The switch has now taken the meter out of the bridge circuit and connected it to the final amplifier screen voltage supply to meter the screen grid current in a conventional meter shunt type circuit. Resistor R118 in the transceiver unit and resistor R318 in the power supply unit form the shunt resistor complement with the metering taking place in the ground return side of the screen voltage supply. The meter scale carries a 0-25 milliampere calibration to monitor the screen current drawn by the final amplifier tubes.

6-6. AALC SYSTEM.

The Amplified Automatic Level Control circuits are in effect only in the transmit mode. To properly employ the peak power capability of the linear power amplifier, the stage must be driven up to and slightly into the control grid current region and yet not over-driven into unwanted distortion known as "flat-topping" the envelope.

AALC action goes into effect when transmitting single sideband signals at peak levels where control grid current begins to flow in the final amplifier tubes (V16 and V17). The grid current pulses generate a small signal voltage across the resistance in the bias supply BIAS ADJ. control (R114). The signal voltage is amplified to usable levels by the AALC amplifier tube (V3B) and then rectified by diodes CR4 and CR5 to become a varying DC bias voltage. The bias voltage is then fed to the 6.0 — 6.5 MC IF amplifier stage (V3A) grid to reduce the stage gain as the AALC bias voltage increases. The control voltage is also fed to the meter amplifier tube (V8B) grid to actuate the meter as a warning device. (METER switch set at AALC.) The "AVC" action on the IF amplifier stage makes the transition from desired drive level to over-driven less critical and a smoother more powerful signal results.

6-7. VOX CONTROL.

The Model SR-2000 Transceiver features automatic control of the receive-transmit change-over function for either SSB phone or CW code operation. For either mode of operation, automatic control is placed in operation when the OPERATION control is set at VOX. When operating SSB the change-over from receive to transmit starts with the first syllable spoken into the microphone. The audio signal (f5) is amplified by the first and second microphone amplifier stages (V19A and V19B) and the VOX amplifier stage (V20A). The amplified audio signal (f5), with its gain adjusted by the VOX control (R150), is then rectified with diodes CR21 and CR22. The positive DC control voltage developed is applied to the grid of the relay amplifier stage (V20B) to actuate the VOX control relay K2 placing the transmitter on the air.

The diode load resistors R154 and R155 (DELAY control) and the storage capacitor C210 determine the drop-out time or delay available to keep the transmitter active between the spoken words by sustaining the positive DC control voltage supplied to the relay tube grid.

The sound from the receiver's speaker that reaches the microphone would normally trigger the VOX relay when it wasn't wanted. To avoid this condition, a sample of the receiver audio (f4) is taken from the plate of the receiver audio output tube (V15) and rectified with diode CR15 to develop a negative DC anti-trip voltage.

This potential when adjusted for correct amplitude by the ANTI-TRIP control (R93) and fed to the grid of the relay tube (V20B) cancels the positive DC control voltage generated by the VOX diodes in the microphone amplifier stages. As a result the relay does not close when the microphone picks up sound from the speaker. When the operator adds his voice to the system, however, the positive DC control voltage developed by the VOX amplifier diodes increases and exceeds the established anti-trip potential and the relay closes as desired.

When operating with keyed CW, the changeover from receive to transmit starts with the closing of the key. The keying system operates on the blocked-grid keying principle, therefore when the key is closed, several stages in the transmitter are keyed ON simultaneously; namely, the transmitter driver stage (V18), the second transmitter mixer stage (V11) and the sidetone amplifier stage (V7B). The keyed sidetone signal (X4) is fed into the second microphone amplifier stage (V19B) as well as the speaker, through the output transformer (T5), for sidetone monitoring purposes. The sidetone signal fed to the second microphone amplifier stage (V19B) passes through the VOX amplifier and rectifier circuits to actuate the VOX control relay (K2) in the same manner as for SSB VOX control. The anti-trip circuit is disabled by the OPERATION switch (S4A) in the CW position since its function is not required for CW operation.

The VOX delay circuits, for CW operation, hold the transmitter in the active state between short breaks during CW keying but will release the control relay for receiver operation at the end of transmission. The delay period for CW control is adjusted, as for SSB, by the DELAY control (R155).

SECTION VII
SERVICE DATA

WARNING

LETHAL VOLTAGES ARE PRESENT IN THE MODEL SR-2000 AND MODEL P-2000 UNITS. NEVER DEFEAT THE SAFETY INTERLOCKS OR WORK INSIDE THE CABINETS WITH PRIMARY POWER CONNECTED.

7-1. COVER AND CHASSIS REMOVAL.

A. Top Cover Removal.

Loosen the four top-cover screws 1/4 turn only and lift cover clear. To replace the cabinet cover, line up the plastic nuts with the cabinet slots, seat the cover and tighten the cover screws 1/4 turn only. The plastic nuts can be damaged by over tightening.

B. Bottom Cover Removal.

Remove the four bottom cover screws located near the cabinet feet and remove the cover. Should the mounting screws be misplaced, use 6-32 x 3/16 inch replacement screws. Screws longer than 3/16 inch will bottom against the chassis before securing the bottom cover.

C. Chassis Removal.

Disconnect all rear chassis cables. Remove both top and bottom cabinet covers. Remove the four cabinet screws at the bottom of the cabinet, near the corners of the chassis, and carefully slide the chassis and panel assembly out the front of the cabinet.

7-2. TUBE AND DIAL LAMP REPLACEMENT.

Access to all tubes, except the two final amplifier tubes, may be had by removing the top cabinet cover. Refer to paragraph 7-1A.

To service the dial lamps, the panel and chassis assembly must also be released from the cabinet and shifted forward far enough to expose the dial lamp assemblies. Remove the four cabinet screws at the bottom of the cabinet, in the corners of the chassis, to release the chassis assembly.

7-3. FINAL AMPLIFIER TUBE REPLACEMENT.

Access to the final amplifier tubes may be had by removing the top cabinet cover (paragraph 7-1A) and removing the final amplifier compartment cover, held in place by five screws. Note that the rear edge of the compartment cover is clipped to the rear lip of the chassis structure. When replacing the cover, be sure to engage the clip properly and line up the interlock stud on the cover with the interlock plunger before replacing the mounting screws.

The power tubes may be lifted straight up out of their sockets after disengaging the plate clips and moving the parasitic suppressors to one side. The tube chimneys need not be disturbed. Do not disturb the neutralizing tab near the plate of tube V17.

CAUTION

BE EXTREMELY CAREFUL WHEN REMOVING OR INSERTING THE TYPE 8122 POWER TUBES. CAREFULLY ALIGN THE BASE AND SOCKET KEYING AND INSERT THE TUBES GENTLY INTO THE SOCKETS. MAKE SURE THE TUBES ARE PROPERLY SEATED AND THE PLATE CAPS ARE RECONNECTED SECURELY.

7-4. PLATE CONTROL RESTRINGING PROCEDURE.

Remove the cabinet top cover (paragraph 7-1A) and final amplifier compartment cover (five screws), to gain access to the PLATE control drive mechanism. Note that the rear edge of the compartment cover is clipped to the rear lip of the chassis structure. When replacing the cover, be sure to engage the clip properly and line up the interlock stud on the cover with the interlock plunger before replacing the mounting screws.

Restring the plate capacitor drive system with 50 pound test dacron cord or equivalent, following the arrow and letter sequence in figure 10. Maintain a spring expansion of approximately 1/2-inch on the dial cord spring.

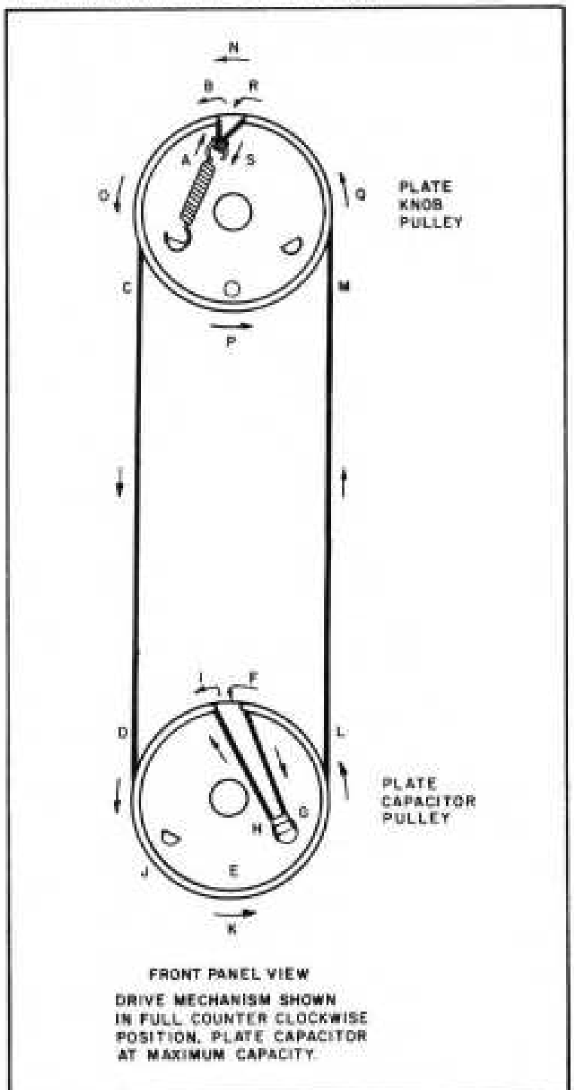

Figure 10. Plate Control Restringing Diagram.

After completing the stringing operation, rotate the PLATE control knob counterclockwise until the plate tuning capacitor is completely meshed (maximum capacity) and, if necessary, loosen the knob set screw and re-index the knob at 1 on the panel calibration scale.

7-5. TROUBLESHOOTING.

In the design of this transceiver, full consideration was given to keep maintenance problems at an absolute minimum. As in all well designed electronic equipment, maintenance and repair problems are generally confined to the checking and replacement of tubes and semiconductor devices which may become defective. Malfunctions of this nature are usually easily isolated and corrected. However, it is entirely possible that a more obscure malfunction may arise. In this event, only thoroughly trained technical personnel should attempt to service equipment of this complexity.

A recommended aid to troubleshooting the Model SR-2000 Transceiver is a general coverage receiver which can be used to provide a quick check on the various oscillator circuits within the SR-2000. A lead connected to the antenna of this receiver, when placed in the proximity of the oscillator tube in the circuit to be checked, can determine the presence or absence of signal from the stage in question.

If a malfunction occurs when operating on one particular band and/or mode of operation, the unit should be checked on all other bands and in all other modes of operation to isolate the difficulty. A careful study of the block diagram (figure 9) will give a quick clue as to which tubes should be checked. The voltage and resistance charts (figures 11 and 12) and schematic diagrams (figures 21 and 22) will also aid in isolating and correcting a malfunction.

7-6. SERVICE AND OPERATING QUESTIONS.

For further information regarding operation or servicing of the Model SR-2000 Transceiver, contact the dealer from whom the unit was purchased. The Hallicrafters Company maintains an extensive system of Authorized Service Centers where any required service will be performed promptly and efficiently at no charge if this equipment is delivered to the service center within 90 days from date of purchase by the original buyer and the defect falls within the terms of the warranty. It is necessary to present the bill of sale in order to establish warranty status. After the expiration of the warranty, repairs will be

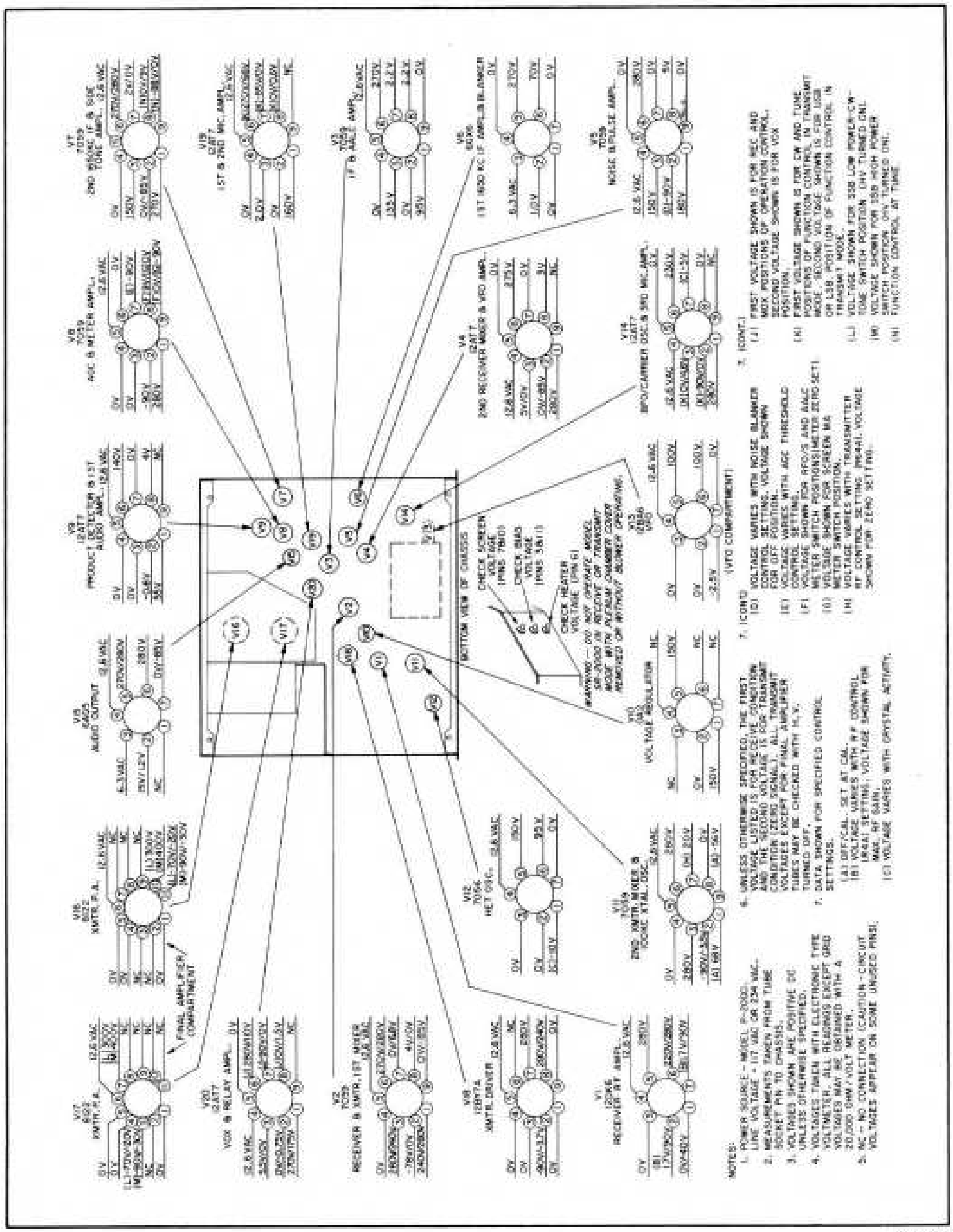

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Figure 11. Model SR-2000 Voltage Chart.

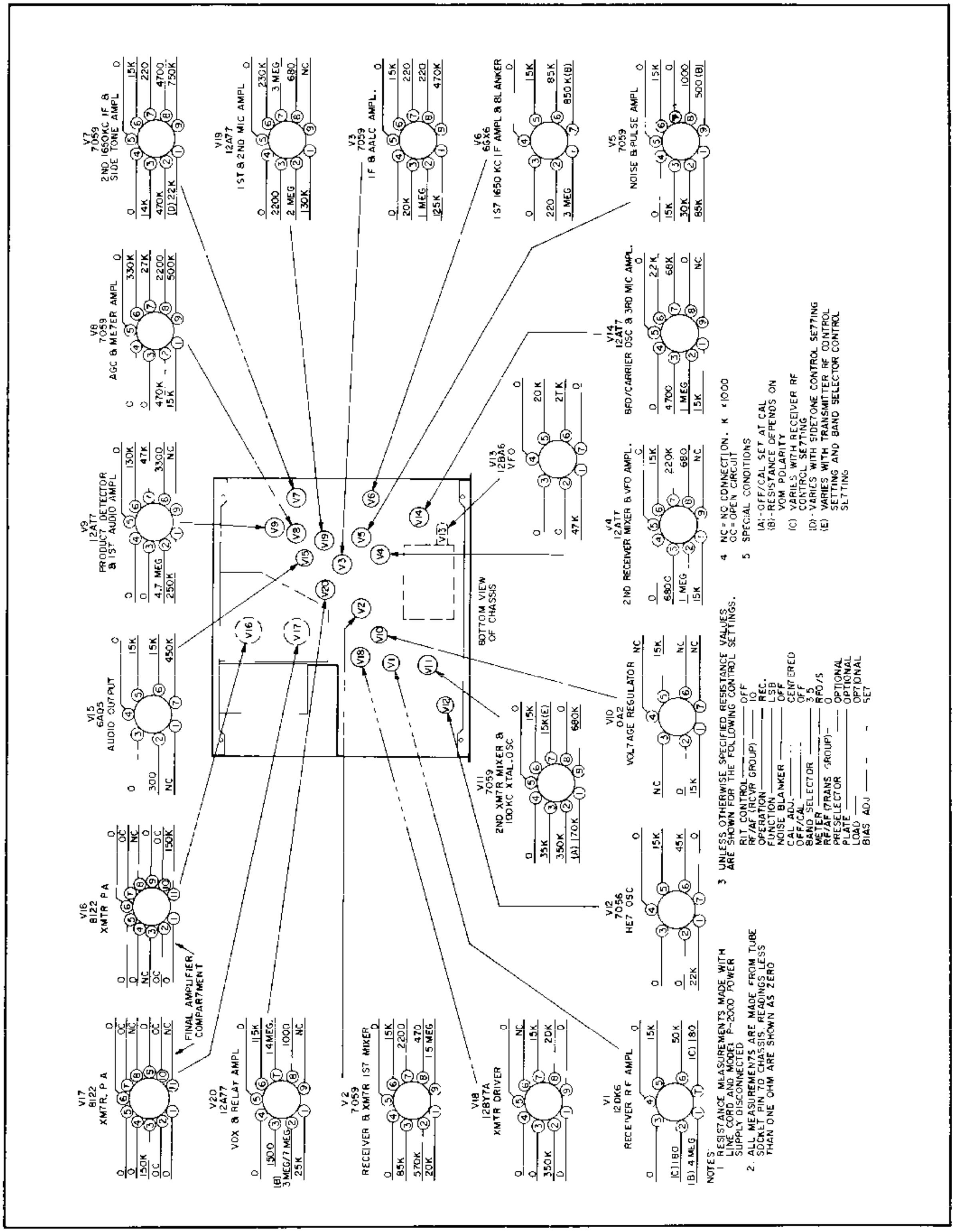

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Figure 12. Model SR-2000 Resistance Chart.

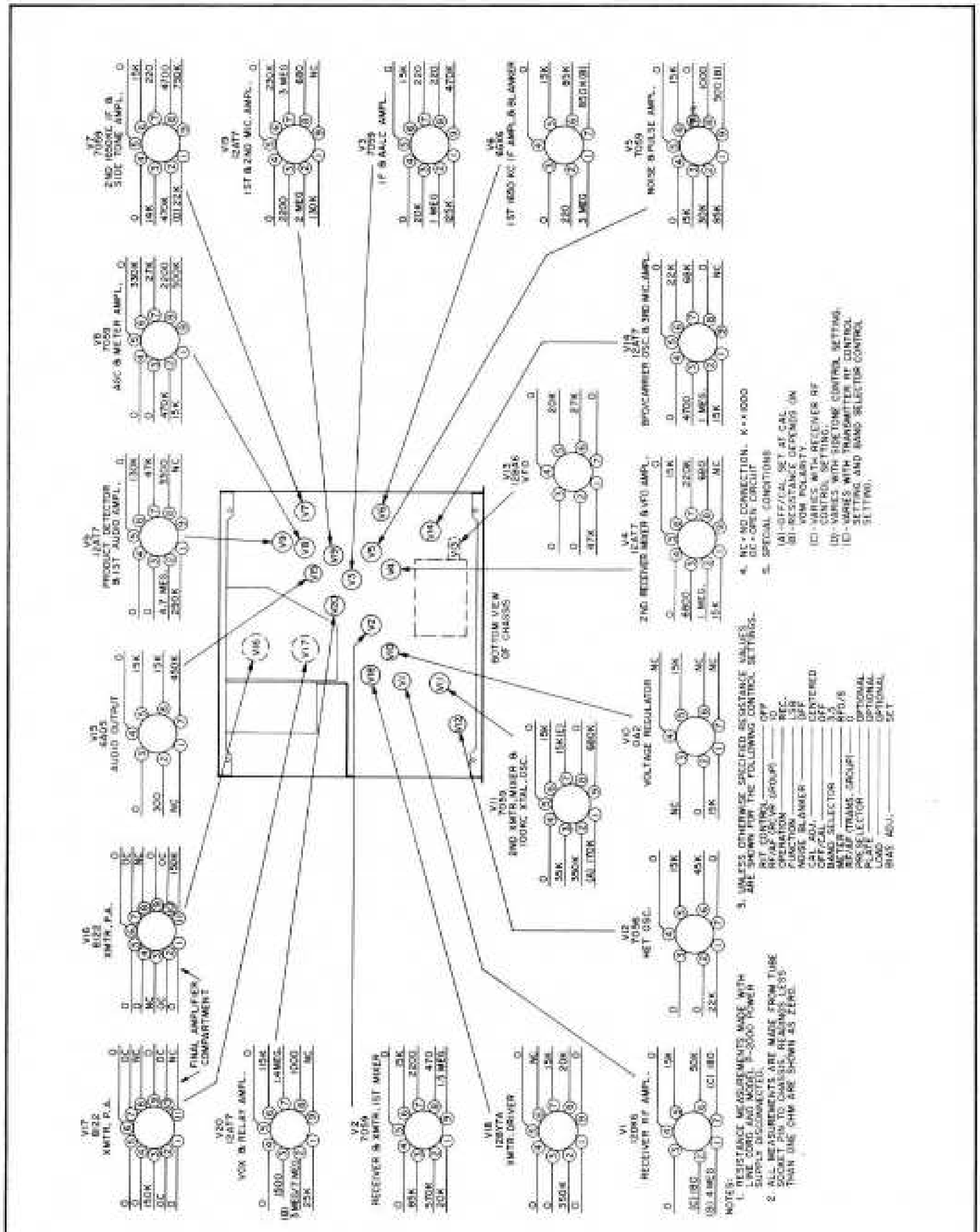

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Figure 12. Model SR-2000 Resistance Chart.