

MULTIPHASE EXCITER

MODEL 20 A

INSTRUCTION MANUAL

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No. 2,566,876

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CONDENSED OPERATING INSTRUCTIONS FOR MULTIPHASE EXCITER MODEL 20A

Connect an antenna or a linear amplifier to the 52 ohm RF output. Set bandswitch to the band desired and the VFO-Xtal switch to the proper position. Turn CARRIER knob fully clockwise. Turn OPERATION selector to MANUAL and tune the MIXER AND AMPLIFIER for maximum output as shown on the RF INDICATOR, an oscilloscope or an antenna meter.

TO OPERATE SINGLE SIDEBAND

Set the MODULATION selector to one of the sideband position (SB1 or SB2). Turn the OPERATION selector to MANUAL. With the CARRIER knob set at "0" adjust the CARRIER NULL controls A and B for minimum RF indication with the INDICATOR switch in CARRIER NULL position. Now return the INDICATOR switch to SET MAX LEVEL. Adjust the SPEECH LEVEL control between 9 and 12 o'clock, depending upon microphone gain. Talk into the microphone and you're on SSB1

TO OPERATE AM

Place the MODULATION selector in the AM position. Leave the CARRIER NULL knobs in the balanced-out condition, Advance the CARRIER knob until maximum output is obtained. Then reduce the CARRIER level to one half of the maximum value on the scope or to one half the maximum antenna current. Adjust the SPEECH LEVEL until the modulation peaks just reach the maximum output value on the scope. Too little or too much carrier will make the AM transmission sound distorted.

TO OPERATE PM (Narrow band phase modulation)

Turn the MODULATION selector to PM position. Leave the CARRIER NULL knobs on the balanced-out condition. Advance the CARRIER knob to nearly full output. Adjust the SPEECH LEVEL control so that the modulation peaks do not exceed the carrier.

TO OPERATE CW

Turn the MODULATION selector to CW. Place the OPERATION selector on MANUAL. Advance the CARRIER control to nearly full output. Plug key into jack on front Panel.

TO USE THE VOICE CONTROL CIRCUIT (VOX)

Connect the receiver speaker to the Exciter as shown in the circuit diagram. The resistor across 1 and 2 on the rear terminal strip should be about two to three times the speaker voice coil impedance and rated at twice the power output. The extra contacts on 8, 9 and 10 may be used to operate an antenna relay, additional receiver silencing circuits, etc. With the OPERATION selector in VOX position talk into the microphone and adjust the VOX sensitivity control on the rear of the chassis for proper operation.

CALIBRATION LEVEL CONTROL

When the OPERATION selector is in the CALIBRATE position the CAL LEVEL control will vary the output of the Exciter for frequency "spotting".

INDICATOR SWITCH

In the CARRIER NULL position the speech circuit is disabled and the RF INDICATOR operates at maximum sensitivity. The CARRIER control should always be at "0" while balancing out the carrier with CARRIER NULL knobs A and B. In the SET MAX LEVEL position, the RF INDICATOR sensitivity can be adjusted by the IND LEVEL control,

RF INDICATOR

The 6E5 RF INDICATOR shows the peak RF voltage output of the Exciter. It can be used for peaking the Mixer and Amplifier tuning controls and also to determine the proper speech level while operating SSB. To determine the maximum undistorted SSB output of the Exciter or linear amplifier, advance the CARRIER control until no further increase in output is observed. Now set the IND LEVEL control to just close the eye. Return the CARRIER CONTROL to "0" and adjust the SPEECH LEVEL until the voice peaks reach about 80% of the full carrier value.

EXTERNAL BLOCKING BIAS

In the standby position, -100 volts DC appears at terminal 7 on the rear terminal strip. If a bias supply is used for a linear amplifier the positive should be returned to this terminal of the Exciter. All positive components in the bias supply must be "floating" from ground, and connected only to the positive lead.

When zero bias tubes are used, the amplifier grid return lead should be by-passed and then connected to terminal 7. A secure ground connection should be made between the Exciter, linear amplifier, linear amplifier power supply and the bias supply.

If an antenna relay with auxiliary contacts is used, these auxiliary "make" contacts can be used to key the blocking bias by connecting them to #6 and #7 on the rear terminal strip. Proper keying sequence is required so that the antenna circuit makes before the blocking bias is removed.

When the auxiliary contacts on an antenna relay are not used to key the transmitter, the jumper should remain between terminals 6 and 7 on the strip.

RESISTIVE LOADING OR "SWAMPING"

When driving a linear amplifier, some resistive loading should be used at the Exciter or at the amplifier grid circuit. Non-inductive resistors should be used and may be connected to the two screw terminal output strip on the rear chassis. The amount of resistive loading required will depend upon the type of tubes used in the amplifier. Pentodes, tetrodes and zero bias triodes require only a small amount, while medium and low mu tubes will require heavier swamping for low distortion.

If the exciter is lightly loaded, there is a possibility of the system going into self-oscillation. Resistive loading is not necessary when the Exciter is coupled to a constant load, such as a 50 to 70 ohm antenna.

PRELIMINARY ALIGNMENT INSTRUCTIONS.

THE FOLLOWING IS RECOMMENDED FOR UNITS CONSTRUCTED FROM KITS.

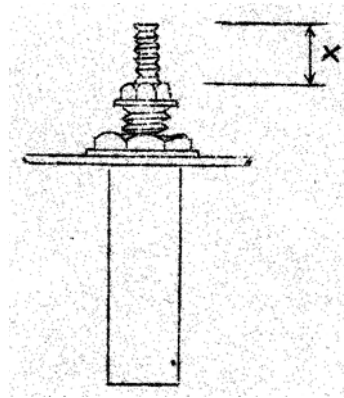
Check for "B" shorts with an ohmmeter before power is applied.

Before plate voltage is applied, the 6AG7 grid bias should be checked. This should be done by removing the 5U4G rectifier tube. With the relay in the normal position, the reading at Pin #4 of the 6AG7 should be -100V DC plus or minus 10% measured with a VTVM. When the relay is operated by hand, there should be approximately -11V DC at this point. After the 5U4G is inserted the operating bias should be -10.5V DC obtained from the voltage divider R47 and R48.

Insert the 5U4G rectifier and apply power. Check "B" voltages in accordance with the chart on the circuit diagram, with the OPERATION switch on MANUAL.

Preliminary rough alignment of the slug tuned coils. If a grid dipper is available the coils should be aligned to the frequencies indicated on the Alignment Data Chart (Fig. B) If no dipper is available they should be set as follows BEFORE POWER IS APPLIED:

| | |
|---------------|-------|
| No. 1. Red | 1/2" |
| No. 2. Green | 3/16" |
| No. 3. White | 1/2" |
| No. 4. Black | 1/2" |
| No. 5. Blue | 1/2" |
| No. 6. Orange | 5/16" |
| No. 7. Yellow | 5/16" |
| No. 8. Blue | 3/8" |



(Not used on Model 10B)

The Audio Balance controls should be set in approximately mid-position.

During alignment, a slight amount of tension should be kept on the adjusting screws by proper adjustment of the locking nut to prevent erratic operation.

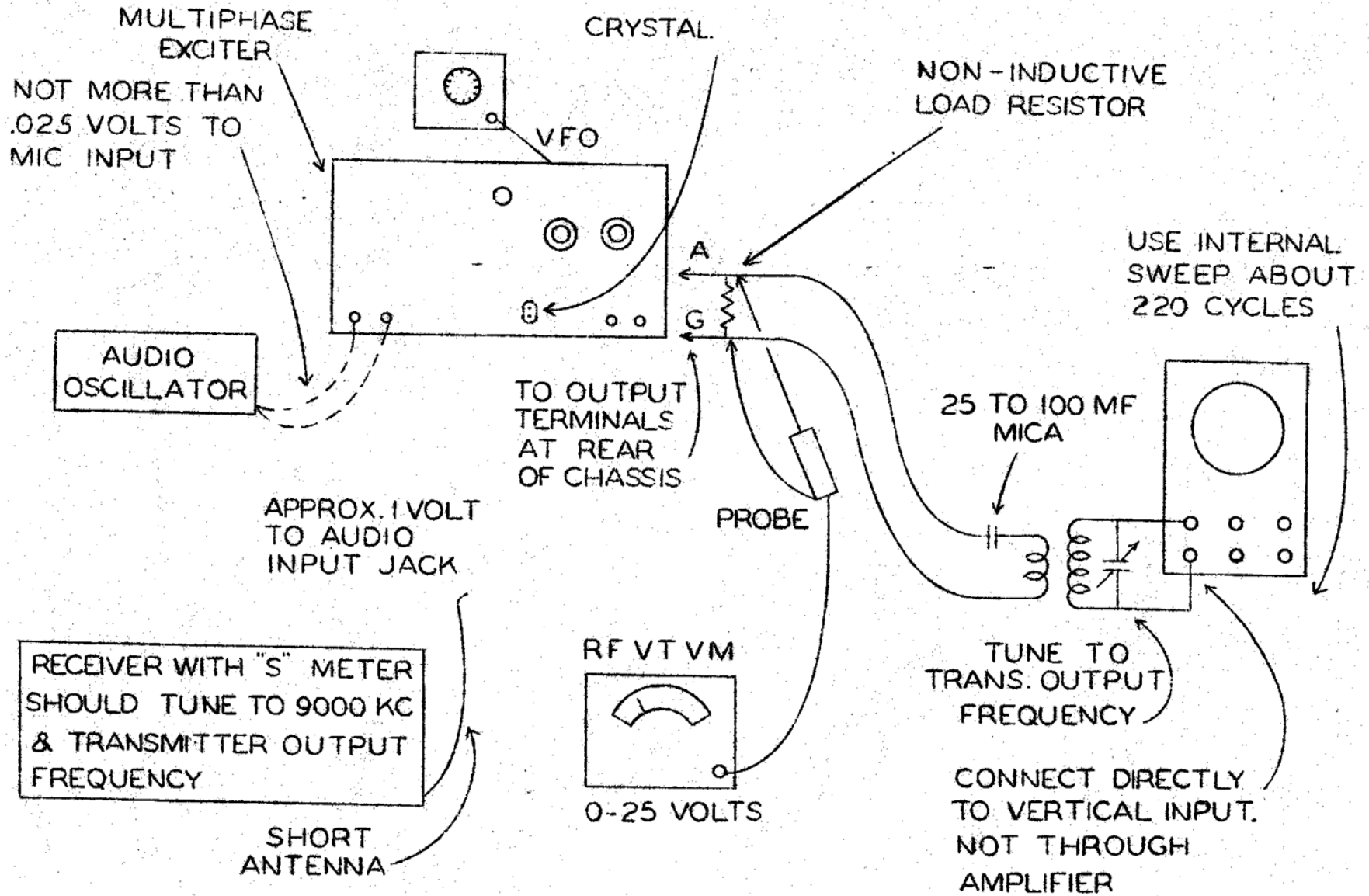


FIG A

20A GENERAL ALIGNMENT PROCEDURE

The front panel controls should be set as follows:

OPERATION SWITCH, in MANUAL
SPEECH LEVEL, completely counter-clockwise
MODULATION SWITCH, Sideband 1
CARRIER NULL A, middle position
CARRIER NULL B, 80% clockwise
CARRIER, completely counter-clockwise
VFO-XTAL SWITCH, in correct position
INDICATOR SWITCH, an SET MAX LEVEL
INDICATOR LEVEL, completely clockwise
BANDSWITCH, to proper band
TUNING CONTROLS, to output frequency

Refer to Fig. A. Connect a non-inductive load resistor of about 50 ohms, 20 watts to the Exciter output terminals. This resistive load may consist of several one or two watt composition resistors in parallel or series-parallel to provide the proper resistance and dissipation.

Connect an oscilloscope, lightly coupled, to the RF output.

If available, an RF vacuum tube voltmeter with a 25 to 50 volt RMS range should be connected to the RF output.

CAUTION: Never remove the 9000 kc. crystal from the socket while the 6U8 tube is operating. This may damage the tube.

In Exciters that are constructed from kits and are being aligned for the first time, it is recommended that the initial 9 MC alignment of L1 through L5 be made with the red lead removed from the center arm of CARRIER NULL pot A (R23). This will prevent interlocking of the adjustments. After peaking these circuits twice, connect the red wire back to the pot. This procedure will not be required on units previously aligned.

At this time it should be possible to hear a signal on the output frequency with the receiver operating near full sensitivity (AVG on) provided the VFO or frequency conversion crystal is operating. The receiver should be coupled lightly to the Exciter RF output terminal. Refer to Fig. B. Adjust L2, L3, L4, L5 and the MIXER AND AMPLIFIER tuning capacitors for maximum output. As maximum output is reached, it will become necessary to reduce the carrier output by adjusting CARRIER NULL pot B and also reduce the sensitivity of the RF INDICATOR by turning the CAL LEVEL control counter-clockwise to prevent the eye from overlapping. Now adjust CARRIER NULL knobs for minimum carrier output. If you have removed the red lead from R23, it must be connected at this time. Next, unbalance CARRIER NULL pot B a slight amount and peak L2

through L5 again. NOW adjust both CARRIER NULL controls for minimum output. Minimum output will not necessarily occur at the center of the rotation due to stray capacities, etc.

When L2 (green) is mounted approximately 3/4" (center to center) away from L1 (red), the RF voltage from the arm of each CARRIER NULL pot to ground will be equal when the carrier is balanced out. If desired, this may be checked with an RF vacuum tube voltmeter.

ADJUSTMENT OF L6 and L7

When operating on the 20 meter band, these trap circuits reduce the radiation of the third harmonic generated in the mixer by the heterodyning crystal or VFO operating in the range of 5 to 5.3 MC. With the bandswitch set to 20 meters, the SPEECH LEVEL turned off, carrier balanced out, and OPERATION switch in the MANUAL position, RF output will be found when the Mixer and Amplifier tuning controls are set at about 15.5 MC. Adjust both these traps for minimum 15,450 kc. output while using a crystal at approximately 5,150 kc, If no crystal in this range is available, one at approximately 3,850 kc. will supply sufficient 4th harmonic output for this purpose. If you do not intend to operate 14 MC crystal controlled, it will not be necessary to adjust L7 (yellow). When only VFO operation is contemplated in this band, L6 (the orange coil on top of the bandswitching assembly) should be tuned for minimum 15,450 kc. output with the VFO set at 5,150 kc,

Although the 3rd harmonic output may be only a few percent of the total, it can be amplified by the 'Mixer and Amplifier stages and result in considerable output. With the trap circuits properly aligned, the power output at 15,450 kc. will be less than 10% of that normally obtained at 14 MC., even though the Mixer and Amplifier are peaked at 15,450 kc. When the Mixer and Amplifier are peaked at 14 MC. the other signal will be down in excess of 50 db. in the Exciter. The addition of a properly tuned linear amplifier stage will increase the rejection of the 15 MC. signal to at least 70 to 80 db, down.

The VFO output should be advanced to the point where additional coupling will not increase the Exciter output. Over-injection to the Mixer can cause unnecessary spurious radiation.

ADJUSTMENT OF 5 MC. TRAP L8

Blue coil near the right edge of the chassis. Set the bandswitch to 80 meters. With either a 5 MC. crystal plugged into the socket on the front panel or 5 MC. VFO insertion, adjust the Mixer and Amplifier tuning controls for maximum 5 MC. output. This will occur slightly lower in frequency than the 7 MC. dial calibration. Adjust L8 for minimum output.

ADJUSTMENT OF C81, C82, C83, C84: These four trimmers appear on a strip at the right of the bandswitching assembly, just below the 12BH7 tube. They tune the cathode coils on 10, 15, 20 and 40 meters, respectively. The 10 meter trimmer is the one closest to the chassis; the second one is 15 meters, etc. They should be peaked for maximum output in the center of their band with a small amount of CARRIER inserted.

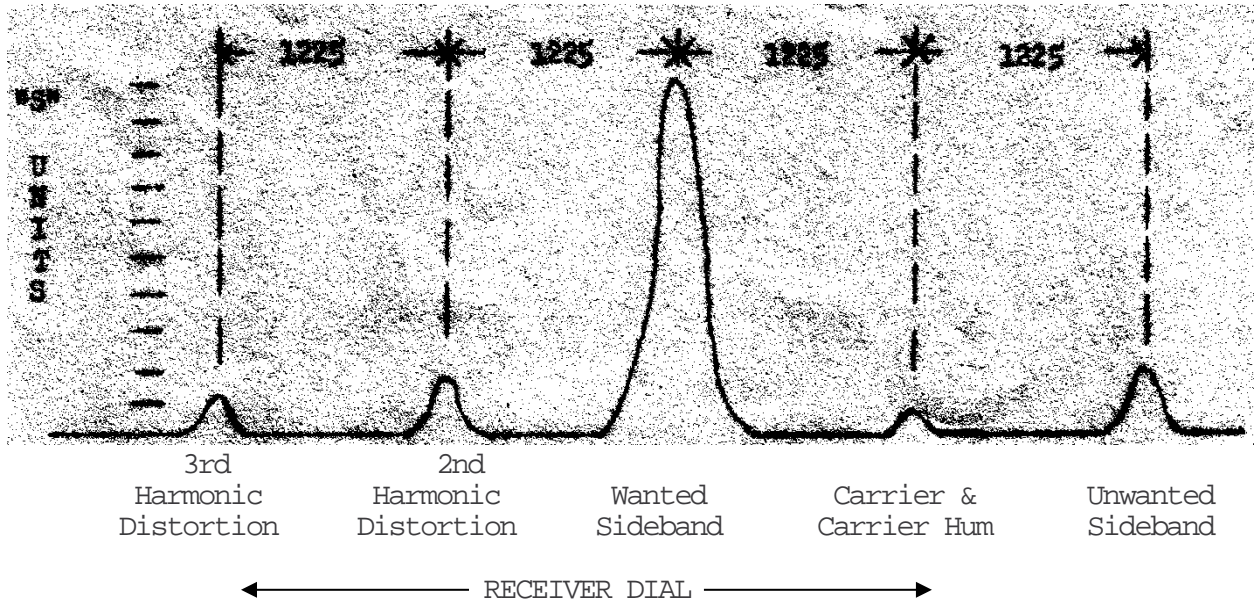
SIDEBAND SUPPRESSION ADJUSTMENT: Before proceeding with the Single Sideband adjustments, it is recommended that the operator familiarize himself with the illustrations of the oscilloscope patterns shown in this manual. The ultimate objective in the single sideband alignment is to obtain a pattern containing a minimum amount of ripple when a pure sine wave is applied to the microphone input. These adjustments should preferably be made at less than full output, to prevent amplifier overloading,, which might "wipe off" the small modulation ripple.

A low distortion audio oscillator (less than 1%) set to approx. 1,225 cycles, with an output level between .005 and .05 volts should be connected to the microphone jack. CAUTION: If a voltage in excess of .075 is applied to the Mic. input the speech amplifier will overload and it will be impossible to adjust the exciter properly.

Adjust both CARRIER NULL pots for minimum carrier output. Advance the SPEECH LEVEL control until about half of maximum output is obtained on the oscilloscope. At this point a fair amount of ripple will be observed on the output wave. Adjust the Audio Balance controls for minimum ripple. Now switch from Sideband 1 to Sideband 2 and observe the ripple in each. If the amount of ripple is not equal, vary the adjustment slightly on L2 until the displays are identical in either sideband position. However, each time L2 is tuned, it will be necessary to rebalance both carrier null controls for minimum. It will also be necessary to readjust the Audio Balance controls again.

It is possible to make these sideband suppression adjustments using a receiver in place of an oscilloscope. Turn the AVC on, the BFO off, and remove the antenna to prevent receiver overload. Now tune in the signal. Minimum modulation heard in the loudspeaker corresponds to minimum modulation of the R.F. envelope. Adjust as described in the previous paragraph.

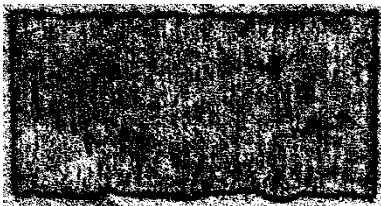
After the alignment has been completed, an analysis of the emitted wave may be made if the receiver has a sharp crystal filter and a calibrated "S" meter. The following illustration is an example of the "S" meter levels as the receiver dial is tuned through the signal with a 1225 cycle tone input to the exciter.



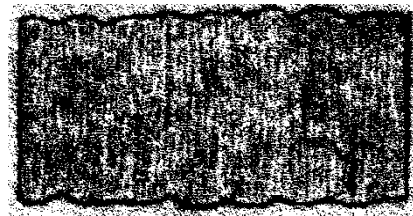
It is possible to obtain an almost ripple-free pattern in one sideband at the expense of degradation of the other. Under this condition the suppression of the better sideband will be about 45 db., while the other is only 35 db. down. The Object is to have them both equal, approximately 40 db. down.

If a deep modulation ripple is noticed on both sideband positions (with carrier balanced out), one side of the audio phase shift circuit is probably operating improperly. Check the Audio Balance controls adjustment, the 12AT7(B) modulator tube, sideband switching circuit, or the phase shift network.

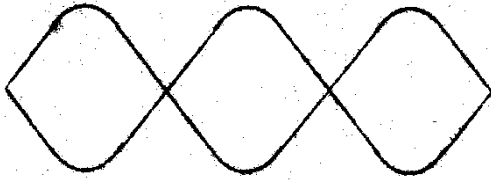
After the alignment has been completed, be sure to tighten the #6 lock-nuts on the iron core slugs



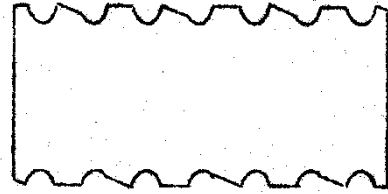
Good SSB Signal
Pure Tone Input



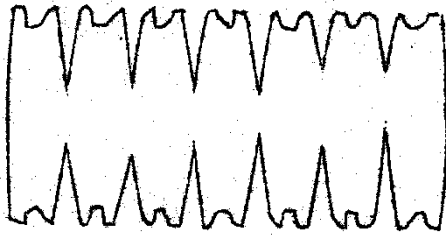
- SSB Signal, Tone Input
1. Carrier leakage
 2. Improper RF phasing (L2)
 3. Improper AF balance (R18-15A)
 4. Balanced Mod detuned (L3)
 5. Poor sideband rejection



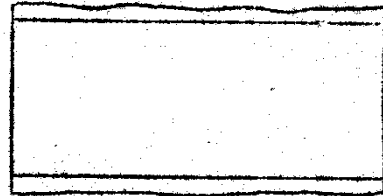
SSB SIGNAL, TONE INPUT
WITH PROPER CARRIER INSERTED
100% MODULATED



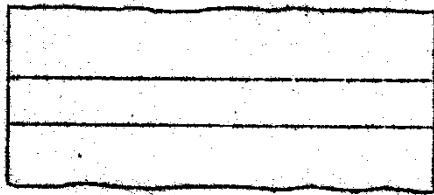
SSB SIGNAL, TONE INPUT
AUDIO DISTORTION
EXCESSIVE AUDIO INPUT



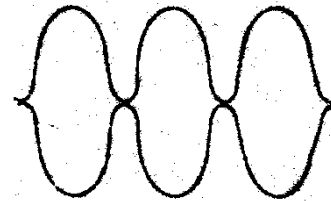
SSB SIGNAL, TONE INPUT
INSUFFICIENT 9000 kc. XTAL
OSCILLATOR OUTPUT



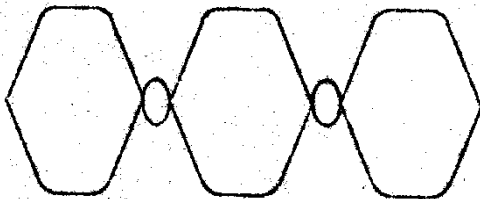
GOOD SSB SIGNAL, TONE
INPUT WITH SMALL PER
CENT OF SPURIOUS RADIA
TION (RF)



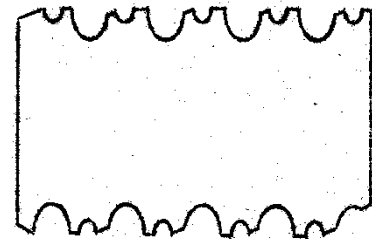
GOOD SSB SIGNAL, TONE INPUT
WITH LARGE PERCENT OF
SPURIOUS RF RADIATION



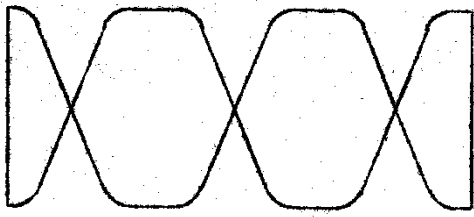
SSB WITH CARRIER, TONE
INPUT IMPROPER AMPLIFIER
BIAS



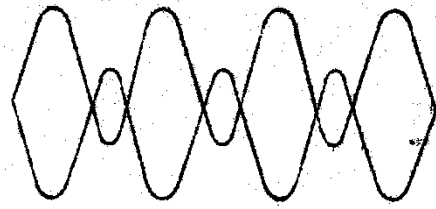
DOUBLE SIDEBAND WITH CARRIER
EXCESSIVE TONE MODULATION
WITH AUDIO PEAKS SQUARING OFF



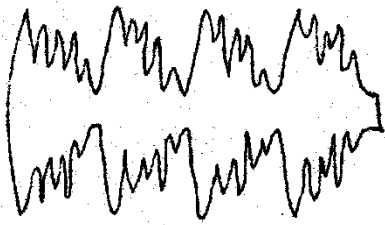
SSB SIGNAL, TONE INPUT
BALANCED MOD DETUNED (L3)



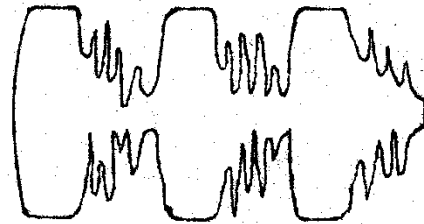
SSB WITH CARRIER, TONE INPUT
 1. EXCESSIVE AUDIO
 2. INSUFFICIENT ANT LOADING



DSRC DOUBLE SIDEBAND REDUCED
 CARRIER OBTAINED BY REDUCING
 CARRIER LEVEL AND INCREASING
 AUDIO INPUT LEVEL



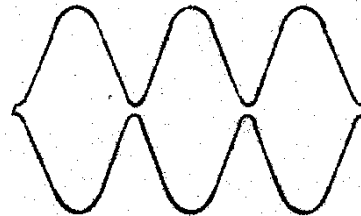
GOOD SSB SIGNAL
 VOICE INPUT



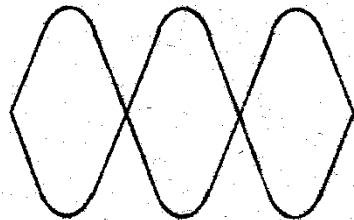
SSB SIGNAL, VOICE INPUT SQUARING
 AUDIO PEAKS EXCESSIVE SPEECH GAIN



SSB SIGNAL, TONE INPUT
 AMPLIFIER OVERLOADING DUE TO
 EXCESSIVE AF OR RF DRIVE NOTE
 THE LACK OF SMALL RIPPLE ON
 ENVELOPE



DOUBLE SIDEBAND AM WITH
 CARRIER 100% MODULATED

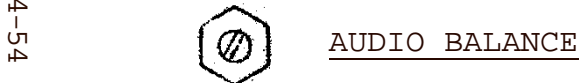


TWO TONE LINEARITY TEST
 OBTAINED WITH SINGLE TONE
 INPUT, WITH CARRIER BALANCED
 OUT ON AM

FOR ADDITIONAL REFERENCE THE
 FOLLOWING IS RECOMMENDED:

SUGAR COATFD LINEAR AMPLIFIER
 THEORY - OCT. '51 QST

HOW TO TEST AND ALIGN A LINEAR
 AMPLIFIER - MAY '52 QST



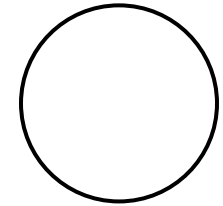
AUDIO BALANCE

Adjust for minimum unwanted sideband ripple with 1225 cycle tone Input



AUDIO BALANCE

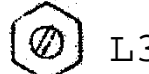
Adjust same as above



L1



L2



L3



L7

1. RED XTAL OSC. 9000 KC
Peak for maximum Output

with CARRIER NULL knob B unbalanced

2. GREEN 90° PHASE SHIFT 9000 KC.

Peak for max. output with CARRIER NULL knob B unbalanced slightly. Afterward, adjust for equal sideband suppression with 1225 cycle tone input

3. WHITE BALANCED MOD. 9000 KC

Adjust for max output With CARRIER NULL B knob unbalanced slightly

7. YELLOW TRAP 15.5 MC

Adjust in same manner as orange trap. Will tune only with 20 meter xtal in use

6. ORANGE TRAP 15.5 MC. Use VFO at 5150, or else an xtal at 5150 or 3800. Adjust for min. 15.5 Inc. output on 20 m. band with mixer and amp tuned for max. 15.5 mc. output

5. BLUE 9 MC FILTER
Same as 4

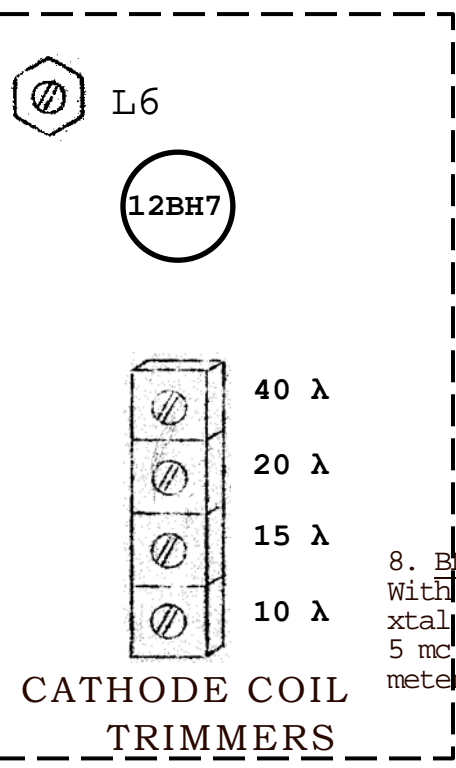
4. BLACK 9 MC FILTER
Adjust for max out with CARRIER NULL B Knob unbalanced slightly



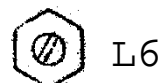
L5



L4



CATHODE COIL TRIMMERS



L6



12BH7

ON BAND SW. ASSEMBLY



L8

8. BLUE TRAP 5 MC
With 5 mc VFO or xtal, tune for min 5 mc. output on 80 meter band.

ALIGNMENT DATA FOR MULTIPHASE EXCITER MODEL 20A

FIGURE B

