BENCH ALIGNMENT PROCEDURE FOR RECEIVER MODEL 4ER30B2

GENERAL

The following instructions cover the procedure for completely aligning the Receiver. Whenever a stage has been tampered with, misaligned or modified, etc., follow the procedure as outlined in this instruction.

SERVICE OUTLINE

The Simplified Alignment procedure may be used if only the oscillator, multiplier, limiter or the secondary of the discriminator need retuning.

METHODS OF ALIGNMENT EXPLAINED

Most of the stages in this receiver are designed for either loose or critical coupling and can be tuned by simple peaking methods. The 1st IF (T324 or T318) is overcoupled and must be tuned by the resistor load method (best) or the peak and dip method.

Peaking Method:

An RF signal of the proper frequency is fed to a loosely or critically coupled stage and the stage is then adjusted for maximum meter reading at its output.

Discriminator Adjustment Method:

An unmodulated RF signal of the proper frequency (i.e., 290-kc) ± 10-kc is applied to the discriminator stage. The signal source should be of a constant amplitude over this ± 10-kc deviation. The primary tuning slug is adjusted to obtain equal plus and minus voltages for ± 10-kc deviation. At -10 kc the voltage is negative and at +10 kc the voltage is positive.

Resistor Load Method:

An RF signal of the proper frequency is fed to an overcoupled stage. Placing the proper load resistors across the coils makes the coils critically coupled, so that they can be

tuned by a simple peaking procedure. After peaking, the resistor loads are removed, returning the coils to normal (overcoupled).

Peak and Dip Method:

An RF signal of the proper frequency is fed to an over-coupled stage. The first coil is adjusted for maximum, while the second coil is shorted out. The short is removed and then placed on the third coil, while the second coil is tuned for minimum. The remaining coils are also shorted and alternately peaked and dipped. The metering is done across the first coil during the entire procedure.

PRELIMINARY OPERATIONS

Warmup

The receiver should be allowed to warm up for 5 minutes or more before tuning.

The signal generator may require as much as a half hour for warmup. See individual signal generator manual for recommended warmup.

Voltage

Check for proper battery or supply voltage (6.6, 13.2 or 26.4 volts d-c or 117 volts a-c).

Discriminator Zero

During the entire alignment, the generator frequency must be checked every few minutes for zero discriminator (after the discriminator has been correctly set at 290-kc.) The 290-kc signal should just saturate the second limiter grid. The 290-kc signal can be inserted at any stage ahead of the stage being tuned.

Crystal oven cycling, causing a slight frequency variation with temperature (.0005% of crystal frequency), can be observed when setting the discriminator for zero. This same crystal oven cycling is also present on the transmitter. When setting for discriminator zero, this cycling can be taken into account by first observing the maximum meter variation and then setting zero for an average of this variation.

Signal Generator Connections

Signals from the signal generator should be applied through a .01-mfd capacitor for all the procedures except when applying

the signal to the antenna jack. The leads from the capacitor should be as short as possible. Connect the generator ground probe as close to the point of signal input as possible.

Metering

Before using a 20,000 ohm-per-volt meter or VTVM for metering, make certain that the meter reads exactly zero for the position it is being used. Since adjustments are to be made within 1-4 microamperes of zero, it is very important that zero is accurately set.

RECEIVER SENSITIVITY

Noise Current

The 2nd Limiter noise current was 110 microamperes or more when shipped. No loss of receiver sensitivity will occur as tubes age, until the noise current drops below 60% at J303 (2nd Limiter grid). To check for normal gain, make certain that the antenna transformer and RF tanks are both peaked. Replace the antenna with a 50-ohm load resistor. A reading of 100-microamperes or more at the 2nd Limiter grid will indicate normal gain.

Stage Gains

As a means of checking stage gains, the signal levels given in Table 1 may be used. When applied at the points indicated, these signal levels will give a reading of 40-microamperes at the 1st Limiter grid. A variation in readings greater than 2-to-1, indicates a possible source of trouble. High noise current in a set may interfere with proper measurement of the first three figures in this table, in which case, both the input and 1st Limiter current may be doubled or tripled to estimate performance.

TABLE 1

SIGNAL GENERATOR FREQUENCY	SIGNAL LEVEL IN MICROVOLTS (Approx.)	INPUT POINT
Operating Frequency	14	RF grid (XV320-1)
3.2-Mc	85	1st Mixer grid (XV302-7).
290-Kc	320	2nd Mixer grid (XV319-2).
290-Kc	1350	XV305-1
290-Kc	100,000	XV306-1

A receiver having 20 microamperes of 1st limiter noise current might give the 1st limiter signal currents as shown in Table 2.

TABLE 2

RF (72-76 MC to Cavity)	1ST LIMITER GRID JACK (J302)	
MICROVOLTS	VOLTS	MICROAMPERES
.00	0.4	20 (noise)
.75	0.7	40 (signal)
1.50	1.0	65 (signal)
2.00	1.3	80 (signal)
3.00	1.8	110 (signal)

DISCRIMINATOR ALIGNMENT

EQUIPMENT REQUIRED

1. A non-metallic screwdriver.

2. A 0-3 volt d-c meter. (20,000 ohm-per-volt or VTVM) or a 0-100 microampere d-c meter (EX-1-C)

3. A 290-kc calibrated signal source. (Generator can be calibrated against the 290-kc signal present in another receiver which has not been tampered with).

PROCEDURE

1. Apply 290-kc ± .002% signal through a .01-mfd capacitor to XV307-1. Use a signal strong enough to saturate the 2nd LIMiter grid.

2. Connect voltmeter between DISC jack (J304-orange) and ground.

3. Remove 3490-kc crystal (Y304) to PREVENT SIGNALS OR NOISE FROM INTERFERING WITH ALIGNMENT.

4. Tune top slug (secondary) of discriminator transformer (T308) for zero reading on voltmeter.

5. Turn signal generator dial to 280-kc and note value of negative voltage on meter.

6. Turn signal generator dial to 300 kc and note value of positive voltage on meter.

7. Positive and negative voltages noted in steps 4 and 5 must be equal in amplitude. If not equal, tune bottom slug (primary) of discriminator transformer (T308) until the voltages are equally positive and negative within 0.3-volt on a VTVM or 0.1-volt on a 0-3 voltmeter. Adjusting the primary slug will require that the secondary be readjusted.

IF ALIGNMENT

3.2-MC IF TRANSFORMER (T316)

Equipment Required:

1. A non-metallic screwdriver.

2. A 0-3 volt d-c meter or a 0-100 microampere d-c meter.

3. A 3.2-MC signal source.

Procedure:

1. Apply a 3.2-Mc signal through a .01-mfd capacitor to XV302-7. Do not saturate the 1st Limiter. Keep signal zeroed to discriminator (Remove the 1st Osc. crystal).

2. Connect meter between LIM-1 jack (J302-green) and ground.

3. Leave the 3490-kc crystal (Y304) in its socket.

4. Tune the four coils of the transformer for maximum meter reading.

Discriminator-Idling:

When a set has been completely and properly aligned, the no signal reading of the discriminator (noise only) should be within ± 0.6-volt of zero when read on a VTVM. This is equivalent to 10.0-microamperes on a 2400-ohms microammeter or 0.2-volt on a 20,000-ohms-per-volt meter. Whenever a receiver has been phase tuned (see section on Phase Tuning), the discriminator idling is determined by the phase tuning adjustment. For a properly aligned receiver, the discriminator idling should not exceed 0.6-0.9-volt as read on a VTVM.

290-KC IF TRANSFORMER (T324 and T317)

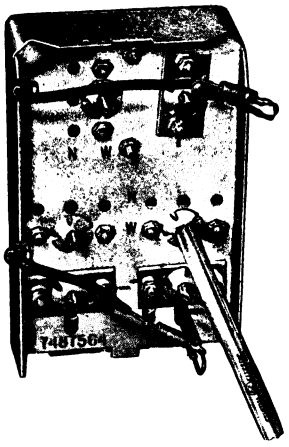
Equipment Required:

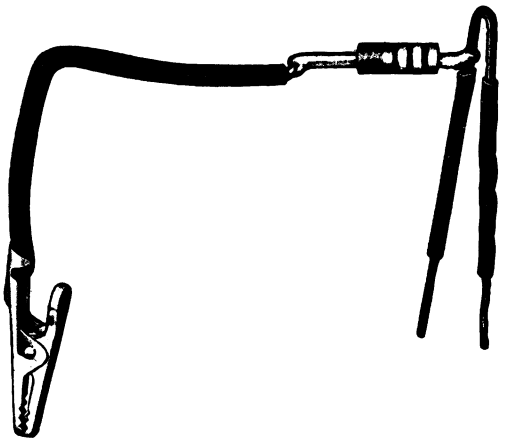
1. A non-metallic screwdriver.

2. A 0-100 microampere d-c meter (G-E Type EX-1-C).

3. A 290-kc signal source.

4. Two load resistor assemblies made up as shown in Fig. 1 for resistor loading method (22,000-ohm resistors)





LOADING RESISTOR ASSEMBLY

MATERIAL

1/4 watt resistor, common bobbypin, insulating sleeving for bobbypin, alligator clip and a 3-inch piece of test lead.

CONSTRUCTION

Flatten the tips of the bobbypin together so that they are flush, then spread the bobbypin legs out to form a "V". This is done so that when the bobbypin is inserted into the pin jack it will spread out and bind in the test jack for good electrical contact. Solder one lead of the resistor to one leg of the bobbypin near its loop, and solder the other resistor lead to the test lead terminated in an alligator clip. Clean and tin the bobbypin ends to prevent corrosion and to assure good electrical contact. Slide insulating sleeving over the bobbypin ends to prevent shorting. Sleeving should be tight enough to prevent slipping.

USING LOAD RESISTOR ASSEMBLY

Fasten the alligator clip to the chassis and insert the bobbypin into the pin jack. Two loading resistor assemblies can be used simultaneously while peaking coils in the six coil transformer assembly.

(RC-444A)

FIG. 1 - Load Resistor Assembly

Resistor Loading Procedure (Best):

1. Apply a 290-kc signal through a .01-mfd capacitor to XV319-2, when aligning the 1st LO IF or to XV305-1 when aligning the 2nd LO IF.

2. Connect meter between LIM-1 jack (J302-green) and ground.

3. Refer to Fig. 1 for proper use of load resistors and Fig. 2 for location of coils and loading jacks.

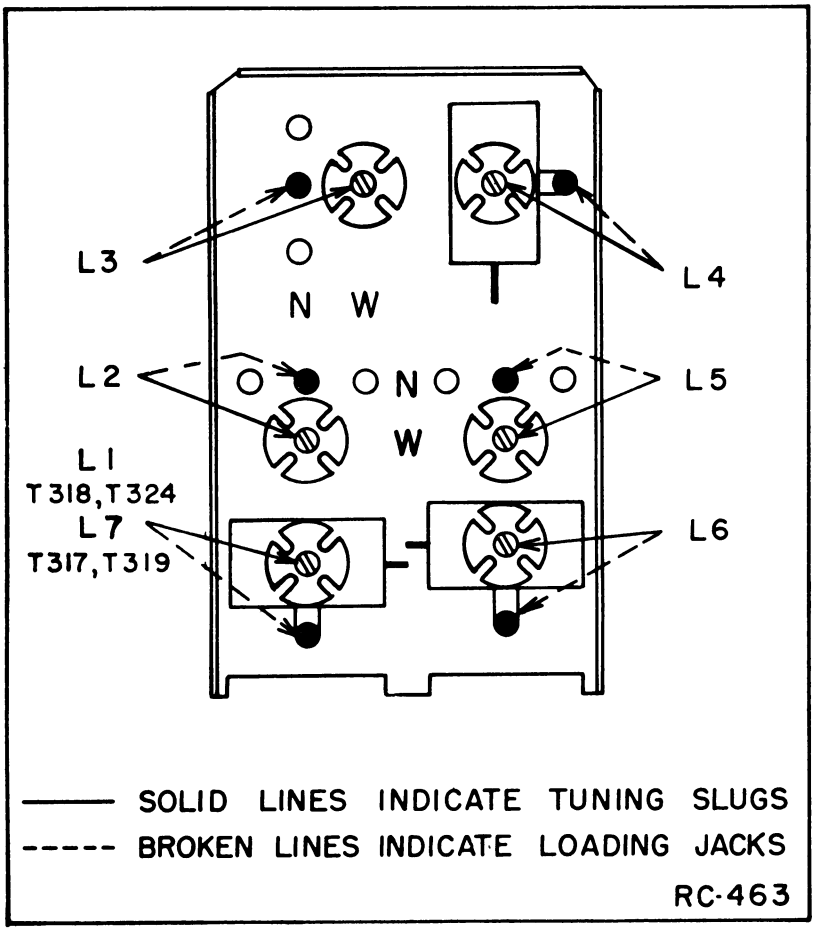


FIG. 2 Location of Tuning Slugs and Jacks, 290-kc IF Transformers - T317, T318, T319 and T324

4. Load L-2 and peak L-7 (or L1).

5. Remove load from L-2. Load L-7 (or L1) and L-3 and peak L-2.

6. Remove loads from L7 (or L1) and L-3. Load L-2 and L-4. Peak L-3.

7. Remove loads from L2 and L-4. Load L-3 and L-5. Peak L-4.

8. Remove loads from L-3 and L-5. Load L-4 and L-6. Peak L-5.

9. Remove loads from L-4 and L-6. Load L-5 and peak L-6.

10. Remove load resistor from L-5.

11. Repeat steps 4 to 10 to insure proper alignment.

Peak and Dip Procedure:

1. Locate tuning slugs and pin jacks as shown on Fig. 2.

2. Connect meter between L-7 (or L1) pin jack and ground.

3. Short coils with jumper wire and tune as in following table:

Short	Tune	Meter Reading
L-2	L-7 (or L1)	Peak
L-3	L-2	Dip
L-4	L-3	Peak
L-5	L-4	Dip
L-6	L-5	Peak
None	L-6	Dip

FRONT END TUNING

The frequency of the receiver may be changed by replacing the 1st oscillator crystal and retuning the oscillator, multiplier, and RF stages as described below. When changing frequency refer to the notes on the Elementary Diagram for component change information. If the receiver needs to be completely retuned, use the procedures outlined in the foregoing portion of this instruction.

The front end portion of the two, three or four frequency Receiver should be aligned on a frequency mid-way between extreme channel frequencies, when separations exceed 160 kilocycles. One of two procedures may be employed to satisfy this requirement. The ideal procedure would be to procure a test crystal, which is ground to a frequency mid-way between extreme channel frequencies and employ this crystal during alignment of the front end. When this procedure is not practicable, it is recommended that the front end be peaked on extreme channels and the position of tuning adjustments noted. The tuning adjustments should then be set to a position midway between the two settings. THE OSCILLATOR SHOULD ALWAYS BE TUNED ON THE HIGHEST FREQUENCY CHANNEL.

When the frequency separation of extreme channels is less than 160 kilocycles, the front end may be tuned on either channel (sensitivity will be NORMAL ON each).

EQUIPMENT REQUIRED

1. A non-metallic screwdriver.

2. A 20,000 ohm-per-volt voltmeter with a 0-3 volt scale.

3. A crystal of the proper frequency for the first oscillator.

4. A signal generator with a 72-76 megacycle range such as a Measurements Corporation Model 80, a Boonton 202-C, a Marconi TF-913, a Marconi TF-1066 or New London Model 100C. If a generator is not available when tuning the receiver in the field, connect the proper antenna to the receiver and transmit a weak signal from the transmitter with which the receiver is intended to operate.

PROCEDURE

Meter readings listed below are to be taken between the jacks indicated and ground.

NOTE

For tuning ceramic trimmers, use dot of solder on ceramic part of rotor as a pointer for indicating maximum or minimum. When the mounting screws of trimmer are not visible, the maximum or minimum position will be marked on the housing in which the capacitor is mounted. Where mounting screws are visible, maximum capacity will be realized when the pointer lies toward the mounting screws on the perpendicular to a line joining the two mounting screws. Minimum capacity will then be attained by rotating rotor 180 degrees.

1. Turn the receiver on and allow it to warm up for five minutes. Be sure that the battery or supply voltage is normal (6.6 or 13.2 volts d-c or 117 volts a-c).

2. Insert the First Oscillator crystal in the First Oscillator crystal socket (XY305-2, -8)

3. Connect a 0-3 volt meter equivalent to 4EX2B1 or EX1C to the OSC-1 jack, J305 (green-negative).

Crystal Oscillator

1. Tune the oscillator tank coil, Z306 for maximum oscillator grid meter indication. If there is any doubt about being on the correct peak, turn the adjustment fully counterclockwise, then clockwise to the first peak.

a. (For Models up to and including REV.D). Note the reading and turn the iron core counterclockwise until the meter reads 80% of the maximum grid metering voltage. The reading on a 0-3 volt meter should be approximately 0.25 volts.

b. (For Models incorporating REV.E). Note the reading and turn the iron core counterclockwise for 50% of peak reading or .25 volts, whichever is greater.

2. Connect a signal generator to pin 7 of XV302 using maximum generator output, zero generator to discriminator. This zeroing should coincide with an increase in LIM-1 meter indication.

3. Reduce the signal generator output until the LIM-1 meter indicates below saturation, but above noise.

4. Retract the slug of Z307 fully, then tune capacitor (Z307-C5) for maximum First Limiter current.

RF and Antenna Transformer

1. Connect signal generator to pin 1 of XV320. With generator adjusted to zero discriminator and output below limiting, peak the three circuits of T339. Care must be exercised in peaking the third tuned circuit of T339 (C7 and L6 located from underside of chassis) as in some instances the circuit can be tuned to the crystal frequency. First retract the slug of L6 fully and peak C7 for maximum First Limiter current; then set C1 and C4 for minimum capacity and peak L4 and L5. Repeak C7.

2. Move signal generator to antenna jack (J1 on antenna transformer). Use 50 ohm T pad (or equivalent) of Signal Generator accessories for a dummy antenna.

3. With meter at LIM-1 (J302) and signal on operating frequency applied, peak antenna transformer (T338) trimmers C11 and C13 (top and bottom of housing).

4. Recheck the RF and multiplier tuning. If possible monitor an unmodulated signal from a system transmitter for this check using the system antenna to pick up the signal.

A. Recheck the tuning of Z306 (meter connected to J305, OSC).

B. Recheck the adjustment for discriminator "O" (C320 on second oscillator).

C. With meter connected to J302, LIM-1, recheck the peaking of C11 and C13 of T338.

D. With meter connected to J302, LIM-1, recheck the peaking of Z307 and T339. Tune for maximum quieting whenever maximum quieting and maximum sensitivity do not occur together.

PHASE TUNING

The Phase Tuning procedure outlined below can only be used when the following conditions are met:

1. The Receiver must be properly aligned and have a sensitivity of 20 db of quieting for 0.4-uv input.

2. The discriminator reading on both noise and signal must be no greater than ± 0.2-volt on a d-c meter (20,000 ohms-per-volt).

Equipment Required:

1. A non-metallic screwdriver.

2. A 0-3 volt d-c meter or a 0-100 microampere d-c meter.

3. A 72-76-Mc signal source (signal generator or station transmitter).

4. A noise generator constructed as shown in Fig. 3.

Procedure:

1. Connect the antenna or signal generator, and the output of the noise generator to the Receiver antenna input through a "T" connector.

2. Radiate a weak ON frequency signal enough to quiet the receiver about 20 to 25-db.

3. Turn the noise generator switch to "ON".

4. Listen to the Loudspeaker for noise.

5. Tune L4 or L1 of T316 (L one-quarter turn in either direction for a noise null.)

6. If a noise null cannot be obtained, return the slugs to their original position. (maximum meter reading at LIM-1 jack), and proceed as follows:

Tune L4 and L6 of T324 or T318 for best noise null but do not turn slugs any more than one-quarter turn.

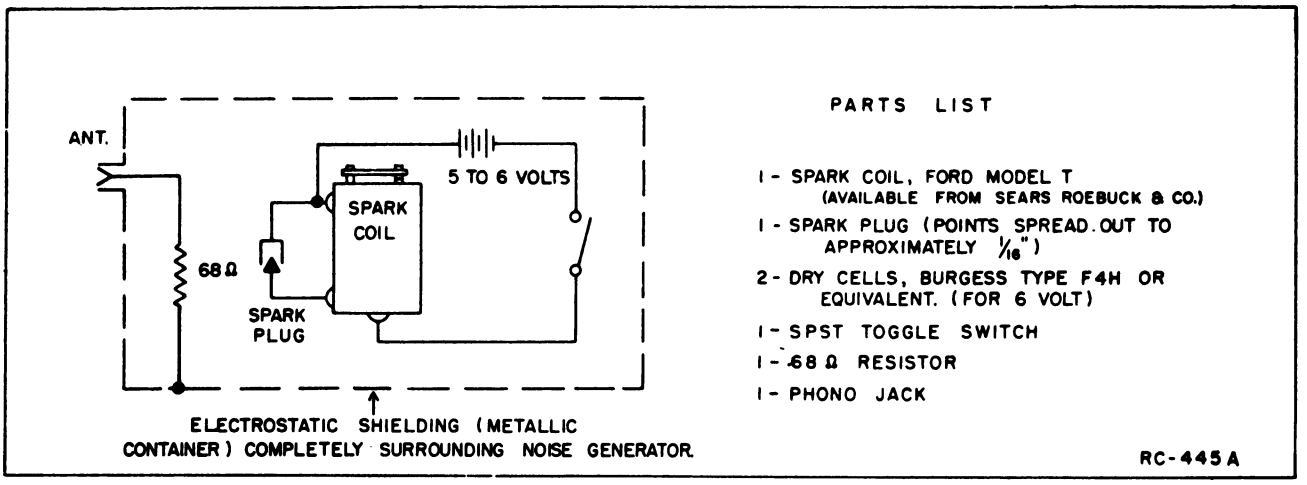


FIG. 3 - Noise Generator

7. It is not necessary to recheck the discriminator idling reading on noise when phase tuning is completed.

5330

COMMUNICATIONS PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
LYNCHBURG, VIRGINIA

Printed in U.S.A.