BENCH ALIGNMENT PROCEDURE FOR 406-420 MC RECEIVER MODEL 4ER26B40

GENERAL

The following instructions cover the procedure for completely aligning the receiver. The Simplified Alignment procedure may be used if only the oscillator, multiplier, limiter or the secondary of the discriminator need retuning.

SERVICE OUTLINE

Whenever a stage has been tampered with, misaligned or modified, etc., follow the procedures outlined in this instruction.

METHODS OF ALIGNMENT

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 (T303) and 2nd IF (T306) are over-coupled 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.

Deviation Method:

Unmodulated RF signals of the proper frequency (i.e., 290-kc) ± 10-kc are applied to the discriminator stage. The signal source should be of a constant amplitude at both ± 10-kc and should be strong enough to saturate the first limiter. The tuning slugs are 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 load resistors across the coils makes them 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 overcoupled 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 can be inserted at any stage ahead of the stage being tuned, and should just saturate the second limiter grid. This means that the first limiter plate is also saturated.

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 1st Limiter noise current was 15 microamperes or more when shipped. No loss of receiver sensitivity will occur as tubes age, until the noise current drops below 50% of the original reading at J309 (1st Limiter grid). To check for normal gain, make certain that the cavity and RF tank are both peaked. Replace the antenna with a 50-ohm load resistor. A reading of 15-microamperes or more at the 1st Limiter grid will indicate normal gain.

Stage Gains

As 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 I

SIGNAL GENERATOR FREQUENCY	SIGNAL LEVEL IN MICROVOLTS (Approx.)	INPUT POINT
48-Mc	1.2	1st Mixer grid (XV302-1)
48-Mc	16	1st Hi IF grid (XV306-1)
48-Mc	250	Hi side 2nd Mixer grid
3.2-Mc	8	Hi side 2nd Mixer grid coil (XV307-2)
3.2-Mc	150	Low side 3rd Mixer grid coil (TB-1)
3.2-Mc	9,500	Hi side 3rd Mixer grid coil (XV308-2)
290-Kc	45	Hi or low side 3rd Mixer grid coil (XV308-2) or TB-1
290-Kc	450	XV309-1
290-Kc	60,000	XV310-1

A receiver having 20 microamperes of 1st limiter noise current will give the approximate 1st limiter meter readings shown in Table 2.

TABLE 2

RF (406-420 MC to Cavity)	1st LIMITER GRID JACK (J309)	
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 .01-mfd capacitor to XV310-1.

2. Connect voltmeter between DISC jack (J310-orange) and ground.

3. Remove 3490-kc crystal (Y302) to prevent signals or noise from interfering with alignment.

4. Tune top slug (secondary) of discriminator transformer (T305) 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 (T305) until the voltages are equally positive and negative within 0.3-volt on a VTVM or 0.1-volt on a 0-3-voltmeter.

IF ALIGNMENT

290-KC IF TRANSFORMER (T306)

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 calibrated signal source.

Procedure:

1. Apply a 290-kc signal through a .01-mfd capacitor to XV309-1.

2. Connect meter between LIM-1 jack (J309-green) and ground.

3. Remove 3490-kc crystal (Y302) to prevent signals or noise from interfering with alignment.

4. Load the primary by soldering a 100,000-ohm, 1/2 watt resistor across transformer leads #3 and #4. Keep the leads short.

5. Tune the secondary (bottom slug) for maximum LIM-1 reading. Keep the input signal below limiting.

6. Leave the primary loaded and load the secondary by soldering a 22,000-ohm, 1/2 watt resistor across transformer leads #1 and #2.

7. Tune the primary (top slug) for maximum LIM-1 reading.

8. Remove both loading resistors and replace Y302.

3.2-MC IF TRANSFORMER (T312)

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 SV307-2. Do not saturate the 1st Limiter. Keep signal zeroed to discriminator.

2. Connect meter between LIM-1 jack (J309-green) and ground.

3. Leave the 3490-kc crystal (Y302) in its socket.

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

5. The front end of the receiver should now be aligned (FINAL TUNING) before adjusting the idling.

6. Connect meter to DISC jack (J310-orange).

7. If voltmeter reads more than ±0.2-volt (3.5-microamperes) with no signal, check all alignment slugs.

8. When the idling voltage has been brought to less than ± 0.2 volt, grid coil T312-L4 may be tuned for DISC zero. The receiver should be fully warmed up before adjusting the idling.

290-KC IF TRANSFORMER (T303)

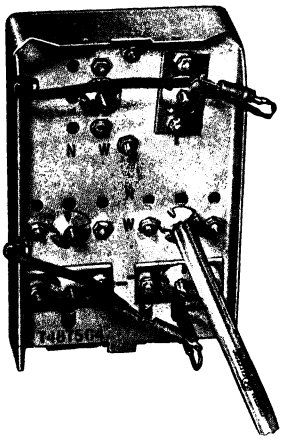
Equipment Required:

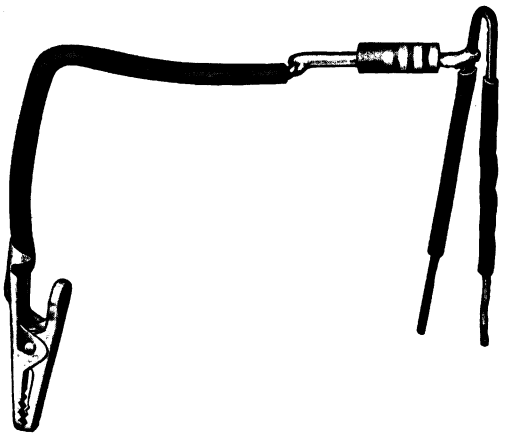
1. A non-metallic screwdriver.

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

3. A 290-kc signal source.

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





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

Resistor Loading Procedure (Best Method):

1. Apply a 290-kc signal through a .01-mfd capacitor to XV308-2.

2. Connect meter between LIM-1 jack (J309-green) and ground.

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

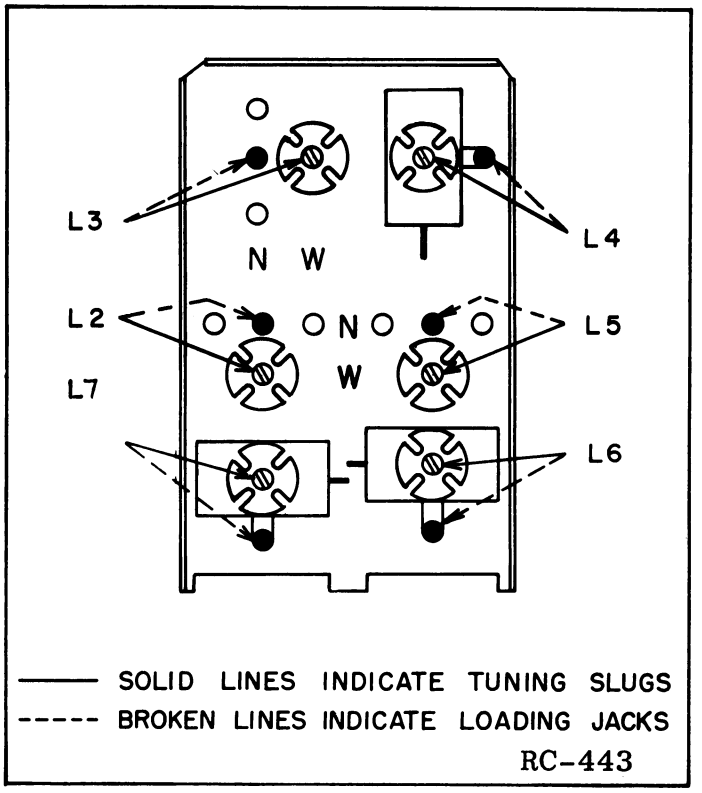


FIG. 2 Location of Tuning Slugs and Jacks, 290-kc IF Transformer - T303

4. Load L-2 and peak L-7.
5. Remove load from L-2. Load L-7 and L-3 and peak L-2.
6. Remove loads from L7 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 (Alternate Method):

1. Locate tuning slugs and pin jacks as shown on Fig. 2.
2. Connect meter between L-7 pin jack and ground.

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

Short	Tune	Meter Reading
L-2	L-7	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

48-MC IF TRANSFORMERS (T301 and T311)

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 48-Mc signal source.

Procedure:

1. Apply 48-Mc signal through .01-mfd capacitor to XV306-1.

2. Keep signal zeroed to discriminator (If the front end of receiver is aligned, a transmitter signal can be used).

3. Connect meter between LIM-1 jack (J309-green) and ground.

4. Using a signal level below saturation, tune T311 transformer tuning slugs for maximum meter reading. If a peak cannot be obtained within a few turns, back the tuning slugs fully counter-clockwise. The tuning slugs can then be turned clockwise by equal amounts until a peak is obtained. If the tuning slugs are allowed to get too close together, they can become inductively coupled and give a false peak reading on the meter.

5. Apply signal to XV302-1, keeping signal level below saturation.

6. Tune the top and bottom slugs of transformer T301 for maximum meter reading.

FINAL TUNING

RF AND ANTENNA STAGES

Equipment Required:

1. A non-metallic screwdriver.

2. A 0-3 volt d-c meter.

3. 1st Oscillator crystal of the proper frequency.

4. A 406 to 420 Mc signal source (signal generator or station transmitter).

Procedure:

To change frequency or to align RF and antenna stages, proceed as follows:

1. Insert the new crystal in the crystal oven mounted in the 1st Oscillator crystal socket. For 12-volt operation, the crystal oven is plugged into the crystal socket so that the 12-volt marking ("12V") on top of the can appears on the same side as the pin 4 chassis marking. For 6-volt and station operation, the crystal oven is plugged into the crystal socket so that the 6-volt marking (6"B") on top of the can appears on the same side as the pin 4 chassis marking.

NOTE

In changing from 6-volt to 12 volt operation, or vice-versa, the crystal oven must be rotated 180° in its socket. Reversing the crystal oven may change the 1st oscillator frequency by changing the capacity from the crystal to ground. Check the 1st oscillator frequency whenever the crystal oven is reversed.

2. Connect the meter between OSC-1 jack J1 (green) and ground.

3. Turn L1 fully counterclockwise.

4. Turn L1 clockwise for peak meter reading (360 microamperes or 1.5 volts). Note the meter reading.

5. Turn L1 counterclockwise until the meter reads 80% of the reading noted in step 4, or 1.3 volts, whichever is less.

6. Connect the meter between MULT-2 jack J305 (green) and ground.

7. Tune the primary of the 1st doubler transformer (T310) for maximum meter reading (0.7 volt).

8. Connect the meter between MULT-3 jack J304 (green) and ground.

9. Tune Z305-L1 for maximum meter reading (0.5 volt).

10. Tune the MULT-3 PLATE (C312) for minimum MULT-3 meter reading. If C400 and C401 are known to be detuned, align the paint marks on the capacitors with the paint marks on the chassis (Maximum capacity) before tuning C312.

CAUTION

The MULT-3 PLATE adjustment is in the B-plus circuit.

11. Disconnect the antenna cable from J1.

12. Apply an unmodulated RF signal at the receiver frequency to J1.

13. A coarse adjustment of the cavity-adjustment screw (Z302-C1) may be made by setting the screw so that the following amount of thread shows between the screw head and the bushing:

Frequency	Screw Thread
406 Mc	7/16 inch
413 Mc	9/16 inch
420 Mc	11/16 inch

14. Connect the meter between LIM-1 jack J309 (green) and ground.

15. Tune MULT-4 PLATE control C401 for maximum LIM-1 meter reading.

16. Tune Z302-C1 and RF PLATE control C400 for maximum LIM-1 meter reading.

17. Peak Z302-C1, the RF PLATE tuning (C400) and the MULT-4 PLATE tuning (C401). Repeak these tuning controls.

18. To adjust the receiver for a signal from a transmitter which is known to be on frequency, connect the voltmeter between DISC jack J310 (orange) and ground and proceed as follows:

While receiving a signal from the transmitter, adjust the FREQ ADJ A control (C18) for a DISC meter reading of zero.

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