

ALIGNMENT

(ALL MULTI-BAND RECEIVERS - BOTH A.C. AND BATTERY MODELS)

PREFACE

Re-alignment of a radio receiver may be in order periodically. Replacement of R. F. and I. F. transformers or by-pass condensers in associated circuits, should always be followed by complete re-alignment. Tube changes may also be followed by re-alignment, if it is required that the receiver be kept up to maximum performance. Irrespective of the type of receiver, re-alignment should only be attempted where proper equipment is available, to ensure that the various adjustments are made in accordance with the following instructions.

In the past, where the I. F. transformer coupling was fixed, re-alignment, without the use of special equipment, has been practised with more or less satisfactory results. Invariably, where such adjustments have been made without the use of a signal generator and output meter, relying on a station signal and the ear only, the results have been far from satisfactory.

With the introduction of special I. F. systems, such as those encountered in the models described, alignment by ear is not only impossible, but also disastrous to receiver performance. Improper alignment will render expanding I. F. amplifiers inoperative, so far as the high fidelity expansion process is concerned, and make impossible the attainment of high selectivity in the selective position. *It is, therefore, imperative that the equipment specified be used when re-aligning receivers. Of equal importance is the necessity of strict adherence to the routine of aligning adjustments given in the schedule which follows.*

EQUIPMENT

A list of equipment is supplied and although definite specification as to the manufacturer is not given, the recommendation is made that only dependable equipment, of a reliable manufacturer, be used.

The list of equipment is in two parts; (A) "Essential Equipment" and (B) "Optional Equipment." Wherever possible the equipment under (B) should be available for use. Such equipment is used in the production testing of these receivers and it follows that service adjustments if they are to equal the original standard, should be made with similar equipment.

(a) ESSENTIAL EQUIPMENT

1. A satisfactory aligning wrench and screw-driver such as Part No. 32702.
2. An output meter of the rectifier type, with several ranges permitting its use with receivers of a type other than those under discussion. Two ranges, 0-2 volt and 0-5 volts will generally be adequate.
3. A signal generator or service oscillator, capable of supplying a modulated signal at 150, 400, 456, 600, 1,600, 1,800, 5,000, 6,000 and 17,800 kc/s. The signal generator frequency should be variable at all the above frequencies and *must have a good variable attenuator or output control.* If the signal generator is to be used with the oscillograph suggested under (B), it should be equipped for connection to the Frequency Modulator and should be arranged so that the audio frequency modulation may be cut out.
4. A non-inductive, 400 ohm 1 watt resistor (filament type), to be used as police and short-wave band dummy antenna. Part No. 32608.
5. A .0002 mfd. midget mica condenser for use as a dummy antenna when aligning at broadcast frequencies and for "X" band.
6. A .05 mfd. paper condenser (400 volt) for use during I. F. alignment.
7. A .01 mfd. paper condenser (400 volt) with short leads and clips to short osc. section of gang condenser during I. F. alignment.

(b) OPTIONAL EQUIPMENT

The following equipment can be used to advantage where it is available. It permits visual examination of the I. F. alignment and enables adjustment of the I. F. stages so that expansion and contraction of the selectivity curve is symmetrical. This expansion and contraction as explained in detail elsewhere is accomplished through a mechanical variation of the coupling between primary and secondary windings of one or more of the I. F. transformers. Details of operation of the oscillograph and associated equipment are invariably supplied by the manufacturers of such equipment and will not be dealt with here.

1. A Cathode-Ray Oscillograph which should employ a built-in "vertical" amplifier and linear sweep and synchronizing circuits.
2. A Frequency Modulator.
3. A signal generator as discussed under Section (A) 3.

Some manufacturers of the foregoing equipment present it in the form of a single or two unit assembly. The choice of single or multi-unit equipment is entirely a matter of personal preference. (Prices of any of the above equipment sent on application.)

PROCEDURE OF ALIGNMENT

With the equipment available, the routine to be followed becomes of first importance. Before attempting alignment, carefully read over the following procedure to fix in mind the order in which adjustments are made. Reference should be made to the top view of chassis layout for location of the various aligning points mentioned. Always remove the chassis from the cabinet during alignment.

I. F. STAGES (See also "Use of Oscillograph")

- (1) Connect an output meter of suitable range directly across the voice coil terminals of the speaker.
- (2) Connect the .01 mfd. by-pass condenser across the oscillator section of the gang condenser C1.
- (3) Connect the output lead of the signal generator to the control grid of the type 6A7M (1C6S) tube through the .05 mfd. condenser. Allow the control grid clip to remain in position. Wave change switch must be in "broadcast" position and gang condenser at minimum capacity (all out).
- (4) Adjust the receiver "Fidelity" control to "normal" position. *This is very important.* This is the contracted or maximum selectivity position.
- (5) With receiver and signal generator "on", adjust signal generator to exactly 456 kc/s. Adjust receiver sensitivity and volume controls to maximum and generator output to give a low reading on output meter. (See Note X).
- (6) (a) Commencing at the secondary of the diode stage I. F. transformer and working progressively backward to the output of the 6A7M stage, align condensers C23, C22, C21, C20, C19 and C18 in that order for maximum increase in reading of output meter. Carefully recheck adjustments until further adjustment fails to improve alignment.
(b) In receivers having a separate A. V. C. system, the A. V. C. transformer trimmer C24, should be adjusted for minimum output.
- (7) Adjust receiver "Fidelity" control full counter-clockwise to the "High Fidelity" position. With the control in this position the receiver will be in the "expanded" or least selective condition.
- (8) Adjust generator output to a low level and gradually tune it upwards in frequency until a peak is found, which should appear at approximately 463.5 kc/s. (or ± 7.5 kc/s.). Holding the generator output constant, note carefully the exact output meter reading.
- (9) Still holding the generator output constant, slowly tune the generator lower in frequency, to locate a second peak which should appear at approximately 448.5 kc/s. (or $- 7.5$ kc/s.). If it is impossible to determine the 7.5 kc. interval exactly, it is important that these two measurements be made at exactly the same frequency interval above and below 456 kcs., otherwise symmetry cannot be obtained.
- (10) Upon locating the second peak (and if the original adjustment has been properly made) it should be found that the reading of the output meter is approximately the same value as that noted at 463.5 kc/s. Small variations in the order of plus or minus 5% are permissible. If the two readings agree within the limits given, it may be considered that proper alignment has been reached and that further adjustment of aligning condensers is unnecessary. Following this, other alignment can be carried out.
- (10a) If, however, it is found that the output meter readings do not agree within a reasonable amount, further adjustment will be in order. First try further aligning adjustments as outlined under section 4, 5 and 6 and rechecking as per sections 7, 8, 9 and 10 *with the coupling in the selective position*. Should this fail to produce results, locate the peak at which the lower output reading is obtained and try to increase this by carefully adjusting C, and C of the diode stage I. F. transformer. As this stage peaks rather broadly, it is possible that slight misalignment may be encountered which would result in the condition discussed under section (10a). *Do not attempt to re-align any of the 1st or 2nd I. F. trimmers with the coupling in the high fidelity or expanded position.*

Where an oscillograph and frequency modulator is available, it is possible to observe visually on the screen of the cathode ray tube the actual selectivity curve of the I. F. stages under "normal" (contracted) and "high fidelity" (expanded) conditions and to watch the change in this curve as the "Fidelity" (or selectivity) control is adjusted.

The ability to visualize this change permits precise adjustment of the diode stage aligning condensers so that symmetrical expansion of the I. F. selectivity curve takes place as the "Fidelity" control is rotated from the normal towards the high fidelity position. Most satisfactory results will generally be obtained by first aligning by standard method using output meter, and then using the oscillograph to "shape" the selectivity curve by adjustment of the diode trimmers.

Details of the operation of the cathode ray oscillograph will not be given here as they are usually supplied by the manufacturer of such equipment.

A routine covering the application of this device to the I. F. adjustments is, however, of value. The routine is as follows:

- (1) Complete alignment of all I. F. stages in accordance with sections 1 to 10 inclusive of section headed "I. F. Stages."
- (2) Connect output of signal generator to the control grid cap of the 6A7M (1C6S) (Osc.-Mod.) tube through a .05 mfd. condenser. Allow grid clip to remain in position, band switch being in the broadcast position. Tune oscillator to sweep I. F. at 456 kc/s.
- (3) Connect input terminals of vertical amplifier (of cathode ray oscillograph) to the contact arm and grounded terminals of receiver volume control.
- (4) Place receiver, oscillograph generator and frequency modulator in operation. Adjust receiver volume control to maximum. Adjust "Fidelity" control to normal position. Synchronize oscillograph pattern in center of screen. Adjust vertical and horizontal amplifier gain controls for reasonable amplitude and width.
- (5) Observe the wave form projected on the screen, noting any regularities or departures from a normal pattern. If irregularities are present, carefully check adjustment of I. F. aligning condensers, particularly those associated with the diode stage transformer.
- (6) Adjust "Fidelity" control slowly to the full counter clockwise position (expanded) checking oscillograph pattern closely to ensure that expansion is taking place symmetrically. If a lop-sided pattern develops, it is due to mis-alignment of the diode transformer. Correct by adjusting diode aligning condensers to produce symmetrical pattern. (See Illustration, Page).
- (7) Recheck pattern at contracted position (normal). This completes I. F. alignment.

R. F. AND OSC. STAGES (STANDARD BROADCAST BAND)

- (1) Connect the generator output to antenna and ground terminals "A" and "G" with the .0002 mfd. condenser right at terminal panel. Ground receiver and generator.
- (2) Connect output meter across speaker voice coil terminals.
- (3) Adjust wave-band switch for standard band operation.
- (4) Set receiver volume and sensitivity controls at maximum. Adjust fidelity control to normal position.
- (5) Set receiver dial to log exactly 1,600 kc/s. Adjust signal generator to exactly 1,600 kc/s. and set for a low value of reading on output meter. (See Note X).
- (6) Align carefully C3, C7 and C11, (parallel padders) in that order for maximum increase in reading of output meter.
- (7) Adjust signal generator to exactly 600 kc/s. Set receiver to 600 kc/s. signal and align C15 (series padder) rocking the tuning control in the usual manner during this adjustment. If dial does not log correctly, loosen set screw and re-adjust.
- (8) Retune signal generator and receiver to 1,600 kc/s. and check condition of alignment of C3, C7 and C11, at that point. If C11 required more than a small amount of adjustment it may be found necessary to re-align the parallel padders to correct logging.

This completes the standard band alignment.

R. F. AND OSC. STAGES ("X" BAND)

- (1) Connect output meter across speaker voice coil terminals. Connect signal generator output to the conventional antenna terminals "A" and "G" of the receiver, the .0002 mfd. condenser being in series with the antenna lead right at the terminal panel. Ground receiver and generator. Remove .01 mfd. condenser from osc. section of gang.
- (2) Place receiver and generator in operation. Adjust wave-change switch for "X" band operation. Set volume and sensitivity controls at maximum. Adjust "Fidelity" control to "normal" position. Tune receiver (dial) and generator to exactly 400 kc/s. Adjust generator output for low value of reading on output meter. (See Note X).
- (3) Starting with the oscillator stage, align carefully C2, C6 and C10 for maximum increase in reading of output meter.
- (4) For most satisfactory results, start with oscillator trimmer screwed up fairly tight, so that it is necessary to reduce capacity to tune in signal. The antenna and interstage trimmers should be fairly loose in starting.
- (5) Tune the generator to exactly 150 kc/s. Adjust the receiver to tune in the 150 kc/s. signal. Align C14 (series tracking) rocking the tuning control slightly during this adjustment. If C14 is found to be out more than a very slight amount, it will be necessary to recheck carefully the parallel pads C2, C6 and C10.

This completes "X" band alignment.

R. F. AND OSC. STAGES (POLICE AND AMATEUR BAND)

- (1) Connect the signal generator output to antenna and ground terminals "A" and "G" with the 400 ohm resistor in the antenna lead right at the terminal panel.
 - (2) Connect output meter across speaker voice coil terminals.
 - (3) Adjust wave-band switch for police band operation.
 - (4) Set receiver sensitivity and volume controls at maximum. Fidelity control should be in normal position.
 - (5) Set receiver dial to log exactly at 5,000 kc/s. Adjust signal generator to exactly 5,000 kc/s. and adjust output for a low value of reading on output meter. (See Note X).
 - (6) Align carefully the parallel padders C4, C8 and C12, in that order for maximum increase in reading of output meter.
 - (7) Adjust signal generator to exactly 1,800 kc/s. Set receiver tuning to 1,800 kc/s. signal.
 - (8) Align 1,800 kc/s. series padder C16, rocking tuning control slightly in the usual manner, during this adjustment, until maximum output is obtained.
 - (9) Retune receiver and generator to 5,000 kc/s. and check condition of alignment of the parallel padders C4, C8 and C12, at that point. If the series padder C16, required more than a small amount of change, it may be found necessary to align the parallel padders to correct logging.
- This completes the Police-Amateur band alignment.

X NOTE: Excessive output from the signal generator may cause overload of one or more stages. If overloading occurs, false aligning peaks may be indicated by the output meter. It is very important, therefore, that only sufficient output from the signal generator be used that will give a readable indication on the output meter.

As the various stages are brought into alignment, the receiver sensitivity will increase, necessitating a gradual reduction in the output of the signal generator.

As it is impossible to set the dial scale itself for logging purposes on more than one band, it should only be set for the broadcast band where scale calibration is more important than on the other bands. For this reason, all adjustments should be made on the broadcast band before attempting alignment of any other band.

The antenna and ground connections for Police and Short-wave Bands referred to above are for receivers built to use the C. R. C. special antenna. On the older models, the connections remain the same except that the middle terminal "D" should be shorted to "G". Should any doubt exist as to the internal connections, then connect "D" to "G", otherwise on the older sets, the two high frequency bands would be dead at the antenna circuit.

SHORT-WAVE FOREIGN BAND

R. F. AND OSC. STAGES

Alignment on this band is somewhat different and should not be attempted until the following procedure is carefully studied, otherwise it is possible to apparently align the parallel pads but still find the sensitivity extremely low.

1. Connect signal generator output to "A" and "G" terminals of receiver with 400 ohms, dummy antenna resistor right at receiver terminal panel.
2. Ground generator and receiver.
3. Place receiver and generator in operation. Adjust wave-change switch to short-wave band. Set volume and sensitivity controls at maximum. Adjust fidelity control to "normal" position. Tune receiver dial to 17,800 and set generator at same frequency.
4. Commence aligning procedure by adjusting oscillator trimmer C13, then the interstage C9, carefully rocking to gang condenser meanwhile. This is important, as the sensitivity may be down as much as ten times when the normal "straight-through" process of alignment is used. When further rocking and alignment produces no improvement in sensitivity, proceed to align the antenna circuit C5. Sometimes rocking the gang while aligning will improve the sensitivity on this band.
5. Adjust signal generator to 6,000 kc/s. and tune in the signal on the receiver. Adjust the series padder C17 while rocking the gang in the usual manner until the sensitivity is maximum.
6. Recheck all adjustments at 17,800 kc/s. being sure to rock the tuning condenser at the same time the interstage trimmer is adjusted.
7. The set should now be checked to make sure that the oscillator has not been aligned on the image. Leave the signal generator set at 17,800 kc/s., increase its output considerably then tune the receiver 912 kc/s. lower in frequency or to 16,888 kc/s. (approximately). If the oscillator is correctly aligned, the image will be found here. If it does not appear, it will be found 912 kc/s. higher in frequency than 17,800 kc/s. then tune the receiver 912 kc/s. lower in frequency or to 16,888 kc/s. (approximately). If the oscillator is correctly aligned, the image will be found here. If it does not appear, it will be found 912 kc/s. higher in frequency than 17,800 or at 18,712 kc/s. This indicates that the wrong oscillator peak has been chosen. The trimmer should be loosened off until the correct one is located.