VINTAGE RADIO

By JOHN HILL

Aligning vintage radio receivers, Pt.2

Last month's Vintage Radio column covered the various components involved in receiver alignment. We now move on to the equipment used for alignment and describe how it is used.

It is both easier and quicker to align a superhet receiver if you have the right equipment. The right equipment in this case is a radio frequency (signal) generator and an output meter. However, as these instruments are not always available, we will also describe the alignment procedure without them.

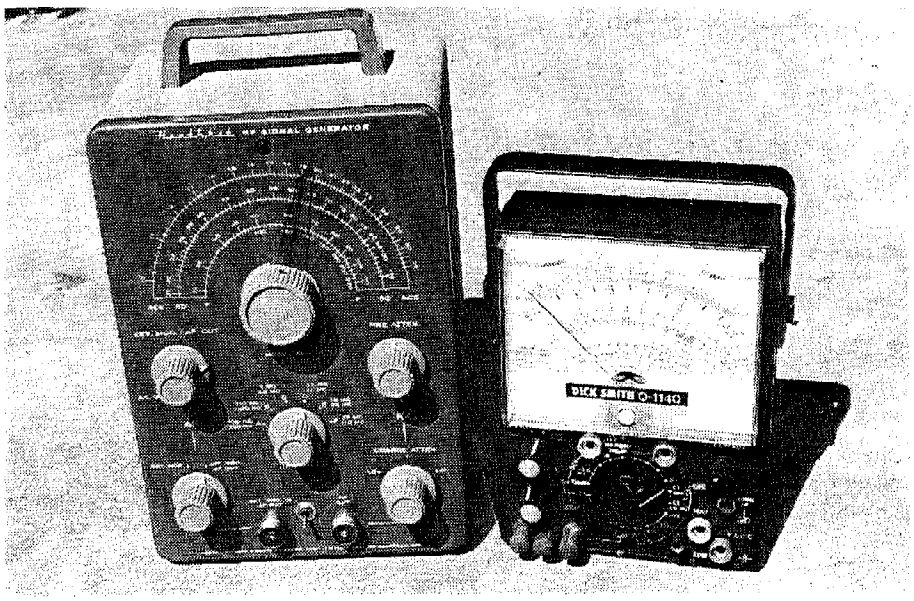
Signal generators

A signal generator does exactly what its name implies – it generates RF signals which can be injected into a radio receiver at various points. It is usual to modulate the RF signal with an audible frequency of around 400-1000Hz, so that the signal can be heard in the receiver's loudspeaker. Signal generators are tunable and any desired frequency can be obtained simply by selecting a frequency range and setting a calibrated dial.

Modulating the RF signal with an audible tone is similar to what happens at a radio station's transmitter, where the radio frequency signal (carrier) is modulated by audio frequencies (speech, music, etc). A simple way of looking at this is to think of the RF signal as the vehicle and the audio frequency signal as the passenger. The receiver is designed to receive, amplify and separate the two signals, for it is only the passenger that is of interest in the end.

Likewise with the signal generator. It is of little use injecting a radio frequency signal into a receiver if we cannot monitor it. If we modulate the RF signal with an audio signal, we can both hear it and see its strength on an output meter.

The main advantage of using a signal generator is that it supplies a constant and stable signal at any chosen frequency. Also, its amplitude can be varied as appropriate during the various alignment stages, thus making it more convenient to use than a distant radio station.



An RF (signal) generator and an output meter make the task of receiver alignment much easier. This photo shows a Heathkit RF signal generator and a standard multimeter.

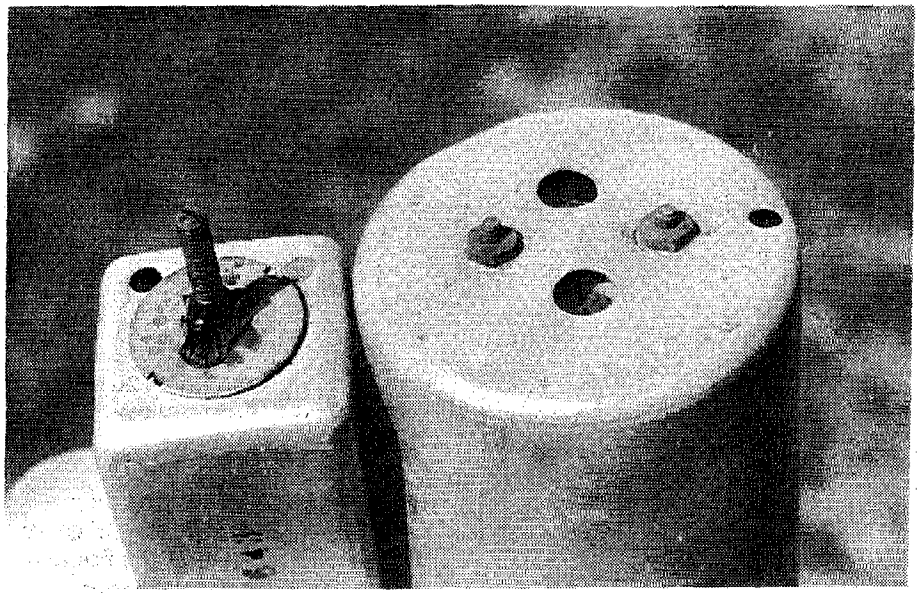
Output meter

An output meter is used to measure the output signal strength of the receiver being aligned. Its two leads are usually connected to the anode of the output valve and to the chassis. In some cases, it can be connected across the loudspeaker's voice coil but this method is not successful unless the meter is particularly sensitive.

Some multimeters have a special output socket (to accept the lead connected to the output valve anode) but, unfortunately, many lack this refinement, which makes things a little more difficult. However, any multimeter with an AC volts range can be easily adapted for use as an output meter.

To explain, not all voltages are pure AC or DC – some can be a mixture of both. In the case of an output valve, the AC audio signal which drives the loudspeaker is superimposed on a DC voltage of about 250V which is applied to the valve's anode. An output meter is designed to ignore this DC voltage and display the AC (audio) component only.

This seemingly difficult task is easily accomplished by placing a high



IF transformers are adjusted by one of two means – either by using trimmer capacitors, as shown at right, or by adjustable iron slugs (left). Some early transformers may only have one adjustment instead of the usual two.

voltage capacitor (of about .047µF, or larger) in series with one of the meter leads. This capacitor blocks the DC voltage but allows the AC voltage to register on the meter.

Therefore, any multimeter with AC ranges can be used as an output meter by making up a special lead with a suitable capacitor in series with it. Such a lead requires a small insulated alligator clip at one end and a banana plug or whatever to suit the meter socket at the other end. The capacitor connections must be well insulated.

If you have a multimeter with an output socket, the blocking capacitor is already built into the meter. However, it is advisable to check this capacitor. Either check the circuit for specification or open the back of the multimeter and have a look. The capacitor must have at least a 400V rating and should ideally be a modern plastic type if it is to be used on valve receivers.

I speak from experience. The only meter I have with an output socket has already blown its original 400V capacitor and now has a 630V replacement. Perhaps the capacitor was faulty but it sure did burn out. Correction: it blew out – pow!

If you don't have a signal generator, then there is little point in using an output meter in the manner described above. When using radio stations as a signal source, an output meter will flicker up and down according to the instantaneous level of the voice or music signal being received.

On the other hand, if using a signal generator, the meter needle will remain steady because the audio signal is constant. Under these conditions, it is very easy to align a receiver for maximum needle deflection on an output meter.

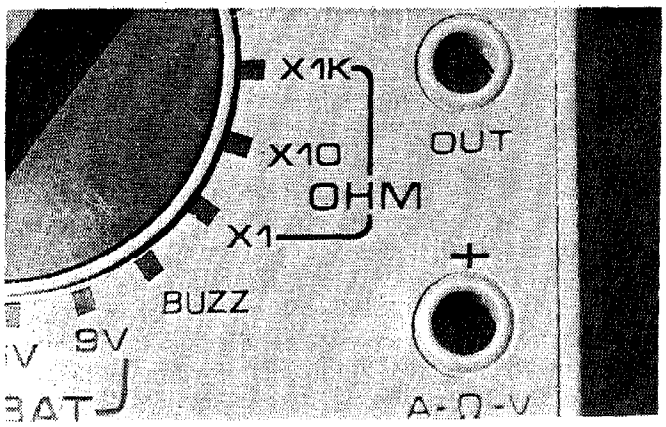
Alignment tools

The tools used for alignment adjustments are confined (in most instances) to insulated screwdriver blades. However, the everyday screwdriver is not the best tool to use. Simply touching a metallic screwdriver blade onto some alignment components will change the alignment. And in some cases, it can cause a high tension short circuit or give the operator an electric shock.

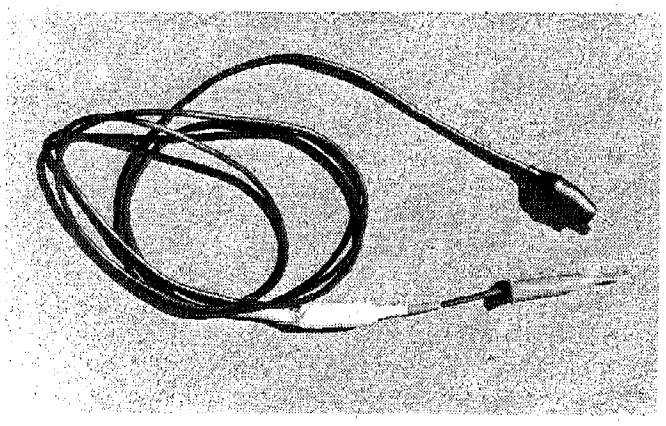
The recommended tool in the old days was a non-metallic screwdriver fashioned from a toothbrush handle or similar insulating material. Such a tool is quite satisfactory provided it will turn the adjustment screw.

Unfortunately, plastic screwdriver blades are a bit gutless when it comes to torsional strength. If the adjustment screw shows any degree of resistance, then the blade simply snaps off. In addition, many modern insulated alignment tools are moulded from a flexible plastic material which is often inadequate for valve radio applications.

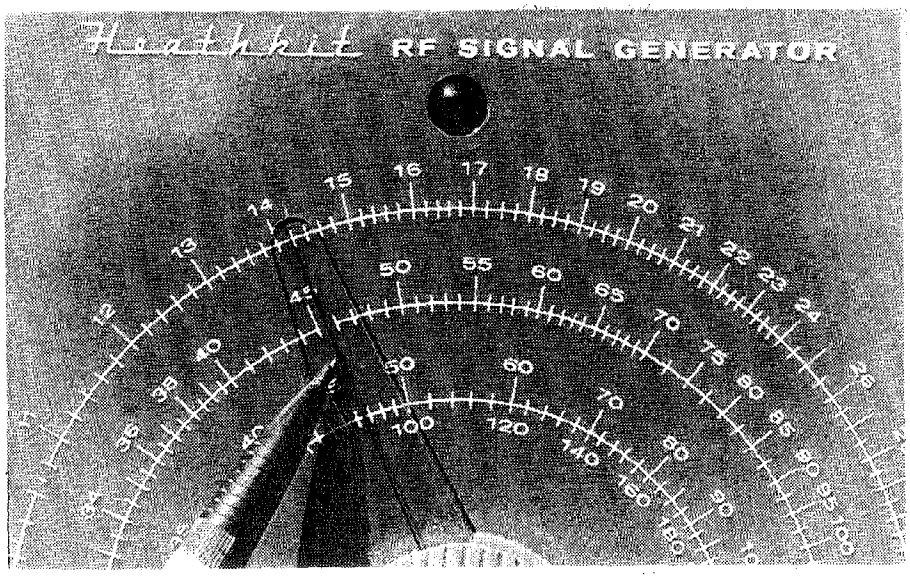
I recently made a couple of alignment tools from 6mm-diameter acrylic rod. Into the ends of these rods are cemented very short metal screwdriver blades which have been spe-



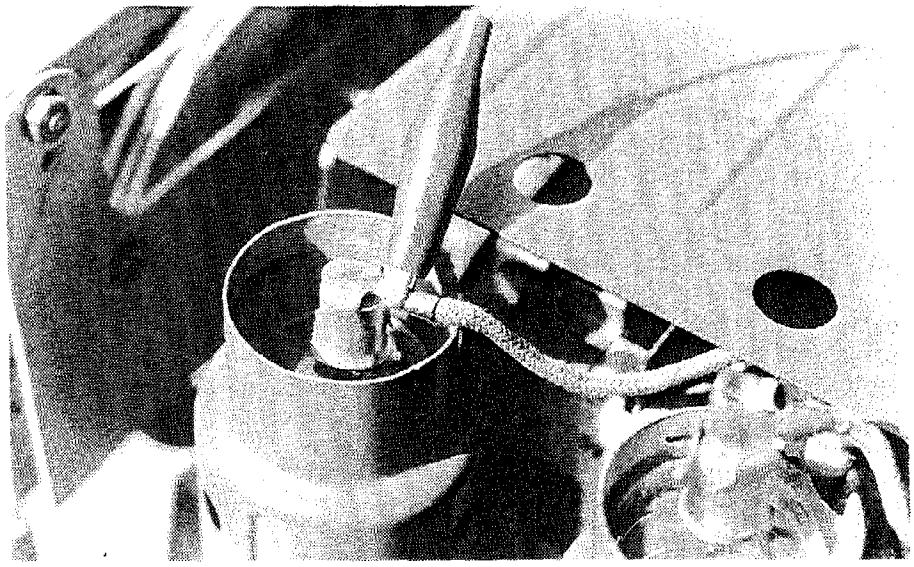
This multimeter has an output socket with a high-voltage capacitor in series with the meter circuit to block any DC components. It can thus be used to monitor the output signal level by connecting it directly to the anode of the output valve. Not all multimeters have this function.



An AC voltmeter can be used as an output meter simply by fitting a .047µF 400V capacitor in series with one of its test leads. The capacitor blocks the DC voltage on the anode of the output valve but allows AC signal voltages to register on the meter.



455kHz is by far the most common IF for valve radios. However, many early superhets had odd frequencies, with 175kHz being quite common in the 1930s.



When aligning the IF transformers on a superhet, the generator signal is injected into the circuit via the grid of the frequency converter valve. If the valve does not have a top cap, a connection on the appropriate fixed plates of the tuning gang will do the job just as well (see text).

cially made in various sizes from high carbon steel. These alignment tools give the best of both worlds in that they are reasonably strong and the small metal tip has little or no affect on the alignment setting.

In some cases, however, the alignment components are so stiff that they can only be turned with a standard screwdriver. This is of no great concern provided the tool is used properly.

First, the blade needs to be fully insulated to within one millimetre of the tip, to prevent short circuits and possible electric shock. This can be done using insulation tape or a piece of heatshrink tubing of appropriate size and length.

Second, after each adjustment, the metal screwdriver must be removed from the screw slot so that the output meter can display the true reading. Alignment may be a bit slow and tedious by this method but sometimes there is no alternative. If the adjustment screws are tight, then a metal blade is the only way to move them.

Alignment procedure

The correct starting point for superhet alignment is at the intermediate frequency (IF) transformers. The first step is to connect the RF generator leads to the grid of the frequency converter valve and to chassis.

If you have trouble working out where the grid is on the converter valve, it is usually the top cap that connects to one of the tuning capacitor gangs. If the valve has no top cap grid connection, trace the wiring to determine which tuning gang section connects directly to the converter valve and connect the generator lead to the fixed plates of that particular section (or to the corresponding valve socket connection).

It is important to inject the correct frequency into the receiver in order to tweak up the IF transformers. Today, the industry standard IF is 455kHz and this frequency has been established long enough for it to apply to many valve receivers as well. However, some early superhets had quite weird IFs, as a quick look at Table 1 will show. The set's IF transformers should be tuned to the frequency that they were supposed to operate on but this frequency is not always known.

Now if a receiver with a 460kHz IF is aligned to 455kHz, it will not prevent the receiver from working – although it will work better when aligned to the correct frequency. In particular, it may upset the dial calibrations slightly and/or the front-end tracking. More on this later.

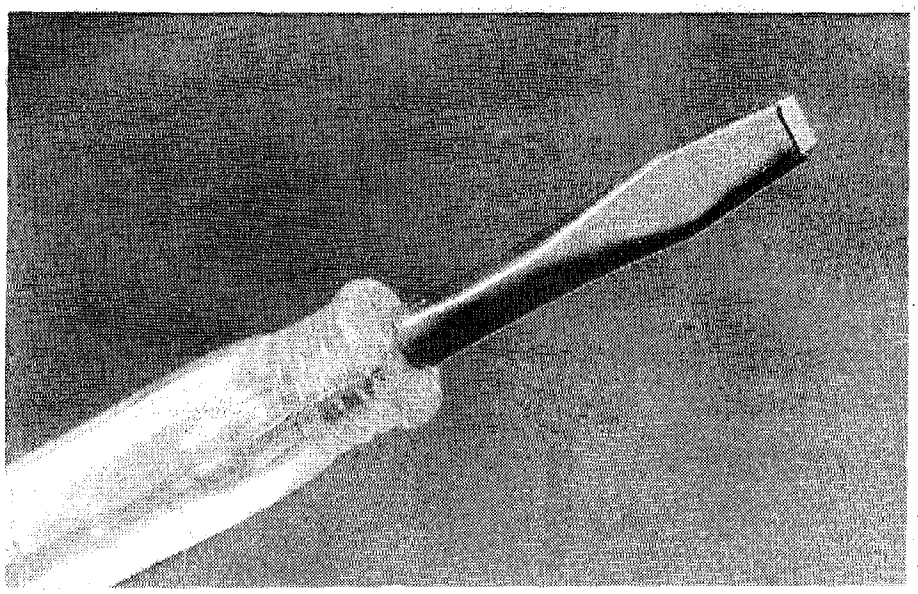
One way to ascertain an unknown IF is to connect the signal generator to the receiver and adjust the generator dial until maximum signal is heard in the loudspeaker. Provided that the IF transformers have not been previously tampered with, the generator dial should indicate the receiver's IF.

Once the IF has been established, the IF transformers can be adjusted

TABLE 1

Variations in intermediate frequencies as taken from the 1938 Australian Radio Service Manual

kHz	kHz	kHz
175	392	458
180	450	468
182	452.5	462.5
250	456	465
252	456	470
252.5	457.5	472



A metal-bladed screwdriver can be used as an alignment tool when the adjustment screws are tight. This particular tool has an insulated blade with only the tip exposed. Such a precaution is necessary when adjusting early IF transformers to prevent short circuits and possible electric shocks.

for maximum output. This should be done with the tuner plates completely out of mesh, the volume control at maximum and the signal generator adjusted to feed in just enough signal to activate the output meter.

AVC action

There is a very good reason for these level settings and that is to effectively disable the AVC (automatic volume control) system. If the AVC is operating, it will try to counteract any increase in output signal due to improved alignment, thereby making the improvement less obvious. Since most AVC systems are (level) delayed, keeping the input level down renders them inoperative. As sensitivity increases with alignment, the input level from the generator should be progressively decreased, to keep the output approximately constant.

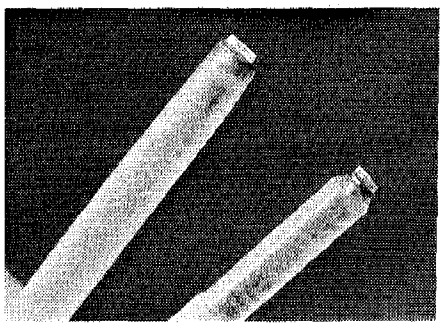
If an off-air signal must be used, there is another way to set up an output meter, this time so that it monitors the AVC system. By using a stronger (off-air) signal, the AVC system will be activated and, by monitoring this, we can measure the effect of adjustments.

The AVC action can be monitored by measuring the voltage developed across the cathode bias resistor of the IF amplifier (typically 3V). As alignment progresses, more AVC voltage is applied to the valve grid, less current is drawn, and less cathode bias is generated. So you simply adjust the IF transformers for a dip in the meter reading, rather than a peak.

Note, however, that the meter may not respond to adjustments to the IF secondary winding. The AVC voltage is normally taken from the primary of this transformer. But all earlier stages (aerial, RF, oscillator and IF primary) can be monitored.

When making these adjustments, it matters little in what order they are done provided that the trimmers or cores are peaked a number of times. Some adjustments will be sharper than others.

At this stage the IF transformers are aligned. The next step is to align the aerial and oscillator circuits. This will be covered in next month's Vintage Radio. **SC**



These two special alignment tools were made using acrylic rod and metal screwdriver tips. The small steel tips were cemented into the ends of the rods.