VINTAGE RADIO

By JOHN HILL

The basics of receiver alignment

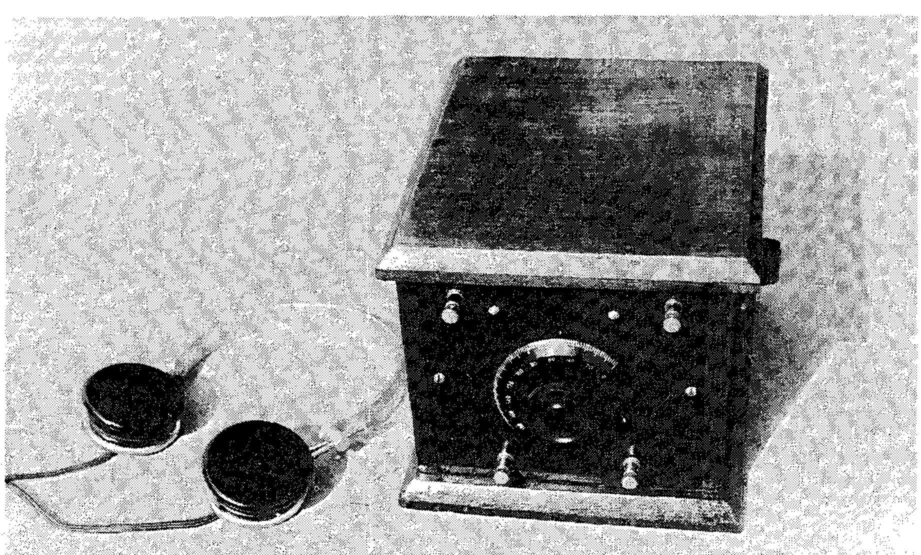
There is little point in restoring an old valve radio unless the receiver is accurately aligned afterwards. If you don't, it's like putting a reconditioned engine into a car without fitting new spark plugs or tuning the carburettor.

The subject of receiver alignment has been "waiting in the wings" for quite some time, simply because it is a fairly difficult subject to cover in detail. Radios from different eras use different types of components and therefore require different alignment techniques. Some receivers require more alignment than others, while odd sets need no alignment at all.

Perhaps the best way to approach the problem is to start at the beginning and work our way through. It looks like a project that will run over several months, so let's commence by studying the simplest of radio receivers, the humble crystal set.

A basic crystal set consists of a coil of copper wire, a variable capacitor, a crystal detector and a pair of headphones. The coil and variable capacitor together form a tuned circuit. When tuned to a station, the radio frequency (RF) energy from the resonant coil is passed to the crystal detector, where it is rectified to audio frequencies which are then turned into audible sounds by the headphones.

These same basic functions can be found in more elaborate receivers. All radio receivers select various radio frequency signals, detect them and then convert the detected signal to sound. However, whereas a crystal set has only one tuned circuit, a multivalve receiver has many tuned circuits, all of which need to track accurately with each other if the set is to perform well. The alignment of these circuits is what this article is all about.



This simple crystal set is from the very early days of radio. It has only one tuned circuit and thus requires no alignment.

Tuned amplifier circuits

It was discovered long ago that there were certain advantages if the feeble RF signals from the aerial were amplified (using valves) and selected by tuned stages before being fed to the detector stage.

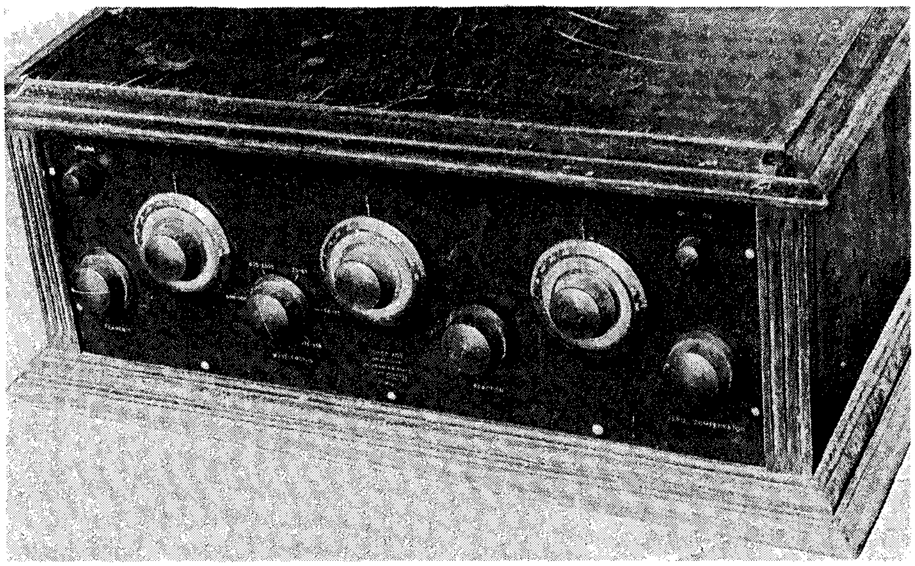
Early radios from the mid-1920s often had two or three dials on the control panel which indicated the number of tuned amplifier circuits. Unless these separate circuits were all tuned to the same frequency, the set would perform poorly because it was out of alignment. To tune such a receiver from station to station required accurate adjustment of up to three individual tuned circuits.

However, many operators were intimidated by these multi-dial receivers and three tuning dials were more than some people could handle.

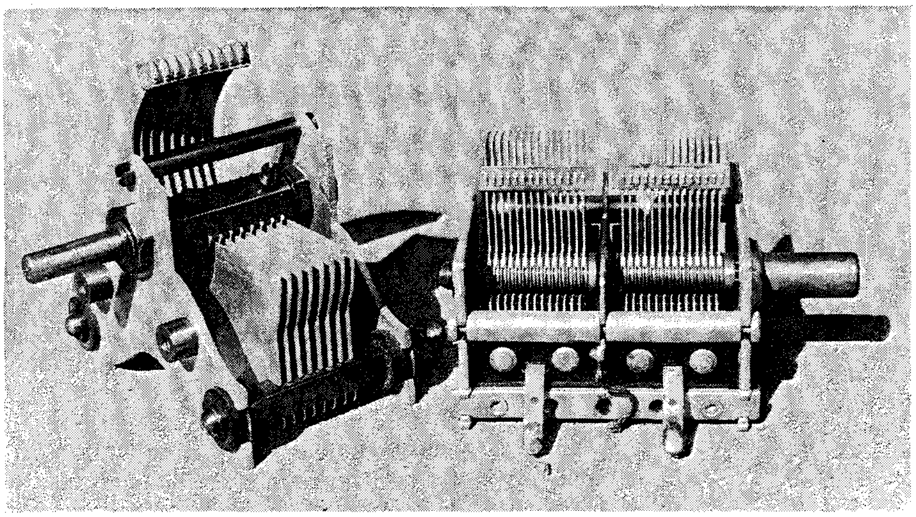
Naturally, the move to single dial tuning was a logical next step. No longer were there two or three separate tuning capacitors. Instead, they were "ganged" together to form a single unit. During the transition stage, there were various attempts at ganging by connecting single tuning capacitors together, using gearing, metal belts, or some other mechanical means.

Ganged capacitors

Around the 1930s, ganged capacitors made single knob tuning possible for as many as four tuned circuits. It was from this point on that receiver



This old UDISCO receiver from the mid 1920s has three tuned circuits as indicated by the three tuning dials. Alignment of the three circuits was part of the "tuning" procedure. Failure to correctly adjust any of the three tuning capacitors would degrade the signal.



Early receivers used only single tuning capacitors (left) and it was not until the late 1920s that single knob tuning became common. Single knob tuning required ganged tuning capacitors, as shown at right. From this point on, receiver alignment became important.

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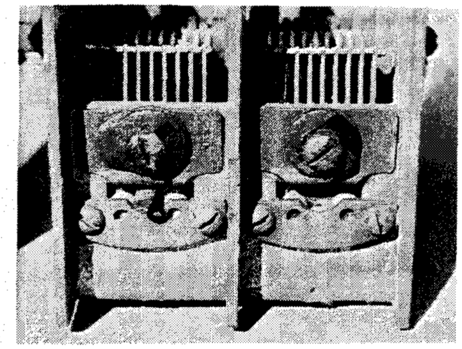
With the old setup of separate dials and tuning capacitors, it did not matter greatly if the capacitors were not closely matched in value because each tuned circuit could be peaked individually to the chosen signal.

However, with a ganged tuner, each section must be very closely matched to the others over the full range of its travel, otherwise it will not track accurately. Even then, stray capacitance due to wiring and minor coil variations can upset tracking at the high frequency end of the band.

To correct this, small trimmer capacitors were built into early tuning gangs, so that the capacitance could be varied slightly on each section. In later years, it became more common to fit the trimmers into the circuit rather than to the tuning capacitor.

As far as the TRF receiver is concerned, the alignment procedure is limited to the adjustment of these trimmers. This should be done at the high frequency end of the tuning range and each trimmer peaked for maximum audio output.

The only other adjustments that can be made to a TRF receiver are to the tappings on the aerial coil. Changing



Trimmer capacitors are often built into the tuning capacitor. They can also be separate units installed elsewhere in the circuit.

the aerial tappings can have a considerable affect on the set's selectivity.

Superheterodyne receivers

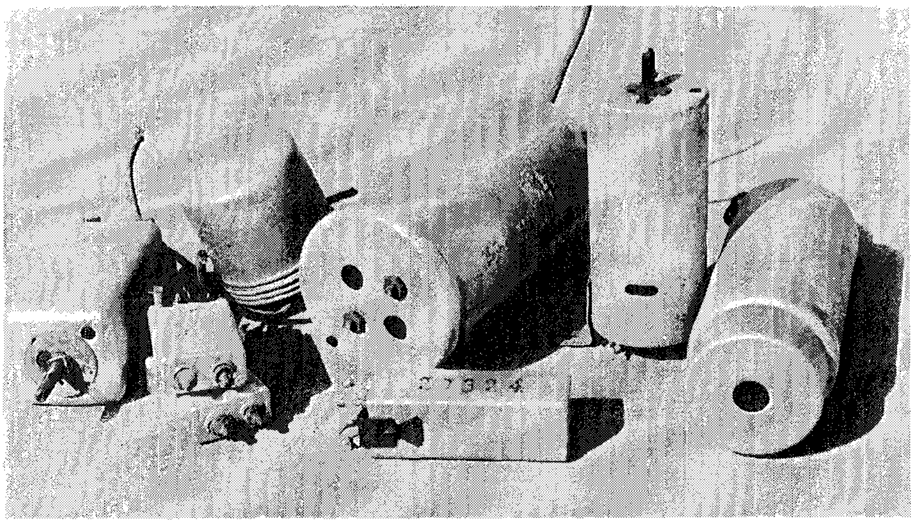
With the advent of the superheterodyne receiver, alignment procedures became more involved and a really good job requires special equipment – namely an RF generator and an output meter. But before going on to a describe superhet alignment, there are a few things to discuss first.

The superheterodyne circuit differs from the simple TRF receiver in that it converts each incoming signal, as selected, to the same frequency. This is called the "intermediate frequency" (IF) and is produced by a frequency converter stage which mixes the incoming RF signals with a frequency produced by an internal "local oscillator". The IF chosen varied greatly, depending on the design of the receiver, and ranged from 175-465kHz in domestic receivers.

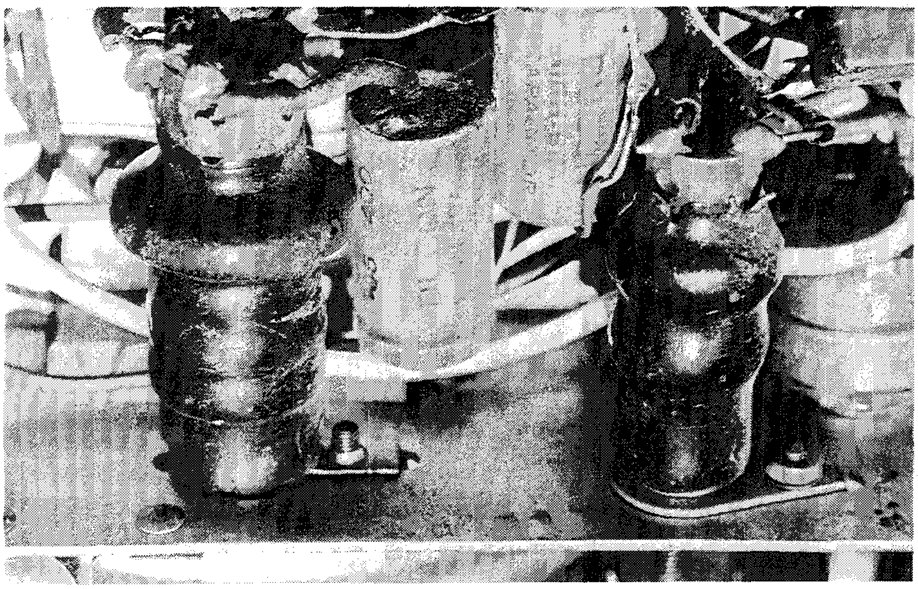
The intermediate frequency is the difference between the signal frequency and the local oscillator frequency. In theory, the local oscillator may be higher or lower than the signal frequency but, in practice, it is normally higher.

Thus, a signal of 600kHz would need an oscillator at 600 + 455 = 1055kHz in order to produce a 455kHz IF. And a signal at 1500kHz would need an oscillator at 1955kHz to produce the same IF.

The vital point about these figures is that, while the signal range is 2.5:1, the oscillator range is only 1.85:1. Yet these two frequency ranges have to be provided by two identical ganged tuning capacitors; one tuning the aerial circuit and the other tuning the oscillator circuit.



This photo shows a selection of old IF transformers. The early types were adjusted by built-in trimmer capacitors while later versions used adjustable iron cores.



This under-chassis view shows the aerial and oscillator coils (black objects) in a 1950-model Radiola. The larger of the two (at left) is the aerial coil. Many receivers have these coils encased in metal cans, which makes their identification more difficult.

This is done by connecting a carefully chosen value of capacitance in series with the oscillator tuning capacitor, which reduces the capacitance range of this section. This capacitor is called a padder and may be fixed or made adjustable for alignment.

Adjusting these two circuits – aerial and oscillator – so that each tunes exactly to the required frequency at each point across the tuning range is called tracking. It can be the trickiest part of the whole alignment procedure and must be done properly for best results. More about this later.

In the majority of domestic receivers, the IF is amplified by one valve (sometimes two) and this valve is coupled into the circuit by IF transformers. These IF transformers are (naturally) designed to work at the receiver's IF and can be adjusted to ensure that the transformer windings are peaked for maximum signal transfer.

The type of IF transformer adjustments vary depending on the age of the receiver, so a quick look at these would be appropriate for those who are unfamiliar with old radios.

Early IF transformers are adjusted by small trimmer capacitors which are built into their metal shields. Access to the trimmer screws can be through holes at the top of the shield can, on the sides of the can, or from underneath. In all cases, adjustments are made using a non-metallic screwdriver, as the adjustment screws may have a high voltage applied to them. Apart from the possibility of an electric shock, a short circuit between the adjusting screw and the metal shield could damage the fine windings of the transformer.

More recent IF transformers (from the late 1930s) feature adjustable iron-core tuning. The iron cores, or slugs, are attached to slotted brass screw threads which protrude from each end of the transformer.

IF transformers made from around 1950 onwards are more likely to not have brass adjustment screws. Instead, these are adjusted via a slot in the iron core itself and these slotted slugs are easily damaged if they are stiff to turn. Once the slot has been gouged out it is impossible to adjust the transformer unless other techniques are used (see Vintage Radio, July 1990).

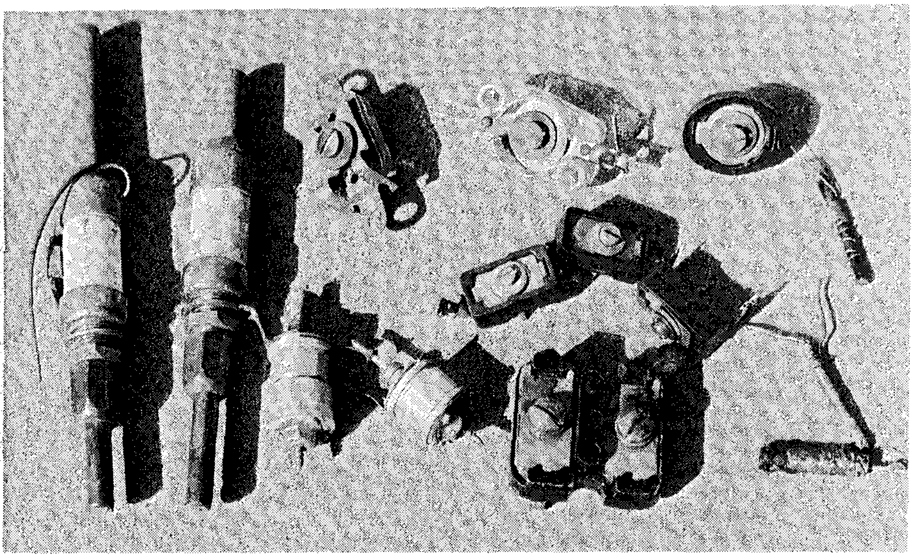
Other parts of a superhet that need to be recognised are the aerial and oscillator coils. These are often open coils mounted on the underside of the chassis or they can be enclosed in a shielded can, which makes identification a little more difficult.

If the coils are visible, then the aerial coil is usually the slightly larger of the two. If the coils cannot be seen, just trace the aerial through from the aerial terminal. The aerial goes to the aerial coil, which means that the other coil must be the oscillator coil.

Most aerial and oscillator coils have adjustable iron cores but occasionally only the oscillator coil will be adjustable. However, very early receivers will have no slugs at all. (No wonder I have put off writing about receiver alignment for so long).

Trimmer capacitors

The next components to find are the aerial and oscillator trimmers and these can be found in a number of places. Some, as previously mentioned, are built into the tuning capacitor or soldered onto it. They may be fitted into the circuit close to the aerial and oscillator coils. They may even be bolted to the front, rear or top of the chassis with a small hole in the chassis for adjustment purposes. Sometimes they may even be labelled so that they are readily identified (but not often).



Trimmer capacitors come in all shapes & sizes. But regardless of their physical differences, they all perform the same basic function.

Some trimmer capacitors don't even look like trimmer capacitors. One type consists of a central insulated wire with a coil of much finer wire wound around the outside. This type – which I understand was made by Philips – is inconvenient to work with because it is not easily adjusted. The capacitance of the trimmer is decreased by removing some of the outside coil. However, if the capacitance has to be increased, then wire has to be soldered to the outside coil and a few extra turns wound on.

Another type consists of a long brass rod that slides in, but is insulated from, a metal tube, and is held in place with a locknut. While these are much larger than the compression type, they had much to recommend them. They were used by AWA, HMV and many other makers for many years.

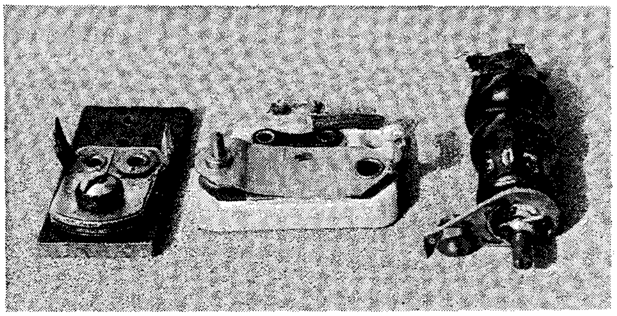
Unfortunately, without the proper tool, they can be difficult to adjust but, with it, they work well. The available movement is quite large for a given capacitance range and, once adjusted, they are very stable – much more so than the compression type.

The alignment tool used to adjust these was a composition rod with a box spanner at one end – to adjust the locknut – and a right angle hook at the other. The hook was used to engage a hole in the end of the brass rod, enabling it to be moved in and out of the insulator.

It is unlikely that such tools would be encountered these days although it should be possible to make one with a little ingenuity.

The final alignment component to identify is the padder capacitor. In early superhets, this takes the form of a compression type variable mica capacitor and is adjusted with a screwdriver. Many are made of white porcelain and these are easy to recognise.

The padder capacitor is part of the local oscillator circuit and the correct value is important for accurate tracking. In later model sets, the padder capacitor was a fixed type, tracking adjustments being made by an adjustable iron core in the oscillator coil.



Padder capacitors in old radios usually take the form of a compression mica type which can be adjusted with a screwdriver.

So far, I have tried to keep this article as simple as possible and for good reason. Nearly all the vintage radio collectors I know cannot do their own repairs. They have had little or no electrical or radio experience prior to becoming collectors and these people need precise directions if they are to align their receivers.

It is pointless discussing alignment procedures if the reader is unsure of what he is doing. However, now that the preliminaries have been dealt with, I hope to be able to cover the subject more fully. From this point on, if I refer to the padder capacitor or the oscillator trimmer, I expect the reader to have some idea of what it looks like and where it might be found.

Incidentally, there are two ways of doing an alignment job. One way is to use alignment equipment such as a radio frequency generator and an output meter; the other method is to do the job without them. Although the right equipment makes the task easier, a reasonable job can still be done without it.

In the next few months, Vintage Radio will cover both methods. So if you are about to tune up a recently restored receiver, then you will have to wait until then for the finer points on alignment. **SC**