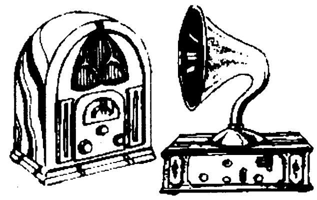
Vintage Radio

by ROGER JOHNSON



Taming the Autodyne

Although there were all-triode superhets during the 1920s, for all practical purposes the autodyne was the superhet of the 1930s. Understanding the basics of autodyne operation isn't too hard, but getting the most out such a set is more of an art than a science...

It is sometimes useful to explore the derivation of some of the technical terms used in a bygone age. 'Autodyne' comes from two Greek words: *autos*, meaning 'self', and *dunamis* meaning 'force', or 'work', hence an autodyne is a 'self working' superhet.

To get the maximum performance from one of these circuits, it is necessary to understand how they do 'work' (no pun intended).

The circuit in Fig.1 is typical of the many, many five-valve autodynes produced during the 1931 to 1935 period. It is actually reprinted from *Radio & Hobbies* for November 1943, where the late Neville Williams wrote a comprehensive article on keeping such sets alive and well during the war years (because there were no new radios available for the domestic market).

Every major manufacturer produced autodynes, and they fell into three main categories:

(a) The 1931/32 first series, using the five pin, 2.5V valves 224A, 235, 224A and 247 and 280 rectifier.

(b) The 1933/34 second series, using the six pin later series 2.5V valves 57, 58, 57, 2A5 or 59 and 80. During this period some manufacturers opted for the Philips 4.0V 'gold series' E446, E445 or E447, E444N or E446, and E443H or E463 output. Occasionally, the type 2A6 or a similar Philips variety was used for diode detection.

(c) The last series of 1934/35, using the 6.3V pre-octal valves 6C6, 6D6, 74, 42 and 80. Not infrequently a 6C6 was used as an anode bend detector.

Invariably the first and second series used a 175kHz intermediate frequency or thereabouts, and therefore had a three-gang tuning capacitor with a 'pre-selector', or bandpass tuning to improve selectivity and reduce or eliminate double spotting. The last series used the more conventional 465kHz IF and had the conventional two-gang tuning capacitor. There were some exceptions to the above classifications, but they were generally true for the vast majority of sets.

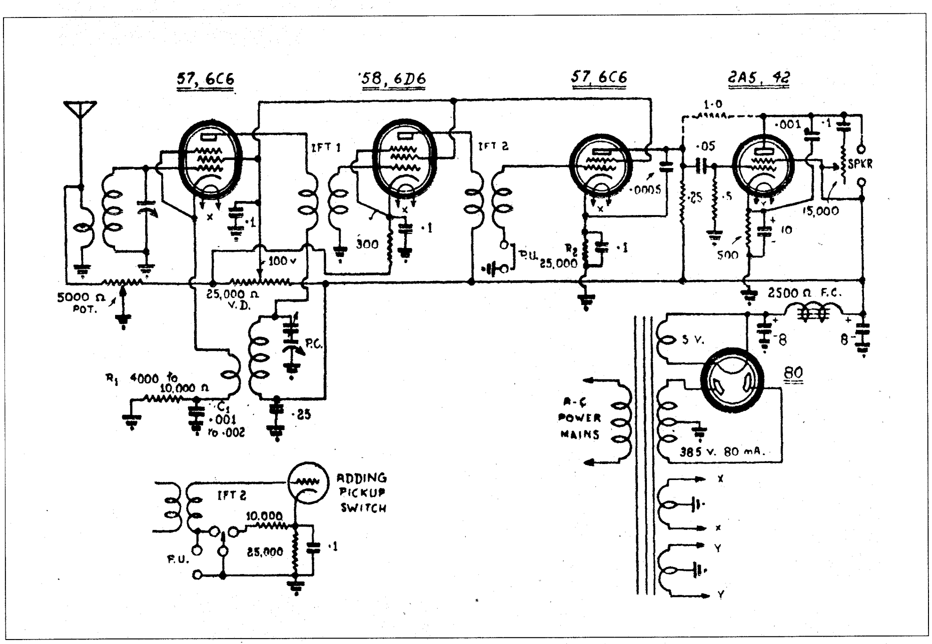


Fig.1: An autodyne circuit of the 1930s, as given in Radio & Hobbies for November 1943.

Local oscillator

The oscillator section is the heart of the autodyne. Whether it is anode tuned or cathode tuned, the primary of the first IF transformer is in series with the anode and either one of the windings of the oscillator coil, as appropriate. For the moment the IFT can be ignored, but its importance cannot be overlooked and there will be more discussion further in the text.

For the purposes of oscillation and the oscillator frequency, the first valve is working in grounded-grid mode. Instead of the cathode being at ground (or bias) potential, and the signal being applied to the grid, the grid is quite effectively earthed via the tuning winding of the main tuning coil. The oscillations are established between anode and cathode.

Crucial components

The cathode resistor R1 and capacitor C1 are an important part of the oscillatory circuit, and serve the function of oscillator 'grid' capacitor and its associated 'grid leak' resistor in a more conventional circuit. However, the DC conditions of the valve must be taken into account, as R1 also provides the cathode bias. If there is much variation in these components, the valve may fail to oscillate. Therefore, in a receiver which is not working and all of the coils are intact and the valve is good, replacement of these components within the range suggested may well prove beneficial.

Of the dozens of these circuits that have been examined, there has been practically no, if any, deviation of the values as shown in the circuit diagrams.

Cathode tuning

The earlier autodynes generally employed the oscillator circuit as shown in Fig.2. Here, the oscillator coil winding in the anode circuit is the 'tickler', and the tuning coil is in the cathode circuit. In other words, the windings were reversed.

The one variation is that the cathode resistor and capacitor are tapped down the tuning coil. The texts seem to be devoid of an explanation for this practice, but a likely reason may have been to prevent too much of the oscillator voltage appearing at the cathode and causing problems with the valve's operating characteristics, or causing problems with mixing. Again, the resistor and capacitor form part of the oscillator circuit as well as providing DC bias to the valve.

It is said that the plate-tuned circuit was preferable. Possibly a plausible reason was to prevent the intermediate frequency being in turn coupled to the tuning coil and hence being fed back into the valve, thereby causing stability problems. The 'tickler' winding would be of low impedance at intermediate frequencies — all the more so at 175kHz.

In each case, the oscillator frequency is determined by the section of the tuning gang connected across the main section of the oscillator coil, as shown in the diagrams. The series-connected padder capacitor (PC) is used to achieve tracking — i.e., oscillation at a frequency spaced away from the input by an amount equal to the IF (usually on the high side).

The signal input, tuned by the first gang section, appears between grid and cathode in the normal sense for an RF pentode. Resistor R1 in these circumstances only serves to provide DC bias to the valve.

Thus, we have the valve receiving a tuned signal input to the grid, and an oscillator circuit in the cathode. These two signals are mixed in the same manner as a conventional mixer.

The first IFT

When we come to the first IF transformer, there is a major departure from the superhets using a heptode or triode-hexode frequency converter (6A7, 6A8-G, AK1, AK2 etc). As the primary of the first IFT is in series with the oscillator coil, its inductance acts as an RF choke.

Usually, an IFT's internal compression trimmer, or the fixed capacitor in later years, was 50-70pF, and the inductance chosen to match the given IF. However, if that were the case with the autodyne, the inductance could well be large enough, and therefore offer sufficient impedance, to prevent the coil and the valve from oscillating.

Therefore, to suit autodynes, engineers designed a first-IFT with a high C/low L ratio in the primary. Usually the capacitor was about 150pF. The subsequent IFT windings have no effect on oscillator performance, and are of conventional design.

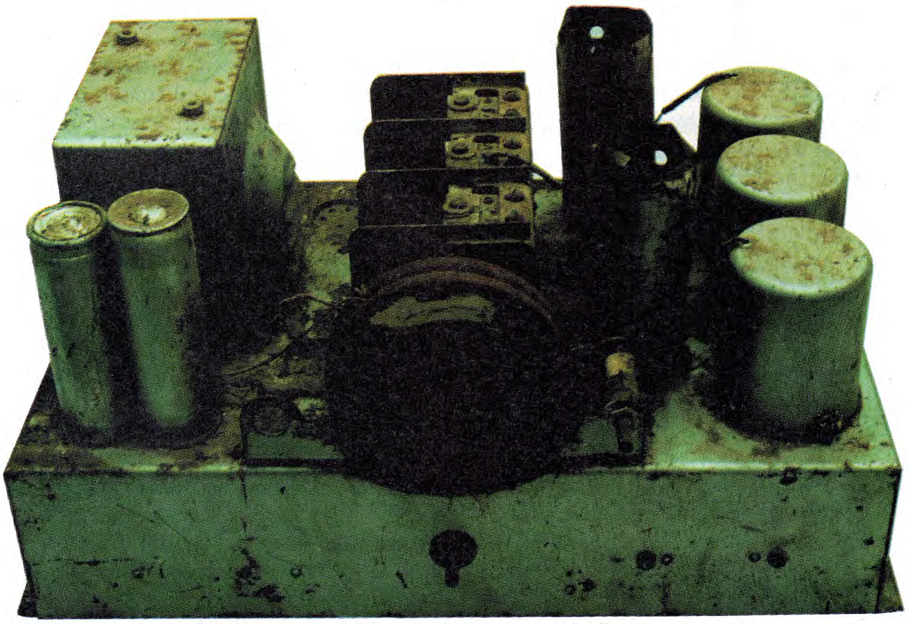


Fig.4: A typical early autodyne chassis, made by 'Eclipse' and in this case straight from the maison-de-chook and awaiting a sympathetic restoration...

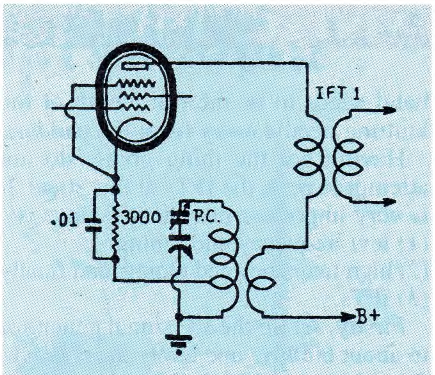


Fig.2: The connections for the alternative cathode-tuned autodyne oscillator, also taken from R&H for November 1943.

Alignment — 465kHz IF

The alignment of these sets is where science gives way to art! First and foremost, you will need a suitable tool to adjust the padder. Modern, slim tools designed for modern small components are useless; you'll need something more sturdy.

Firstly, apply a minute amount of penetrating oil via a pin or a sewing needle to the thread of the padder adjusting screw, and ensure that it turns freely. Next, go to grandma's knitting bag and pinch one of those big fat plastic knitting needles about 6 - 7mm thick, and with a file, fashion a screwdriver blade at the free end.

This is important. Whether the padder is in the plate circuit of the cathode circuit, it will suffer considerably from hand-capacity effects and de-tune if a metal screwdriver blade is used. Your

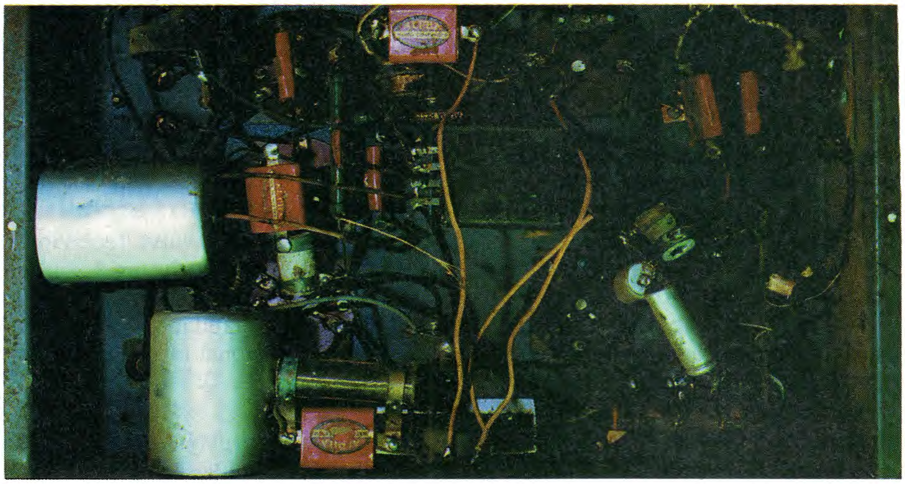


Fig.5: Underneath the chook-house special. The two cans are for the oscillator coil and first IFT, which are inter-connected.

hand needs to be the full length of the knitting needle away from the padder.

Having got the thing going, do not attempt to peak the IFTs at this stage. It is very important that the sequence is:
(1) low frequency end tuning;
(2) high frequency end tuning; and finally
(3) IFTs.

Firstly, set up the RF signal generator to about 600kHz and apply the signal to the antenna terminal. With the volume full on, and the generator output suitably attenuated, adjust the tuning gang and padder for maximum output. There will be a spot on the dial where a given combination of tuning gang setting together with padder adjustment will provide maximum output.

It is not merely a matter of setting the tuning gang to an approximate position and then adjusting the padder to suit. These things have a mind of their own, and there will be an optimum setting of gang and padder adjustment...

In some locations, there are stations at the very low frequency end of the dial. Examples are 5UV Adelaide at 531kHz and 3WV in the Wimmera at 594kHz. With a superhet of later design, it may be possible to tune down to those stations with no noticeable deterioration in performance. However, with an old autodyne, you can forget it. Any attempt to tune down that low will seriously disrupt performance at the high frequency end.

Next, tune the generator to about 1500kHz and repeat the process by rocking the gang and adjusting the trimmers (on the tuning gang). A point will be usually found where the output is again noticeably higher than any other setting. Again, don't try for those stations right up at 1600kHz if it won't tune that high. Attempts to reach those frequencies may cause image problems further down the dial!

Lastly, with the generator connected to the grid of the mixer, and WITHOUT touching the trimmers, gently rock the generator tuning near the intermediate frequency until a peak is obtained. Take no notice of the frequency, no matter what it might be! Then, and ONLY THEN, peak the IFTs for maximum output, again by using grandma's tried and true alignment tool.

Adjust the secondaries first, then the second IFT primary, and then the first IFT primary. The second IFT secondary in particular will be very flat indeed, and a peak may be difficult to obtain, so try that again last of all.

Although the foregoing flies in the face of conventional wisdom, the IFTs in these sets also have a mind of their own! They have a 'preferred' setting.

The real fun...

For those unfortunate to have an old set with a pre-selector and a 175kHz IF, start with step (1) above. At the high frequency end, all sorts of problems can arise. It is a matter of mathematics. One of the tuning coils could easily be tuned to say 1500kHz, and the other, by an inappropriate setting of its trimmer, be tuned to either 1675 or 1325. The difference, is of course, the IF. If these two signals are fed into the mixer, the difference frequency will beat with the IF and cause any number of 'joeys'.

It must be stressed that the tuning characteristics of the old solenoid coils are so broad that any difference in the relative settings of the two coils that are within coo-ee of the IF will cause the problems described.

The solution is patience, trial and error. If joeys are present, try removing the signal generator and using a local station or stations, try and tune them out by adjusting each trimmer a fraction of a turn and gently rocking the tuning gang.

Having satisfied yourself that there are no spurious oscillations, try connecting the generator again tuned to about 1500kHz, and repeat (2) above as for the 460kHz IF. Remember, adjust the trimmers only a fraction of a turn at a time. NOW you can peak the IFTs in the manner described.

If you are really keen, the whole process can be repeated, particularly peaking the IFTs. But keep in mind only undertaking FRACTIONAL adjustment of padder and trimmers, otherwise the whole alignment can be easily be thrown out.

It must be stressed this is *not* a five-minute job. The best part of an hour can be spent setting up one of these sets, especially one of the early pre-selectors.

Having said that, they do perform reasonably well given the limitations of the tuning range and lack of AGC. A full treatise on detection, volume control and other quirks and peculiarities of these sets are discussed in *Radio & Hobbies* for November 1943, April 1944 and October 1944. ❖

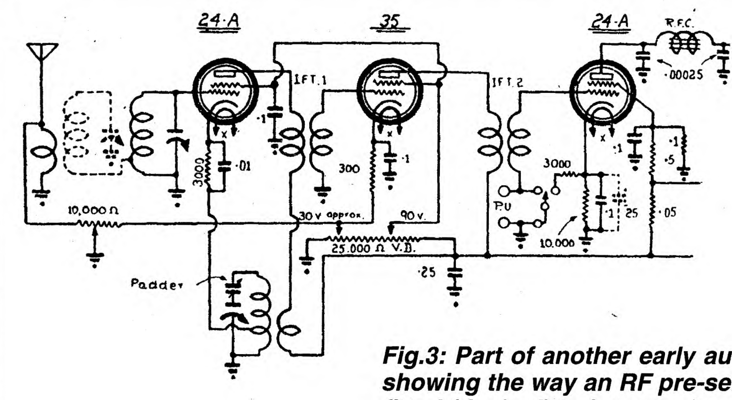


Fig.3: Part of another early autodyne circuit, showing the way an RF pre-selector coil was fitted (dashed) to improve image rejection.