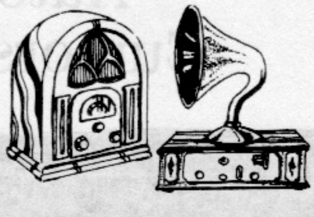
Vintage Radio



by PETER LANKSHEAR

Early tuning indicators

Right from the early days of radio broadcasting, many listeners have experienced difficulty in tuning their receivers accurately to a station. Early receivers used some novel systems to help overcome this difficulty.

A proportion of non-technical radio users have always seemed to experience problems in achieving accurate tuning, but the problem became more widespread in the late 1920's when receivers were fitted with automatic gain or volume control (AGC, AVC) to minimise the effect of fading and variations in received signal strengths. A minor disadvantage of AGC is that it produces an apparent reduction in receiver selectivity, 'spreading out' the apparent position of each station and making accurate tuning more difficult – at least for some users.

An old problem

That this might be a problem was recognised right from the first use of AGC, and today's up-market radios still include fancy LED tuning displays among the 'bells and whistles'. Here we're going to look at early tuning aids, several of which were to be found in Australian made receivers. Some were quite ingenious, although with an element of sales gimmickry.

About the earliest receiver incorporating AGC seems to have been the all triode, mains-powered RCA model 64 superheterodyne of 1928. As was general with valve AGC systems, the gain of the receiver was governed by automatic adjustment of the grid bias on RF and IF amplifying stages. The stronger the signal, the greater the AGC voltage and the corresponding reduction in the anode currents of the controlled valves.

The RCA 64 had a tuning indicator – a reversed scale milliammeter registering the anode currents of the controlled valves. By observing the needle movement, the user could peak the tuning accurately. As AGC became into wider use, these 'tuning indicators' or 'resonance meters' became more common, generally in prestige models. Owners of lesser models presumably had better tuning skills, or uncritical ears!

Although a few large receivers used a separate sharply tuned circuit and detector valve to control the meter, standard practice still was to monitor the anode currents of AGC controlled valves.

Shadow meters

Meters were regarded as looking somewhat too 'technical' for domestic receivers, and by 1933, alternative 'Shadowgraph' and 'Shadow Meter' systems were in use, especially by Philco. These were simple moving iron meter movements with lightweight vanes rather than pointers. Most registered the anode current of AGC controlled stages, but in America, Zenith used a separate metering triode with its grid connected to the AGC line.

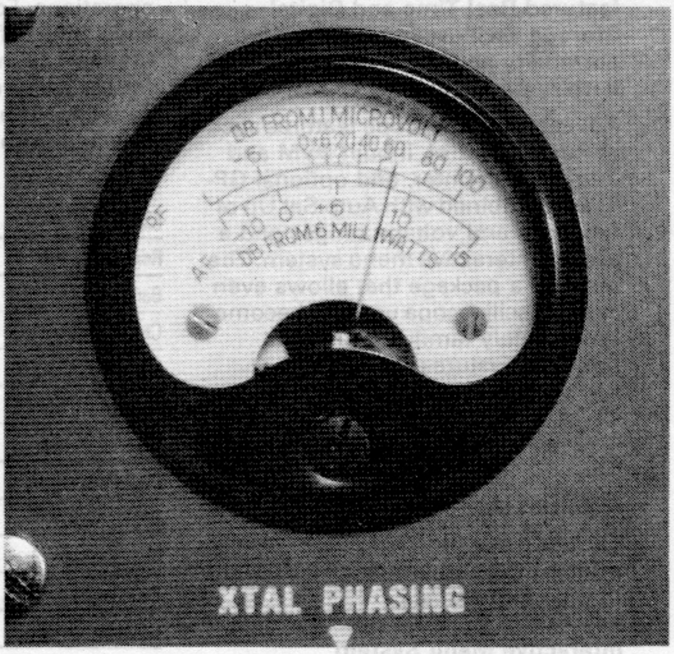
All used a simple optical system, projecting the light from a pilot lamp to throw a shadow of the vane on to a small translucent screen. Resonance was indicated by the narrowing of the shadow.

Although expert operators are quite capable of tuning receivers accurately without assistance from tuning indicators, top grade communications receivers have always used calibrated tuning meters, commonly called 'S' meters. While the beat frequency oscillator (BFO) is far more useful as a tuning aid, the S meter is valuable for judging received signal strengths.

Neon indicators

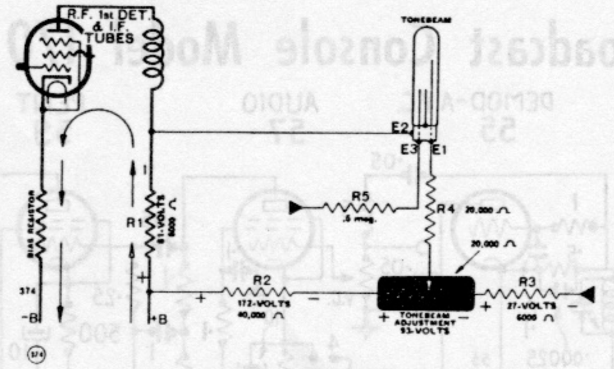
In 1932, an all electronic tuning aid appeared. Given such fancy names as 'Tonebeam' and 'Flashograph', it was a thin neon lamp about 100mm long containing three electrodes. Atwater Kent used the 'Tonebeam' in several models, and their description of its operation is reproduced in diagram 1.

The neon lamp used in the Tonebeam system had an unfortunate tendency for the glass to blacken and become opaque – the condition in which they're usually found nowadays. Unfortunately good replacements are practically unprocurable.



Although the tuning meter dates from the 1920's, this one belongs to a 1960 Hammarlund SP600 communications receiver.

Diagram 1: The 'Tonebeam' system.



TONEBEAM CIRCUIT IN MODEL 812.

ACTION OF TONEBEAM

The Atwater Kent tonebeam is a neon light-column that indicates visually when the set is tuned correctly to resonance with the incoming signal.

A typical circuit arrangement for the tonebeam is shown below. This particular circuit is used in Model 812.

The tonebeam requires an initial bias to make the short center electrode (E-2) positive with respect to the long electrode (E-1). The bias is adjustable to take care of different tonebeam tubes, the adjustment being provided by a potentiometer in series with resistors R-2 and R-3 which limit the range of adjustment. In the circuit shown below, the bias voltage across E-1 and E-2 can be adjusted from 91 to 184 volts.

When a signal is tuned in, the automatic volume control increases the negative bias on the control grids of the R.F., 1st-detector, and I.F. tubes, thus decreasing their plate current. This decrease in plate current causes a decrease in voltage across R-1 and a corresponding increase in the voltage difference between electrodes E-1 and E-2. The increase in voltage across E-1 and E-2 causes the neon glow to extend up the long electrode. When the initial bias voltage is adjusted to the correct operating point, an increase of about 20 volts across E-1 and E-2 will cause the neon glow to extend up to the top of the long electrode E-1.

The electrode E-3 and resistor R-5 are used to ensure stable operation of the tonebeam. Resistor R-4 is used to make the tonebeam action more uniform on weak and strong signals.

A fairly obvious method of tuning indication would have been to use a low current incandescent lamp in series with the controlled valves, and Canada's Rogers did just that. They used a 0.5 watt 24 volt lamp which dimmed as resonance was reached, but the wattage was too small for impressive displays. Later, Rogers used a 6F6 power valve solely to drive the tuning lamp.

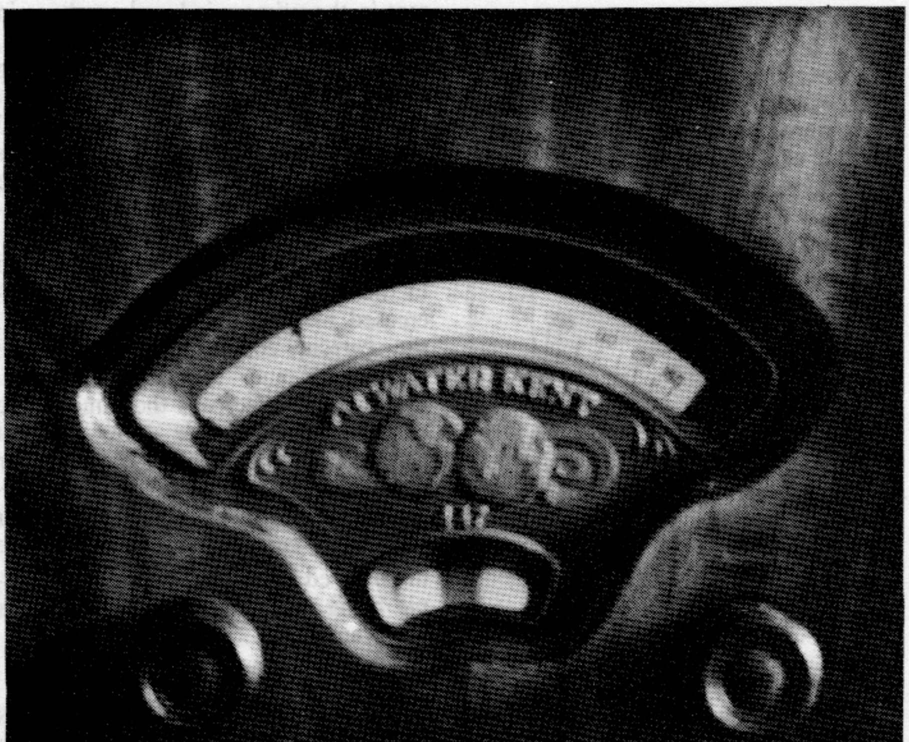
'Hi-tech' lamps

Several methods of using larger lamps were based on transformers with saturable cores. American Majestic's was first used in 1932, and its operation is shown in diagram 2. Anode current for the RF and IF valves passed through the winding on the centre leg. In the absence of AGC voltage, this current was sufficient to create a large magnetic flux, saturating the core. Current to a lamp flowed through the windings on the outer legs. With the core saturated, these windings presented little impedance to the flow of lamp current, which glowed at full brilliance.

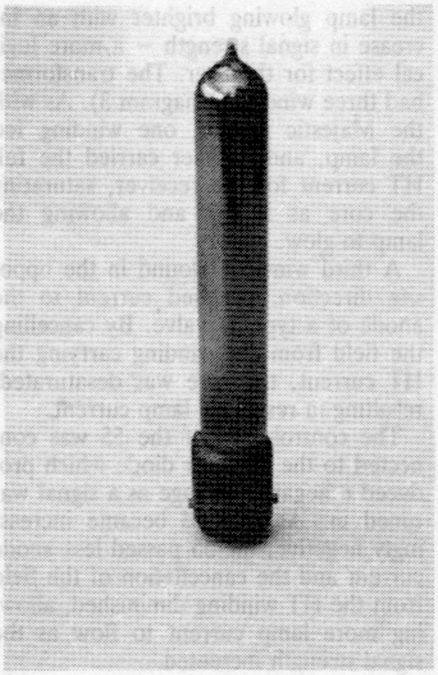
However, when AGC action reduced the valve currents through the centre winding, the core ceased to be saturated and the lamp windings impeded the flow of lamp current, which dimmed in step with the changes in AGC voltage.

It is interesting to note that if all the windings had been on one leg of the core, transformer action would have superimposed a large AC voltage on the anode supply. As it is, the lamp windings were in opposition and there was no transformer effect.

Australia's Tasma reversed the action for their 'Visual Tuning Indicator', with



The dial of an Atwater Kent model 447, fitted with shadow tuning. Increasing signal strength narrowed the shadow visible in the lower window.



The neon lamp from an Atwater Kent 'Tonebeam' tuning indicator. It used a standard small bayonet cap. Like many, this one has become blackened.

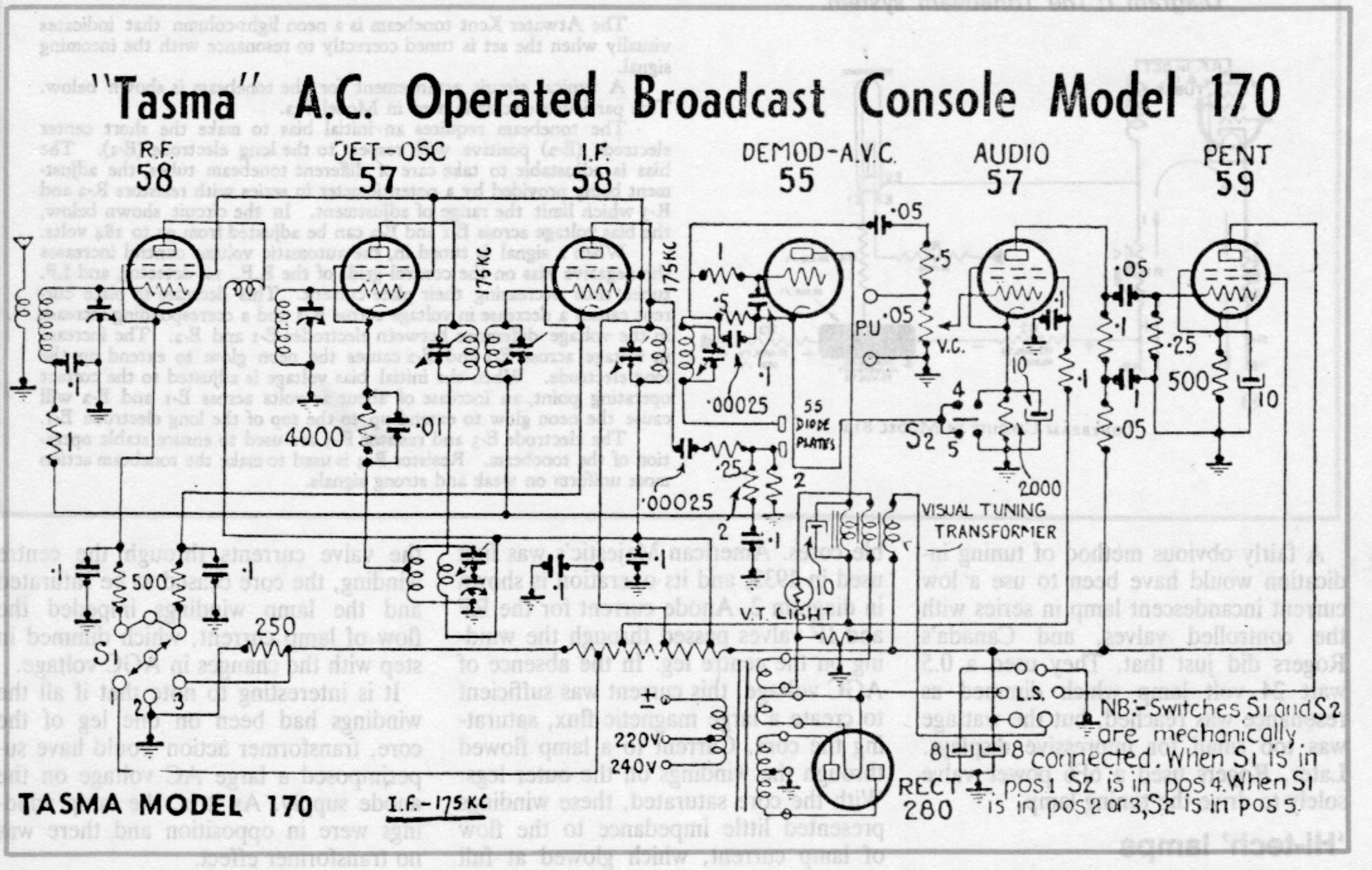


Diagram 3: TASMA improved on the Majestic system by reversing the action. As signal strength increased, the lamp became brighter. Control was via the triode section of the 55 valve.

the lamp glowing brighter with an increase in signal strength – a more logical effect for the user. The transformer had three windings (diagram 3). As with the Majestic system, one winding fed the lamp, and another carried the full HT current for the receiver, saturating the core as before and allowing the lamp to glow.

A third winding, wound in the opposite direction, supplied current to the anode of a type 55 valve. By cancelling the field from the winding carrying the HT current, the core was desaturated, resulting in restricted lamp current.

The control grid of the 55 was connected to the detector diode which produced a negative voltage as a signal was tuned in. As its grid became increasingly negative, the 55 passed less anode current and the cancellation of the field from the HT winding diminished, allowing more lamp current to flow as the signal strength increased.

Midwest flamboyance

Midwest, who favoured large flashy receivers at budget prices, came up with the interesting variation of the tuning lamp shown in diagram 4.

A 3.2 volt lamp was connected to a 6.3 volt source via the primary of a small transformer, whose secondary leads were connected to the anode and cathode of a 6C5 triode. The lamp current in the primary induced a voltage in the secondary, and with no grid bias, the 6C5 conducted on the positive going cycles. The resulting primary current flow caused the lamp to light to full brilliance. (As the negative excursions were lost, the lamp could never receive more than half the effective supply voltage).

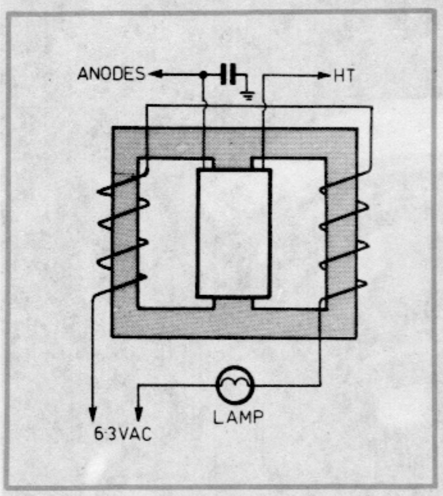


Diagram 2: The Majestic lamp tuning indicator, which was the forerunner of several related systems. Although crude by today's standards, it shows a sound knowledge of basic theory.

The 6C5's control grid was connected to the AGC line. As AGC voltage increased with the tuning in of a signal, the current conducted by the valve diminished and the lamp dimmed. Overall, the effect was the same as the earlier Majestic system – but Midwest further refined it to provide dial *colour* changes at resonance! They used a saturable transformer arranged to transfer the display current between two groups of coloured lamps, the operating principle being much the same as in GEC's 'Colorama'.

Colour tuning

GEC's 'Colorama' tuning represents the final development of the lamp-type tuning indicator. Quite impressive, it was an ingenious combination of the previous systems, but with colour as

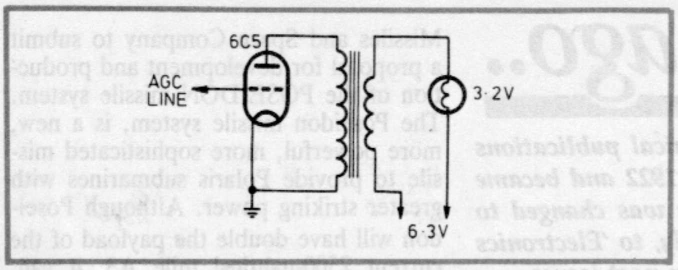


Diagram 4: What, no high tension? The Midwest system used the control valve as a grid controlled rectifier, varying the impedance in series with the lamp.

well as intensity changes.

Four red coloured series-parallel connected and three series connected green coloured 6.3 volt 0.15 amp lamps formed the display. With no received signal, the red group

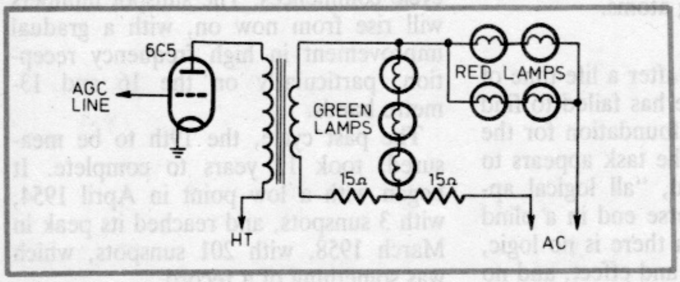


Diagram 5: The slightly more complex American GEC 'Colorama' system. As the signal was tuned in, the display changed from red to green.

was at full brilliance, with the green group invisible. As the signal strength increased, the red lamps dimmed, while the green lamps commenced to glow. When a strong signal was fully tuned in, the red illumination disappeared and the green display was at full brilliance.

The essentials are shown in diagram 5. The grid of the 6C5 valve was controlled by the AGC line. HT current to the anode of the 6C5 was fed via the primary of a saturable transformer, which decreased the reactance of the lamp winding from a high value with no anode current in the strong signal condition, to a low value at maximum current.

At saturation, full current flowed through the lamp winding to the group of four red lamps. As the signal increased, the 6C5 drew less current, the reactance of the winding increased and current commenced to flow through the green lamps shunting the winding. A large AGC voltage resulted in no lamp current flowing through the reactor winding. The green lamps were then lit fully. Although the red lamps were still passing current, their parallel connection meant that they were operating at 50% normal current and consequently their light output was small. The visual effect was quite spectacular, with the dial colour changing from red to green as a station was tuned in.

Final phase

During 1935, the familiar green fluorescent 'Magic Eye' valve tuning indicator was introduced. Cheaper and simpler than previous types, it remained practically unchallenged to the end of the valve era, over 30 years later. But that story will have to wait for another time.