ANTIQUE RADIOS

Tuning "eyes" and AVC

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LAST TIME WE LOOKED AT ONE POPULAR advance in early radio circuits: the automatic tuner. This month we'll take a look at several other, more controversial advances: tuning indicators and Automatic Volume Control (AVC) circuits. If you ever wondered how a "magic-eye" tuning indicator works, or how to troubleshoot one, you'll find our discussion valuable.

The Truetone model *D925*

Our Antique of the Month, made by Western Auto, is a fine-looking radio that incorporates several of the advanced features we'll be discussing. It has a magic-eye tuning indicator and pushbutton tuning, as well as a tone control and the ability to receive shortwave signals. To override the pushbuttons, the spring-loaded tuning knob is pushed in. The seven-tube (not counting the magic eye) superhet uses a type-80 rectifier tube, and it has an IF of 455 kHz.

Automatic tuning devices like that on the Truetone model *D925* did little to hold the cost of a radio down; and cost, in the early 1930's, was of prime consideration to manufacturers. But not all circuit improvements increased cost. In fact, one of the most important advances actually reduced cost in the final analysis. The superheterodyne circuit reduced interference and improved reception to such an extent that pounds of shielding could be eliminated.

During World War I, many engineers worked on the superheterodyne circuit, which was first

FIG. 1

patented by Major Armstrong after the war. Because of patent-right contention, superhet sets didn't really become widely available until the early 1930's. However, as late as 1940, TRF (*T*uned *R*adio *F*requency) receivers were still being built. But long before patent restrictions were eased, hobbyists began converting their sets from information published in radio magazines. If you come across one of those altered sets, you'll never be able to track down an accurate schematic.

Along with circuit refinements like the superhet, accessories like tuning indicators became popular. The tuning aids we'll discuss were, in a sense, a spin-off of AVC circuits. Of course, if a set was properly aligned, and if the dial pointer was set accurately, you could tune stations in with few problems. But manufacturers thought that it would be a good idea to provide a *visible* indication of tuning status.

The magic eye was one popular tuning indicator. It is a tube-like device that mounts in a socket similar to a panel-light socket. A metal bracket holds the tuning eye and the socket so that the top of the tube is visible through the front of the cabinet. A fluorescent coating and a "shadow" indicate relative signal strength. The smaller the shadow, and the larger the fluorescent area, the better a station is tuned in. A tuning eye was often considered as just another of the set's tubes, so it was tested with the other tubes when a service man repaired a set.

The magic eye is similar to a dual-triode tube that has a common cathode. One triode is connected to the set's AVC circuit; it determines the brightness with which the fluorescent part illuminates. The other triode is really the indicator; its plate is the fluorescent target, and its grid, which is controlled indirectly by the other triode, is what actually determines brightness.

The eye works as follows. When a signal is *not* tuned in, the AVC voltage will be very positive. That will decrease the current flow through the second triode, so the "shadow" area of the fluorescent screen will increase. But as a station is tuned in, AVC voltage decreases, so more current flows, so the illuminated area increases.

Tuning-eye troubleshooting

Problems with the eye shouldn't be difficult to diagnose, especially if you have an antique tube tester like my NRI model *70*. First test the regular triode section of the tube with the usual short and emission tests. Then check the eye section; but watch the fluorescent screen, not the meter, while making the test. Without the tube tester, only a limited continuity test can be done. If the tube tests OK, there's a good chance you've got a problem in the AVC circuit.

If your radio produces no audio, but the tuning eye still appears to operate, your set's RF stages are probably in working order. The problem is probably in the audio output stage or in a speaker. If the set is dead and the eye has a red glow, you probably have a defective power supply.

You might be baffled by a receiver that works OK, but whose eye doesn't close, especially if the eye and the AVC check out. In that case, the problem may be a resistor connected to the fluorescent plate. That resistor may be located *in* the socket of the tuning eye. Remove the eye from its socket, and carefully pry the socket open with a small screwdriver. Measure the resistor and replace it if necessary. It'll probably be a high-valued unit—100,000 ohms or so.

Other tuning indicators

In the late 1920's there were a dozen or more different kinds of tuning indicators, including a not-too-popular tuning meter. Such meters have fancy escutcheons and make fine collectables. As a station was tuned in, the pointer would swing to the right. There is also an indicator that makes an audible sound when the station isn't tuned in properly.

A popular tuning indicator in the 1930's was the *Shadowgraph*, used on Philco and other sets. By opening its case, it becomes obvious that it's really a meter-type tuning indicator. The moving vane serves to obscure light emanating from a pilot lamp inside the meter. The movement of the vane is controlled by the AVC. As the vane moves, it changes the size of the shadow from the pilot light; that shadow is then imposed on a celluloid screen. The screen is visible on the front panel, and, as with the magic eye, the smaller the shadow, the better the signal. Here's a few hints on *Shadowgraph* troubleshooting.

If the screen is completely dark, first check the pilot lamp. If the lamp is good but the shadow doesn't change when tuning, check the AVC. If that checks out, you may have to open the case to examine the meter movement.

Tuning indicators went hand-in-hand with AVC. But so far we've been talking about AVC circuitry as if it came into existence with no birth pains at all. However, that's not the case; let's see why.

The birth of AVC

In the 1920's there was much debate in radio circles concerning the merits of AVC versus its cost. Was the added cost of an extra tube, an extra socket, a tuning indicator of some sort, and other parts worth it just to get a receiver that didn't blast or fade? As we'll see below, AVC helped to sell radios; but even so it took patience to tune in a station while watching an indicator. Later, many listeners tired of watching the tuning indicator just to be able to see what their ears were already hearing.

Most people who thought that AVC was unjustified lived in areas of good reception. Also, they attached little importance to the popular hobby of DX'ing. And they thought that programming on distant stations wasn't high quality. They were often, but not always, right. Programs originating from independent stations sometimes were amateurish, as those stations couldn't afford to hire the best entertainers.

However, even people in good signal areas sometimes suffered the effects of interference. For example, if a receiver had an antenna tuner or a loop-operated superhet, any nearby radio could be overloaded by a deafening squeal.

Those in favor of AVC usually wanted to—or could only—listen to distant stations. Not all receivers were located in the shadow of the transmitter. Also, by that time, consumer radios had to be simple to operate. Housewives, shopkeepers, and other workers wanted to listen to their radios while going about their daily routine. Having to make frequent volume adjustments was a nuisance to them as it interfered with their tasks.

Audio amplifiers

After the RF and AVC stages comes the audio amplifier. Many designs were popular, but an interesting one is the push-pull amplifier, which was popular in larger, more expensive antique radios. The push-pull amplifier is also called a balanced amplifier. It has two tubes that are operated 180 degrees out of phase with each other. In other words, one tube amplifies the positive, and the other, the negative, half-cycle of a signal.

The grids of the two tubes are connected to opposite ends of the secondary of the input transformer. The plates of those tubes are connected to opposite ends of the primary winding of the output transformer. Both transformers have center taps that are connected to AC ground.

The pentode

In the past we've discussed the origin of the diode and the triode. The screen-grid tube has also been mentioned. Now let's talk about the pentode, which was announced in the early months of 1930 by the CeCo manufacturing company. Of course, it's called a pentode because it has five elements including a cathode and a plate like a diode, a control grid like a triode, and a screen grid for the plate like a tetrode. CeCo's innovation was to add a screen grid between the cathode and the control grid.

CeCo said its five-element tube was three times as powerful as the screen-grid tube. That proclamation brought much criticism from other radio manufacturers, despite promises to share advances and circuit designs. Critics said that tube sales were already low and that a new tube was unneeded at the time. They also said that the pentode wasn't really new, as it was already in use in Europe, especially in England.

Furthermore, it was unclear how the pentode could be used. However, CeCo engineers said that the more powerful pentode would increase tube sales because radios could be made with fewer tubes; thus, radios would cost less, and more people would buy them—by the millions! And that, of course, would increase tube sales.

Of course, the pentode *did* survive. By the end of 1930 several pentodes were available: the 238 and the 247. The original pentode was probably made from a 24 screen-grid tube, a tetrode. Using the same base and envelope, the extra grid was attached to a terminal on the side of the tube base, instead of adding another prong to the tube base. In later designs, the suppressor grid was usually connected to the tube's cathode internally.

Hobbyists and other experimenters were quick to purchase the new tubes from the mail-order houses. Again, they were guided by information and circuits in the radio magazines. It's unlikely that you'll find any of those early pentodes around. If you do, consider yourself lucky. **R-E**