VINTAGE RADIO

By JOHN HILL

Converting an Airzone to AGC

Although automatic gain control (AGC) became common in receivers from the early 1930s on, there were a number of sets made at around that time which lacked this useful refinement. This month, we look at how a 1937 Airzone receiver was fitted with AGC.

It was one of those things that I had been meaning to do for some time. In my collection of old radios, there is a rather stately looking Airzone - a 1937 console model which has no AGC. Just why it lacks AGC is a bit of a mystery, for nearly all radios of that era were fitted with this feature.

At one stage, I suspected that an AGC circuit must have been lurking in there somewhere but had become inoperative. However, a close inspection of the chassis (as best as one could without a circuit diagram) soon confirmed that the set had never had AGC. There were two reasons for this conclusion:

(1). the receiver had no valves which contained diodes; and

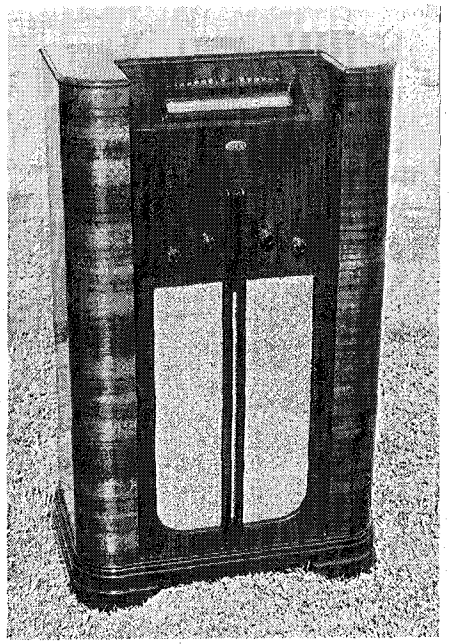
(2). the volume control was a wire-wound potentiometer in the cathode circuits of the frequency converter and IF amplifier valves.

Clearly, the set was never designed for AGC.

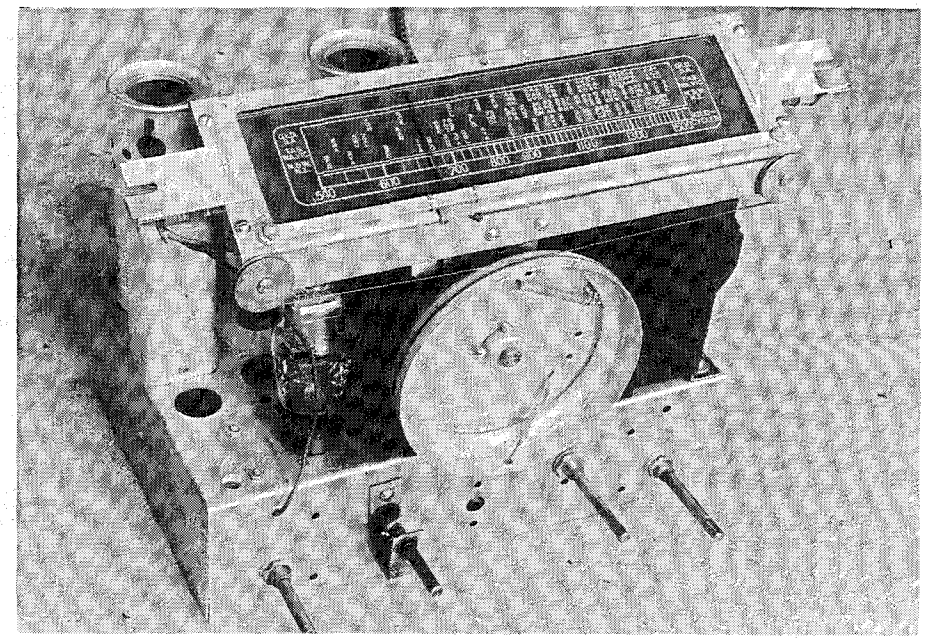
The valve complement (confirmed by a sticker inside the cabinet) is as follows: 5Y3, 6A8, 6U7, 6J7 and 6F6. This is a fairly standard layout for a 1937 5-valve receiver, with the exception of the 6J7. Most sets of that vintage would use a 6B6 or a 6B8 instead. Both these valves contain diodes which would have made AGC easy to implement.

Valves with diodes

As explained in last month's column, there was a change in superhet design in the early 1930s, when valves containing diodes were first intro-



This is the 5-valve Airzone that was converted to AGC. It is a 1937 console model with a 10-inch electrodynamic loudspeaker. Adding AGC makes it a far more pleasant set to use.



The Airzone chassis. The valve complement is as follows: 5Y3, 6A8, 6U7, 6J7 and 6F6. This is a fairly standard line-up for a receiver of that era with the exception of the 6J7 (most sets would have used a 6B6 or 6B8).

duced. These diodes could be used for both an improved form of detection (diode detection) and a more practical form of AGC than any previous attempts. Along with these changes came a change in volume control methods. The volume control was moved from the cathode circuit of the IF valve(s) and, in some cases, the frequency converter as well, to the control grid of the first audio valve.

An AGC circuit rectifies the received signal and produces a negative voltage which is directed back to the grids of the IF and converter valves, to control their gain. Strong signals increase the AGC voltage, which reduces the gain, whereas weak signals have the opposite effect.

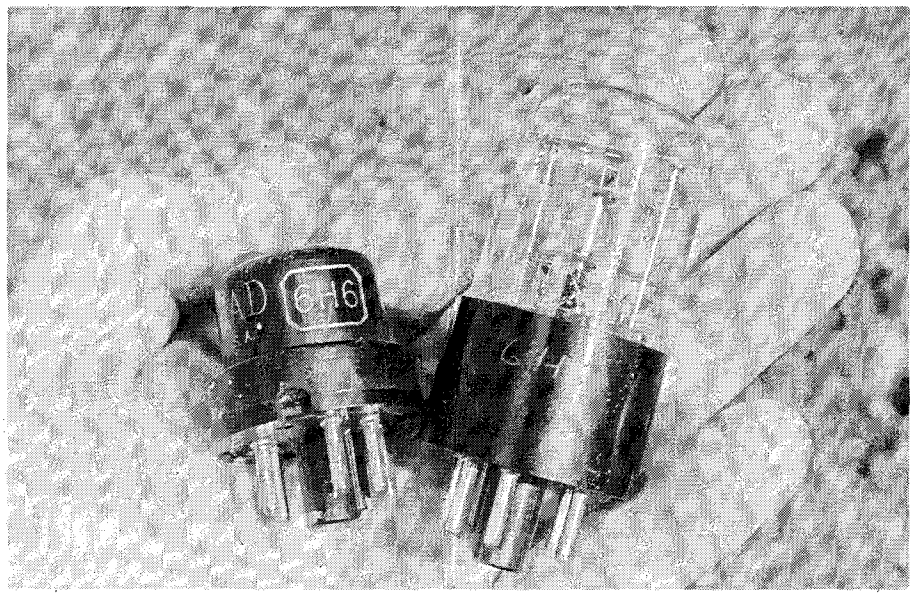
As AGC circuits work with variable mu valves, there was little reason why the old Airzone could not be converted to AGC. Both the frequency converter and the IF amplifier valve were common types, as used in conjunction with AGC in other receivers. All that was needed was to add a couple of diodes and a few other bits and pieces.

Conversion options

There were a number of ways to approach the diode problem. First, a different first audio valve such as a 6B6 or a 6B8 could be fitted, which would have a pair of diodes in the same envelope. Another possibility was to fit a separate twin diode valve, thus retaining the existing 6J7 as the first audio valve. As a last resort, a couple of modern solid state signal diodes would do the job just as well as any thermionic type - do I sense some readers throwing up their hands in horror?

In any case, if the 6J7 is to be used as a straight audio amplifier, rather than a detector, its operating conditions should be changed. As a detector - almost certainly an anode bend detector - it would be biased close to cut-off, using a high value cathode resistor and, possibly, a low screen voltage. This would restict its operation as an amplifier.

In the end, I decided to install a 6H6 twin diode valve. One reason for this decision was the fact that the chassis already had provision for an additional valve. Fitting the 6H6 was as easy as removing a cover plate and bolting in a new socket. The heater pins of the 6H6 socket were wired to the heater pins of a nearby valve.



The 6H6 twin diode was made in both metal & glass envelope versions. At least the glass version looks like a real valve, even if it is rather small.

An AGC circuit was required and the one shown in Fig.1 was taken from an old radio book. There are some variations in AGC circuits (eg, simple AGC and delayed AGC - see last month's story), and some look far more complex than others. The circuit used requires only one diode and so the 6H6 anodes and cathodes were connected in parallel to form a single unit.

The next step was to fit a new volume control. A 500kΩ carbon pot was installed in place of the old wirewound pot. However, although the old control was removed from the chassis, it was left connected in circuit. More about that later.

The new volume control was wired in accordance with Fig.1, with the wiper arm going to the 6J7 via an existing .01µF capacitor. Also added were the various resistors and capacitors needed for the AGC circuit, plus the heater wiring for the 6H6. The circuit also shows the changes made to the 6J7 circuit. This left only the two AGC outlets to be connected.

These two AGC lines had to be connected to the control grids of the first two valves, via the first IF transformer's secondary winding in one instance, and the aerial coil secondary winding in the other. However, it was not just a matter of connecting the AGC lines to existing connections, because they were both connected to chassis.

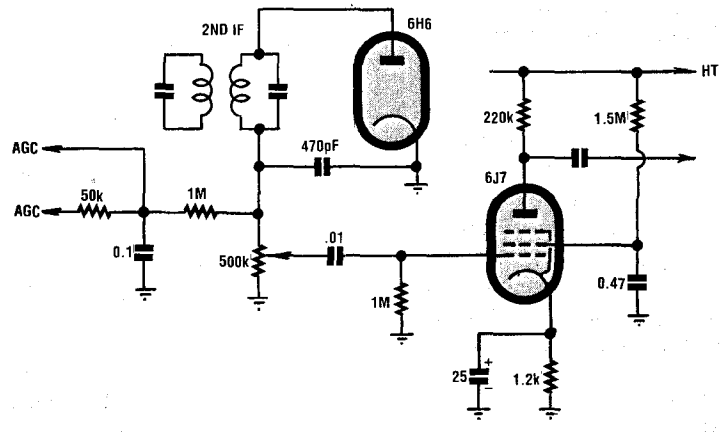
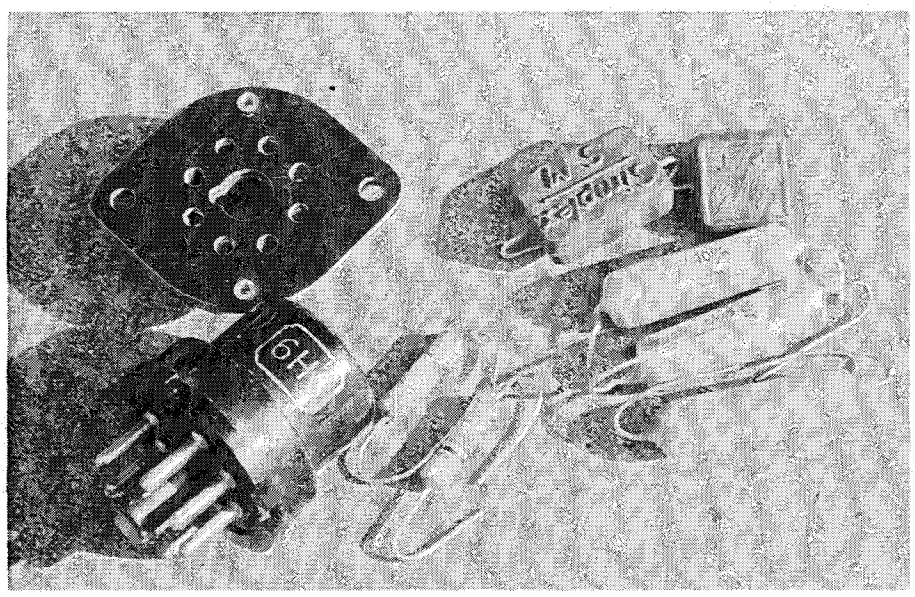
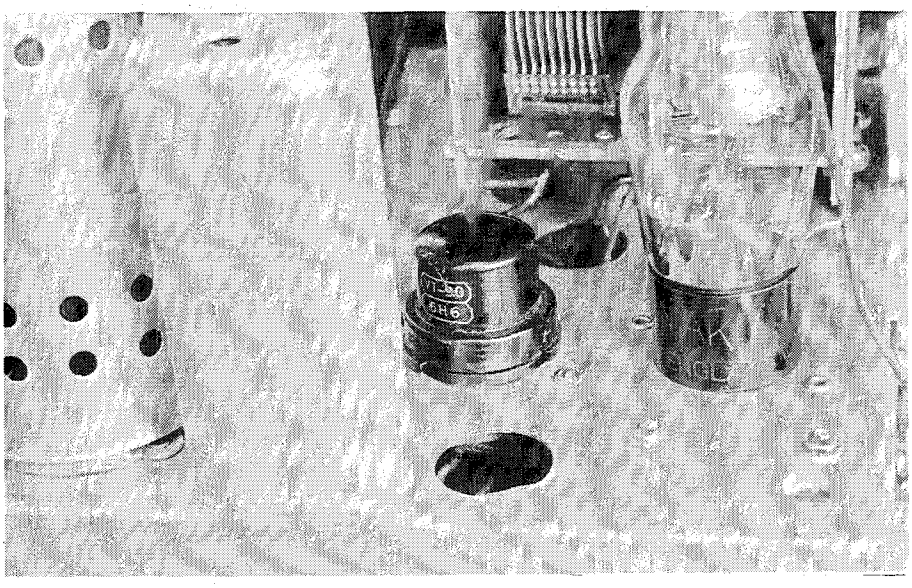


Fig.1: the AGC circuit produces a negative voltage and this is applied to the grids of the first two valves, via the aerial coil secondary winding in one instance & the first IF transformer secondary winding in the other.



Only a handful of components was required to convert the old Airzone to AGC. The 6H6 twin diode was chosen so that the original 6J7 first audio valve could be retained but other approaches should prove equally viable (see text).



The 6H6 twin diode valve was easily fitted to an existing valve socket hole in the chassis of the old Airzone.

These connections need to be carefully traced back from the valve grids and unsoldered from the chassis, so that the AGC lines can be connected to them. After the AGC lines were connected to the coil terminations, these points were bypassed to chassis via 0.1µF capacitors. At this stage everything was ready for a trial run.

Initial results

The initial results were a bit disappointing. The AGC additions had thrown the front end of the receiver considerably out of whack. Motorboating, whistles and howls indicated that all was not well and there was a brief moment when I reflected on the wisdom of drawing up the original circuit in case the set had to be returned to "as it was" condition.

At this stage I was glad that I had left the original volume control in circuit. It was, in fact, nothing more than a variable resistor in the cathode circuits of the first two valves, and capable of providing variable cathode bias for them.

That was all that was needed to correct the instability. After finding a position where everything worked reasonably well, the potentiometer resistance was measured and a fixed resistor fitted in its place.

The set was greatly improved by the AGC conversion but I was still a little disappointed regarding its effectiveness. Strong stations were still fairly strong, while weak stations were still inclined to be weak.

Out came the single substitute cathode resistor and in went two 5kΩ pots; one in the frequency converter cathode and the other in the IF amplifier cathode.

With the set tuned to the noise between stations (virtually no signal), the volume level could be brought up quite noticeably by fiddling with each cathode resistor. After replacing these pots with fixed resistors the AGC was more effective (Note: the cathode resistance was determined simply by setting the pots for maximum volume without instability). These adjustments made a significant difference to distant stations but seemed to have had little or no affect on close stations.

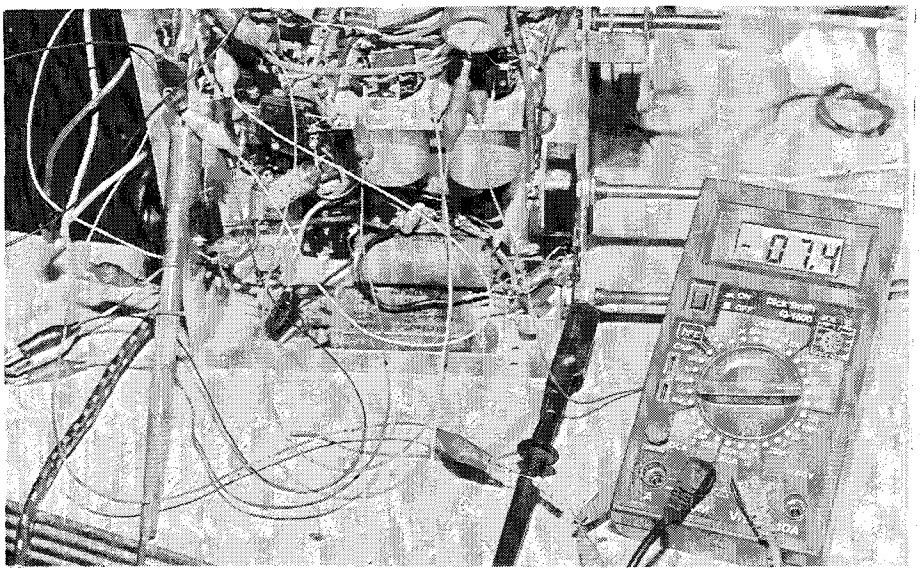
One noticeable change with the AGC conversion was that the receiver needed retuning. This was particularly evident with the first IF transformer, which had its secondary circuit upset by the addition of the AGC line. A complete re-alignment of the receiver was in order and, while it was not badly out, there were noticeable improvements when the job was finished.

The conversion turned out to be quite successful and I love the old Airzone even more than before.

Other conversions

Flushed with success I decided to convert another 1937 set, a console model Playola. Although fitted with a 6B6 and using diode detection, the receiver had no AGC, which seemed a bit cheap and nasty to me. It too responded well to the conversion and is now a far more pleasant set to use.

The third and last radio to be converted (a 1934 model Commodore) was a little different. It uses a 57 as an autodyne frequency changer, followed by a 58 IF amplifier, and has no diodes. In this instance, a germanium signal diode was used, with only one valve, the 58 IF amplifier, being AGC controlled. (The old 58 was one of the first variable mu tubes to be made).



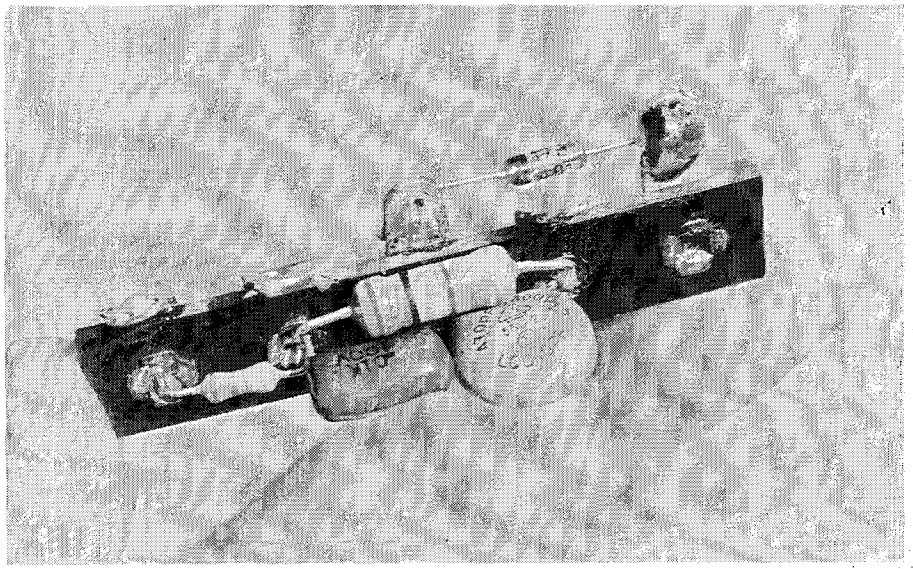
This temporary test rig shows that the AGC circuit produces a negative voltage (the larger the signal, the higher the voltage). This negative bias is directed to the grids of the pre-detector valves.

The frequency changer was not suitable for AGC control for two reasons: (1) the 57 is not a variable mu tube; and (2), an autodyne frequency changer is notoriously cranky (even a minor change in operating conditions can cause it to stop oscillating).

The old Commodore responded fairly well to the treatment, considering that AGC is applied to only one valve. It certainly is a big improvement on no AGC at all.

Converting a receiver to AGC can easily introduce other problems because the circuit has been interfered with. There may be other methods of solving the problems I encountered, but the sets I converted all work well, and that's what matters most.

Altogether, these three AGC modifications took quite a bit of time to do, but they were worth both the time and effort. It was an interesting project and the addition of AGC made all these receivers far more pleasant to operate. **SC**



This simple AGC conversion module was built up on tagstrip & fitted to a 1934 model Commodore receiver. In this case, a germanium signal diode was used, with only one valve, the 58 IF amplifier, being AGC controlled. The tagstrip method makes the conversion a bit neater than the more usual point-to-point wiring method.