VINTAGE RADIO

By JOHN HILL

Anode bend to diode detection

During the early to mid-1930s era, the low priced 5-valve superhet console radio was very popular. Many employed anode bend detection but they can be easily converted to diode detection for improved audio performance.

The early '30s were the tough times of the Great Depression years, when about 25% of the workforce was out of work. And, of course, they were without the back-up support that the unemployed have today. This meant that any radio manufacturer who wanted to stay in business had to produce a range of receivers that were affordable. The formula, in most cases, was to keep things fairly basic.

The usual format for these cheaper radios was the autodyne superhet – a 5-valve receiver with an autodyne mixer, IF stage, anode bend detector and a single output stage. Some designs used a 175kHz IF and this necessitated a pre-selector stage, using a 3-gang tuning capacitor, in order to control the double spot problem created by of such a low value.

Other makers chose a 455kHz IF, which was rapidly gaining popularity, and which solved the double spot problem automatically. This allowed the use of a cheaper 2-gang capacitor.

Either way, this broad design concept was a compromise between price and quality and while these sets worked reasonably well, they had several disadvantages.

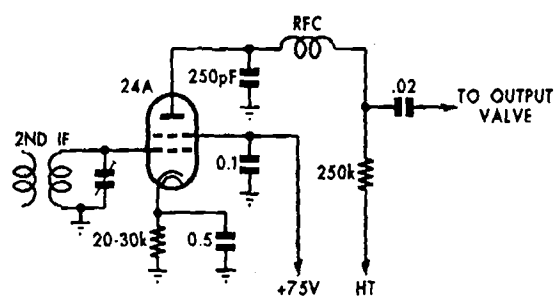


Fig.1: the circuit of a typical anode bend detector. The valve type shown is a 24A tetrode or similar sharp cutoff tetrode. Later circuits used a type 57 pentode, although the basic arrangement remained the same.

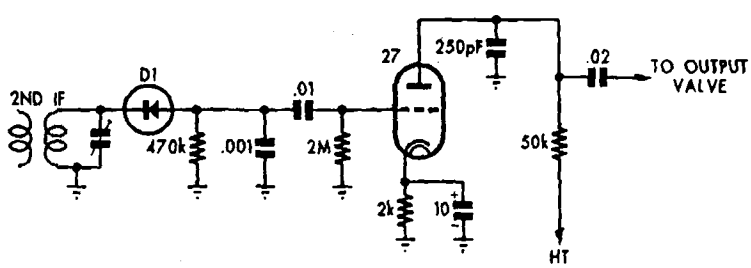


Fig.2: this is what the circuit looked like after conversion to diode detection. The original type 24A tetrode was replaced by a type 27 triode valve.

Design drawbacks

One problem was the lack of automatic gain control. This circuit innovation came into existence in the early 1930s but was only found on the more up-market receivers.

Another difficulty with the autodyne setup was that, while it worked OK on broadcast band frequencies, its performance on shortwave was not so good.

And finally, the anode bend detector used in these sets created a level of audio distortion that left something to be desired. While this distortion may have been acceptable in the 1930s, by today's standards it is not very good and can be quite distracting. It may have been fairly distracting in the 1930s too, because by the middle of that decade most manufacturers had changed to diode detection.

Some of those old receivers with anode bend detection sound better than others and in many instances the loudspeaker must play a part. The moving coil loudspeaker had been in existence for only a few years at that stage of radio development and there were still things to learn and manufacturing techniques to master. While an early '30s moving coil loudspeaker was a remarkable improvement on a '20s horn speaker, there was still quite

a lot of developmental work ahead of it.

Basic circuit

Fig.1 shows the circuit of a typical anode bend detector. The valve type shown is a 24A or similar sharp cutoff tetrode. When the type 57 valve (a pentode) was developed, it replaced the radio frequency tetrode, although the circuit arrangements for anode bend detection were still the same.

The main aspect of the anode bend detection method is the very high cathode bias resistor, which operates the valve at close to cutoff. The term "cutoff" simply means that the anode or plate current will be at or near zero when no signal is being received.

When a modulated radio frequency (RF) signal is applied to the control grid, there will be pulses of anode current during the positive half cycles and little or no anode current during the negative half cycles. Therefore, the anode current is a rectified version of the signal waveform at the grid.

Filtering of the RF component after detection is achieved by a small plate bypass capacitor (typically around 250pF) to chassis and an RF choke in series with the plate load.

Anode bend detection has some odd characteristics and the distortion it produces can be minimised by varying the value of the cathode bias resistor.

However, if the cathode bias is selected to give good low distortion sound with a strong signal at the control grid, then the performance is not as good on a weak signal and vice versa. So, after much experimenting, the cathode circuit is often returned to its original form, as the manufacturer's setup was probably a reasonable compromise.

Detector conversion

I have quite a number of old autodyne/anode bend console radios and I find some of them quite irritating due to their high levels of distortion. There are times I like to listen to my radios for hours on end and if they sound crook, there is no listening pleasure at all.

The last of these receivers to come off the restoration assembly line was an old 1932 Darelle (see June 1995). While the Darelle was no more annoying to listen to than any of the others, it was the one I selected to see if the sound reproduction could be improved by converting the set to diode detection. The experiment produced a surprisingly good result, so allow me to fill you in on the details.

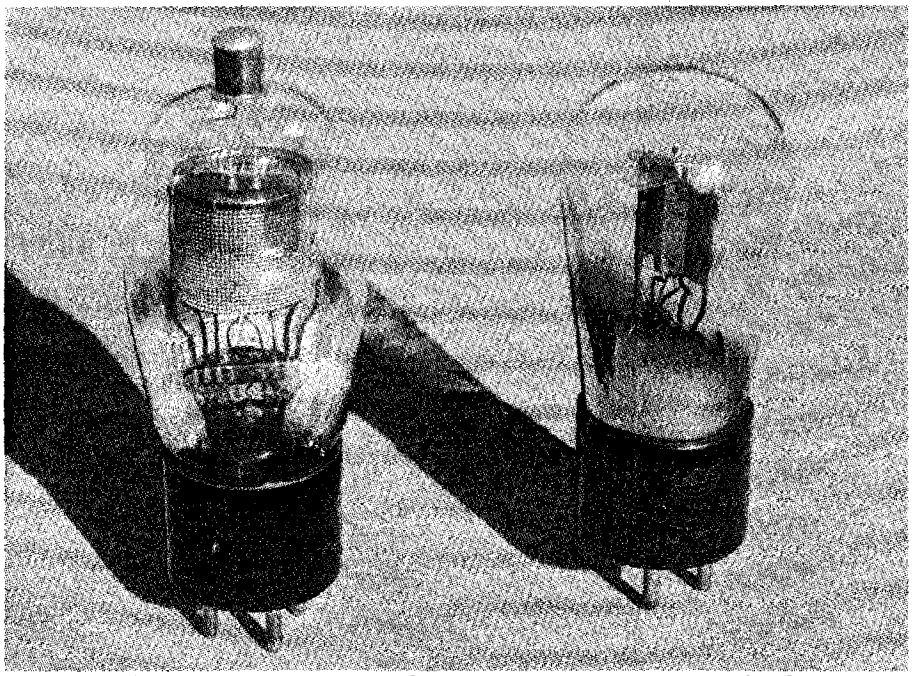
Shown here is the Darelle 5-valve superhet cabinet. It is affectionately known as the "tea chest on legs". The Darelle's chassis was converted from anode bend detection to diode detection and this simple modification gave a significant improvement in sound quality.

There are several choices when it comes to converting a set to diode detection. One can use either a valve with diodes in it, a triode connected as a diode, or do the unforgivable and use a germanium signal diode.

As the old Darelle used tetrode valves, there was no applicable diode type valve apart from the 55 duo-diode triode. The use of this valve would require a valve socket change from 5-pin to 6-pin.

Using a triode connected as a diode was not an option either because there was insufficient room to accommodate it. So that left the unthinkable – a germanium signal diode.

Not being a modern electronics man, I was not really sure how to incorporate a solid state diode into a valve circuit. I mentioned what I planned to do to young David (a collector friend) and he drew up a circuit of what he thought I needed to make a solid state diode detector work in a valve receiver – see Fig.2. I might add that



The original anode bend detector valve was a 24A, as shown at left. This was replaced with a 27 triode (right) and this worked well as an audio amplifier, something that the 24A could not do.

David's circuit was a little more involved than what I had in mind.

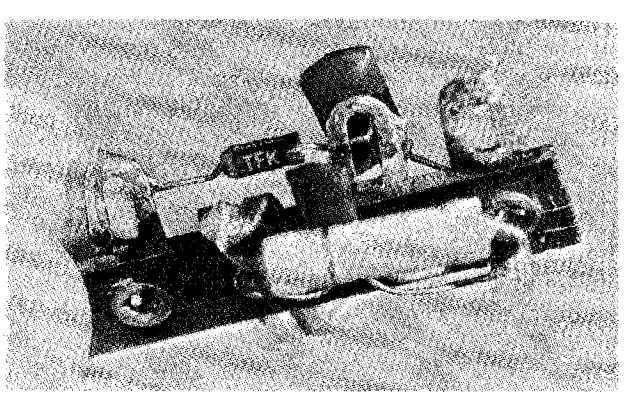
Another aspect of my conversion was to retain the existing 24A anode bend detector valve and use it as an audio amplifier – if that was at all possible. David was not confident that this could be done but as I wanted to keep the original valve line-up, I would try to do it anyway. Whether or not it would be successful was in doubt at that stage.

Many radio frequency valves (the 57 and the 6J7 for example) can be used as audio valves when connected as either pentodes or triodes. Hopefully, the 24A would perform likewise, although there is no mention of audio frequency application in the valve manual. (Editorial comment: the 24A, being a tetrode – as distinct from the above mentioned pentodes – is less suitable for use as a resistance/capacitor coupled audio amplifier. When it was used as an audio amplifier, it was usually in the choke/capacitor coupling mode. This permits a much greater plate voltage signal swing without distortion).

The detector circuit was made up on a small piece of tagstrip to form a compact detector module (see photo). This module was then bolted to a convenient part of the chassis and wired to the second IF transformer and the control grid of what was the anode bend detector. But while the set worked, one could not say that it was working well.

Actually, the sound quality was really good at moderate volume levels, but distorted badly as the volume increased.

Various alterations were made to the 24A audio amplifier. It was tried as a tetrode, a triode, with high and low plate voltages, and with a variety of cathode bias setups. None proved to be really satisfactory, although the triode connection wasn't too bad except for a drop in overall volume. It had to be considered unsatisfactory for that reason alone.



The diode detector module was built from miscellaneous components mounted on a tagstrip. The small size of the module allows it to be mounted in some out-of-sight location if so desired.

Valve replacement

It was time to do what should have been done in the first place and that is fit a valve that was more suitable for audio frequency work than a 24A. A 27 was a logical choice as its 5-pin base was compatible with the existing valve socket. Rewiring the socket to suit the triode valve required a couple of alterations, as the 27 has no top-cap grid connection.

After fitting the 27, all the previous problems associated with the diode detection modification suddenly disappeared. Triode audio amplifiers were all the go in the early 1930s and a triode also proved to be most successful with this particular circuit arrangement.

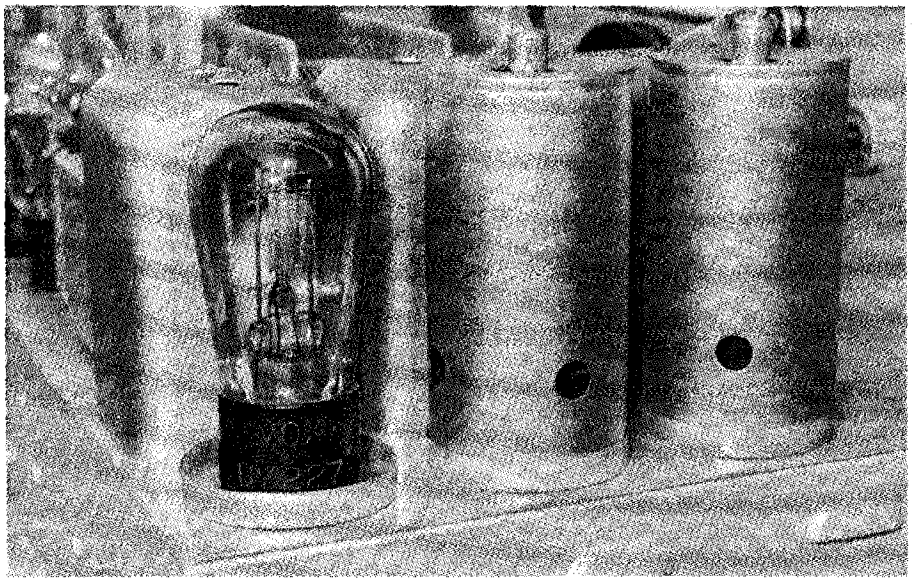
Once everything was working OK, it was time to experiment a little. The detection module was disconnected and another signal diode substituted. This setup used no grid leak, no coupling capacitor or anything else – just the diode between the IF transformer and the grid of the valve. It made little difference apart from an ever so slight increase in volume.

So it would appear as though there are many ways to incorporate a signal diode into a valve circuit – and they will all probably work. However, if one decides to do this modification, remember that the second IF transformer will require realignment. That would be about the only inconvenience incurred.

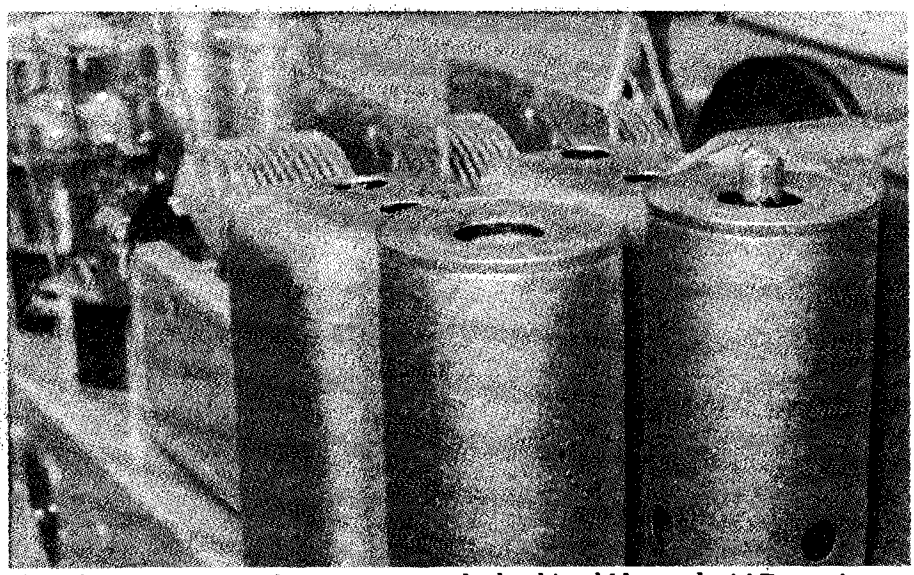
After this little experiment, the original detector module was reconnected into the circuit.

Practicality vs originality

No doubt some readers will have difficulty in understanding why I would want to modify an existing circuit and ruin the set's originality! Well, in this case, I want to listen to the radio and not be annoyed by it. It is as simple as that! What's more, if a receiver can be significantly improved by implementing such a simple modification, then why not do it? In this



Efforts to use the original 24A valve failed miserably. Substituting the 27 involved some socket rewiring and the removal of the top-cap connector. It was worth the effort, as it solved the problem of trying to use the 24A in a role for which it was never intended.



The missing top-cap and connector may look a bit odd but so be it! Removing the anode bend detector and replacing it with diode detection was an experiment that paid off with a cleaner audio output.

instance, the improvement was well worth the effort.

Should a future owner wish to convert the receiver back to original, it can easily be returned to its anode bend state. Why someone would want to do this I don't know, but if they did, they may not be happy with the distortion that this detection method produces.

The diode detector described here can be a completely invisible modification if so desired. Although I chose to mount the diode and accompanying components on a small tag strip underneath the chassis, there is no reason why it cannot be housed inside the second IF transformer shield can or positioned in some other out-of-the-way place where it is out of sight.

As far as I'm concerned, if everything looks OK then that's all that matters. A few devious modifications here and there don't upset me in the least, especially if they improve the set's performance. The fact that the old Darelle sounds a bit better than most radios from that era must be worth something! **SC**