

# VINTAGE RADIO

By JOHN HILL



## How good are TRF receivers?

**In the early days of broadcasting, the TRF or tuned radio frequency receiver reigned supreme. Although there were odd superhets around from about 1924 onwards, they did not become really popular until a decade later.**

The reluctance of buyers to go the way of the superhet has always puzzled me as there is little doubt that the superhet was by far the better receiver. But price often dictates terms and it was perhaps for this reason that the TRF remained popular for so long. Another factor may have been that selectivity – the superhet's main claim to fame – was less important while

there were only a few stations on the air. As the number of stations increased, better selectivity became more and more important.

Nevertheless, in recent months I have restored a number of TRF receivers and, as a result, I have come to look upon them more favourably than I had in the past. Compared to superhets of the same era, some TRFs were very good receivers – and still are!

Back in those distant days of the early 1930s, the TRF receiver had reached the peak of its development, whereas the superhet was still in the developmental stage. Those early superhet designs were unduly complex and expensive, and there were problems with double spotting and the choice of a suitable IF. It also needed an extra valve for the local oscillator which, according to superhet opponents, "didn't do anything". This initial criticism created a marketing problem and it wasn't until the mid to late 1930s that an acceptable design compromise was reached and the superhet came into its own.

Let's take a look at some of those old TRF receivers and try to ascertain just how good (or bad) they really were.

### The TRF receiver

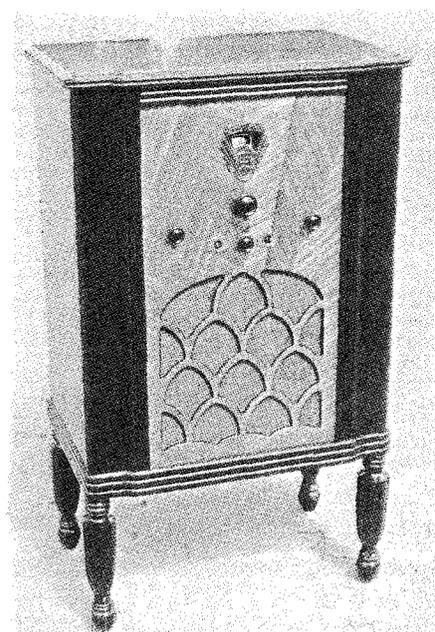
A TRF receiver must have at least one stage of radio frequency amplification ahead of the detector, typically a leaky grid or anode bend type. Those two stages alone constitute a TRF re-

ceiver and a 2-valve set of this type is practical although it would be suitable for headphone use only.

However, such a simple receiver can be greatly improved on. More valves and tuned circuits can be added to the front end to increase amplification and selectivity, while extra valves can be added after the detector to give increased amplification and more power output for the audio signal.

These additions have their limitations, however, and three RF stages and three AF stages was about as far as most manufacturers were prepared to go. Exceeding these limits could lead to instability unless special precautions were followed.

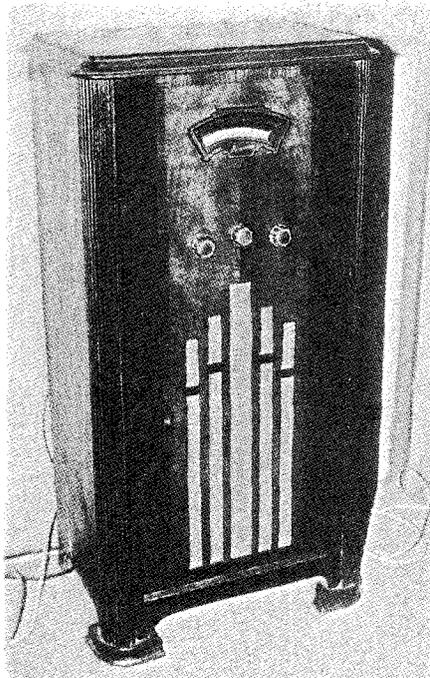
Some of the cheaper TRFs had only



**This stylish looking Radiola 45E console is a 5-valve TRF receiver of 1930 vintage. Most 5-valve TRFs were reasonably selective because of their three tuned circuits but the cheaper 4-valve types had selectivity problems.**



**Another 5-valve TRF receiver. This set is typical of many early 1930s receivers that were made for a price. While the front looks good with its attractive walnut veneers, the sides were just very plain plywood.**



**A 4-valve "el-cheapo" TRF receiver. This unit has been left unrestored and does not inspire much enthusiasm. It lacks aesthetic appeal and its performance is poor to say the least.**

4-valves, including the rectifier. With just two tuned circuits, these simple budget-priced receivers were not very selective or sensitive. They did not perform as well as a 4-valve receiver with a regenerative detector, for example.

Regeneration was, however, incorporated into some of the low priced TRFs which was perhaps a mixed blessing in a radio of this type. Positive feedback (regeneration) improves both sensitivity and selectivity quite dramatically but it can also introduce distortion and alter the tuning of the detector stage. Most TRF receivers did not use regeneration.

### The 5-valve TRF

The standard 5-valve TRF was a better compromise, as it allowed three tuned circuits which gave more selective tuning. Even so, if such a set is operated in close proximity to a strong local broadcasting station, then that station will occupy a considerable portion of the dial. This clearly indicates the lack of selectivity of the basic TRF design.

However, where the average TRF had a 3-gang tuning capacitor and limited selectivity, some of the better sets had 4-gang capacitors which added

still another tuned circuit.

In fact, up to five tuned stages were used in a few of the really up-market receivers such as some of the American Majestics. Short wiring and well shielded stages allowed such receivers to be quite stable. They were very selective, extremely powerful and boasted a huge complement of valves. They also had a loudspeaker that could handle the power. The speaker alone in an old Majestic receiver weighs close to 10kg and the fully assembled sets were big and heavy to say the least.

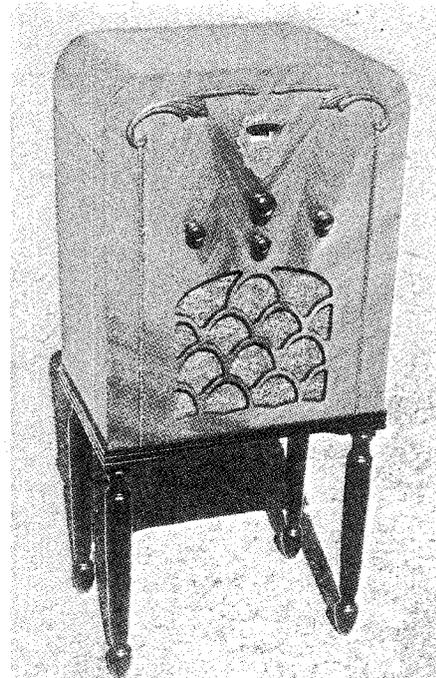
Perhaps one problem with some early TRF receivers was the fact that the ganged tuning capacitors used in the late 1920s and early 1930s were not manufactured to the precision standards that were to follow in later years. The same can be said for the RF coils used in these receivers.

Component variations like this make perfect multi-stage alignment a difficult, if not impossible, process because, unless the tuned stages track together in near perfect unison, the set's performance will be only mediocre. TRF receivers need to be well aligned.

### Valve limitations

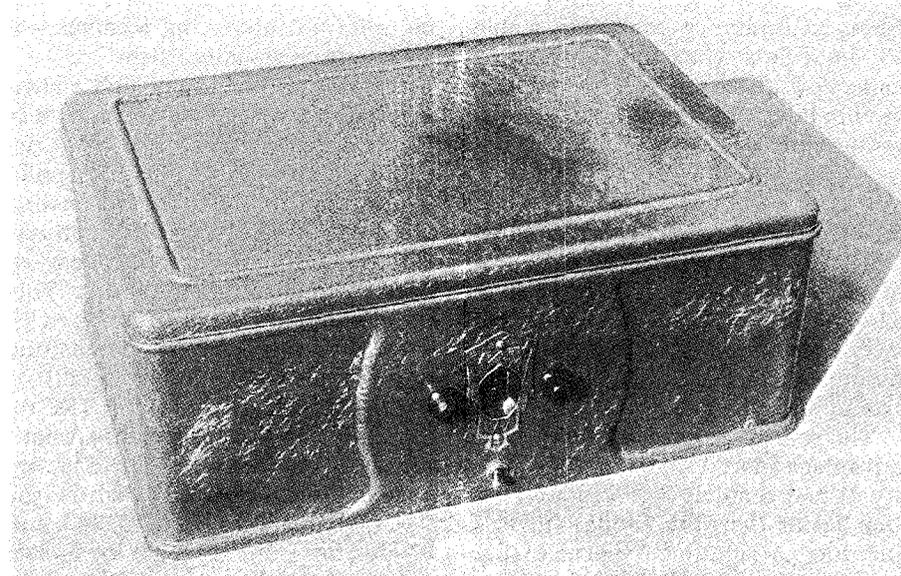
TRF receivers were first developed in the days when the triode valve was the only type available. However, there are two distinct disadvantages when using triodes as RF amplifiers.

First, a triode valve does not have a

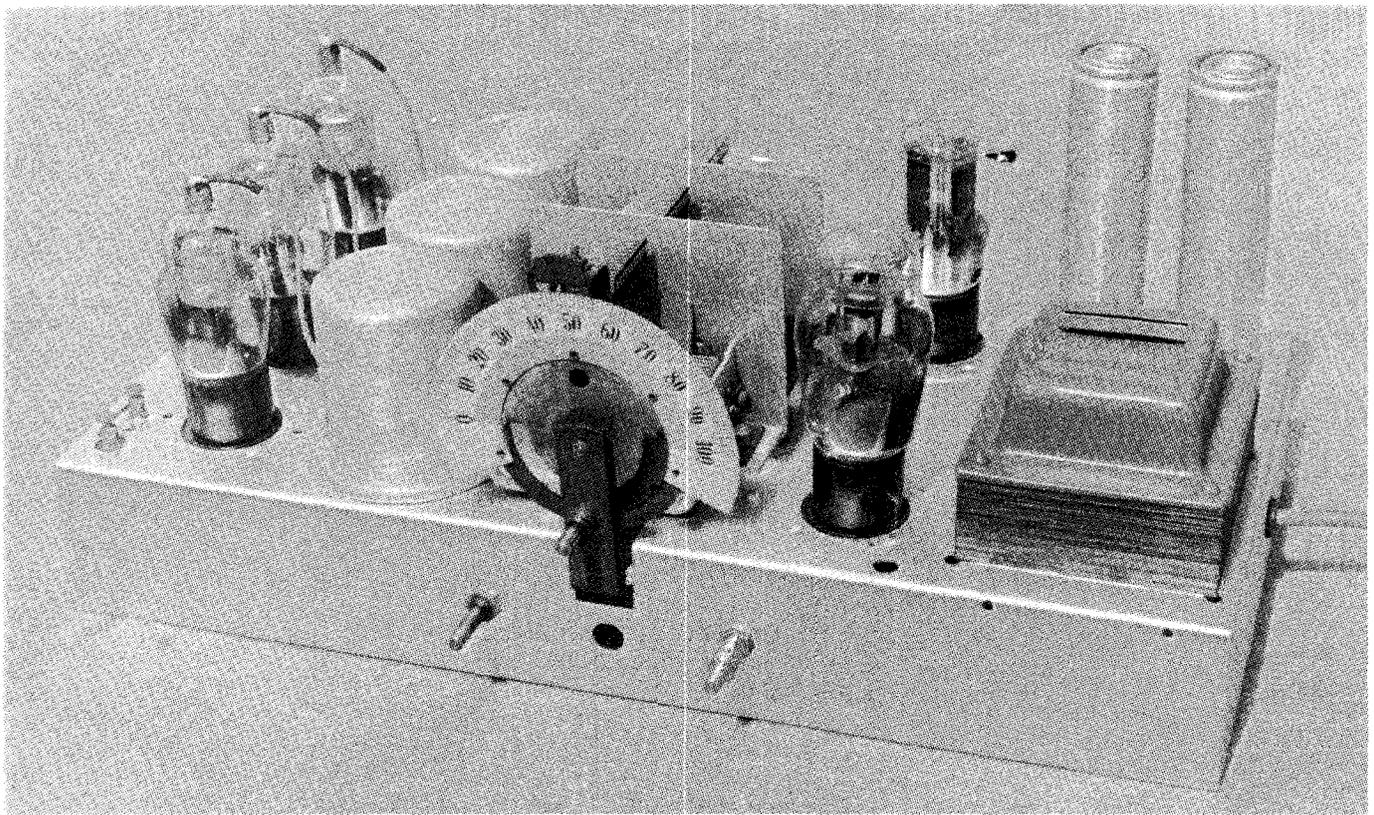


**This mediocre 4-valve TRF receiver at least looks a bit different from the usual console. Actually, this Radiola 34E is a large table model that was sold with optional legs (circa 1931).**

very high amplification factor and many valves are needed if high gain is to be obtained. Second, the internal capacitance between the grid and plate of a triode valve provides an unwanted positive RF feedback path between the plate circuit and the grid circuit. In an RF amplifier stage, with the plate circuit and the grid circuit both



**This 8-valve Apex receiver with its push-pull output stage performs rather well for an old TRF. Many budget-priced TRF receivers from the late 1920s were housed in pressed steel cabinets.**



**TRF receivers were at their peak when this unit was made. With its three 24As and 47 output pentode, it is quite a reasonable radio set. The chassis cleaned up quite well.**

tuned to the same frequency, this feedback will cause instability, whereby the set bursts into uncontrollable oscillation.

The triode's feedback problem was overcome by a process known as neutralization and receivers using this technique were known as "Neutrodynes", a registered trade name at the time. Neutrodynes have very stable RF amplifiers when the neutralizing capacitors are correctly adjusted. Unfortunately, the adjustment can be quite critical.

### The RF tetrode

Neutralizing suddenly became history with the advent of the radio frequency tetrode, or screen grid valve. The tetrode valve's screen grid, between the control grid and the plate, eliminated the positive feedback problem of the old triode.

The screen grid valve had another advantage apart from better RF stability. It had a much higher amplification factor than the triode and this provided a significant boost to the performance of TRF receivers using screen grid valves.

Speaking from my own experience,

I believe that a tetrode TRF with two RF stages is roughly equivalent, in gain, to a triode TRF with three RF stages.

The last of the TRFs went one better and used the first generation radio frequency pentodes. A TRF using these valves and using diode detection and automatic gain control could be quite an interesting receiver – if such a thing actually exists.

(It most unlikely that such a commercial set was ever made, if only because there was no real mass demand. There was also a technical problem in that the tuned circuit feeding the detector had to be earthy on one side, which does not suit a conventional diode detector circuit. This problem could be overcome, with some difficulty, and home construction designs were published. Ed.)

All of the mains-powered TRF receivers I have encountered use American-designed valves. The triodes are nearly always type 27, while the tetrode types have been 24, 24A and 35. No doubt there are a lot of sets around with other valves in them (26s for example, as well as European types) but the majority are these old

faithfuls from the early AC era.

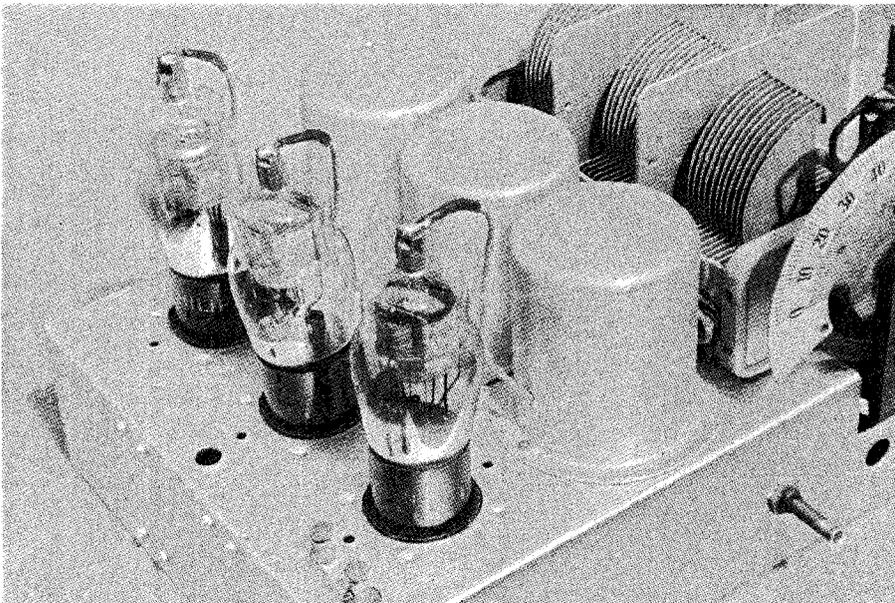
Speaking of old faithfuls, the output valves seem to be either 71As, 45s or 47s. These old warriors are direct heated types with a rather heavy filament for thermal stability.

Many of the better TRF receivers had twin output valves in push-pull. Such a setup can produce quite a few watts of output power and a set of this type can sound surprisingly healthy for such an ancient radio receiver. I have a 1929 Apex, an 8-valve set with two 45s in push-pull, and it really can make that speaker cone rattle back and forth.

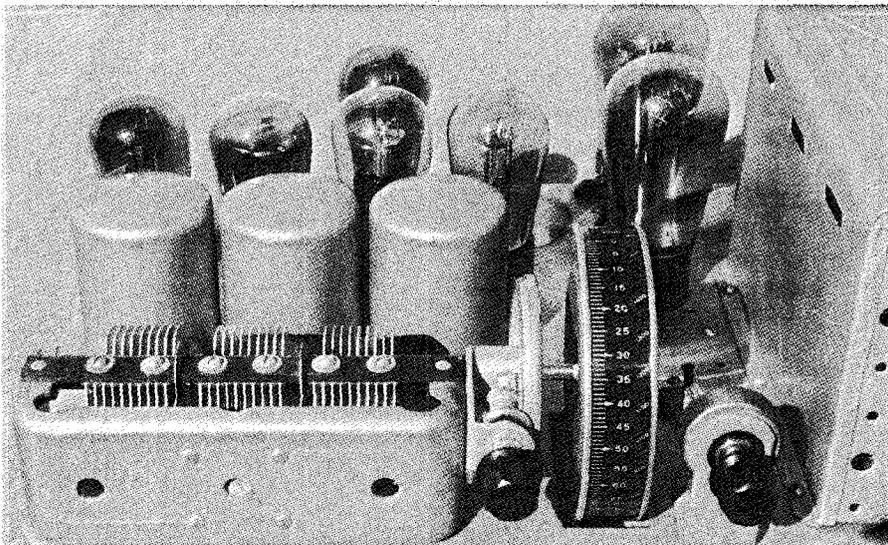
Interestingly, only a few years earlier, around 1926-27, nearly all radio receivers were battery powered with outputs that were considerably less than half a watt. What was the latest thing in 1927 was completely obsolete by 1930. The radio scene changed rapidly during that period.

### Collecting TRF receivers

From a collector's point of view, any TRF receiver is a good find but they are few and far between. As far as mains-powered receivers are concerned, I have found only two in 10 years of collecting. On the other hand, I know a collector who has located about 10 in the past 12 months, so I



A typical layout for a TRF receiver – a tuning section with three valves, three coils and a three-gang tuning capacitor, all neatly arranged side by side. In addition, this receiver employs an output valve and a rectifier valve, giving five valves in total.



This old Apex chassis has an impressive line-up of valves. The rectifier is out of sight behind the transformer cover. The old style valves really look the part on this chassis.

guess I must be looking in the wrong places.

I do have a few battery-powered TRFs which I have yet to restore. Some are multi-dial types in which the tuning capacitors are not ganged but are individually controlled by separate dials. There is also another old battery operated Neutrodyne in the shed which has single knob tuning and it should make an interesting story one day. All I need is a little more time!

Radio collectors are a funny lot with some specialising in receivers of specific types. Personally, I like to diver-

sify and have a little bit of everything and that includes a few TRF receivers to maintain some kind of balance in my collection. As I stated earlier, I have come to look upon them more favourably than I had previously.

So how good were those early TRF radios of the pre-superhet days? Well, they varied from poor to very good, with several categories in between. Then, as now, price dictated the quality of an item and if you paid out enough of that crinkly folding stuff, then you bought yourself a good radio receiver.

SC