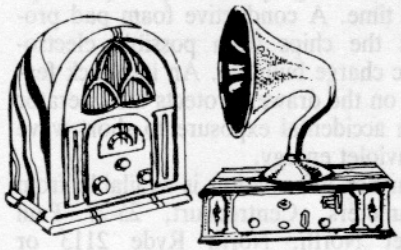
Vintage Radio



by PETER LANKSHEAR

Early receiver developments: 1925-30

Last month we progressed to the mid 1920's, where the radio receiver had become reasonably easy for the non-technical operator to use. In the pre depression euphoria, the radio industry boomed. McMahon's "Radio Collectors Guide" lists nearly 950 different American models for 1926 alone! The British market too was booming but with generally modest models, including crystal sets – which the Americans did not take seriously.

With the notable exception of some RCA superhets, the TRF receiver was virtually universal in the USA by the mid 1920's, with more variations in cabinet styling than circuitry. However, despite the lively market, there was a serious shortcoming still to be satisfactorily overcome. Dependant on battery power, radios were fiddling and expensive to operate.

The majority used the ubiquitous 201A triode, with a filament rating of 5 volts at .25 amperes. This was far in excess of the capabilities of dry cells, and the then-standard 6 volt car battery was commonly used. This generally went flat at the wrong time, needed frequent trips to be charged. Consequently home chargers were popular, a common practice being for the battery to be trickle charged when the receiver was not in use.

There was no question of running directly heated filaments from mains power. Hum made AC completely unusable, and the components necessary for practical mains operated DC supplies did not exist. In short, filament supplies were most unsatisfactory.

Some receivers did use low consumption UX199 type 60mA dry cell operated valves, but even these needed a bank of six large No. 6 cells. In some moderately successful RCA receivers, the filaments of 199 valves were connected in series and lit from rectified and filtered mains current.

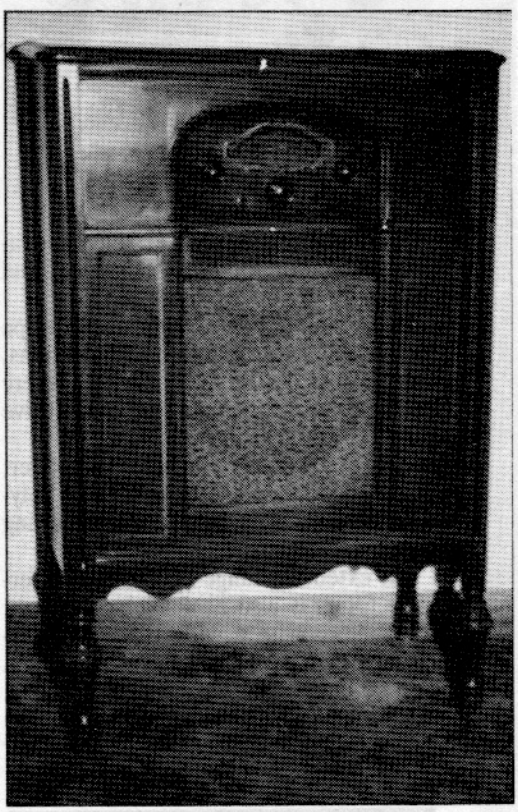
Batteries expensive

High tension requirements were anything from 90 to 180 volts, initially supplied by blocks of dry cells. Smaller sized batteries were groups of cells comparable with modern type D. The "super" 45 volt batteries cost 30 shillings each, so that a set of three would have been something like $100 in today's money! Furthermore, a working wage was proportionately far smaller than today. Next time you pay $5 or so to repower that ghetto blaster, give a thought to great grandfather and his battery bill.

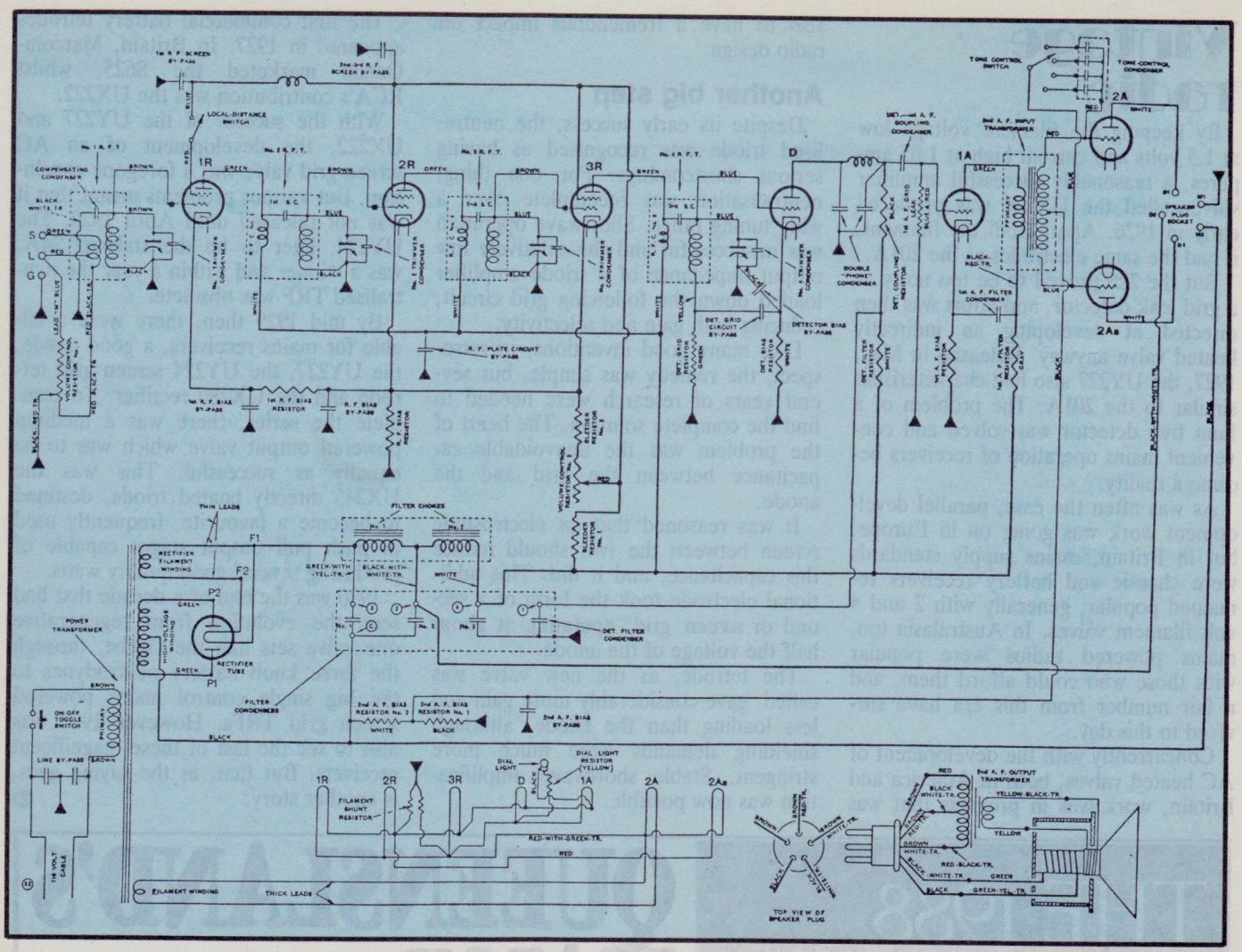
One alternative was for HT batteries to be assembled from small lead acid cells. Whilst these supplies had excellent characteristics, they were initially very expensive and there were the same objections as with lead acid filament batteries.

In Europe and Britain, the situation was little different. There, as well as in the US, considerable effort was put into developing mains operated HT supplies.

Fortunately, mains supplies for the modest HT current demands were a practical proposition and compact units often called "B eliminators" or "power packs", containing a transformer, recti-



Top: The Atwater Kent model 70 8-valve screen grid TRF receiver in its console, dating from 1930. It had a massive 12" moving coil speaker. Above shows the classy nickel-plated chassis, with its 4-gang tuning capacitor and thorough shielding. The inverted tray-type chassis became standard for valve receivers and other equipment.



The circuit of the model 70. TRF receivers like this are still capable of performing well.

fier and smoothing circuits soon appeared. A typical supply was the subject of the March *EA* mystery picture.

Three different types of rectifier were used. The most primitive was the "slop jar" or more politely, the electrolytic rectifier. These consisted of small jars containing a borax solution and a pair of pure aluminium electrodes. These were capable of rectification and were the parent of the electrolytic capacitor.

More conventional were metal oxide rectifiers, but they most successful used valve rectifiers, both cold cathode and thermionic. One of these valves, the UX213, evolved into the UX280 described in a previous article.

Chokes, resistors and paper capacitors were used in "eliminators" for filtering and voltage taps. The capacitors were rarely more than a couple of microfarads, which could result in instability in receivers designed for well regulated battery supplies. For all that, the basic concept of the mains HT supply was sound and the eliminator became popular.

Indirectly heated valves

Although operating costs were reduced with mains powered HT, the filament supply situation remained messy and untidy. The real need was for valves that were not dependent on DC heating.

Hum is generated by direct AC heating because the constantly changing potential difference along the length of the filament modulates the electron stream, and thin filaments have insufficient thermal capacity to maintain a constant temperature during the current cycle. The solution was, of course, the *unipotential cathode*, comprising a metal sleeve or tube heated internally by an insulated filament.

Although research had started about 1920, the first heater type valves marketed in the US are credited to F.S. McCullough, who in 1925 produced his 410 – with electrical characteristics similar to the 201A, but with a terminal block on top to take the 3 volt heater wiring. These valves could be plugged into standard UX 4-pin sockets and with a twisted pair of heater wires linking the tops of the valves, ready conversion of existing radios was possible.

Other small manufacturers were producing various styles of AC valves, with Arcturus making some with carbon heater elements!

These developments were by small firms, and soon Westinghouse was investigating AC valves for RCA. Rather than working on an indirectly heated cathode, their first efforts were concentrated on directly heated cathode valves. Why this apparently retrograde research was undertaken when indirectly heated valves were already in existence has not been explained. Even in those days, the activities of Big Business were convoluted and it is likely that the directly heated cathode promised quicker results and possibly fewer legal wrangles.

Vintage radio

By keeping the filament voltage low at 1.5 volts and current high at 1.05 amperes, a reasonably successful amplifier valve called the UX226 was produced early in 1926. Apart from the filament, it had the same electrodes as the 201A.

But the 226 proved to be too noisy as a grid leak detector, and effort was then directed at developing an indirectly heated valve anyway. Released in May, 1927, the UY227 also had characteristics similar to the 201A. The problem of a hum free detector was solved and convenient mains operation of receivers became a reality.

As was often the case, parallel development work was going on in Europe, but in Britain, mains supply standards were chaotic and battery receivers remained popular, generally with 2 and 4 volt filament valves. In Australasia too, mains powered radios were popular with those who could afford them, and a fair number from this era have survived to this day.

Concurrently with the development of AC heated valves, both in America and Britain, work was in progress that was also to have a tremendous impact on radio design.

Another big step

Despite its early success, the neutralised triode was recognised as having serious shortcomings. For one thing, neutralisation was incomplete over a wide tuning range. Shortwave operation was unsuccessful and the relatively low output impedance of a triode amplifier loaded down the following grid circuit, reducing both gain and selectivity.

Like many good inventions, in retrospect, the remedy was simple, but several years of research were needed to find the complete solution. The heart of the problem was the unavoidable capacitance between the grid and the anode.

It was reasoned that an electrostatic screen between the two should reduce this capacitance, and it did. This additional electrode took the form of a second or *screen* grid, operating at about half the voltage of the anode.

The tetrode, as the new valve was called, gave considerably more gain and less loading than the triode, although shielding demands were much more stringent. Stable shortwave amplification was now possible.

The first commercial battery tetrodes appeared in 1927. In Britain, Marconi-Osram marketed the S625, whilst RCA's contribution was the UX222.

With the success of the UY227 and UX222, the development of an AC screen grid valve was a foregone conclusion. But various problems meant that it was not released until April 1929. The UY224, later to be the stalwart 24A, was a winner and within a year the neutralised TRF was obsolete.

By mid 1929 then, there were available for mains receivers, a good triode, the UY227, the UY224 screen grid tetrode and the UX280 rectifier. To complete the series, there was a medium powered output valve which was to be equally as successful. This was the UX245 directly heated triode, destined to become a favourite, frequently used in push pull output stages capable of producing several good quality watts.

1930 was the end of a decade that had seen the evolution from regenerative one valve sets like the Grebe, through the three knob battery neutrodynes to the big single control mains powered screen grid TRFs. However 1930 was also to see the last of these magnificent receivers. But that, as the saying goes, is another story. EA