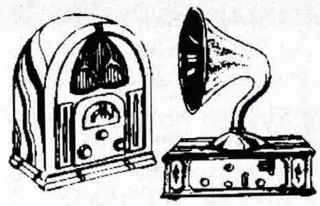
Vintage Radio

by PETER LANKSHEAR



Restoring a monster

Many collectors keep a lookout for radios from the interesting period around 1930 — when most receivers used simple tuned radio frequency (TRF) amplification, and had evolved into impressive devices built like battleships. This month we look at typical project involved in bringing one of these beasts to life.

For radio manufacturers, the late 1920's were a busy period with rapid changes. The major problems of successful mains powering had been solved, and with the introduction of the screen grid valve, adequate and stable RF amplification had become possible.

High power audio valves were now available to drive the increasingly popular moving coil loudspeakers, but created greater demands on power supply current capability. Higher voltages and improved filtering were necessary, spurring on the development of electrolytic capacitors. Safety, the size and weight of power supply components, and RF stability had required baseboard construction to give way to massive pressed steel chassis. Progress was rapid, and by 1931, anti-trust litigation having forced RCA to relinquish its patent monopoly, there was a wholesale change to the more efficient superheterodyne. This abandonment of the 'big TRF' coincided with the expansion of the Australian radio industry following the banning of the import of complete radios.

Many of the pre-1931 receivers surviving today are American built TRF types and the chassis from one of these, the 1930 Columbia AC-9-30, is the subject of this months 'adventure'. As can be seen from Fig.1, it is very massive — weighing about 20 kilos — and has an equally substantial early Jensen speaker to match.

There were several American firms selling radios with the Columbia label, the best known being the Columbia Phonograph Company of New York, whose chassis came from various suppliers during the late 1920's and early 1930's. However, this month's receiver is from the Columbia Radio Corporation of Chicago, a much smaller and short lived company which marketed receivers during 1929 and 1930.

As can be seen from the photograph, the chassis is quite long, with the four RF stages and detector in a row along the centre line. In front of these is the shielded four-gang tuning capacitor. Running transversally are the audio and rectifier valves, while at one end are the rectangular boxes containing the power transformer and filter capacitors.

Covered in dirt

When it arrived on my workbench, the Columbia chassis appeared to be in a bad way. Not only was it covered in dirt, straw and rubbish better left unidentified, but there were ominous signs of very black pitch deposits and overheating around the power transformer. Fortunately, the free standing loudspeaker appeared to be in good condition, with the cone intact.

Inverting an ancient chassis for the first time is a bit like the first look at lottery results. There is always an uncertainty as to what will be revealed; so it was with a degree of anticipation mixed with trepidation that I removed the base plate and looked underneath. Fig.2 shows what was revealed. I had half expected to find less than pristine wiring, but this had undergone a lot of mutilation, and was very untidy. As there clearly had been various servicing sessions, with quite a number of more modern replacement components, the next procedure was to sit down with the chassis and the circuit and quietly compare the two.

For the restorer of American equipment, John F. Rider's *Perpetual Trouble Shooter's Manuals* are invaluable. Rider brought out massive loose-leaf volumes annually from 1930 onwards, later editions running to something approaching 2000 pages per volume. In these are circuits and service data of all the major US manufacturers' receivers, and probably 90% of the lesser brands.

So it was to Rider that I referred, and sure enough, there in Volume III was the circuit of the Columbia AC-9-30. (Not much imagination needed in selecting a type number by the way: obviously I wanted a 1930 AC model with nine valves). The circuit is also identified as SG-9, probably the identification given to the chassis and cabinet combination.

Of course, many prospective restorers will not have reference sources like

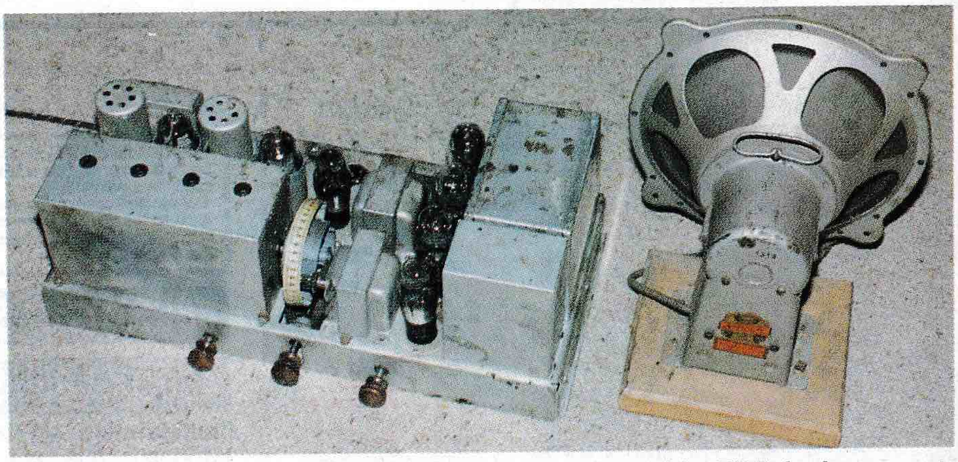


Fig.1: By the year 1930, receivers like this Columbia TRF had grown to massive proportions.

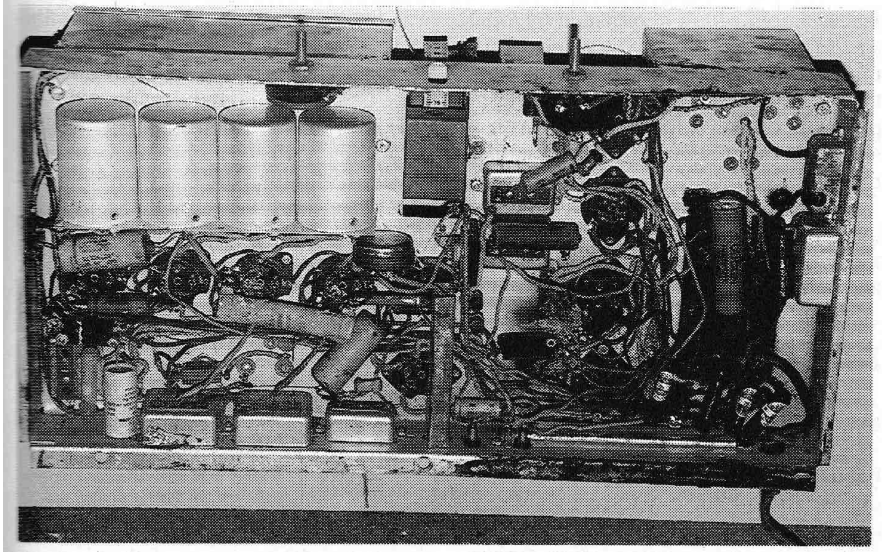


Fig.2: A couple of fires, and numerous component replacements had left the underside of the Columbia's chassis in a disorganised state.

Rider, but I would remind readers that both the HRSA and NZVRS have extensive libraries of circuits and data available to members. Addresses for membership applications are given at the conclusion of this column.

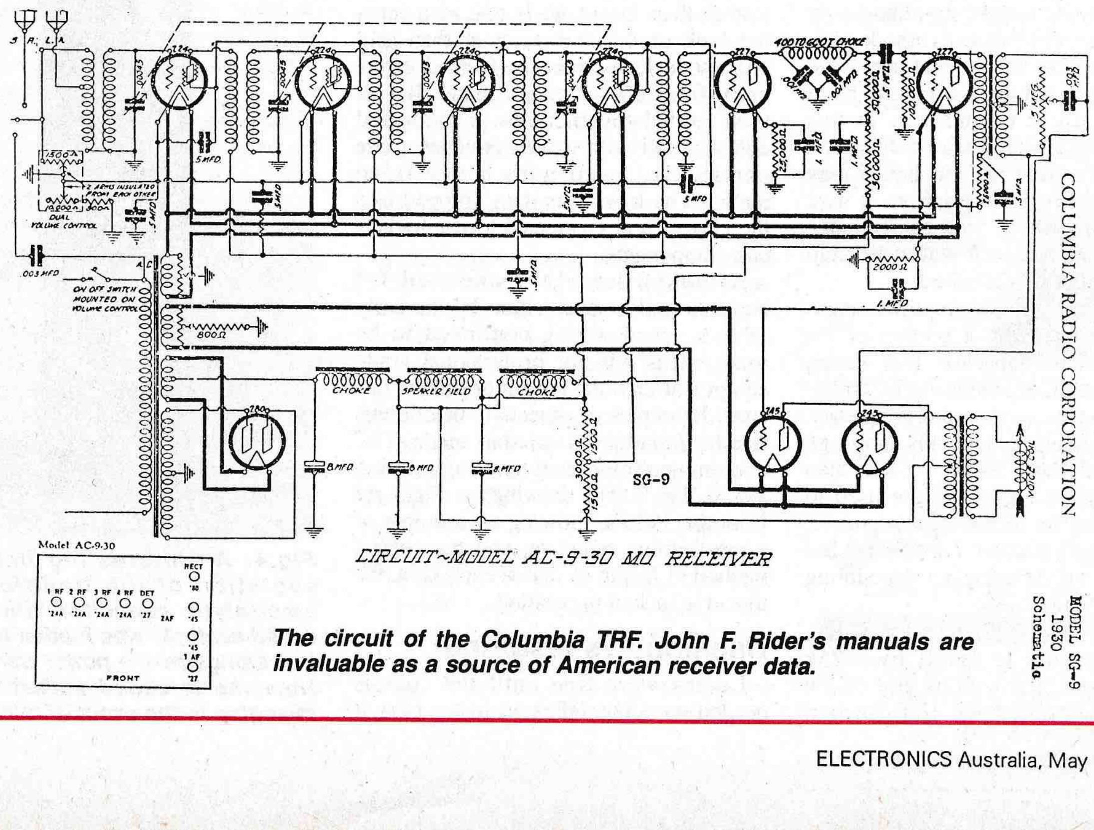
Without the circuit, tracing the wiring would have been a time consuming exercise, and it would have been very hard to identify modifications with certainty. The configuration turned out to be typical of larger screen grid receivers of the period, and it is interesting to compare it with that of the contemporary but nominally obsolescent all-triode Majestic Model 90B, described in this column for August 1992.

Starting with the input terminals, there is provision for three different types of aerial. Long aerials ('long' meaning more than about 20 metres) are connected to a tap on the primary winding of the aerial coil. Short aerials are switched to the full primary winding. The third alternative is a mains aerial, with the aerial winding being connected to the mains via a switch and small capacitor. This type of aerial connection was useful as an alternative to a proper installation, for obvious reasons of economy and convenience. House wiring, and overhead service lines, pick up a useful amount of RF and 65 years ago, there were fewer devices with commutators, fluorescent lights, TV timebases and computers creating interference. In fact, for use in high signal strength areas, it was possible to buy adaptors, each containing nothing more than a small capacitor, to screw or plug into lamp sockets for connection to receiver aerial terminals. This method is not recommended today, especially for 240 volt mains!

Volume control

Two major difficulties with the new 224 screen grid valves were obtaining effective volume control and cross modulation from strong nearby signals. Inserting a variable resistor between the aerial and the receiver certainly provided positive control of volume and cut down cross modulation interference from other programmes, but the receiver then operated continuously at full gain, creating a very noisy background. Alternatively, varying the screen or cathode voltages of the RF stages controlled their gain, but the sharp grid cutoff characteristics of the 224 meant that a worthwhile increase in bias, or reduction in screen voltage created serious nonlinearity, increasing cross modulation and distortion.

The best compromise was to provide,



The circuit of the Columbia TRF. John F. Rider's manuals are invaluable as a source of American receiver data.

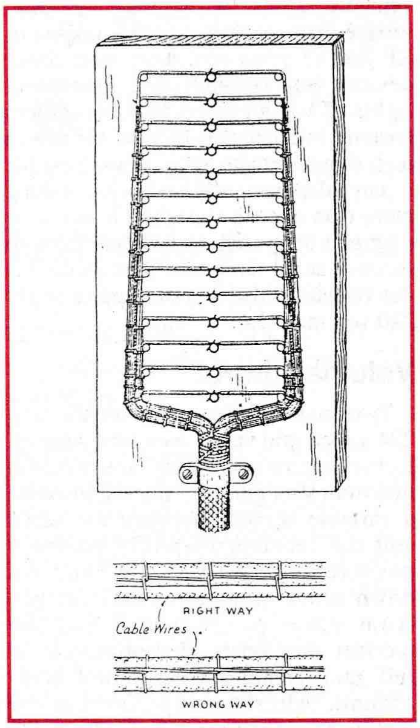


Fig.3: These old drawings show the use of a template to pre-form a telephone wiring loom, and how the correct method of lacing prevents unravelling. Some early and professional radio equipment used this system for wiring chassis.

as in this receiver, combined controls on a common shaft which simultaneously varied both aerial input and cathode bias. The aerial section has a 1500 ohm wire wound element, but the bias control has a 10k carbon track. Fortunately, in this case, the control was in reasonably good condition, otherwise some ingenuity may have been needed for repairs. As it was, dismantling, cleaning with mineral turpentine and relubricating with petroleum jelly was all that was required.

Four identical 224 RF amplifier stages follow, each tuned by a section of the four-gang variable capacitor. This section provides the bulk of receiver gain, and as all stages operate on the same frequency, stable amplification demands thorough shielding and short leads. No less than six 0.5uF bypass capacitors are used to assist stability. As technology improved, designers used smaller capacitors, but relied more on isolating or decoupling resistors in supply leads.

Next is a type 227 detector valve, biased practically to cutoff by a 25k cathode resistor, and with its grid driven through an untuned RF transformer. Audio amplification is provided by what was at the time virtually a standard arrangement of a 227 general purpose triode — transformer coupled to a push-pull pair of 245 triodes, biased with a single 800 ohm resistor between the filaments and earth.

The massive power supply, with the inevitable type 280 rectifier, is typical of the period. Chokes provide hum filtering and the loudspeaker field is part of the voltage dividing system.

Restoration viability

A check with a test meter showed that the chokes and audio transformer windings were intact. It would have not been at all surprising to find at least one of the audio transformers with an open circuited winding. However, the only major component needing repairs was the power transformer. It seemed therefore, that restoration could be a practical proposition.

A more detailed inspection showed that there had been two 'fires' in the set's history. The first was probably the result of arcing across the rectifier socket, which had caused most of the soot and blackening visible in Fig.2. Some of the wiring loom had been damaged, and repairs had involved removing the lacing thread and cutting off the damaged portions of some leads. The second fire came from the burnt out power transformer and was more serious.

It was very common to use looms for wiring these early sets, a practice inherited from the telephone industry. Rather than install leads one at a time, the bulk of the wiring, other than grid and anode leads, was pre-formed externally from colour coded leads. It was then cabled together into a loom and either bound with woven braid or, more commonly, laced with heavy linen thread. The loom was then dropped into the chassis and connected to the sockets and components.

Although largely abandoned for domestic radio construction by the early 1930's, laced wiring continued to be used extensively for professional grade equipment until the advent of printed circuits. Examples of especially neat looms can be found in Australian made STC communications receivers built during World War 2. The drawings in Fig.3 are from the 1920's, showing an example of a pre-forming template, and the correct method of lacing so that at each knot, the thread is locked in position.

Repairing vs restoring

Looms were fine until the chassis needed servicing. Often, as in this case, it was necessary to alter the configuration of the wiring to suit replacement components. Consequently loom lacing had to be undone with untidy results.

This brings us to an important aspect of dealing with very old receivers such as the Columbia. In early equipment, paper capacitors were usually enclosed in metal boxes, often in multiple, and wirewound resistors were frequently built as a common unit. Over the years, these may have been replaced by more modern wire-ended components, physically quite different from the original types. This, along with the fire damage, was to a large extent responsible for the Columbia's untidy appearance.

It is easy in these circumstances to accuse servicemen of shoddy workmanship, but they worked under serious constraints. Performance of the receiver, after repairs, would be little different with meticulously positioned components. Rather, the customer was generally only interested in getting the receiver back in good working order as soon as possible and at minimum cost. The successful serviceman was the one who could diagnose a fault accurately and quickly and then make rapid and reliable repairs.

Today, as restorers, we can take as long as necessary to bring the receiver back to as close to original condition as possible with few cost constraints — a

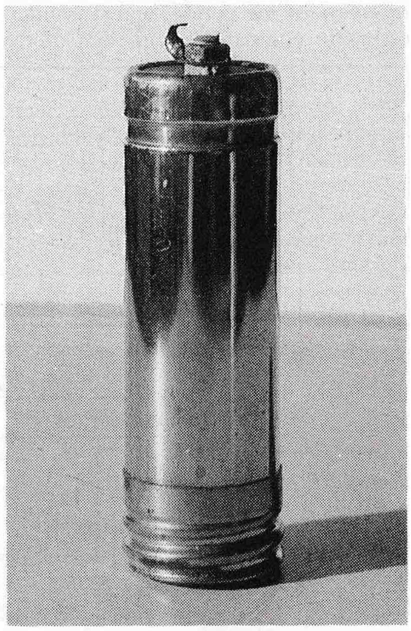


Fig.4: An interesting link in the evolution of the traditional wet electrolytic capacitor, this copper cased example was hidden inside the box alongside the power transformer. Note the threaded socket for easy changing in the event of failure.

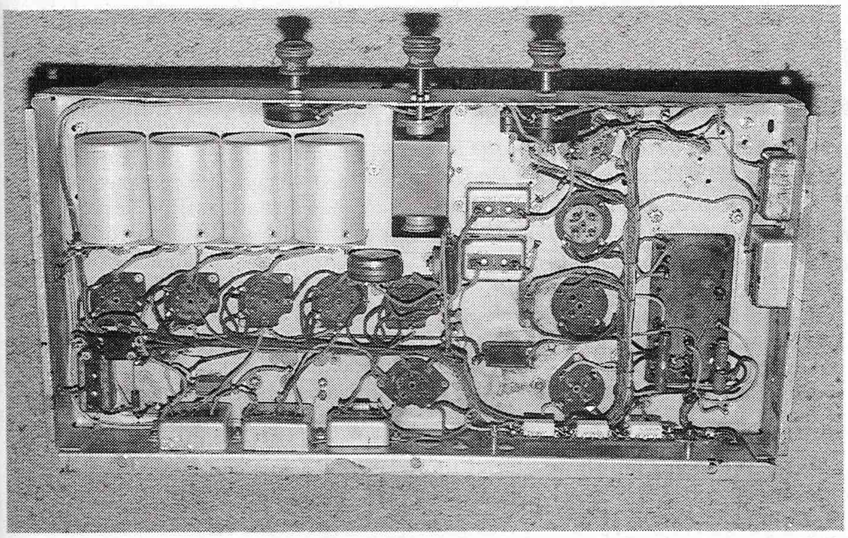


Fig.5: A view underneath the receiver following the author's restoration job. Compare this with Fig.2, to see the amount of work that had to be done.

Utopian situation that most servicemen could only have dreamed about. The prime object today is not rapid repairing of faults, so much as returning the receiver to as near as possible to original condition, and in the process, not creating further damage.

We must not forget too that there were many backyard 'servicemen' —handymen with a enough knowledge to get some sort of life from an ailing receiver. A lot of their success came from a 'try it and see what happens' experimental approach, and their workmanship could vary from competent to downright poor, with soldering that looked as if it had been done with a poker, or even no soldering at all.

Frequently too (and there was evidence of this in the Columbia), they would fit the nearest available but inappropriate replacement component. One example can be seen left of centre in Fig.1, where a large 25 watt resistor of the wrong value has been used to replace a 5-watt section of the voltage divider (mounted on the right hand rear of the chassis).

Capacitor surprise

Apart from the major project of rewinding the power transformer, to be covered later, restoration of the Columbia was straightforward, entailing renewal of resistors and of the contents of the capacitor boxes, and replacement of the damaged and shortened leads before relacing the wiring loom.

The original capacitor contents were removed readily from their boxes by digging out the embedding wax and pitch, and modern plastic dielectric capacitors were easily fitted in as replacements. One small problem was working out, largely by a process of elimination and deduction, which box (most of which were dual units) had originally contained which capacitors.

There was a small surprise waiting when the large above-chassis filter capacitor box was removed. The original three 8uF capacitors had long since been disconnected, and replaced by cardboard cased electrolytic capacitors visible in the under chassis photograph.

The filter capacitor box was unbolted, and found to contain not a tightly packed group of paper filter capacitors (which it was obviously originally designed for), but instead three unusual copper-cased electrolytic capacitors, one of which is shown in Fig.4. 1930 was a period of rapid advances, and probably what had happened was that the development work on the chassis had been based on using paper filter capacitors, but by the time that production was under way, the cheaper and higher capacitance Mershon electrolytics had become available.

These copper cased capacitors proved to be an interesting evolutionary type. They are the same size as the standard aluminium cased wet type that were to be found in many chassis made during the 1930's, but they are mounted in a threaded brass socket, with the terminal at the top end. No doubt the elaborate mounting was to facilitate replacement in the event of failure — a likely possibility with the new and relatively unproven type of capacitor.

The use of higher value capacitors than the original design would have called for may explain the unconventional arrangement at the output of the second filter choke — which is connected to the resistors supplying the anode current of the two type 227 valves. Normally the junction would have been bypassed to earth, to provide additional filtering. As it is now, the choke serves little practical purpose, and in fact, savings could have been made during manufacture by its elimination. At 100Hz, a 20 henry choke has a reactance of about 12.5k, which is of no great significance when compared with the 25k and 50k resistors in series with it.

Three high wattage resistors comprising the voltage divider and output stage bias resistor were originally in a 'Kandohm' unit, a flat wirewound strip that was clamped in a tinplate cover, hence the name. The elements had long since failed, and as repairs are not very easy, it was replaced by three standard five watt resistors mounted on a strip of fibre. Of course, if a genuine voltage divider of the correct type ever turns up, it will be a simple matter to install it.

The major exercise of the project was dealing with the burnt out pitch-encased power transformer. This warrants an 'in depth' description, and it also involved some calculations. As space has run out, next month's column will describe how this was done, and as well we'll look at power transformer voltages generally and hints on selecting replacements.

Here once again are the addresses to write to for membership applications for the vintage radio societies:

Historic Radio Society of Australia
Mr J.R. Wales
PO Box 283,
Mt Waverley, Vic 3149.

New Zealand Vintage Radio Society
Mr B. Marsh,
20 Rimu Road,
Mangare Bridge, Auckland 1701. ❖