

Vintage Radio

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The Weston Model 660 Radio Set Analyser

Ever since the advent of radio communications at the start of the 20th century there has always been a need for test instruments. This month, we take a look at some of the common test instruments that were used and describe the unusual Weston Radio Set Analyser Model 660.

MANY DIFFERENT TEST instruments have been used in the radio field over the years. Some are quite complicated but sometimes they can be extremely simple – even just a finger or a screwdriver!

For example, with octal and pre-octal valves, it was common for the control grid to come out to a cap on the top of the valve. As a result, it was common for a serviceman to touch the grid cap of valves like the 6B6G to see

if there was a healthy “blurt” from” the loudspeaker due to the resulting injected hum.

This test method was quite effective in determining that the audio amplifier was actually working. However, it gave no real indication as to how well the stage was operating.

There was also a trap here for the unwary. Not all valves have their top cap (if one exists) connected to the control grid. For example, some power

valves like the 807 and the 6DQ6A/B have the plate (anode) attached to this terminal and so the top cap operates at the potentially lethal HT voltage!

For this reason, it is always necessary to check what is connected to the top cap before touching it, as death is permanent! And even if the top cap doesn't normally operate at high voltage, it's possible that a lethal voltage can appear there under fault conditions.

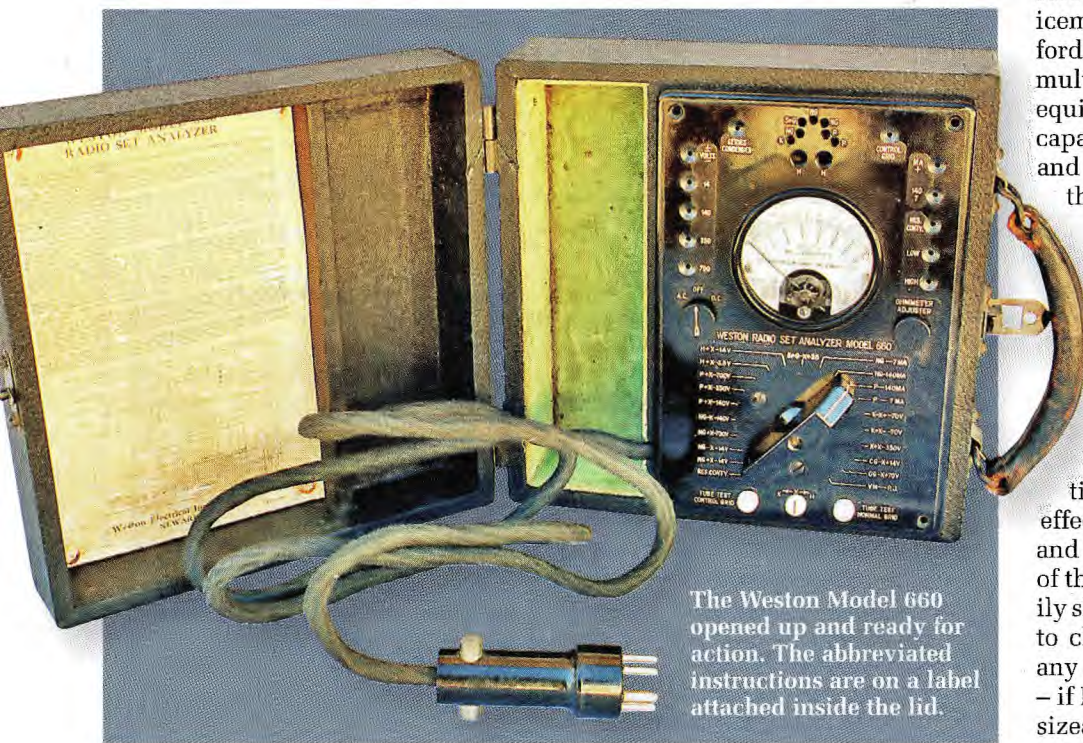
In short, although servicemen used this technique for many years, it is not recommended because of the possibility of electrocution. At the very least, always use a multimeter to check whether a high voltage is present at the top cap.

The screwdriver technique

Now I'll tell you about the common screwdriver test technique. Most servicemen in early times could only afford an elementary 1000 Ohm per volt multimeter. Only a few had access to equipment such as signal generators, capacitor testers and valve testers, etc and those that did often built the gear themselves.

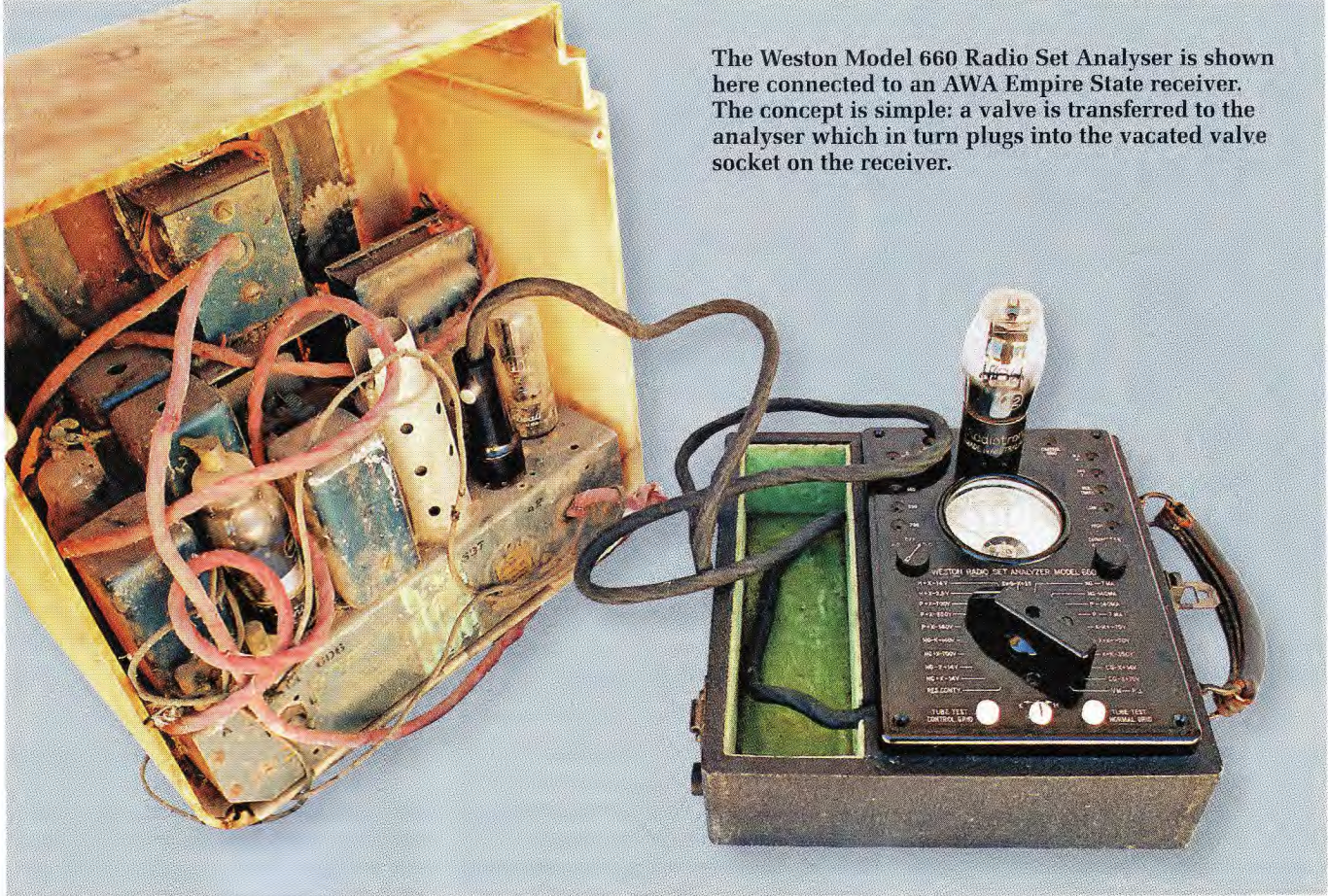
Some so-called “servicemen” didn't even use a multimeter and labelled those servicemen who did as “sissies”. Instead, they were quite content to use a screwdriver as a test instrument.

In practice, the screwdriver was used to short out various sections of a set while listening for the effect in the speaker (or headphones) and – sometimes – observing the size of the spark. For example, momentarily shorting the HT (high-tension) line to chassis to determine if there was any high tension was a common test – if HT was present, there would be a sizeable spark!



The Weston Model 660 opened up and ready for action. The abbreviated instructions are on a label attached inside the lid.

The Weston Model 660 Radio Set Analyser is shown here connected to an AWA Empire State receiver. The concept is simple: a valve is transferred to the analyser which in turn plugs into the vacated valve socket on the receiver.



Of course, rectifiers, chokes, filter capacitors and transformers do not take kindly to that sort of treatment. And just try this with solid state circuitry and see how long the transistors and other solid-state devices last!

Many so-called servicemen were very proud of the fact that a screwdriver was all they used to trace faults in early days. However, all they could really determine was that amplification was taking place in a certain stage or that a voltage was at a particular point. They had no idea if the gain of the set was normal or if the voltages were as they should be.

Although this technique (practised with extreme care) could be useful in some circumstances, I certainly do not recommend it. **It is potentially very dangerous and there are much safer techniques available, both for the set itself and the serviceman.**

Something more dangerous!

As if the screwdriver test technique wasn't bad enough, there was another even more dangerous test technique that was used by a few (mainly) de-

ceased "servicemen". What they did was to use their fingers to "test" the voltages in a receiver, the claim being that they could judge the voltage levels by the shocks they received. Just how many died trying this insane "test" method is unknown.

Fortunately, this stupid and potentially lethal technique died out many years ago – pun intended.

Observation

There are of course other fundamental "test" instruments that we all have. The most important are our senses of sight and smell.

When you have a set to restore, the first step after removing it from its cabinet is to use your nose to check for burnt smells from power transformers and resistors, or any other parts that may have seriously overheated. It's then a matter of using your eyes to see where the obnoxious smells are coming from.

This may take quite a bit of doing in some cases and a multimeter will be useful when it comes to checking any suspect parts for shorts.

At the same time, use your eyes to check for wiring changes that shouldn't be there, including components with only one lead connected to anything. Badly soldered joints can sometimes be picked up in this way too, particularly if a head-set magnifier is used.

Cracked or melted insulation can also easily be spotted, as can corrosion in parts such as the aluminium vanes of tuning capacitors.

Your senses of sight and smell are also important when power is subsequently applied to the set. These will sometimes allow you to detect any problems that were not detected when the set was un-powered.

Your sense of hearing is important too when it comes to judging the signal quality. It's also useful for tracking down problems such as hissing, crackling and other noises from a faulty receiver.

Your sense of touch is another useful tool. This can be used to assess whether something is getting hotter than it should or, in some cases, isn't getting hot enough. Similarly, it can be

what you are doing. The chassis and/or other parts may operate at full mains potential (ie, 240VAC), making them death traps for the unwary.

Watch your eyes

When servicing an old radio, it's always advisable to wear protective glasses in case something spits out molten metal or explodes – eg, an electrolytic capacitor. Be warned also that some faulty components can give off obnoxious fumes which are best avoided – especially carcinogens like the PCBs found in some block capacitors.

Take care of your hearing also and don't subject your ears to excessive noise levels – eg, when wearing headphones. In short, use your common sense and avoid the dangerous and foolhardy test methods described earlier. They have no useful role to play in servicing vintage radios.

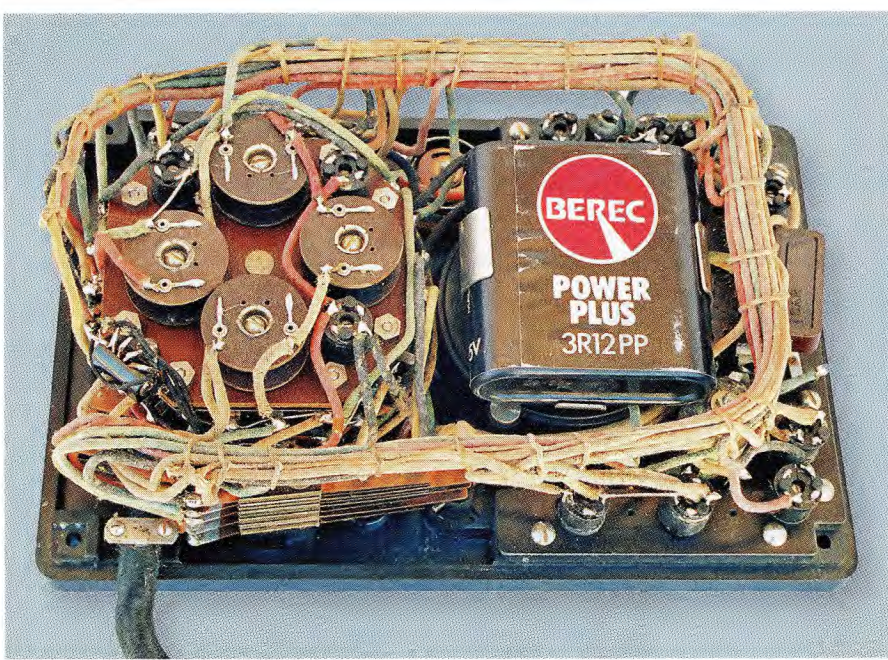
Radio Set Analyser

One interesting piece of equipment I have recently come across is the Weston Radio Set Analyser Model 660. So what exactly is it and what does it do?

Basically, a radio set analyser is a device that's used to check the operating conditions of a valve in a radio circuit. In the early days of radio, during the breadboard construction days, all terminals and leads were accessible from the top of the set. But then – shock, horror – the metal chassis was introduced, with components mounted on both sides. Throw in the additional complexity of tetrode and pentode valves, along with the mysterious new superheterodyne receiver circuit, and many radio enthusiasts simply gave up.

The analyser did, however, make things somewhat easier for those traumatised radio enthusiasts brought up on breadboard construction and coffin-style cabinets. That's because it allowed most testing to be done from the top of the chassis, which made troubleshooting more straightforward.

The stage to be tested first had its valve removed. The lead from the analyser was then plugged into the vacated valve socket, either directly or via a suitable adaptor. That done, the valve was then plugged into the analyser, the set powered up and the valve's performance assessed.



This is the view inside the Model 660. It employed lots of wiring and a rather complicated switching arrangement to select the various test functions.

used to detect whether or not something is vibrating.

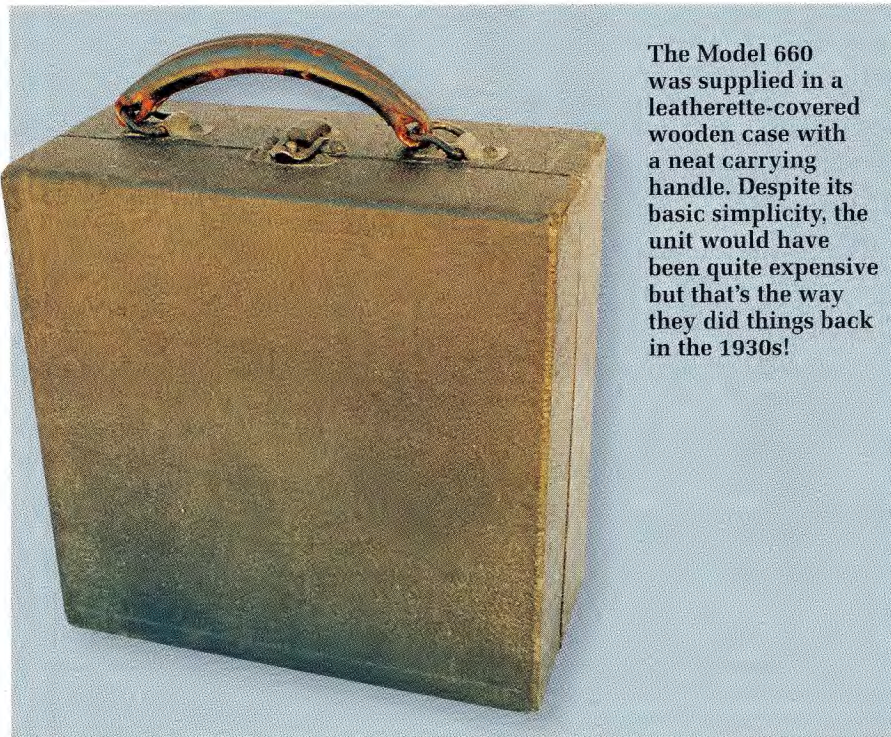
Touch can also be used to subjectively determine whether a power valve is drawing enough current and whether a capacitor is leaky and as a result is heating up.

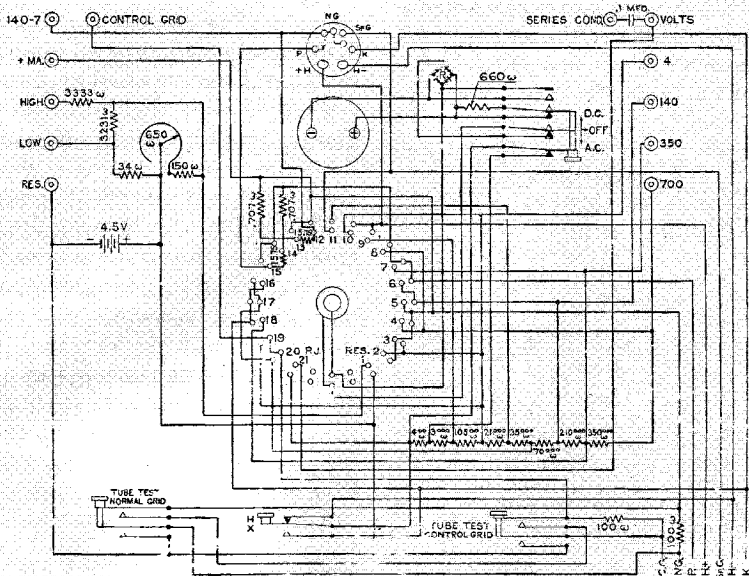
Of course, a great deal of care is needed here to ensure that you don't touch a high-voltage circuit or burn your finger. The safe method is to

disconnect the power before touching anything. Even if a point is not at high voltage, an involuntary reaction to something hot could result in you coming into contact with something that is at high voltage nearby.

It's also vital that you understand the type of circuit you're working on here. **Never go poking around transformerless AC/DC sets unless you are very experienced and know exactly**

The Model 660 was supplied in a leatherette-covered wooden case with a neat carrying handle. Despite its basic simplicity, the unit would have been quite expensive but that's the way they did things back in the 1930s!





Weston Electrical Instrument Corp. NEWARK, N. J.

Fig.1: the circuit of the Weston Model 660 Radio Set Analyser is basically a combined multimeter, elementary valve tester and set analyser.

In practice, its current could be measured, along with the voltages applied to its various elements. It was even possible to gauge the gain of the valve using various tests and to measure resistances.

In short, the analyser was designed to largely solve the perceived problem of removing the receiver chassis from the cabinet for servicing. Valves weren't particularly reliable in those days, so the analyser solved the problem of checking the most vulnerable parts of the radio (ie, the valves) with ease.

As far as I can discover, the radio set analyser was developed in the United States during the late 1920s and early 1930s. In fact, quite a bit was written about these analysers in "Modern Radio Servicing" by Alfred Ghirardi in 1935.

By contrast, only a two-paragraph mention is made of radio set analysers in the Philips Radio and Television Manual by E. G. Beard following World War 2. The reason for this is probably that when octal valves were introduced, the limitations of the analyser were too great to warrant further development.

Weston Model 660

The Model 660 is probably an early 1930s instrument, as Ghirardi's book

shows a 666 which appears to be a later version. As mentioned earlier, the average radio servicemen in Australia could only afford a multimeter to overhaul a faulty receiver. The 660, along with the analysers made by other manufacturers, would have been expensive instruments in their time, so not many were sold in Australia.

In its time, the 660 would have been viewed with a certain amount of awe. It is housed in a 225 x 230 x 115mm leatherette-covered wooden case with a neat carrying handle. The case opens up to present the instrument which is finished in the characteristic black colour of the era.

Basically, the unit is a combined multimeter, elementary valve tester and set analyser. On the lower section of the front panel is a large multi-function switch with 21 marked positions. Above this is a 65mm meter marked with the various ranges, while to either side of this are several sockets to use with the analyser in the multimeter mode.

The valve socket is located directly above the meter. This accepts the valves that are removed from the receiver being tested, either directly or via a plug/socket adaptor.

The connection to the empty valve socket on the receiver is made via a 1.3-metre long cable which emerges from

The Weston Model 660 Radio Set Analyser came with an assortment of leads and valve socket adapters.



der" plug inserted into the empty valve socket – if necessary, via an adaptor. The use of an adaptor all depends on whether the valve is a four, five, six or 7-pin type. If an adapter is used, then a similar adaptor may also be needed at the instrument end, so that the valve can be plugged into the analyser.

The adaptors, by the way, are colour coded either blue or orange and made so that the correct adaptor can only be used in each location.

Once the unit is connected, the set can then be turned on and the voltages and currents measured at each valve pin (ie, without the valve present). At this stage, the voltages should read high and the current should be zero unless there is a bleeder circuit or a fault in the set.

Next, the valve is plugged in and the above tests repeated. The heater or filament voltages should remain virtually the same but the voltages on the plates and screens should be somewhat lower, depending on the circuit. The current drawn by the valve for its screen and plate circuits should be within the range expected for the particular valve type and the circuit configuration.

Switching between ranges on the model 660 while the receiver is operating doesn't cause problems as the range switch is a "break before make" type. Conversely, switching between measurements on the different valve elements should be done with the AC-OFF-DC switch in the "off" position, otherwise the meter may be damaged.

Interpreting the results

Having done these tests, it was then up to the operator to interpret the results. This was generally based on experience, although some manufacturers even provided the expected voltage and current readings for their sets so that set analysers could easily be used.

Having tested the set in a static condition, it was then possible to see if the valve appeared to be amplifying. This was done by pressing either (or both) the "Tube Test Control Grid" or the "Tube Test Normal Grid" switch, which applied an offset voltage to the grid. A variation in the current drawn by the valve would then be observed if the valve was operating correctly.

Each valve circuit in the set would be tested in sequence until the faulty

the lefthand side of the instrument. This cable is fitted with a 6-pin valve plug, with both large and small grid caps on the upper part of the plug.

On the inside cover of the instrument is a set of abbreviated operating instructions, along with a circuit diagram. However, these are not all

that clear and the handbook that goes with the instrument had long since disappeared.

Using the unit

The unit is used as follows: with the radio turned off, a valve in the set is removed and the set analyser "wan-

Rotary Switches: Making The Break

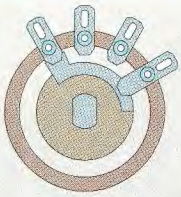


Fig.2: a "make-before-break" switch at rest and in transition.

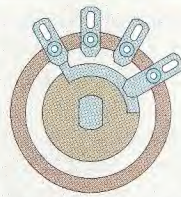
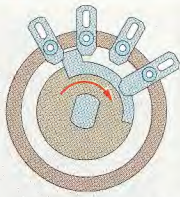
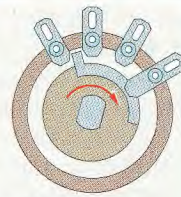


Fig.3: a "break-before-make" switch uses a narrower moving switch contact.



There are two different types of rotary switches used in vintage radios – "make before break" and "break before make". The differences between them are critical in many situations, as we shall see.

Most rotary switches are "make before break" units. This means that as you switch ranges, the adjoining switch sections are connected together ("commoned") for an instant – see Fig.2. This is not important for applications like wave-change switches but can be disastrous in other situations such as when different voltages are to be switched. In the latter case, using a make before break switch could easily lead to its contacts being burnt out and/or the equipment damaged.

The commonly used "Oak" switches are mostly "make-before-break" types but Oak also manufactured "break-before-make" switches. In this type, the moving part of the switch contact is much narrower than in the "make-before-break" units, in order to achieve the break during switching – see Fig.3

Both switch types are used in vintage radios and if you have to replace a switch, be sure to choose the correct type.

Photo Gallery: Raycophone "Pee Wee"



PRODUCED BY THE RACOPHONE COMPANY, SYDNEY, in 1933, the "Pee Wee" was a small 4-valve autodyne superhet receiver. It was housed in an attractive wooden cabinet and used the following valve types: 57 autodyne mixer; 57 anode bend detector; 2A5 audio output; and 80 rectifier. Photo: Historical Radio Society of Australia, Inc.

stage was found – all without removing the set from its cabinet. The hope then was that the fault could be corrected simply by replacing the valve, as this was the most likely culprit. They were not as reliable in the 1930s as they were towards the end of the valve era.

Of course, this was really a rather elementary valve test and it wasn't always the valve that was at fault. If the tests were indeterminate in pinpointing the problem, it would then be necessary to remove the chassis and really get serious about servicing the set.

In reality, it's probable that the chassis had to be removed from its cabinet in at least 50% of the cases to cure any faults. Once the chassis had been removed from the cabinet, it could then be tested using the multimeter functions of the set analyser in much the same manner as with modern multimeters.

Why didn't they last?

The concept of being able to test most parts of a radio circuit without removing the chassis from the cabinet appealed to many people. So why were set analysers only used for a relatively short period of time.

First, although the idea of being able to remove a valve and plug in an analyser was attractive, the only easily replaced component was the valve itself. Replacing other components required access to the underside of the chassis, which nullified the supposed advantages of an analyser.

Now we come to the real problem of set analysers. In practice, a set's operating conditions were altered by extending the various valve element leads. In some receivers, neutralisation was required in the RF sections to overcome the effect of the grid to plate capacitance. This involved fitting a small capacitor.

However, with the leads extended, the grid and the plate leads are alongside each other and the neutralisation no longer works due to the altered operating conditions. In any set that used a tetrode or pentode valve in an RF stage, the fact that the grid and plate leads are now alongside each other would have completely nullified the shielding effect of the screen grid. As a result, the particular stage would probably oscillate uncontrollably.

Problems could also be expected

when testing audio stages. The extended grid lead in the Weston Model 660 set analyser is unshielded, so excessive hum or even "squealing" (due to feedback) could be expected in the output of the audio amplifier if that stage was actually working.

In addition, interfering with the original chassis layout by extending the valve leads could result in incorrect voltage and current readings, simply because the circuit could now be behaving abnormally. An analyser may have worked quite well in checking circuits with low-gain valves. However, later valves had much higher gain than the early types and using an analyser with any circuit that used them would have been out of the question.

As a result, set analysers faded into obscurity within a relatively short period.

Summary

The Weston 660 Radio Set Analyser

is an interesting test instrument from the early 1930s. It would have been quite expensive in its day but despite that, its usefulness would have been quite limited.

Rapidly evolving receiver design and servicing techniques very quickly rendered this type of instrument obsolescent and most would have soon been set aside to gather dust. Certainly, the example I have on loan indicates from its physical condition that it saw very little work. In practice, it would have been much easier for a competent serviceman to employ more conventional servicing techniques.

So if I'd been a serviceman in those early times, would I have bought one? Possibly, because when I was young, I liked to surround myself with test instruments to make up for my lack of knowledge. But knowing what I know now, the answer would have to be no. That said, this unit is well worth preserving as an example of a direction radio took for a short time. **SC**