

# VINTAGE RADIO

By JOHN HILL



## Capacitors cause lots of problems

**Vintage radios, like all radios, have a considerable number of capacitors in their circuitry. Many of these capacitors are a potential source of trouble, especially the paper and electrolytic types. Here's what to look for.**

The first type of capacitor (referred to back then as a condenser) was the Leyden jar. These early capacitors consisted of a glass jar (being the insulating dielectric) with a layer of foil on the inside and the outside of the jar. In principle, they were like any other capacitor: two metal plates separated by a dielectric, their prime function being to store an electrical charge.

Although it worked, the Leyden jar had several disadvantages. It was big and bulky which meant that a much more convenient form of capacitor was necessary to meet the demands of radio. This was

done by rearranging the shape of the plates and by using a thinner dielectric.

Early radio capacitors were constructed out of layers of either brass or copper shim which were separated by thin slivers of mica. Mica capacitors were quite enduring and many of those that have survived from the 1920s are still quite useable today.

Mica capacitors are frequently encountered in valve radios of all ages and they rarely give trouble. Only once have I found it necessary to replace a mica capacitor.

However, mica capacitors are

only good for relatively small capacitance values. As valve radio developed from battery-operated reaction type receivers to AC-powered superhets, there was an increasing need for capacitors of greater capacity than the mica type could conveniently accommodate. The paper capacitor was the next stage in the development of this common radio component.

### Paper capacitors

A paper capacitor is made by rolling up two strips of foil which are separated by wax impregnated paper. Each foil has a wire connected to it and the unit is either housed in a cardboard tube, a plastic casing or a metal can.

While a wax impregnated paper dielectric may sound a bit primitive in the high-tech world of the 1980s, it was about the only practical and reasonably economical material available in the early 1930s when paper capacitors were first put to good use. Incidentally, paper capacitors were still being manufactured for radio and TV use in the 1960s.

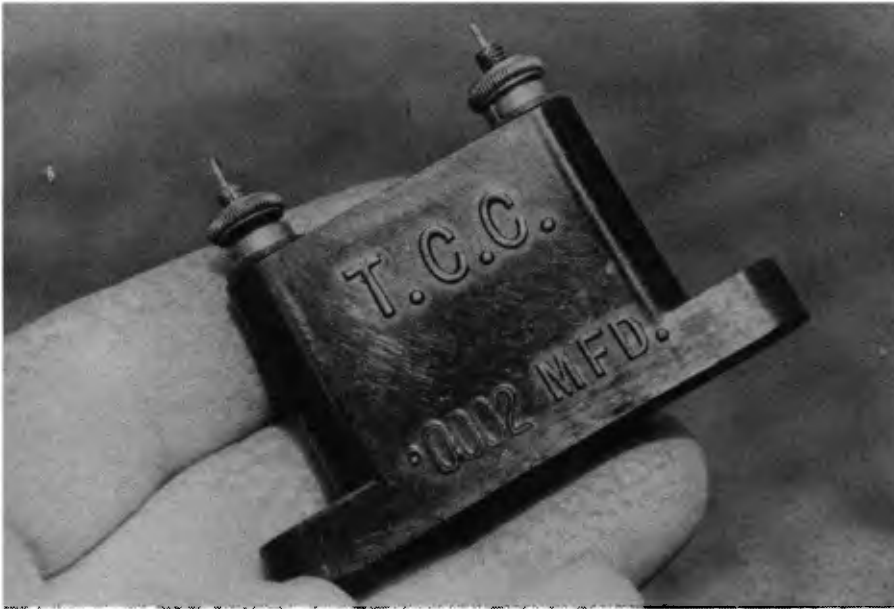
Today's capacitors have shrunk in size, the reason being that the old wax impregnated paper has now been replaced with a thinner plastic dielectric. Plastic dielectrics such as polyester allow the plates of the capacitor to be much closer and, therefore, smaller capacitors can be made. Modern capacitors are about one tenth the size of their old paper counterparts.

### Paper capacitor faults

As far as a valve radio is concerned, paper capacitors are



**A selection of old mica capacitors. These capacitors are very reliable and seldom require replacement with more modern types.**



Many early mica capacitors featured mounting lugs and thumbscrew terminals. This particular unit is rated at  $.0002\mu\text{F}$ .



A couple of typical paper capacitors — cracked, troublesome and quite unreliable.

troublesome and seem to develop lots of faults as time goes on. The older they get, the more unreliable they become.

The reason for this decline in performance is simple: the capacitor absorbs moisture over the years, thus allowing electrical leakage between the two plates. Paper capacitors are one of the most suspect components one can find in an old valve radio, with some brands being more suspect than others.

If a modern capacitor of say  $0.1\mu\text{F}$  is tested with a multimeter set on the  $\times 1\text{k}\Omega$  scale, the needle will rise a little as the capacitor is charged, then drop back to zero when full charge is reached.

A similar test with an old paper capacitor will also show the meter needle rise and fall but in many instances it will not fall back to zero. Often a reading of  $2\text{-}10\text{M}\Omega$  is common, indicating that the dielectric allows a certain amount of leakage.

Of course, the voltage applied by

the multimeter to the capacitor is quite low. If this causes leakage, think how much worse the situation will be when the capacitor is placed into a circuit where hundreds of volts are across it.

Many paper capacitors simply can no longer take this high voltage strain. Those old black AWA paper capacitors, in particular, are most troublesome and frequently split open at the ends. On odd occasions, they may even blow themselves apart.

It has been my experience that defective paper capacitors are the cause of many problems in valve radios and are highly suspect at the best of times. To combat this problem I replace all the paper capacitors in the radio sets that I restore. This simple step often cures a multitude of ills and a set that was acting up a bit beforehand will often behave as it should after the capacitors have been replaced.

There are probably a good many readers who agree with my total replacement strategy but there would be others who may object to this procedure, particularly as I use modern replacements. Some restorers have very definite views when it comes to originality and replacing components with modern equivalents just simply isn't done.

I'll go along with originality to a certain extent, but only as far as is reasonably practical. So long as things look original from the back view, I'm happy. Not many people are going to insist on the chassis being removed so as to check for non-standard components underneath.

Now if this originality bit worries you, perhaps there are ways of implanting a modern capacitor inside an old casing. Those paper capacitors that are housed inside a cardboard tube could respond to this treatment quite well, although one would have to be keen to bother.

### Replacing capacitors

Although it seems a relatively simple task to replace a dozen or so capacitors in an old radio, one can run into considerable trouble when doing so.

The best advice I can offer is not to unsolder any capacitor that is be-



Old electrolytic capacitors are a common source of serious trouble in vintage radios. The replacement of all electrolytics during restoration can save a lot of hassles later on.

ing replaced. It is so easy to lose track of where it came from, it just isn't funny. One interruption is all that is needed and the mental picture of where that capacitor was connected has gone forever.

By far the best method is to cut the component out using a pair of sidecutters, leaving the original leads in place to indicate where the new part should be fitted. Of course, you should remove and replace only one capacitor at a time.

Paper capacitors were usually rated at 200, 400 and 600 volts.

Modern replacements will usually either be rated at 100, 160 or 630 volts, although other voltage ratings are available. Even low voltage capacitors can be used quite extensively in a vintage radio.

While a valve radio is basically a high voltage instrument, not all the capacitors are subject to high voltages. This means that 100 volt greencaps are quite suitable for use in many circuit locations. Generally speaking, most 200 volt paper capacitors can be replaced with a greencap.

It has been my observation that

the 100 volt rating on a greencap can be exceeded by 50% without any trouble. They seem very tolerant of voltages above their nominal rating, although it may not be wise to exceed the rating.

If a set is in going order, it is a simple matter to check out the voltage on each capacitor and mark those that really do need a high voltage replacement. 630 volt capacitors are considerably more expensive than 100 volt ones, so they should only be used where needed.

A final word on paper capacitors. Not all paper capacitors are faulty and I dare say I have thrown out a good many of them that were perfectly OK. I also know that I have saved myself quite a few problems by replacing these highly suspect components.

### Electrolytic capacitors

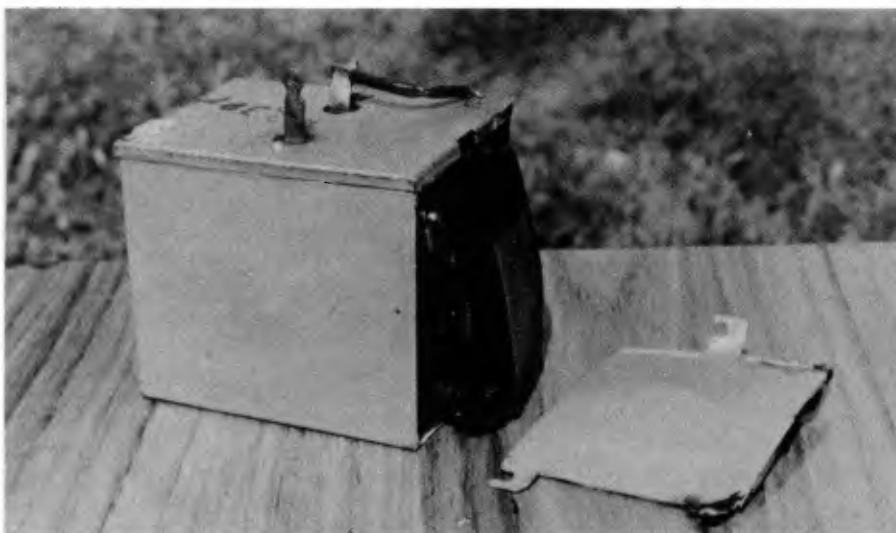
Another type of capacitor found in valve radios is the electrolytic type. They are mostly fitted to the high tension DC supply to filter out the 50Hz mains hum. Considerable variations are found in these electrolytics and they vary in capacity from 8-32 $\mu$ F and can be rated anywhere from 350-600 volts.

High voltage electrolytics are often difficult to come by. Very few manufacturers appear to be making them and even fewer retailers sell them. Like radio valves, they can be found if you shop in the right places but for how much longer remains to be seen.

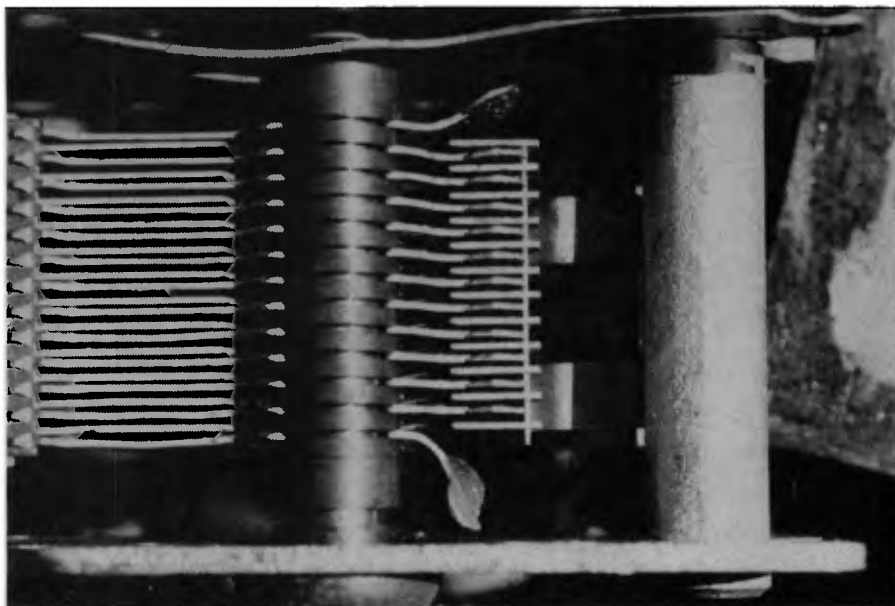
Electrolytics are also troublesome components in old valve radios and their replacement is frequently required. Electrolytics usually contain a liquid or paste which often leaks away, leaving the capacitor dry and useless. Leaking electrolytics are a sure sign of trouble and should always be replaced.

There seems to be no rule that applies to electrolytics. Odd ones seem to last forever while others are relatively short-lived. While some continue to work after 40 years of service, such a life span is the exception rather than the rule.

If old electrolytics are to be used again, they should first be tested using an ohmmeter for short circuits and excessive electrical leakage. In



This old 4 $\mu$ F paper capacitor has seen better days, with internal problems forcing the end off the can.



Many tuning capacitors have the outside plates bent outwards (though not usually as much as shown here) to compensate for capacitance discrepancies between the gangs. Don't bend them back otherwise you won't get accurate tracking across the dial.



Many of the capacitors used in valve radios are high voltage types. Always make sure that replacement capacitors have an adequate voltage rating.

addition, a capacitance test is needed to determine whether the capacity is somewhere near the marked value.

When checked with an ohmmeter, most old electrolytics show a considerable amount of leakage. However, this situation often improves when the capacitor is put back into service. Applying a potential across an old electrolytic capacitor helps to "reform" the oxide dielectric.

Faulty electrolytics can cause a pronounced 100Hz mains hum in the loudspeaker. And if an electrolytic develops an internal short circuit, it will result in the rectifier anodes glowing red hot. Capacitors with these ailments must be replaced.

Now I will probably get wrapped over the knuckles for this statement but the capacitance of an electrolytic replacement is not all that critical. As far as I can see,  $8\mu\text{F}$ ,

$16\mu\text{F}$  and  $24\mu\text{F}$  electrolytic capacitors all work pretty much the same no matter what type of radio they go into. About the only effect they might have is to cause a slight change in the high tension voltage.

If someone wants to take me to task about this, just keep in mind that the only high voltage electrolytics I can buy at the time of writing are  $22\mu\text{F}$  450VW types and these are the ones I use when needed. What's more, they seem to work very nicely.

Some radios also have low voltage electrolytics which are used for biasing. As these capacitors are usually rated at  $25\mu\text{F}$  40VW they offer few problems regarding a suitable replacement and a modern  $22\mu\text{F}$  63VW electrolytic is a suitable substitute.

### Tuning gangs

Perhaps the only other capacitor worth mentioning at this stage is the variable capacitor or tuning gang. While this particular unit does not usually need replacing, it can require a bit of routine maintenance in addition to a good clean.

Tuning capacitors have bearings that sometimes work loose. These can be given a drop of oil or a dab of grease and readjusted if necessary. A good many old tuning gangs have a lock nut on the rear bearing which allows the play to be taken up if the bearings have worn to any extent. Adjustment is only required on odd occasions; usually a lube job on the bearings is sufficient maintenance.

Another point regarding the tuning capacitor: don't straighten the outside moveable plates if they appear to have been bent away in different places. This has been deliberately done so that the two (or three) gangs will track accurately over the full range of the dial — so don't interfere with them.

In summary, the vintage radio restorer needs to pay particular attention to the capacitors in the sets he restores. Electrolytics and paper capacitors, in particular, can be very troublesome and in most cases, total replacement is the only sure method of obtaining reliable and lasting results. ☛