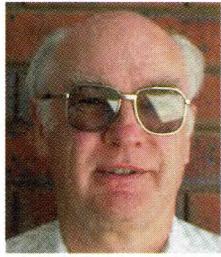


VINTAGE RADIO

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Safety with vintage radios

If you don't know what you are doing or become complacent, a vintage radio receiver can be a very dangerous device. Here's some advice to ensure your personal safety.

Certainly, we now hear a lot about safety in our communities. One example is road safety and this includes the condition of the roads, road signs, the weather, the amount of traffic, the time of day and traffic speed. We also hear about how cars are being made safer, with ABS brakes, airbags, seat belts, better lights, better tyres and so on.

What has this to do with vintage radio you might ask. The only thing it has directly to do with vintage radio is that you and your newly-acquired treasure are more likely to arrive home safely. However, once you're home, you should follow a few strict precau-

dures when working on a vintage radio set to make sure you stay safe.

No warnings

Have you noticed all the safety warning signs on your vintage radios? No? – well that's not surprising as there usually aren't any. Can you pick up and turn over the set you are restoring while it is running and not run the risk of putting your fingers on some point that has a lethal voltage onto it? The answer is probably no.

Obviously safety was not of much concern to the designers and builders of what are now vintage radios. Manu-

facturers would not get away with this careless attitude today.

With this in mind, it was decided that the subject of safety in vintage radio restoration should be revisited. Some vintage radio buffs like to build replica sets and safety should be one of the prime considerations in the mechanical construction of these sets too.

The older the set that is being restored, the more likely it is to have exposed mains and high tension leads and terminals. Some European sets are very bad in this respect, with exposed mains and HT terminals in very easy to touch locations. Take a careful look at the set that is about to be restored and see where the danger points are. Where will your hands go when you are moving the set around? Will your hands touch any of these danger points? It is very easy when concentrating on the job in hand to forget the danger points.

Minimising the danger

How do you minimise the danger? You could get someone else who is more experienced than you to restore the set! However, most restorers like to do the lot; to be able to proudly say "I did it all myself".

Having observed where the danger points are, it may be possible to put a cardboard or plastic sheet cover over them, or even to physically shift the danger point to a spot where it can not easily be touched. Where I haven't been able to do any of the preceding things, I have put glue over the exposed terminal. This may not be the most foolproof method of approaching safety but with several layers of glue, your chances of escaping an electric shock or electrocution are much better if you touch something you



A typical core balance detector. These devices are cheap life insurance at \$20-30 so there is no excuse for not having one.

shouldn't in a moment of carelessness.

Power transformer

In many early mains-operated sets, there is the very real possibility that the power transformer insulation may not be as good as it had been in years gone by. It is possible that the mains winding or the wires to the transformer are defective and so a short or partial short to the frame of the transformer and hence the chassis may occur. And a live chassis is a very dangerous item indeed.

An easy test here is to use the various ohms ranges on a multimeter to test for shorts or leakage between the transformer's mains winding and the frame or chassis. Any indication other than a momentary kick on the meter is to be treated as a possible dangerous circumstance.

If the set has been stored in a damp environment it would be worthwhile putting the set chassis or the transformer alone into the oven in the kitchen. Heat the set for several hours at about 60°C to dry the transformer out and hopefully get rid of the leakage. If leakage is still evident, things are not looking good and a test with a high voltage insulation tester such as John Hill has described or as appeared in SILICON CHIP (May 1996) would be desirable.

Note that an ohmmeter will only detect shorts and leakages that are not voltage dependent. An insulation tester, on the other hand, checks the transformer under stresses similar to when it is operating.

Before applying any power to the set, it is important to check the insulation of all the various wires to ensure that no short circuits exist. That's because insulation can deteriorate over the years – some types more than others. Any insulated wire that has badly deteriorated insulation must be replaced or the wire sleeved with insulation tubing. The mains cord must be replaced without further thought if it has cracked insulation.

Up until the time that valve sets were being replaced by transistor sets, most sets used twin-core power lead. Ideally, the twin-core lead should be replaced by three-core lead, particularly where the chassis or other metal can be touched when the set is back in its cabinet (I am only referring to mains-operated sets here).

For the sake of authenticity if the set had a fabric covered mains lead it would be nice to replace it with one that looks the same. Burton Cables do produce an unfilled brown fabric 3-core mains cable that looks much the same as the cable being replaced.

The 3-pin power plug should also be inspected. The Bakelite on old power plugs may be chipped and a strand of wire could extend beyond the side of the plug – and this could be the Active mains wire! Yes, it is nice to keep the set looking as authentic as possible but safety must be considered and it may mean you have to fit a modern plastic plug. So be it – at least you will be around to enjoy seeing and hearing your set.

Core balance detectors

These devices go under a variety of trade names and a typical one is shown in the accompanying photograph. What they basically do is detect when there is more current passing through the Active 240V lead than is returning via the Neutral lead. How can this be? If there is leakage or a short from the Active lead to Earth, some of the current will return via the Earth lead – or you, with possible deadly results, if there is no Earth lead.

When the current on the Neutral lead is 30 milliamps (30mA) less than through the Active lead, a sensing circuit detects this and trips a small circuit breaker to remove the power.

Fig.1 shows a simple diagram of the sensing circuit of a core balance detector. The Active and Neutral leads go through the centre of a toroid ring core. These act as 1-turn primaries of a transformer, while a third winding consists of many turns of wire to act as a step-up transformer.

Because the currents through the two single-turn primaries flow in opposite directions and are normally equal, the two magnetic fields cancel each other out and no voltage is developed in the third winding. However, when there is leakage and not as much current flows through the neutral lead, the magnetic fields are not cancelled and so a voltage is developed in the third winding. This is detected in the device which trips the circuit breaker and removes the 240V AC from the lead.

The response time for core balance detectors is very fast and your chance of being electrocuted is low, should

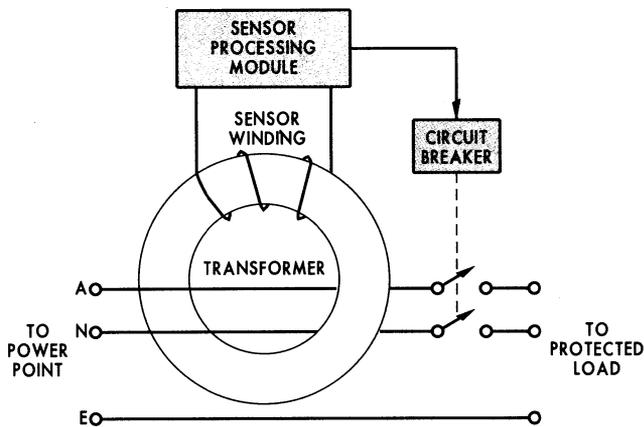


Fig. 1: the basic sensing circuit of a core balance detector.

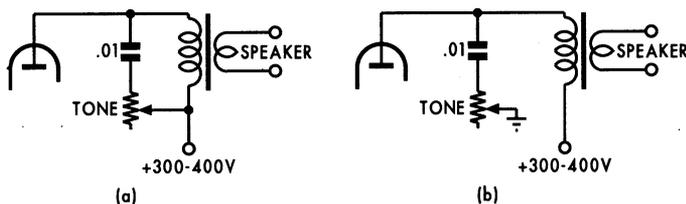


Fig. 2: the tone control circuit shown at (a) can be made safer by wiring it as shown at (b). The capacitor voltage rating may need to be increased though.

possibly saved.

One statement that is often made is to work with one hand and have the other in your pocket. It's often not very practical but the thought is there to minimise your contact with lethal voltages. I often go part way there by clipping a short lead (with small alligator clips) between the set chassis and the negative lead of the multimeter. The positive lead is the only one then that is being used, so one hand in the pocket is possible.

When changing components in a set, always turn the set off at the mains socket and remove the mains plug. You should also short the HT line to the chassis using an insulated lead in case any charge is left in the electrolytics.

It is advisable to show someone else in the home where the main power switch is so that it can be switched off should something untoward happen. And it isn't a bad idea to have a rubber mat on the floor where you stand to work on your radios, as this will minimise the chance of electric shock.

AC/DC sets

There are some other rather frightening sets that you may come across from time to time. They are the rare AC/DC sets and the even rarer pure DC sets designed for 240 volts DC. Some of these sets even have one side of the mains lead (Active or Neutral) connected to the chassis. WOW!

With care, these sets can be quite safely serviced once you make sure that the NEUTRAL lead is attached to the chassis, not the Active. It is easy enough to change the wiring of the plug over so the chassis is connected to the Neutral, which is also at the same potential as earth. **However, this does not mean that all power points are wired correctly, so never assume that the chassis will be neutral when plugged into just any power point.** These sets are usually quite well insulated so that you cannot touch the chassis when it is in the case.

Even into the 1950s, a number of portable AC/DC sets were made like this. They had a 2-pin non-polarised socket that could be put onto the set plug either way so that a "cold" chassis could be obtained. Also when you opened up the set case, the power socket was automatically disconnected. The ones that I mostly serviced in those days were Astors and

there be a problem in the set with mains leakage to chassis. These devices are cheap life insurance at \$20-30 so there is no excuse for not having one. They also have four power outlets with an overload trip as well. I've mounted mine on the back wall of the workbench and plug any devices that I am working on into it.

Under some circumstances they will trip when no fault exists, mostly at switch on or switch off of the device being run on the detector. This possibly occurs because the interwinding to frame capacity of the power transformer is being charged or discharged, causing a momentary unequal current to flow through the sensing core.

As wonderful as these core balance detectors are, they will not protect you against the effect of voltages after the power transformer. These are every bit as dangerous as the mains, so be vigilant.

It is particularly important to be extremely cautious when endeavouring to restore a set that has been "butchered" by someone in its past. You may have picked the set up because it couldn't be made to work or worse

was even known to be dangerous!

Some time ago, I had the task of restoring a commercially-made late 1920s TRF set. It had been considerably "got at" and required a complete redesign to make the set a goer. In the process, I nearly fell for one of the traps mentioned earlier in this article and could have been electrocuted.

Now we all tend to believe that the shafts of volume and tone controls are earthed to the chassis, even when the moving arm is physically attached to the control shaft as did occur with some early controls. In this set, they weren't earthed, having barely visible fibre washers insulating them from the chassis. One was about 50 volts plus above the chassis, while the other was at a whopping 400 volts!

I broke out into a cold sweat when I realised how close I'd come to departing this world. Fig. 2(a) shows the circuit that the tone control was wired into, while Fig. 2(b) shows how it could have been wired and made quite safe. The capacitor voltage rating may have needed to be increased to cope with the DC plus the audio voltages across it. This is a small price to pay for a life

Healings. Ideally, if you want to service any of these AC/DC sets, you should use a 240VAC isolation transformer.

Straight 240 volt DC sets are a real problem to service as there are probably no locations where 240 volts DC is even available now. Sets like this should be just set aside to admire, unless you care to make a 240 volt DC power supply capable of supplying up to 300mA.

My advice is to leave AC/DC and pure DC sets strictly alone, unless you know exactly what you are doing. (Editorial note: we think that they're death traps).

Summary

(1). Before applying power to any receiver, check that the transformer insulation is in good condition, visually and by instruments.

(2). Check other wiring to make sure no shorts exist in the wiring.

(3). If the power cord is old and the insulation is at all suspect, replace it. The same goes for the plug if it is old and unsafe.

(4). If the set is an AC/DC type, make sure that the Neutral is connected to the chassis or the negative bus. Also, do not take it for granted that the power point is wired correctly. The use of an isolation transformer is strongly recommended.

(5). Use a core balance detector (CBD) on the mains.

With all the above completed, remove the rectifier valve and try the set on power. Check for voltage on the chassis that should not be there, then connect an earth wire to it without touching it yourself. If there are no sparks and the core balance detector does not throw itself out, the chassis will be safe to touch.

Run the set for some time like this while you are there to make sure nothing untoward happens to the transformer. Don't leave the set during this time – it wouldn't be much fun to come back a few hours later only to find that the set had started a fire.

Finally, check and re-check everything at all times to prevent being electrocuted. And never rely on units like a CBD, even though you may have one in use – to do so is to become lazy and complacent.

In conclusion, think safety (yours in particular) and you will be restoring sets for many years to come. **SC**