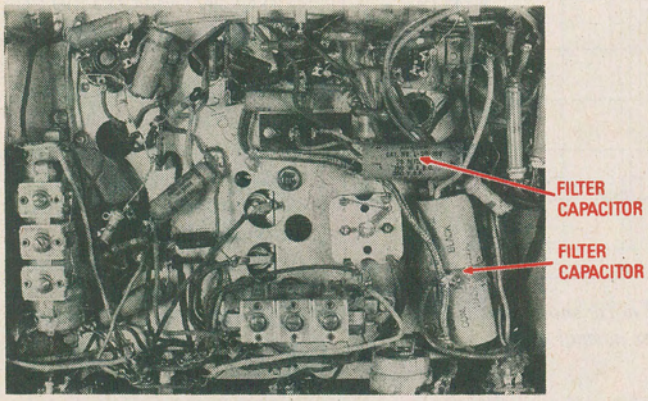
ANTIQUE RADIO

By Marc Ellis

Safety For Restorers: Part 2

Last month, I began to discuss some safety issues for antique-radio restorers. The topic was suggested by a letter received from reader D.K. Owens (Circleville, OH) and discussed in the March, 1991 issue. Mr. Owens was particularly concerned about the dangers lying in wait for newcomers to the hobby. And since I strongly agree with this concern, I've been directing my remarks to the inexperienced restorer.

In last month's column, I discussed the all-important subject of cautions to be observed around household AC power line-particularly when repairing or using AC-DC radios. This month, I'd like to talk about how to work safely around your radio's direct-current supply voltages. Then we'll finish up with some safety pointers concerning outside antennas.



The wiring of tube radios includes many high-voltage points. Filter capacitors (arrows) should be discharged before working on a set that has been recently powered.

DANGER—HIGH VOLTAGE!

Unless you specialize in crystal sets or early transistor radios, your restoration work is going to place you in close proximity to dangerously high voltages—voltages that could be life-threatening. Those voltages, required for operation of the vacuum-tube circuitry, are obtained from the AC-line wall socket—either directly or through a step-up transformer that may multiply the line voltage several fold. The AC voltage is then rectified (transformed to direct current), filtered, and distributed to various points in the receiver.

You're already familiar with the cautions to be observed in the presence of the AC line. Your radio's DC-supply voltages need to be treated with equal respect. The magnitude of these voltages ranges from about 150 for a transformerless (AC-DC) radio to about 350 for a large transformer-powered table-model or console.

And by the way, in a set where 350 volts of direct current is present, the power transformer usually delivers upwards of *800 volts* of AC to the rectifier circuit. Most people don't have to be told to be careful around such a voltage source!

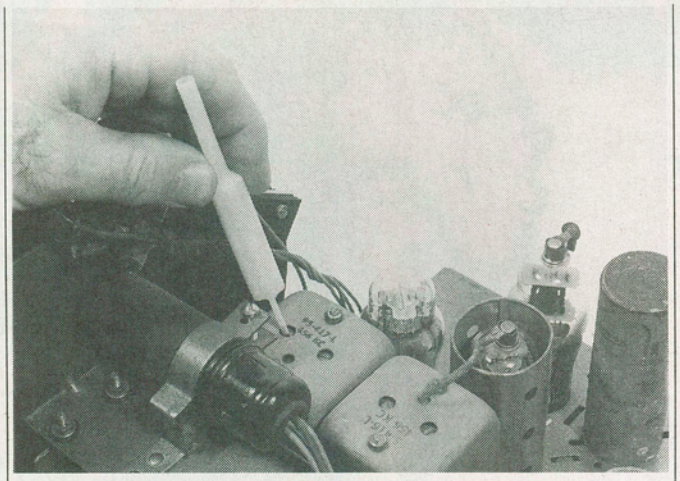
And, because they have a feeling for the large amounts of current available at a wall socket (15 amperes or more), most people don't need to be convinced that the 117-volt AC line must be treated with respect. But they may not have as much respect for the DC operating voltages within a radio once they know that those voltages are available only at currents measured in *thousandths* of amperes.

Although this is not a medical treatise, and I'm certainly not an expert on the medical effects of electric shock, I can assure you of this: Even the lowest DC voltages used by AC-DC radios and battery sets are considered quite dangerous. Depending on the resistance that your body offers to the passage of electric current (which varies with the amount of moisture on your skin, whether current is passing through an open cut, etc.) and the path the shock takes through your body, it's possible for even a 150-volt (or smaller) shock to interfere with the action of your heart and cause death.

Admittedly, most people weather small shocks with no permanent effects, but would you want to risk being the exception? Receiving an electric shock is a very unpleasant experience at best. And the unexpectedness of it could startle you into causing a secondary accident as you jerk your hand away. For instance, you might come in contact with an even higher voltage, subjecting yourself to a stronger shock; you might pull the radio off the bench so that it drops to the floor; or—if holding a test probe—you might overload and destroy a piece of test equipment by touching the probe to the wrong circuit point.

AVOIDING HIGH-VOLTAGE SHOCKS

When we discussed avoiding AC line voltage shocks last month, one of the key points to understand was that the power company grounds one side of the line. Thus, if your feet happen to be grounded (as when standing on a damp basement floor in damp shoes) and you



IF transformer tuning screws (here being adjusted, as is proper, with non-conductive tool) may shock a beginner who touches them with a metal screwdriver.

touch a wire connected to the *ungrounded* side of the line ... ZAP! ... a rather hefty shock passes through your entire body. So the idea is to avoid electrical contact with the ground when working on live equipment.

Protecting yourself from your set's high-voltage DC supply is an analogous situation. Just as with the AC line, one side of the DC supply (called the B−) is grounded. In this case, though, ground means the metal chassis of the radio rather than the earth. The idea is to keep yourself from contacting the chassis and one of the high-voltage (or B+) distribution points at the same time. Otherwise, it's ZAP time again!

But you also have to be careful to avoid contact with earth ground. In the case of AC-DC sets, as you already know, earth ground and chassis ground can be one and the same. Even with non-AC-DC sets, earth ground can be connected to chassis ground through a leaky capacitor or (as is very common) through the ground lead of a piece of test-equipment whose chassis is connected to earth ground via a 3-prong plug.

The fear of becoming accidentally grounded is quite ingrained in the electronics experimenters who cut their teeth during the vacuum-tube era. Being one of them, for example, I find the idea of using a wrist grounding strap (worn to drain off static charges while working with sensitive integrated circuits) quite appalling—even though semiconductor equipment operates at very low voltages.

Because it is required in virtually every vacuum-tube circuit, high-voltage DC may appear anywhere above or below the chassis of the receiver you are working on. The high voltage may appear even in places where it wouldn't normally be expected. For example, as Mr. Owens pointed out in his letter, on the adjustment screws of early IF transformers.

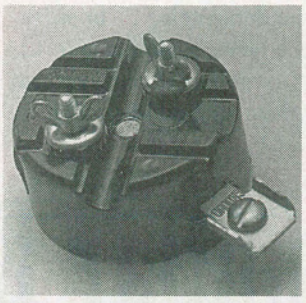
Defective components or improper modification by inexperienced "repairmen" could cause high voltage to appear in even more unlikely places. So unless you have positive information to the contrary, every metal part or connection should be treated as if it were live.

Through last month's discussion, you already know how to avoid being grounded through your shop floor. As an additional precaution against high-voltage DC shocks, some writers suggest keeping one hand in your pocket at all times while working on a live chassis. If you only have one hand involved, it's a lot harder to contact a ground point and a high-voltage point at the same time. And even if you did, the shock would be a lot less severe when passing through one hand only than if it flowed across your body through both hands.

Others (and I am one of them) feel that working with one hand is too clumsy and would be quite likely to cause other kinds of problems. I need both hands to stay out of trouble, and in well over 40 years of working with tube gear, I can't remember receiving even a single shock. For this, I credit my attitude—which is one of great respect for the working voltages associated with vacuum-tube circuits.

Another precaution that you definitely *should* take is to make sure that your tools have insulated handles. Of course, doing any kind of work on a live chassis is not recommended. However, if you must use a screwdriver, pliers, or other tool, make sure there is no exposed metal on or near the handle.

As a final caution, keep in mind that your chassis may not be free of high voltage even after you cut the power. The set's filter capacitors can store an electrical charge for quite a long time—enough of a charge to give you a nasty jolt hours after the radio is shut off.



Static discharge unit as sold by Radio Shack. The wing nuts are antenna connections; the screw on tab is for ground.

You would be well advised to short the leads of all filter capacitors to ground if you must do serious work on a set just after shutting it off. You'll hear a loud "snap" as the capacitors discharge, and you may see a spark as well. There are usually at least two filter capacitors, sometimes separate, sometimes combined in one can. Of course, you must be sure that the tool or clip lead you use for this purpose has an insulated handle.

ANTENNA SAFETY

Most serious collector/restorers eventually put up an outside antenna, and no introductory discussion of electrical safety would be complete without mentioning antenna hazards. There are two major ones: power lines and lightning. Avoiding them requires only simple, common-sense tactics. Ignoring them invites serious property damage, and very easily could cost you your life.

Most residential power distribution is handled via overhead lines operating at several thousand volts. Such lines are a major hazard to antenna installations. Never install an antenna so that it passes over one—not even the lower-voltage power line from the pole to your house. Don't even install the antenna in close proximity to a power line.

If the antenna wire should accidentally fall across a high-voltage line while you are putting it up, you'd probably be electrocuted instantly. Those lines have little or no insulation and, of course, antenna wire is a very good conductor of electricity. Even if you were able

to install an antenna wire near a power line without incident, the wire could easily later break in a storm, falling across the line and conducting lethal voltage into your home through the lead-in connection.

If your antenna uses one or more metal masts, be sure to ground them (use one of the systems designed for TV-antenna masts). Then a lightning strike will be more apt to travel through your mast and grounding system on its way to the earth than through your antenna, lead-in wire, house, equipment, and you!

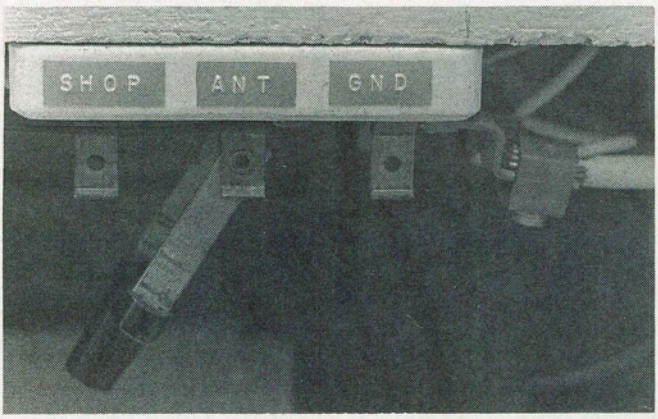
During electrical storms, buildups of static electricity in the atmosphere are more common than actual lightning strikes. The static charge can accumulate on an antenna until enough builds up to arc to ground, either through a receiver connected to the antenna (with destructive effects) or perhaps through an unlucky individual who happens to be handling the lead-in wire.

There are two simple ways to avoid that problem, and I'd suggest using both. (1) Use a static-discharge device, such as those sold for use with TV twinlead (attach your lead-in to one of the two antenna terminals and ignore the other one). When connected to a good ground, this device will continuously leak static charges to earth—therefore preventing dangerous buildup of static electricity. (2) Use a heavy-duty knife switch to transfer your lead-in wire to a good ground system whenever you are not using the antenna.

Just one final point. Everyone in your family should know that it can be extremely dangerous to try to rescue a victim of electric shock. If you touch the victim while he or she is still in contact with a live wire, you'll become a victim yourself.

It would be a wise move to set up your workbench with a master power switch and make sure everyone understands that it should be shut off before attempting a rescue. Also explain the possibility, remote that it might be, of contact with a power line via your antenna lead-in. Stress that rescue from such a situation should be attempted only by professionals.

That's all for this month. We want to be sure to see you all again next time, so please remember to work safely, and send your comments or questions to me at *Antique Radio*, **Popular Electronics**, 500-B Bi-County Blvd., Farmingdale, NY 11735. ■



The antenna lead-in at my house is grounded, when not in use, through a heavy-duty knife switch. Note the large ground conductor at right.