

## Equipment Restoration

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### Plug-In Forms; Doctoring a 1R5; Replacing Resistor Line Cords

At the last AWA Conference, Marc Ellis' seminar on restoration generated so many questions that it could have lasted for hours. Marc plans a repeat this year. He and I have discussed the need for a place where readers can get answers to restoration questions quickly. Over the years I have responded to mailed-in questions from readers and have used some of the material in this column.

We are going to try a Q&A section in this column. You can direct questions to my e-mail address above or by regular mail (with a SASE). We will respond as fast as we can so you won't have to wait for the next issue of The OTB to get an answer. Questions of general interest will appear in this column. If the response justifies it, we will consider establishing a separate Q&A column in The OTB.

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Jim Fred, 5355 South 275 West, Cutler, IN 46920 wrote concerning the suggestion from Alton DuBois (Queensbury, NY) on making your own plug-in coil forms (see Feb, 2001 OTB, p. 47). If you don't feel like using your time that way, Jim makes coil forms for sale. He uses the lowest loss XXP phenolic material with heavy nickel-plated brass pins. Jim offers forms for the Pilot Super Wasp and the National SW-3, as well as generic 4, 5 and 6 pin forms. He sent me a sample of the SW-3 form. It is a work of art that has to be seen to be appreciated. Contact Jim if you need special or standard coil forms.

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Speaking of Alton, he sends a word of caution the item we ran last issue about adapting a 1R5 to replace a 1L6 (May, 2001 OTB, p. 65). The original article suggests using a pair of diagonal cutters for removing pin 5 of the 1R5. Alton says this is a sure way to crack the tube. He uses a cutoff wheel in a Dremel tool with a piece of tin under the pin to protect the glass. Your Editor uses a jeweller's saw with an 8-0 blade.

Jim Fred (see above) also sent me an adapter which he supplied to a parts vendor several years back. It adapts a Loctal 1LA6 to the 7-pin 1L6 socket. I haven't tested it yet, but it is as beautiful as his coil forms and seems like it would add very little capacitance.

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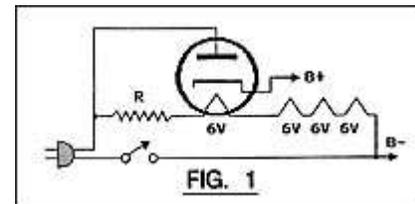
There has been a lot of interest finding a replacement for the resistor line cords used in early AC/DC sets. NOS cords can be found, but all the ones I have seen are hard, brittle and unsafe. Let's look at the requirements for a resistor cord. A survey of Rider's shows 4 typical tube lineups listed in order of worst case to best.

TUBES	VOLTS	LINE CORD	WATTS	SET
1-6V + 1-12V	19	330 ohms	30	Kadette Jr.
4-6V	25	310	28	Kadette Universal
4-6V + 1-12V	38	270	24	Several
4-6V + 2-25V	69	160	14	Many

Line cord resistances are those given by Rider, and the wattage dissipated in the cord is calculated from the filament current of 300 mA. On a 120V line, the cord and filament string consume a total of 36W.

The simplest fix is to replace the line cord with a power resistor, R, inside the cabinet as in Fig. 1. Bill Mitch, N9JTR (Hebron, IN) uses Dale resistors. These resistors are enclosed in metal cases designed to be bolted to the chassis, which acts as a heat sink (remember the old "Candohms"?). A 50W Dale is no larger than a 20W vitreous resistor.

The problem is heat. The Kadettes are not designed to have another 28-30W of heat inside the cabinet. The Kadette was the first set to use plastic cases. That's where their value is, so we can't do anything to endanger the case.

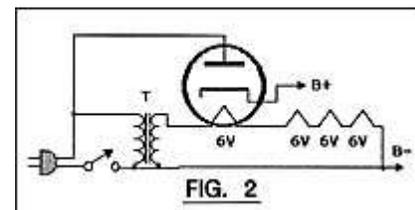


It might be acceptable to put the resistor inside the cabinet in the best case. It could probably handle another 14W if you don't run the radio continuously. The Philco Model 54 does use resistors inside the cabinet, but it is designed with excellent ventilation.

Another fix (for the first and second cases in the table) is to use a small transformer, T, as in Fig. 2. Units rated for 24V/450 mA available from Radio Shack. Plug-in wall transformers rated at 19 or 24V are available from Hosfelt ( 800-524-6464

begin\_of\_the\_skype\_highlighting 800-524-6464 FREE end\_of\_the\_skype\_highlighting ). The first can usually be mounted inside the cabinet. The wall units can be used with 3 wires running to the radio, and no chassis modifications are required.

The third method for reducing the line voltage, suggested by Richard Hurlbut (Toronto, ONT) and Walter Curry (La Mesa, CA), is to use a diode, D, as in Fig. 3. A lot of misinformation has been printed about this method. Many people think that, since the output of the diode is half of a sine wave, the voltage will be half of 120V or 60V. If you



believe this, you'd better have a lot of spare tubes on hand. As Walter points out, the heating value of the diode output is 0.707 times the input. For a 120V line, the output is 85V, not 60V. Don't try to measure the voltage with anything other than a true AC voltmeter. You won't get meaningful readings with a VOM, a VTVM or a DVM. Just take our word for it or do the analysis yourself.

Even with a diode, a series resistor, R, will be needed to drop the 85V down to the filament requirements, but the resistor wattage is reduced considerably. In the Kadette Jr. (first case) where the filament string requires 19V, we need a 220 ohm resistor to drop the 66V difference. The dissipation is 20W - still too much for this little set. The Kadette Universal (second case) would require a 200 ohm resistor dissipating 18W - also too much.

Radios of the third case would need a 150 ohm series resistor dissipating 14W. This is better than a resistor alone dissipating 24W, but borderline depending on the cabinet design and ventilation. Fourth case sets require a 50 ohm resistor dissipating about 5W--a big improvement over 14W with a resistor alone. You should have realized, by now, that using a diode eliminates 10W of heat.

If you use a diode, Walter notes that the negative end of the diode should face the filaments. It may be necessary to place a small (0.005 uF) capacitor across the diode to eliminate hum or buzz, if present.

The method shown in Fig. 4 takes advantage of the fact that a capacitor behaves like a resistor when passing AC and can be used to reduce the line voltage. This is not a new idea, but thanks to John Uscinowski (Greenwich, NY) and Bill Mitch for reminding us. John sent a reprint from a British journal, *Radio Bygones*, No. 33, Mar 1995, describing how to use a capacitor to drop the 240V British mains to 120V to operate an American AC/DC set.

The calculation may seem strange because the results don't add up. They are vector quantities. Think of a right triangle. The line voltage (VL) is the hypotenuse and the filament voltage (VF) and voltage drop across the capacitor (VC) are the other 2 sides. Pythagoras says that  $VL^2 = VF^2 + VC^2$ .

For the worst case of 19V for the filaments and a 120V line,  $VC = \sqrt{120^2 - 19^2} = 118V$ . The filament string draws 0.3A, so by Ohm's Law, the reactance, XC, of the capacitor must be  $118/0.3 = 395$  ohms. The reactance (AC resistance at a given frequency) is  $XC = 1/(2\pi fC)$  or  $C = 1/(2\pi f \times XC)$  where f is the frequency (60Hz).

$C = 1/(6.28 \times 60 \times 395) = 0.0000067$ . The result is Farads so multiply by a million to get 6.7 uF. Yes, a 6.7 uF capacitor can replace a 30W resistor. The only energy consumed by the capacitor goes into dielectric heating-- negligible in modern capacitors rated for AC service. Thus a voltage-dropping capacitor generates no heat.

Finding a capacitor of the proper value may be difficult. Don't use electrolytics, even back-to-back. They get hot when carrying AC current. Use Mylar or polypropylene units. As a rule of thumb, the AC rating of a film capacitor is 40% of its DC voltage rating. A 400V DC capacitor can easily withstand 160V AC. If you can't find a combination of capacitors to give the required value, you can put a resistor in series with a larger value.

