Salvaging An Autotransformer

BY JULIAN SIENKIEWICZ

On the project bench or under your Christmas tree, this troubleshooting device from the vacuum-tube era is just as important today.

An adventure inside a flea market in the next state uncovered an item that will be very useful at home this Christmas. I was on the trail for a few table-top antique radios, *circa* 1940's, when I came upon an old autotransformer—commonly called a *Variac*, which is a trade name. An autotransformer can take line voltage and vary it at its output from zero to 140-volts AC. The unit I found was an import that was sold by Radio Shack in the late 1950's; it had been dropped and slightly damaged. The deep dust and dirt covering parts of it did not bother me—that's the easiest thing to take care of. I bought the gadget for three dollars (the seller drove a hard bargain), and I took my prize home.

The Story Deepens. The following weekend I had a chance to scrutinize the autotransformer. I removed the large control knob from the top, and a few screws, and then gently slid the metal protective shell off. After cleaning the case I found repainting was not necessary.

Inspection revealed that some plastic parts were broken, and some of the Bakelite pieces were still inside the unit. One of the leads to the transformer coil was yanked a bit, and the copper wire that was wound on the toroidal core was stretched. That caused the wiper contact at the top of the unit (where the selected AC voltage is tapped) to ride roughly over the top of the coil. Also the power cord had been cut off near its entry point to the unit.

Everything else looked very good. Even the 5-ampere fuse was in good shape. There appeared to be no short cuts in the manufacturer's construction techniques. The unit was rigidly built with solid Bakelite parts.

I hooked up a power cord and gave the autotransformer the acid test—AC power. Without a load connected, the autotransformer took the voltage without any smoke. In fact, almost no heat was detected; so far, so good. A voltmeter connected to the autotransformer's output jack showed that the output could be varied from 0- to 140.4-volts when the input was rated at 115.1 volts AC (the AC power line was low that day). Next, I added a two-photoflood bank of lights and the autotransformer worked well with a 300-watt load. The variable-voltage tap worked well throughout most of the

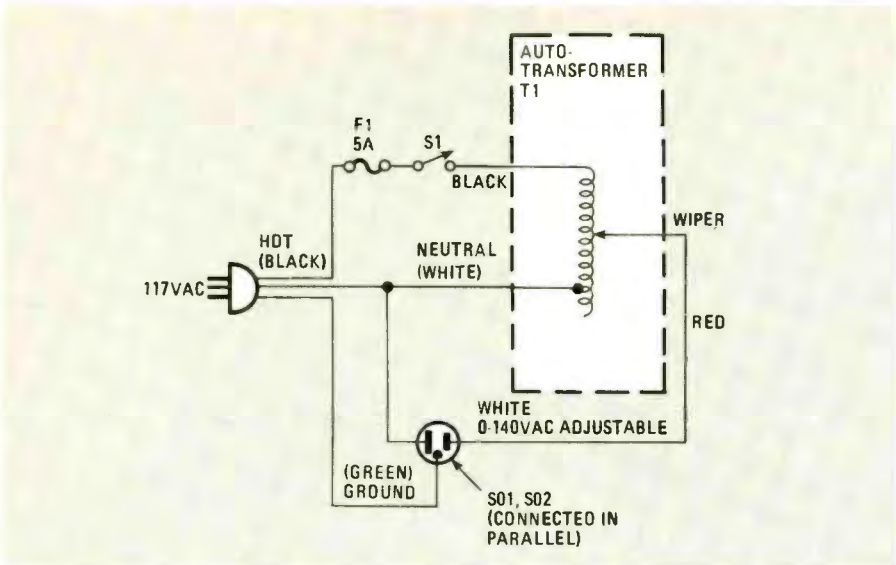


Fig. 1. Here is the wiring diagram for the modified autotransformer. The original fuse holder was reused. The power switch and two-terminal outlet were discarded. Colored insulated wires (black-hot, red-variable AC, and white-neutral) were attached to the short leads on the stripped autotransformer to assist in goof-proofing the final wiring.

range. I was too chicken to take the flood lamps above 130 volts. The results of the tests convinced me that the autotransformer was worth sprucing up and using.

Fixing Up. I began by fixing a *bump* on the tapped coil where the 117-volt AC power line is connected. That was easy to do. Every time I tried to push it down and glue it in place, the turns popped back up again. That technique was not working so I tied a thin leather shoelace to the tap point, and added some weights until the weight was heavy enough to hold the bump down. I applied some epoxy to the sides of the turns so that when the weight was removed, the turns remained in place. Do not ever put glue or cement on the contact surface; the wiper will fail to make electrical contact, and the unit will not work properly. The epoxy set in 24 hours, and the bump was gone.

The next consideration was the broken Bakelite parts. One mounting leg of the autotransformer was gone; broken off and lost forever. However, the rest of the base was good, so I decided that the remaining two legs were sufficient to hold the autotransformer to a breadboard. If necessary, I could have used epoxy to cement the entire base to the board. A plastic tab that was used to secure the cover to the base was floating around inside the case, so I affixed it with some epoxy.

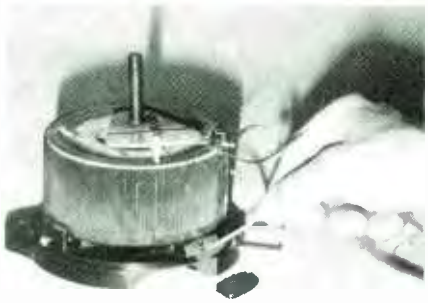
The plastic piece that housed the fuse holder and AC outlet, and passed the line cord to the outside, was broken beyond repair. That was not a total loss, because I was not satisfied with the two-terminal AC outlet used in the original unit. I wanted a three-terminal outlet, and a strong contact surface in the outlet to grab the prongs of the AC plug. So I discarded the plastic piece and covered the opening in the cylindrical housing with a piece of sheet metal cut from a 2-pound coffee can. The price of the can was certainly right. The section I had cut from it had almost the same radius as the metal shield, and its indented ribs (common to coffee cans) made it very rigid. I drilled a hole through it and inserted a grommet in it to protect the insulation of the wires to be passed through it. The metal was painted black before installation, and, when finished, the fabricated cover looked as if it was installed by the manufacturer.

The interconnecting leads from the autotransformer were too short to reach an external electrical box, so they were extended using color-coded stranded wire. The splices were soldered and electrically insulated with black plastic tape.

The rest was easy to do. A 6 × 12- × ½-in. hardboard (veneered on both surfaces) was cut and the edges sanded smooth. Any ½- to 1-in. board cut to a convenient size will do. One idea is to purchase a cutting board in a housewares store should you dislike woodworking.

Here's the autotransformer ripe for repair. With a little effort, it turned out to be a worthwhile test-bench tool.

The autotransformer is a one-coil device wound on a cylindrical iron form with the AC line connected across the bottom of the coil and to a tap on a copper turn about 85% of the distance from the first tap. A sliding contact selects one of the coils to pick off an AC voltage. The plastic piece hanging from the leads of the winding was discarded because it was damaged and the single outlet was neither polarized nor of the three-terminal type.



A broken-off part was joined to the base with epoxy. The piece, which was found inside the unit, contains an embedded nut used to secure the unit's shield.

A piece of a two-pound coffee can was used to close up the hole left in the autotransformer's safety shield. The can had an almost perfect curve and indented ribs for reinforcement. A hole was drilled through it. Once the shield was complete, it was sprayed with a flat black paint. After drying, a grommet was installed.

The leads of the cylindrical winding were too short. Colored leads (a red, a black, and a white) were added to make wiring easy and goof-proof. The splices were soldered, and black plastic tape was used to insulate the splices.

Electrical Work. The autotransformer was secured to the board with wood screws. A 4-in. square electrical box and a face plate for one duplex outlet with toggle switch, was installed on the

I installed a new three-wire power

Here's the autotransformer mounted on the board with the electrical box mounted and wired. Note that the fuse holder is easy to reach for fuse replacement.

board about one inch away. Two of the box's circular knockouts were removed and cable clamps were installed. A third knockout was removed and the original fuse holder was installed. The knockout hole was too large for the fuse holder, so an oversized washer was placed on each side of the hole and the fuse holder was installed through them. Should you wish to do that, do not over-tighten the nut because the plastic fuse holder breaks easily. If you can't find washers of the right size, cut out two squares of aluminum and drill a hole in the center of each. One of them should be sized to fit neatly on the inside and one on the outside of the electrical box.
cord and clamped it to the electrical box. The wires from the autotransformer were passed into the box to begin the wiring of the box. In Fig. 1, as in all electrical circuits, the white wires are ground and connect to the silvered screw terminals on the AC outlet. The black wire (it's electrically hot) from the autotransformer goes to the fuse. The red wire from the wiper terminal is also hot and connects to the brass-screw terminal on the outlet.

The Juice is On. I powered up the autotransformer assembly after the fuse was installed. The original unit called for a 5-ampere fuse, so I used a fuse rated at 5 amperes, however, a fuse that has a lower current rating can be used. A voltage check at the AC outlet indicated an output 0 to 140 volts AC as the control knob was moved through its range.

More than just a Christmas-tree bulb saver, the autotransformer is used here to uncover a failing part in an old relic—a Hallicrafters SX-38B shortwave receiver.

The first task I designated to the autotransformer was to discover a fault in an antique tube-design *Hallicrafters SX-38-B* shortwave receiver. The receiver operation was intermittent, but the trouble never lasted long enough to locate the fault. Voltage was applied and I cranked the autotransformer up to 127-volts AC, when the fault occurred and held. The problem was then traced to a defective wax-paper capacitor.

A used autotransformer may be hard to find when you are looking for one. Mouser Electronics sells them in different sizes and configurations. One unit listed in their catalog is a Staco Variable Transformer, catalog No. 563-3PN501 which sells for $125.98; it is comparable to the unit I found.

In a few weeks Christmas will be here and the autotransformer will be put to work on the Christmas tree's lights. Those miniature-bulb sets last much longer when the voltage is down to about 105-volts. ■