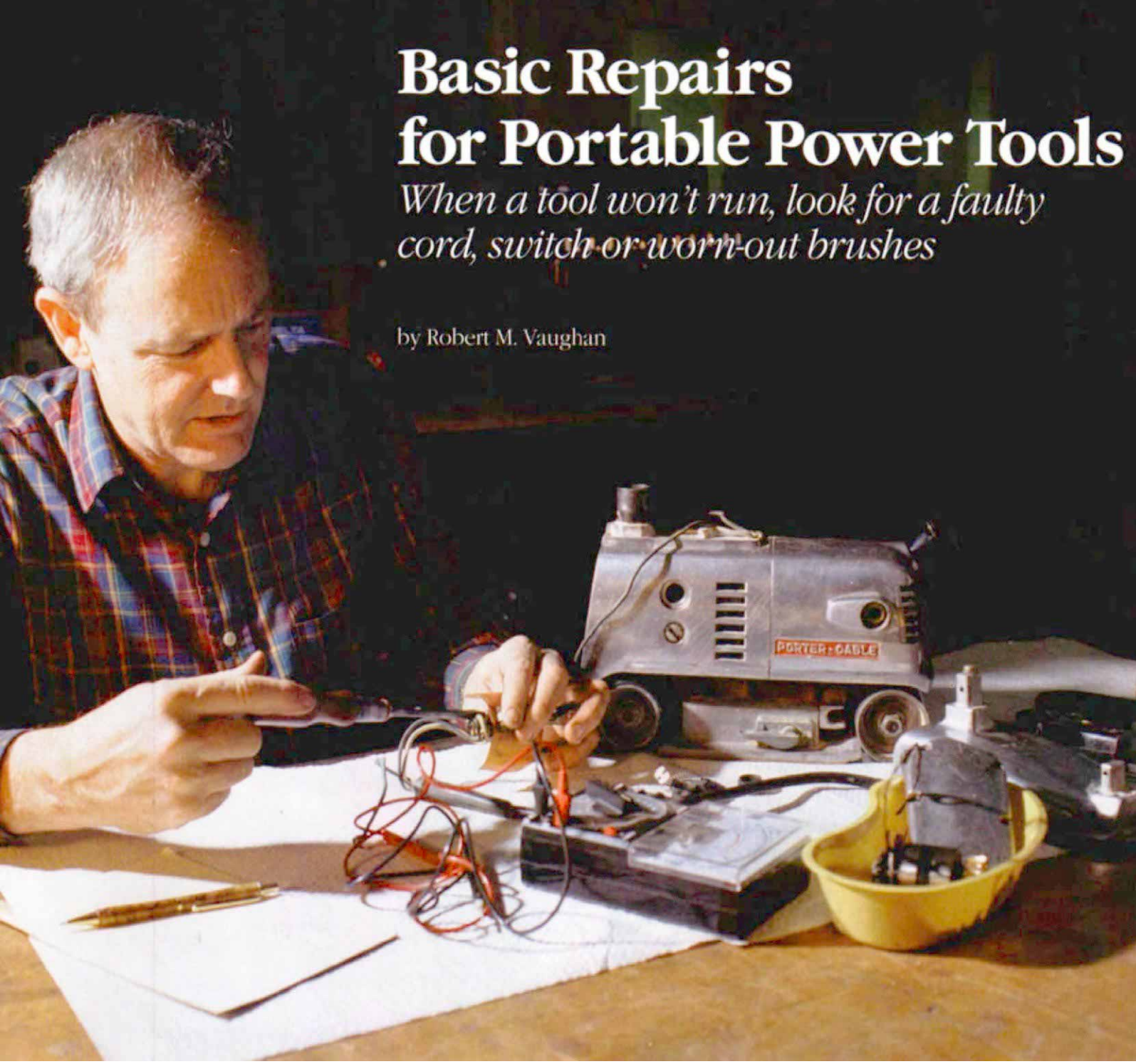
# Basic Repairs for Portable Power Tools

## *When a tool won't run, look for a faulty cord, switch or worn-out brushes*

by Robert M. Vaughan




***Rejuvenating old power tools**—Electrical problems often can be traced to the cord, switch or brushes. When making repairs, be sure to keep your tool unplugged, and make a diagram to aid in reassembly.*

A portable power tool is a small universal motor with a wood-shaping instrument on one end and a woodworker on the other. Mechanical details among drills, routers or belt sanders may vary. But the basic electrical components, such as cords, switches and brushes, are similar, no matter what the machine.

When a power tool won't start, it's a good bet that an electrical part is broken. My procedure for tracing problems begins with testing and examining wires, then switches and finally brushes. The only special tool you will need is a multi-tester, available from an electronics shop for about $25. With it, a host of problems can be traced right to the source.

Many electrical components on power tools can be replaced for $20 or less if you do the repair work yourself. Rechargeable power tools are another matter and won't be addressed here. Before tackling disassembly, be sure to unplug your tool. Find a spot in your shop that is clean, neat and well lighted. Take an organized approach to the job, and draw diagrams of wires and other disassembled components (see the photo above).

### Start by checking the cord for breaks

If you have a tool that won't start, examine the power cord first. Serious kinks, abra-



Photos: Anatole Burkin

sions or cuts sometimes point to a broken copper wire. To check the cord, you have to get inside the tool and find where the cord meets the switch. This is often inside the handle (see the top photo on p. 86).

With the tool open, locate the wires coming from the cord. Connections at these points vary. Among the most common are screw-on terminals, spring-loaded terminals and wire nuts. If there's bare metal at these connections, such as screws, you can test the cord without further disassembly because the probe of your multi-tester can make contact with the screw.

When wires go straight into the plastic housing of a switch, the connection is probably spring-loaded. You'll need to pull out these wires. To remove the wires, insert a needle or thin probe into the small slots located next to the wires. Push until you feel some resistance, and then pull on the wires, one at a time.

With the ends of the cord exposed, use a multi-tester to determine whether current can flow from the plug prongs to the wire ends. The continuity setting on a multi-tester measures electrical resistance. Wires, plugs and simple on/off switches (in the "on" position) should show a resistance reading of zero, which means the current can flow unimpeded. (The multi-tester actually sends a tiny flow of current through its two probes.) Never plug your tool into an outlet when testing its components.

Locate the hot wire (usually the black one), which should be connected to the switch. The switch is sometimes labeled "load" at this spot. The neutral wire (usually white) goes to the motor, and the ground (usually green) is attached to a metal part of the tool.

Touch one probe of the multi-tester to the load wire, and place the other probe against one blade of the plug. If the multi-tester doesn't respond, touch the probe to the plug's other blade (see the center photo on p. 86). One of those blades (the narrow one, if they're not the same size) is the hot side, and you should get a reading of zero. If there's a break in the wire, the meter won't yield a reading at all. If you wiggle the cord during this test, you may get an intermittent reading; that's a sign of a broken wire.

If there are kinks or breaks in the outer insulation of the cord, then those sections are suspect. Breaks are often located near the handle or the plug. At this point, make your best guess about where the trouble spot is, cut the cord and then expose some wire.

# Replace broken cord and plugs

***Cord breaks often occur near strain reliever.*** *The plug on this cord is missing the grounding prong and needs to be replaced.*

***Hardware store replacement plug****—If a cord breaks near the plug, cut it off there and install a new plug.*

If you think the wire break is located near the plug, cut the cord there, and perform another continuity check on the bare wires between the switch and the cut end of the cord. If you get a zero reading, celebrate by installing a new aftermarket plug, available in any hardware store (see the bottom photo). Be sure to use a three-prong plug if that's what the tool came with. A tool with a metal housing must be grounded to avoid a serious shock hazard. Double-insulated tools come with two-prong plugs.

Cord breaks also commonly occur near the thick section of cord called the strain reliever (see the top photo). If your tool has a damaged molded-on strain reliever, it's time for a new cord. Some cords have strain relievers that slide over the cord. If you find the cord inside this section is damaged, pull that portion through the strain reliever, cut it off, strip off some insulation and check for continuity. If, after all this,

you still can't find the break, chuck the cord and get a replacement.

Generic tool cords are available from electrical-supply houses. But before ordering one, examine your power cord carefully. Strain relievers have a section called the clamping ring, which fits a part of the tool housing. These rings vary in shape and size. Check the dimensions before 'getting a replacement cord. Original equipment cords are also available from the manufacturer or, in some cases, local repair shops.

## Preparing raw wire ends

A repaired or new cord is only as good as its connection. Whenever you have raw wire connections, it's best to solder the ends of the wire to prevent the strands from unraveling.

With a soldering gun or iron, you can create nice soldered loops that take the place of crimp-on loop terminals you'd have to buy. Don't be put off by soldering. It's a very simple procedure, no matter what type of connection you are faced with.

Strip off just enough insulation (refer to the original connection). Begin by dipping the exposed wire end into paste flux. Touch the soldering gun's hot tip to the wire. When the flux starts to boil, touch the solder to the wire. After the solder flows into the wire's strands, remove the gun. Dripping solder can burn, so don't do this over your lap. For push-in switch and plug connections, twist the exposed wire in a straight line, and add just enough solder to bind the strands together. Too much solder may make it impossible to get the wire back into the switch.

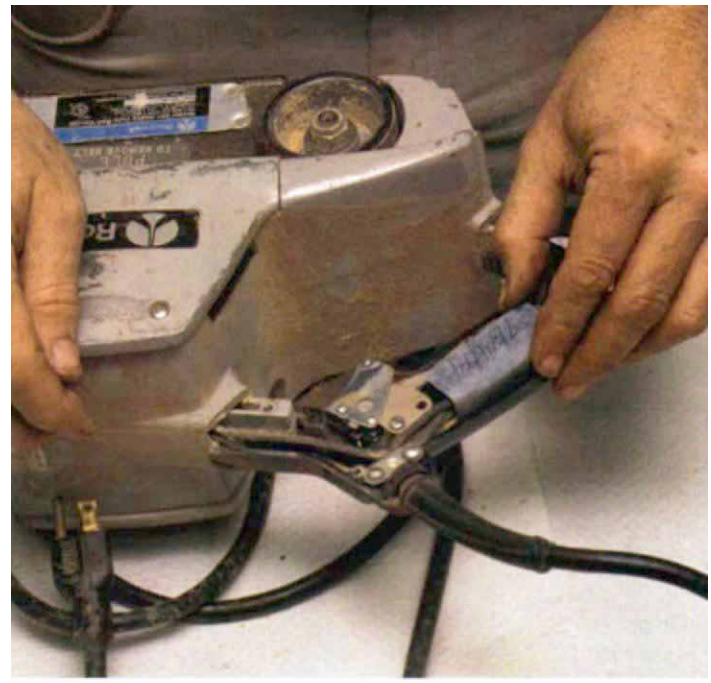
***Soldered loop***

For screw-on connections, making a soldered loop is the ticket. Twist the wire, and then form it into a closed loop around a form slightly larger than the shank of the screw terminal it is attached to. Remove the form, and flow solder on the wire.

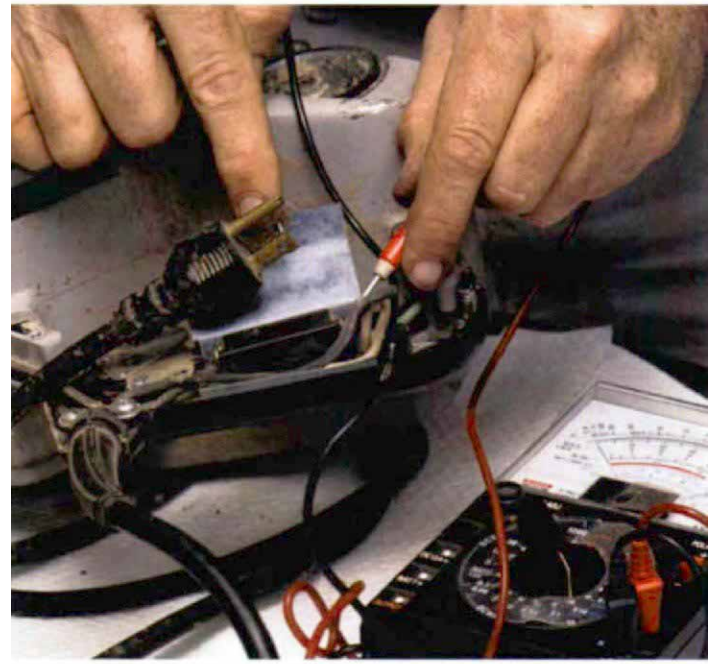
## Testing for a bad switch

A switch is simply a device that interrupts current to a tool's motor. Switches come in many styles and types, from simple toggle switches to complex trigger-action rheostats. I will tackle basic on/off switches

## Test cord and switch



***Find the end of the power cord.*** *Dismantle the tool's housing to expose the end of the power cord.*



***Test the cord for continuity.*** *A multi-tester will tell you if a cord is broken. Current should flow from the plug's prongs to their connections inside the tool.*

***Testing a switch.*** *While the switch is locked in the "on" position, touch one probe of the multi-tester to the incoming line and the other probe to the outgoing line. If the switch is working, the multi-tester should read zero.*

# Replace worn brushes

***Some tools make access to brushes easy.*** *Brushes in this router are exposed by backing out a slotted cap on each side of the housing with a screwdriver.*

***With cap removed, brush pops out.*** *Spring-loaded brushes should come out of their guide channels easily once the end caps are out of the way.*

***Carbon brushes wear over time. The*** *brush on the left is new, the one on the right has worn down to where it needs to be replaced.*

here. The testing procedure is the same as the one used to examine a cord: Check whether current flows when the switch is in the "on" position.

Trace the wire from the power cord to the switch; then locate the wire that leaves the switch and goes to the motor. Using the multi-tester, touch one probe to the incoming line and the other probe to the outgoing line. Cycle the trigger to the full power position. The multi-tester should read zero. If it doesn't, the switch is broken.

Few switches can be successfully disassembled for repair and cleaning. But if you can't resist, do it in the bathtub with the drain covered and the shower curtain pulled. Switches contain tiny parts under spring-loaded pressure that will instantly evaporate in a workshop. When I'm faced with a defective switch, I order a new one.

## Examining and replacing the brushes

If you've checked the cord and determined that the switch is working, but you still can't get your .favorite router to run, it's time to check the brushes. Power hand tools have a pair of these components, which are simply blocks of carbon. Springs keep the brushes pressed against a cylinder of copper strips (called commutator bars) located on one end of the motor. The brushes and springs fit inside enclosures called brush channels.

Electricity is fed to a brush either by a direct wire to the brush or via a conductive metal housing surrounding the brush. When you turn a tool on, current must flow through the brushes and onto the commutator bars before you can make sawdust. Over time, brushes wear down and shorten in length (see the photo at right above). Eventually, there's not enough spring tension left to keep them pressed snugly against the commutator bars.

Some brushes can be accessed via screw-on caps. These caps are usually plastic, and they're somewhat fragile (see the left and center photos above). Often, part of the tool casing must be disassembled to reach the brushes.

Although there's nothing in a woodworker's tool chest that can be used to determine whether a brush is definitely shot, a reliable test can be performed with a probe, such as a pencil. Find a place where you have access to the end of a brush where it meets the commutator. Press the pencil against the edge of the brush, and then push the brush back into the guide channel. The brush should return smoothly and immediately when you release pressure. If it seems loose and sloppy, replace it. Another way to measure brash wear is by visual examination. A rule of thumb: If a brush is shorter than it is wide, replace it.

Rust and dirt can contaminate brush channels and cause brushes to jam. If you suspect this problem, remove the brushes and clean out the channels with a wire brush. Also, check the wire connections at the brush or brush channel. Sometimes these work themselves loose.

Here's one last thing to look for before reassembling a tool. If the commutator bars look broken, have missing sections or irregular channels between the bars, there's a possibility that your tool has some more complicated electrical malfunctions.

It may be tempting to take the motor apart to try to fix it, but more complicated repair work is best left to a local repair shop or a company repair center (the manufacturer can tell you where to find one). It may be cheaper to replace the tool, but it's worth checking first. □

*Contributing editor Robert Vaughan repairs and restores woodworking machinery in Roanoke, Va.*