Amplifier Troubleshooting

By Ken Fischer

Requests for information on trouble shooting guitar amps just keep com ing, so in this issue I'll try to cover some basic techniques. First a very important disclaimer: This information is provided for your general enlightenment. Guitar amplifiers contain lethal voltages even when unplugged. In addition, defective amplifiers can cause burns, fire, and spray hot chemicals, which can do great harm. Leave all amplifier troubleshooting in the hands of *qualified personal.* Ken Fischer, Trainwreck, nor *Vintage Guitar* magazine can be held responsible for any damage to people or equipment caused by using the information provided in this article. There are many professional repair centers advertising in this publication. Unless you are 100% qualified to do this work yourself, we strongly urge you contact one of the expert repair centers and arrange to have them service your amplifier.

Troubleshooting Basics:

First I should tell you this article applies to most amps using 100% tube circuits only. Warning, solid state and hybrid types (part solid state and part tube) *should not* be serviced with the system that follows. To service solid state amps use the *Newt Modern Microchip Repair Guide*.

To use this system you will need at least a volt-ohm meter (VOM) or a digital multi-meter (DMM) of decent quality. A signal generator and an oscilloscope are a major plus. Also, you will need hand tools, spare tubes and parts, soldering equipment and so on.

Go With the Flow

Question number one is, when you plug in your amps and turn on the power switch does the amp draw power? That is, do the tubes light up? Does the pilot light come on? Can you hear the power transformer hum? In other words, is there some activity or is the amp stone cold dead? Let's cover stone cold dead first. Item one is check for a blown fuse. Be aware some amps have internal backup, or other internal fuses which could be blown also. *Never change a fuse with the amp plugged in.* Let's say all fuses are O.K. To be sure a fuse is O.K., even if it doesn't look to be open, check it for continuity with your meter.

If the fuses are O.K. and the amp has no power, place your ohm meter across the plug of your amplifier — main power prongs, not the ground prong. With the power switch on, check for continuity. This checks the plug, power chord, fuse holder, fuse, voltage selector (where one is provided), power (mains) switch, and power transformer primary all with one simple test. If you have an old Vox or amplifier with similar slow start up system it also checks these parts as well. If you have continuity the problem is going to almost always be from the secondary side of the power transformer and beyond. If you don't get continuity check each item in the primary side power chain one at a time. From one prong of the plug check for continuity to the inside of the amp. Do the same for each prong including the ground if so equipped. Don't forget to wiggle the power chord at the strain relief. Often a wire will break at this point. Check the switch for continuity. Then check the power transformer primary winding. Once you found the part with no continuity repair or replace it and chances are the amp is fixed. On amps with multi-voltage power selectors don't overlook the possibility the amp is simply set for the wrong voltage. Let's say the circuit to the power transformer primary is complete and the primary also is O.K. but the amp doesn't light up. Now we check the voltages on the power transformer secondary at the transformer lead or terminals with the amp plugged in and turned on. If you find any of the voltages missing, disconnect that set of leads to isolate them from a possible short down the line. Check for voltage again. No voltage on a secondary winding with an energized primary indicates a bad transformer. If all voltages are present and the tubes do not light up a broken wire or bad connection running to the tube sockets would be the likely fault. Check for these as well as cold solder joints. Light the tubes and the amp should work. Also while inside, check for all proper D.C. voltages at the main points tin the power supply system. Tubes that are lit but have no DC voltages to operate on will not work.

The Fuse Blows:

Maybe instead of not turning on at all, your amplifier blows its fuse every time you turn it on. Step one, remove all the tubes, put in a new fuse of correct value and turn on the amp. If the fuse doesn't blow under these conditions the first step is to plug back in the rectifier tube if your amp has one. If the fuse now blows check the rectifier tube, power filters, output transformer and other items in the B+ path for shorts. Don't forget the choke if your amp has one. Find the short — cure the amp. Let's say plugging in the rectifier tube doesn't blow the fuse. Install the power tubes one at a time. The one that blows the fuse is bad. Replace the entire set with matched tubes such as Groove Tubes and rebias the amp. Preamp tubes don't blow fuses as a rule.

Let's now say your amp uses silicon diodes, not a tube rectifier. First pull out the tubes and try a new fuse. If the fuse doesn't blow, put the power tubes in one by one as before. By the way, I assume you've already checked for proper bias voltage before reinstalling your tubes. No bias will blow the fuse with the power tubes installed. Some amps, such as Marshall, have a high voltage (HT) fuse in the output circuit which will blow in case of shorted tubes or no bias voltage. On cathode bias amps check the bypass cap for shorts. If the amp blows its fuse with no power tubes installed check the diodes and everything described in the tube rectifier section of this article check list. Find the short — cure the amp. Let's say the fuse blows and you find no shorted items. Disconnect all transformer secondary leads. If the fuse still blows a power transformer failure is most likely.

Everything lights, the fuse doesn't blow, but the amp doesn't work:

First check the speaker, and check for continuity between the speaker and output transformer. Repair/replace any bad items. It's important to do this step first because putting a signal into a tube amp without a speaker or dummy load connected can cause damage to the output stage. The easiest step at this point is to substitute tubes since most tube amp failures are just bad tubes. If this doesn't work check for voltages. Eyeball the insides for burnt parts, broken wires or leads, and anything that doesn't look normal. To check for missing voltages start at the secondary of the power transformer, on to the diodes or rectifier tube, choke, resistors between filter stages, standby switch, and so on down the line until you find where the voltage is interrupted. Repair/replace any part, wire, or connection that doesn't go with the flow.

Worst Case:

Let's move on to the worst case in troubleshooting an amp. Everything lights, all working voltages are correct, but the amp still doesn't work. We've checked the speaker and its continuity to the amp, we put in a known working signal be it from a signal generator or guitar to no avail. Tried new tubes and so on. There are now two ways to troubleshoot this amp. From front (preamp) to back (output stage) or from back to front. With a signal generator and an oscilloscope most people use the front to back approach. Let's get into this method first.

Plug a dummy load into the speaker jack. Plug a signal generator into the input jack, turn on the amplifier. Be sure to turn up the volume and tone controls a bit. With the oscilloscope probe check for signal at the first gain stage (input stage). If you get a signal fine, move on to the very next stage and look for a signal. If you do not get a signal, check voltages yet again. If all is O.K. check for bad caps, resistors, solder connections, substitute the tube and so on. Look for shorted, opened, and burnt or out of value parts. Do not go on until you get this stage working. The idea is to go stage by stage from input to output, one at a time, stopping to fix any stage that doesn't do its job. By isolating each stage one at a time, you will have a simple circuit with only a few components to check.

Now let's say you get to a stage and the voltages needed aren't there or are way off. By "way off," I myself use the figure of plus or minus more than 25% of what's called for in the schematic. However, that's not a hard and fast rule. A schematic may call for 1.4 volts on the cathode of a preamp tube. You might measure 2.6 volts, yet the circuit may be fine anyway. Different brands of preamp tubes will self-bias at quite different voltages and still work fine. In any case, if you have no B+ or plate voltage start at the beginning of the power supply and work forward towards the front of the amp to find the interruption. On a preamp tube, measure both sides of the plate resistor for voltage. There should be a drop in voltage on the plate side. No drop in voltage may indicate an open cathode circuit. Too much drop in voltage or lack of a small positive voltage on the cathode may be caused by a shorted cathode cap. A overly high cathode voltage along with a overly large drop across the plate resistor may indicate a positive voltage being applied to the control grid. This may be caused by a leaky or shorted coupling cap from the previous stage.

Back to front troubleshooting works the same way except you hook the oscilloscope to the output and inject the signal in at the output stage and work towards the input to find the non-functional stage.

Using a meter to troubleshoot:

This is a good system to use on the road when you don't have a scope and signal generator handy. The speaker becomes the "scope" the "signal generator" is an alligator clip to inject a hum "signal" and the meter checks voltages and continuity. This system must be used back to front. Clip the alligator lead to the control grid of the tube section in question, starting with the output stage. Let the other end of the alligator clip hang free. *Be careful not to let the loose end touch anything*. In fact, taping it up is a good idea. The lead will pick hum out of the air. When you reach the stage that does not hum with this lead on the control grid you've found the problem. One warning, some amps such as Marshalls, Fender Bassman and Twin Tweed use a cathode follower stage that has B+ on its control grid. Clip your lead to the grid of the stage prior to the cathode follower for testing.

Reverb and Tremolo:

Many problems in the reverb circuit are caused by open or shorted leads and reverb tanks. Bad footswitch leads, plugs, and the switch itself cause many failures of both reverb and tremolo. Be aware some amps need their footswitch for these circuits to work. For example, on a Fender Blackface amp the footswitch completes the circuit for the tremolo function. No footswitch plugged in, or a open circuit in the footswitch unit, and you'll have no tremolo. On the other hand the reverb will work without the footswitch. In the case of the amp's reverb, the footswitch "shorts out" the reverb signal. A short in the footswitch will kill the reverb function. Putting it simply, a short in the reverb footswitch will keep the reverb off, and a short in the tremolo footswitch will keep the tremolo on! The footswitch works the same in every brand of vintage amp. That is it either completes a circuit or "shorts out" a circuit. Testing the electronics of the reverb and tremolo circuits is done the same way as any other circuit.

Other Stuff:

Because the waiting list for Trainwreck amps is getting ridiculously long, and my medical problems continue to plague me, I will soon stop taking orders for my amps until I can clear the backlog. My good friend Henry Kaiser was just in South Africa helping to set up their new health care system. Maybe the U.S. government should enlist his help. Angela is still not married! Call her dad Steve at Angela Instruments (301) 725-0451 to beg for her hand in marriage.

Next issue: Fly fishing with Hiroshi Yagi.

Ken builds his highly-regarded Trainwreck amplifiers in Colonia, New Jersey.

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