Harp Amp Secrets and Tips

Before 1993, when I designed the first tube amp specifically for blues harmonica, little research had been done on how to make a tube amplifier sound best for harp. We all know that tube circuits can be voiced to perform a certain way, but the question is, "How should they be voiced for harp?" In addition, harp players use "industrial grade" high-impedance vintage PA microphones such as the Astatic and the Green Bullet. These type microphones are prone to feedback.

I am gonna share some of my research with you and show you how to modify an existing tube amplifier for use with a blues harmonica; or you can build your own harp amp.

Although I had previously spent time with Kim Wilson (The Fabulous Thunderbirds) listening to various speakers and speaker configurations to determine what was best for harp; it was the internationally famous blues harp player, Paul Orta (The Kingpins), that convinced me to design the first tube amp specifically for harp. Paul brought in an old wooden cabinet National tube guitar amplifier. This particular amp originally belonged to Jimmie Vaughan and was his first guitar amp. It sounded horrible for guitar. It was over-compressed without any clean tone whatsoever. Although I did not date it, I would guess it to be late 40's. It had a field coil speaker driven by two 6L6G's running Class A push-pull. Paul had bought this amp because he liked the tone for harmonica, but he found he could not use the amp in a live gig situation. It was not loud enough and there was too much hum. Even if the amp was miced through the PA, the hum level was beyond usable. Paul loved the tone of this particular amp and felt it to be the definitive tone for harp. We just needed to get rid of the hum and increase the volume about five fold.

Paul asked me to analyze this amp to find the essence of its tone. I would then use what I learned to design and build the perfect harp amp for him.

After studying the old National Amplifier, I broke its essence down into basics. I believe these basics to be perfect for harp amp tones. In the process of analyzing this amp, I stumbled onto a way to fatten the tone and eliminate feedback (more on this later.) Here are the basics along with an explanation:

1. Low plate voltage on the preamp tubes. The National had very low voltage on the plates of the preamp tubes. This would be a terrible idea for guitar but worked great for harp. The plate voltage determines both the frequency response and the headroom. With low voltage, the tube breaks up at almost any volume and the frequency band shifts to a lower register. Since harp frequencies are relatively low compared to guitar, this lower voltage fattens the notes while helping reduce high frequency feedback. Although the National had voltages running around 95 to 100 volts, I experimented with different voltages and found 80 to 90 volts to be ideal for harp.

   If you have a guitar amp you are modifying for harp, you could simply increase the value of the power supply dropping resistor that feeds the plate resistor of the preamp tubes. Since preamp tubes draw very little current, the dropping resistor may have to be replaced with a much larger value. I would use a decade box in place of the dropping resistor and by trial and error find the appropriate value resistor. Do not change the plate resistor, only the power supply dropping resistor!

2. Larger than normal coupling caps. The exact value of a coupling cap determines how much lower frequencies get through the circuit. Larger values simply let more signal pass. Through experimentation, I found the .1 uf coupling cap to be best for harmonica. Of course, if you were modifying an existing guitar amp, you would simply change the coupling caps (typically .01uf or .02uf and sometimes .047 uf) to a .1 uf. You would use a 400 or 600-volt rating.
3. Simple two-stage design. Less is more. If you get more stages of gain, you are amplifying the feedback problem and you will just have to turn down the volume. This explains why the normal channel on a blackface Fender works better for harp than the Vibrato channel.

   The National actually had only one stage of gain and a paraphase style inverter that acted as another stage of gain. A tweed Champ, tweed Princeton and tweed Deluxe are examples of

amps with simple two-stage design. It is interesting to note that all of these amps work great for harp.

4. Paraphase style Phase Inverter. This obsolete design has not been used since the mid-fifties. The paraphase inverted takes advantage of the fact that a tube inverts the signal by 180 degrees. A very small signal is divided off the signal path that is driving the first output tube. The small signal is run through another preamp tube, which drives the other output tube. Since running it through the addition preamp tube inverts the phase by 180 degrees (with respect to the signal driving the first output tube), phase inversion is achieved.

   You can not get a clean tone with a paraphase style inverter because one of the output tubes is being fed by a signal that was run through an extra tube. Any distortion introduced by this extra stage is amplified by one output tube, but not on the other. The result is a "not so clean" tone.

   There are two types of paraphase inverters: the fixed and the self-balancing. A good example of the fixed paraphase inverter would be the 5C3 Fender Deluxe. A good example of the self-balancing type would be the 5D3 Fender Deluxe.

   The National amp had a fixed paraphase inverter, but I opted for the self-balancing type instead. In the self-balancing type, a resistor that is common to both circuits goes to ground. If one side is driving too hard, it phase cancels some of the signal developed across this common resistor, thus balancing everything out. This is where I had a happy accident. (More on this later.)

5. A Cathode-biased, Class "A" push-pull output stage. Cathode biased amps are generally more compressed with a more singing quality. In general, a spongier response is achieved. The Class "A" push-pull output stage simply means the tubes are driven by a phase inverter and they never go into cut-off.

   I used a 250 ohm 10 watt cathode resistor with a 33-uf 100-volt bypass cap. I like going with a higher voltage rating on the cathode capacitor because the higher voltage cap can take plenty of heat and still be within its operating parameters.

6. High idle plate current in the output stage. The high idle current is typical of Class "A" style amplifiers. The output tubes on the National were running about 60 mA per 6L6 tube. Since the National used 6L6G tubes (rated for only 19 watts plate dissipation), I opted to run 6L6GC (30 watts plate dissipation) at an even higher 70 mA per tube.

   If you are converting a guitar amp from fixed bias to cathode bias, the cathode resistor, by developing a voltage on it, makes the tube "think" it is operating at a lower plate voltage. Why? Because the tube only "sees" the difference between the cathode voltage and the plate voltage.

   Let's say you have a Super Reverb that normally operates at 445 volts, and you change from stock "fixed bias" to "cathode bias". You add the typical cathode resistor/ cathode capacitor to the output tubes and measure 45 volts across the cathode resistor. This means the tube only "sees" the difference between the 445 volts plate voltage and the 45 volts cathode voltage. It performs "as if" it were operating at 400 volts. Given this scenario, one could see how we could "idle up" quite high compared to stock. Perhaps 60 mA per side would work fine without the tubes glowing cherry red.

7. Tube rectifier. Of course, the National amp had a tube rectifier. I would always recommend a tube rectifier with a harp amp setup. You need the compression that a tube rectifier gives. I used the GZ34, which is my favorite rectifier tube.

   If you have an amp that does not have a rectifier tube, one can be added by using a 5-volt 5-amp auxiliary filament transformer and an octal tube socket. In this magazine, About 2 years ago, I wrote an entire article called "Converting a Solid State Rectifier to Tube". If you need more info on this and can't find the "Converting a Solid State Rectifier to Tube" article in your archived VG magazines, email me and I'll email you the article.

How to Stop Feedback and Fatten the Tone. I told you about the self-balancing paraphase inverter and I told you I had a happy accident. When I was designing the harp amp for Paul Orta, I thought I would use a potentiometer instead of a fixed resistor so I could dial in the exact value by ear. To my surprise, I found that if I deliberately made the waveform non-symmetrical, the harmonica tone actually fattened up!

Here's the other part of the accident. I found if I connected the speaker reverse polarity with respect to which half of the waveform is bigger, then the threshold of feedback goes up. This means the amp can be turn up to ridiculous volume levels before acoustic feedback occurs! I decided to leave the potentiometer as a "waveform symmetry" control so Paul could fatten his tone while reducing feedback!

I will never forget the time Paul called me after doing an outdoor gig with his new harp amp and said for the first time in his career a sound man actually asked him to "turn it down". It seemed he was burying the drummer and the guitar player in the mix!