

# Different 12A\*7 Family Tubes in a Blues Junior

Everybody talks about how you can tailor the tone of an amp by swapping tubes in various gain stages or the phase inverter. But how many people have actually done it? And how many have actually documented what the swaps do?

Call me crazy, but I went out and bought \$80 worth of tubes and ran them through one of my Blues Juniors, and took scope photos to document the actual effect on preamp distortion and power tube distortion.

The first thing you need to know is that the ubiquitous 12AX7 dual triode is just one member of a family of tubes that have different amounts of gain. The 12AX7 has the most, and is rated at 100. Here are the ratings of its siblings:

12AX7	12AT7	12AY7	12AV7	12AU7
100	60	45	41	20

So the 12AV7 has less than half the gain of a 12AX7, while a 12AU7 has only one-fifth the gain. The 5751 is also in the family, and is supposedly between a 12AX7 and a 12AT7. I tried several, and couldn't find any difference between them and a 12AX7 in this test. There's also a weird cousin, the 12DW7, which has non-identical triodes. One has the gain of a 12AX7, while the other has the gain of a 12AU7. The actual amount of gain in the circuit is determined by the voltages applied and the components selected by the circuit designer. That stuff is hard to change without a soldering iron--and some serious knowledge of what you're doing. But anybody can change tubes.

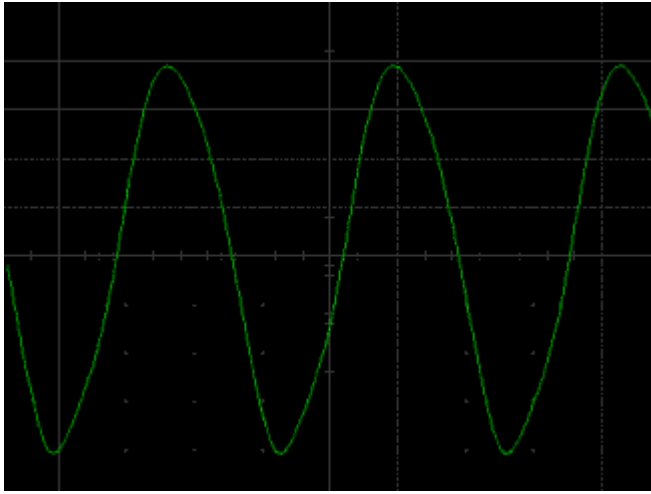
The second thing you need to know is what the three 12AX7s in a Blues Junior do. The first, V1, amplifies the incoming guitar signal and has the volume control between the first two stages. It also has the FAT switch on the second stage, which boosts the stage and deepens the frequency response. Although V2 has two triodes, like all 12AX7s, only one is used. Its purpose is to restore some of the volume lost in the tone stack, which sits between V1 and V2. The master volume control is situated between V2 and V3, the phase inverter. The phase inverter amplifies the signal some more, but its main job is to create two signals that are mirror images of one another to drive the output tubes. The phase inverter itself can go into distortion, and this distortion is made louder by the output tubes. Or the phase inverter can drive the output tubes into distortion. For the purposes of my test, I didn't differentiate--as far as I'm concerned, the phase inverter is an integral part of the output stage.

Since the Blues Junior is a master volume amp, you can isolate preamp distortion from output stage distortion. Setting the master volume low, below the point where you see or hear distortion, lets you focus solely on preamp distortion, which is controlled by the volume control. Conversely, if you keep the preamp below its distortion point and turn up the master volume until you see or hear distortion, you know it's output stage distortion.

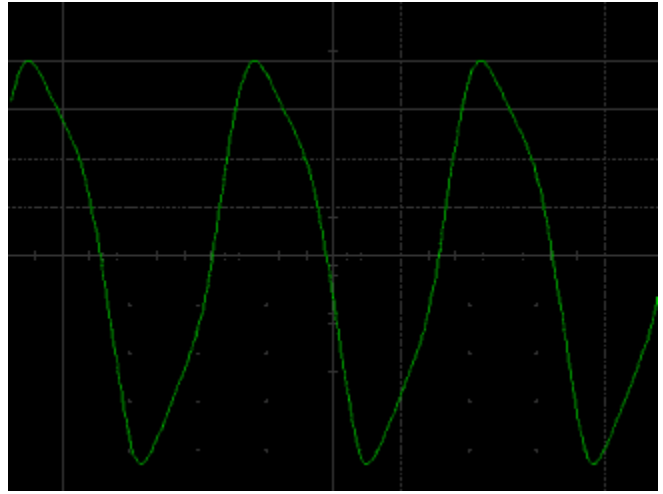
My tests showed that it's pretty much pointless to change V2. Less gain is exactly the same as turning down the master volume. It has no effect on tone or preamp distortion.

So here's what you've been waiting for: the actual scope photos of distortion at different volume settings for each kind of tube.

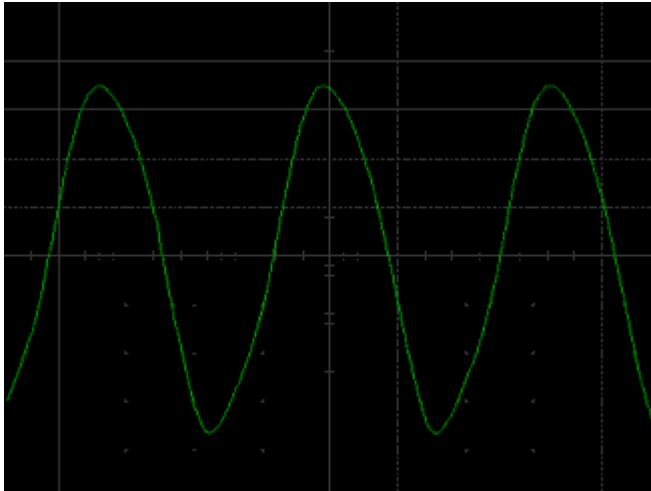
### The Preamp (V1)



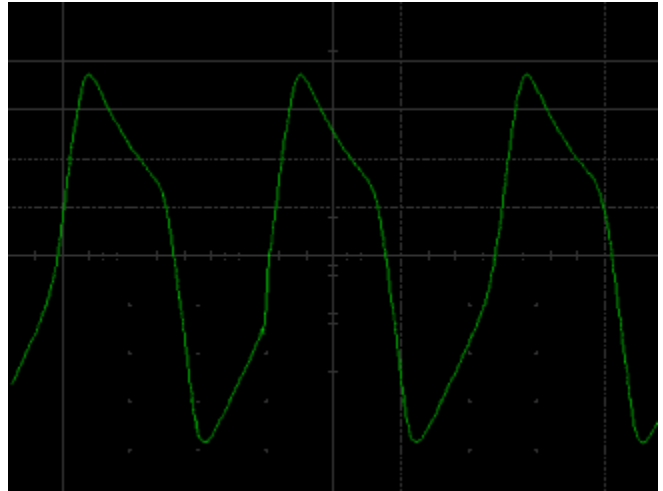
12AX7 at 6.5: Asymmetric waveform shows preamp distortion beginning



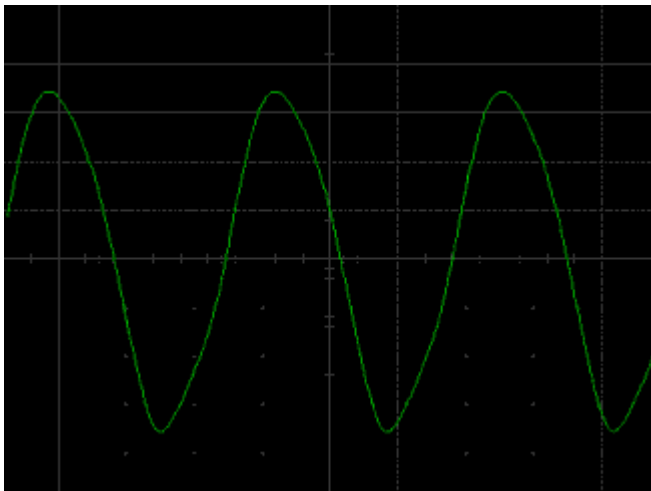
12AX7 at 8: Distortion quite audible



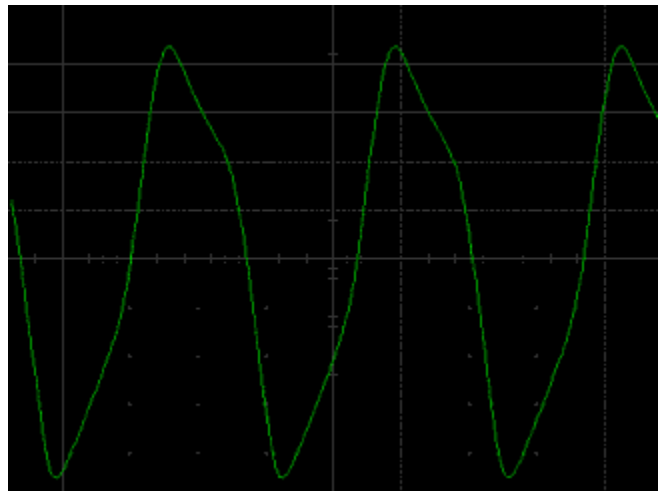
12AT7 at 8: Delayed onset of asymmetrical distortion



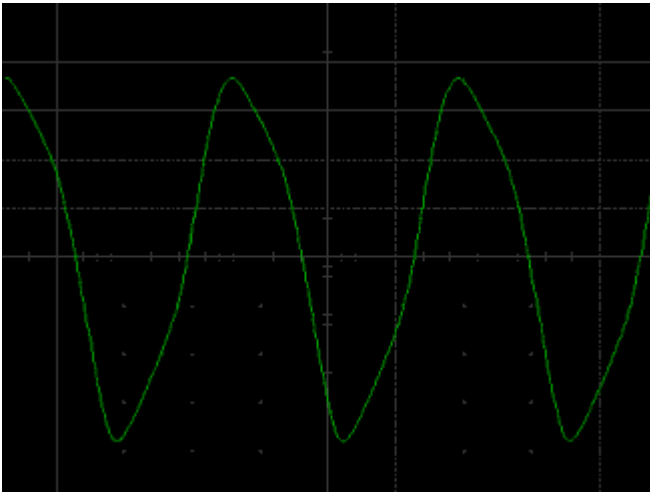
12AT7 at 10: Strong distortion



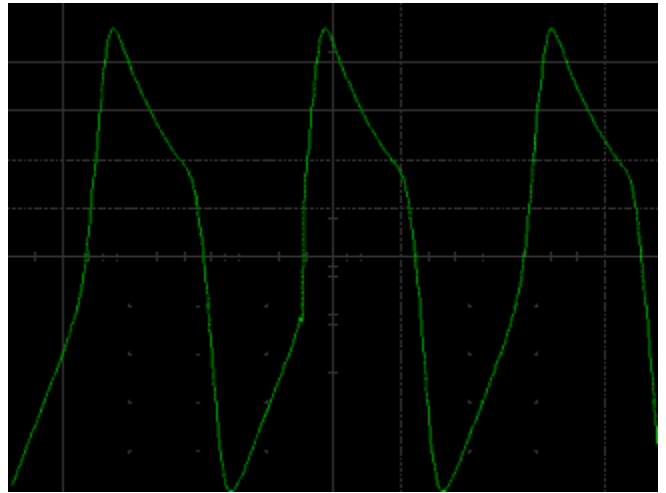
12AY7 at 9: Onset of distortion.



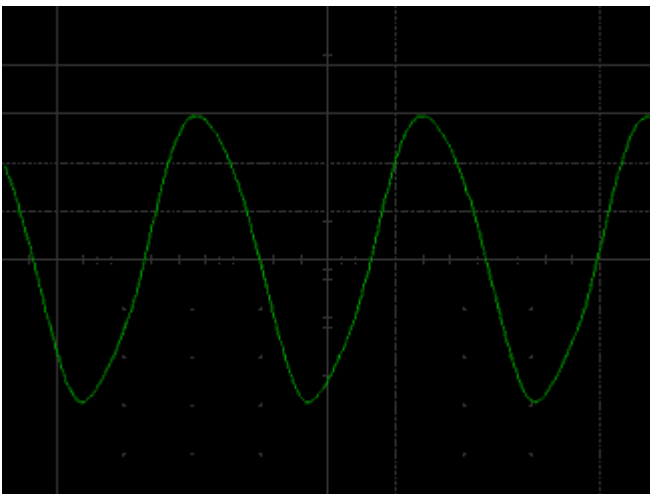
12AY7 at 10



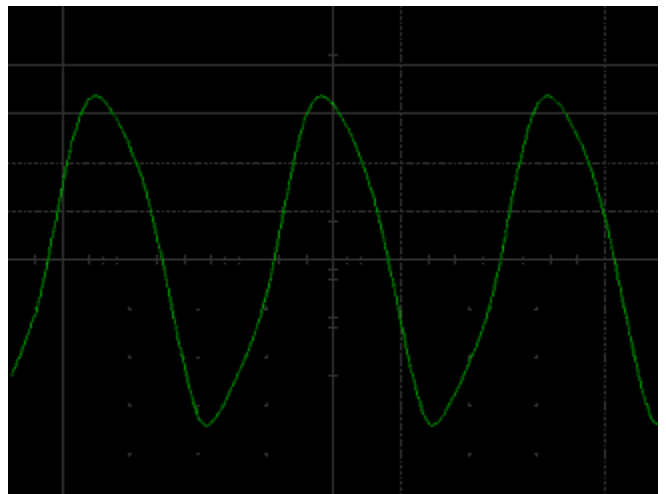
12AV7 at 10



12AV7 at 12

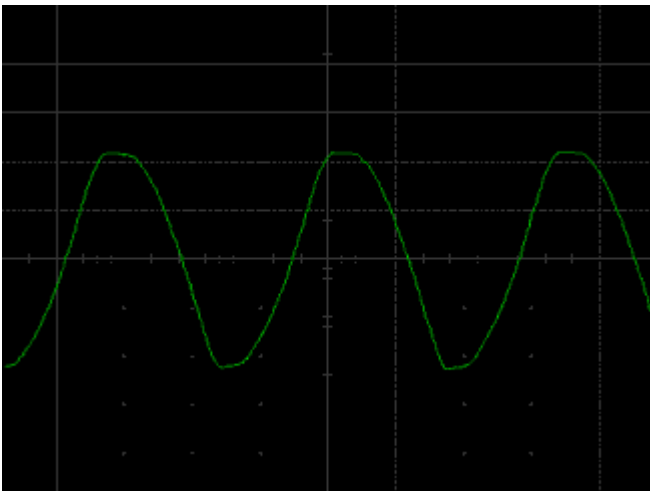


12AU7 at 11

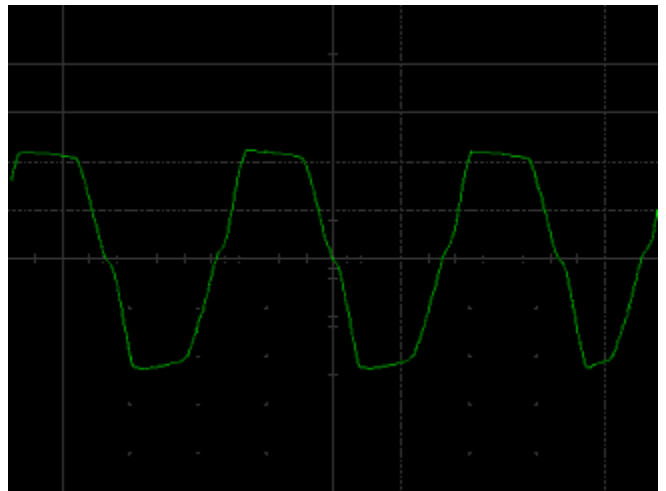


12AU7 at 12

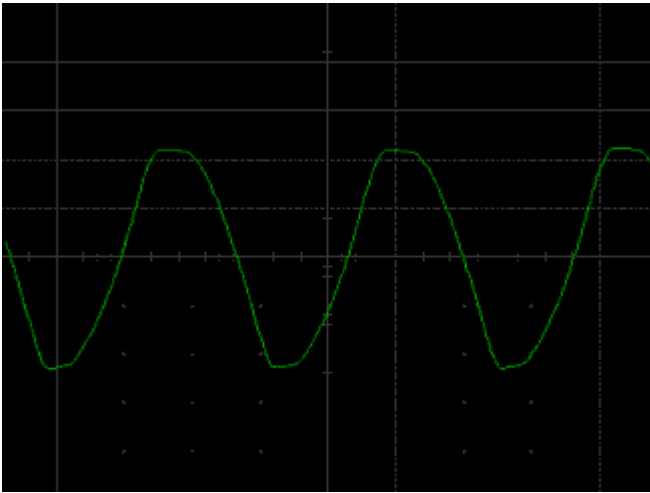
**Phase Inverter (V3)**



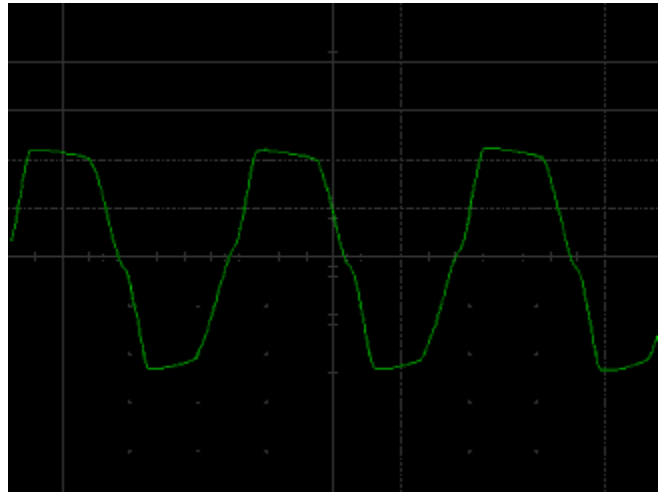
12AX7 at 6.5 (master volume)



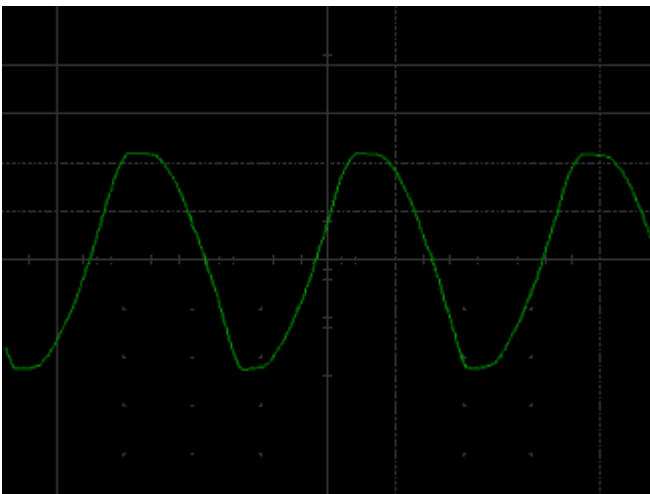
12AX7 at 9



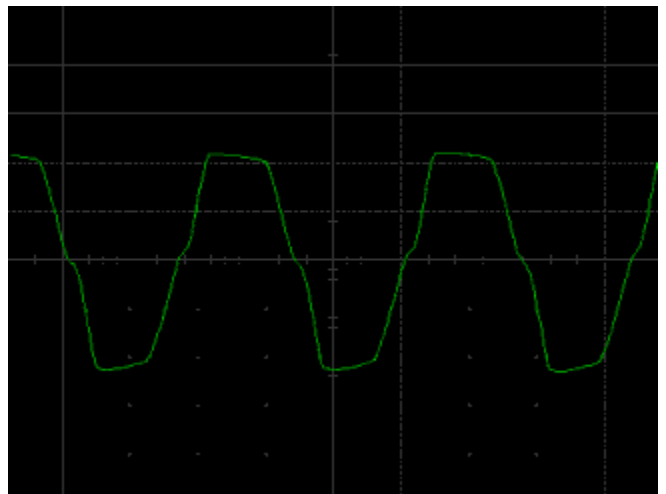
12AT7 at 7



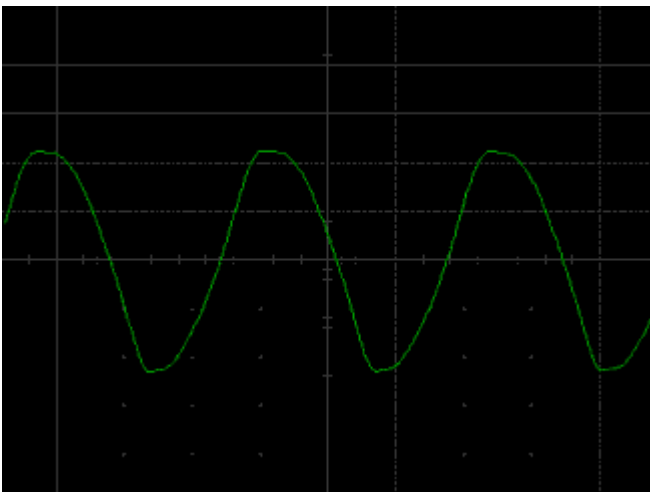
12AT7 at 10



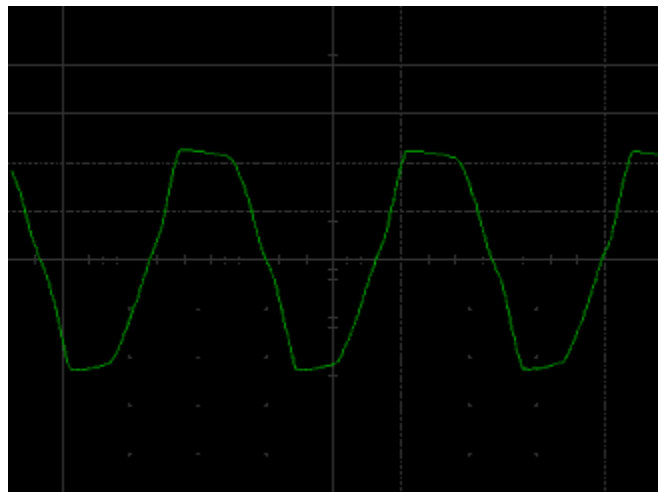
12AY7 at 8



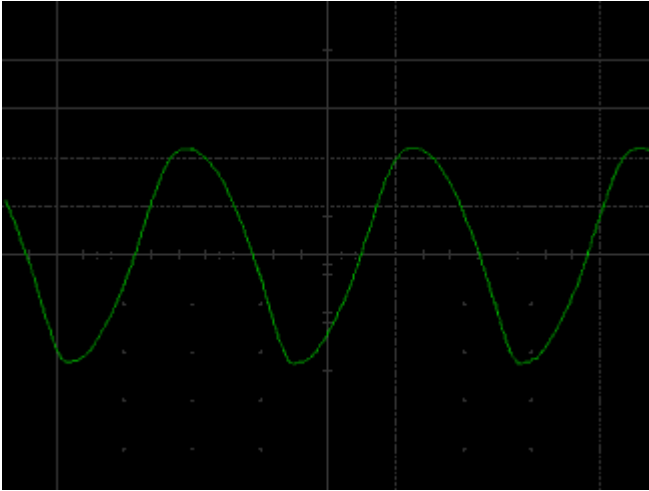
12AY7 at 12



12AV7 at 9



12AV7 at 12



12AU7 at 12

### Conclusions

The preamp distorts differently than the power amp. It mostly makes the waveform asymmetrical, although it is possible to drive the preamp into clipping with more drive from the guitar. These 440Hz waveforms above were normalized to a guitar's volume at about 6 or 7. The volume knob makes large differences in the height of the waveform and the amp's output. I adjusted the scope gain and attenuation continually to keep the waveform on the screen. None of the tubes made a significant difference in the BJR's tone. A one-or-two notch adjustment of the tone controls more than makes up for any difference in brightness. The onset of distortion was the only thing that changed. Yes, every tube sounded a little different, but the differences are completely lost in a non-studio or non-practice situation. When you're playing out, no one will ever hear the difference between a new-old stock Telefunken and a new Sovtek.

Different tubes in the phase inverter do not significantly change the amount of volume available from the power tubes, with the exception of the 12AU7. The output section's characteristic distortion is clipping, and the only difference is the level on the master volume at which clipping begins. As with the preamp, different tubes (a mix of Electro Harmonix, NOS JAN Philips, NOS RCA, and Sovtek), made no real difference in tone.

12AT7s are almost indistinguishable from the stock 12AX7s. You can go a notch or so higher in clean volume, but they sound just like the 12AX7s in breakup. The 12AV7s and 12AY7s are much more noticeable in terms of availability of clean headroom. All of the tones you get with the lower-gain tubes are available with the 12AX7s too, but over a much narrower range. Where the stock tubes will play clean when you play soft and go into touch-sensitive breakup when you play louder, the lower-gain tubes will stay clean through a much broader range of playing.

My favorite combination for clean playing was a 12AV7 in V1 and a 12AT7 in V3. This combo has an extended clean range, but also has some clipping available from the output stage should you need it.

The 12AU7 is so quiet that it's not worth bothering with--unless you want a low-volume practice amp that only plays clean. A BJR with 12AU7s in V1 and V3 is quiet, but still manages a thick warmth when turned up.

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