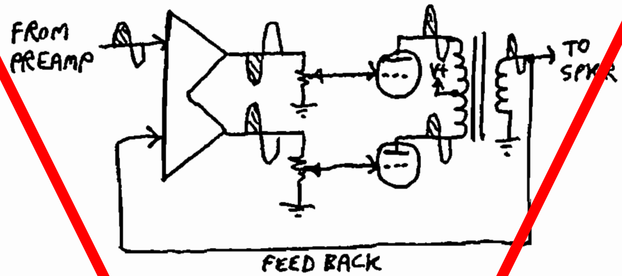

Fig. 5-11: Conventional Power Amp Master Volume

paraphase drive signals are at whatever level the input stage determines to be appropriate to make the feedback signal look like the input signal. If we attenuate these paraphase signals, the input stage must work harder to obtain the required feedback. At some point, the input stage runs out of gain and output capability and begins to distort. The output signal is then distorted as well. The greatest distortion occurs when the interstage level controls are set low. Less signal is transferred from the input stage to the output stage.

It would seem that the intent of the master volume is to produce distortion. Indeed, this is generally true, and the power amplifier master volume does not allow a truly clean sound to be set up, as the conventional master volume is able to do. This means that the power amp master is restricted to those situations where the amp is being set up for one range of tones only, distorted ones.

Typical Power Amp Master Volume Installations

There are two popular methods for installing power amp master volumes. The first is the preferred method, as it is safer and easier to implement. Fig. 5-12A illustrates an AC-coupled master volume pot. C_1 and C_2 are the

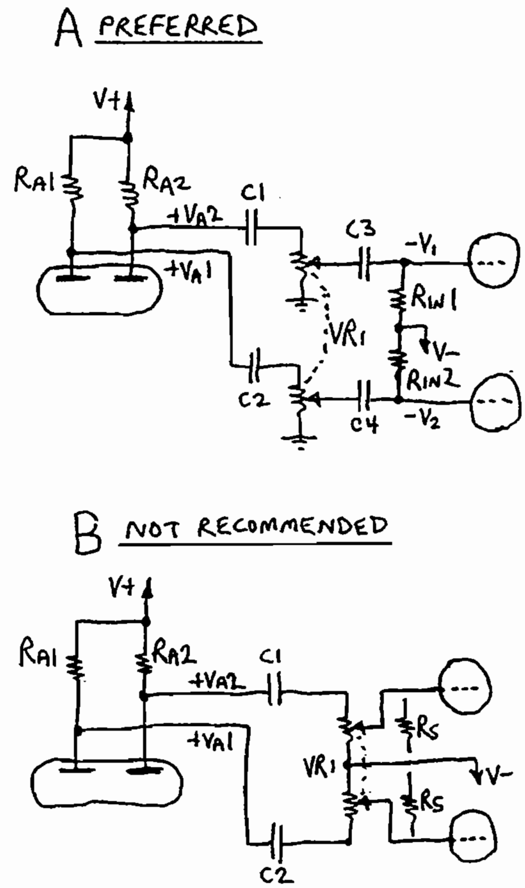

Fig. 5-12: Typical Power Amp Master Volumes

original coupling caps from R_A to R_{IN}. These block the high positive voltages present on the anodes of the input stage, from VR_1.

To block the negative bias voltage on the grids of the output tubes from the master volume control, we must add C_3 and C_4. These caps are effectively in series with C_1 and C_2, and could have a negative influence on the low-frequency response of the amp. Capacitors in series behave as:

$$C_{TOTAL} = \frac{C_1 \times C_2}{C_1 + C_2}$$

C_{TOTAL} can never be larger than the smaller of the two capacitance values. So, to avoid excess change in the low-frequency response, the new caps should be at least ten times the value of the original caps. Where C_1 and C_2 must have a voltage rating suitable to block V+, C_3 and C_4 must only block V-. C_3 and C_4 could have 100V ratings to provide an ample safety margin, while still allowing the use of plastic caps.

In Fig. 5-12B, we see a way to eliminate C_3 and C_4. Several allegedly knowledgable people have suggested this method, but it is VERY DANGEROUS, and we do not recommend it! The method involves replacing the bias feed resistors (R_{IN1} and R_{IN2}) for the output tubes with the dual pot. In one suggestion, the wipers of the pots are tied to the power tube control grids. The contact integrity of the control wiper on the resistive element is not guaranteed, and any intermittent contact interrupts the bias feed to the output tubes. When this voltage disappears, the tube is inclined to draw as much current as possible, which will damage both the tube and the output transformer.

To avoid this situation, we may install the safety resistors R_S from the bias supply end of the pot to the wiper. If the wiper intermits, R_S should feed V- directly to the output tube. This should result in a current reduction and protect the transformer. Another solution is to wire the pot backwards, so that the resistive element replaces R_{IN1} and R_{IN2}. The wipers are connected to C_1 and C_2.

Any DC current flow through a potentiometer will introduce DC noise. Pots become scratchy with normal use, and this is exacerbated by the presence of DC. We also run into potential low-frequency roll-offs with the reverse-wired connection, despite its slightly safer operation. Neither method is ideal, since they involve tampering with the critical bias components. In this regard, we must strongly advise against this type of installation.

The two other types of power amp master volume involve altering the operating parameters of the power amp input stage. One of these methods works very well, while the second is not so successful. Both are explained in detail in the Power Amps chapter.

DISTORTION GENERATING TECHNIQUES

There are three techniques used to generate distortion in guitar preamps, involving, respectively: 1) the optimization of bias levels of individual gain stages for specific harmonic enhancement; 2) cascaded gain stages to achieve cumulative distortion artifacts; and 3) signal bounding techniques to change the shape of the signal dramatically in one step. We will examine each in turn.

1) Gain Stage Optimization

We know from the preceding chapters that we can vary the parameters of the individual gain stages widely. By altering R_K, we change the plate current and q-point.

In Table 4-1, we saw that the signal output capability varies with I_K and R_A. The value of I_K has the ultimate control over the dynamic range of the stage. If I_K is 1mA, and V_A at idle is V+/2, then the peak signal output is V+/2. If R_A is held constant but I_K is reduced by increasing R_K, then V_A at idle will rise. Suppose V_A now equals 3V+/4. The dynamic range for clean signals is restricted to V+/4 as a peak value. However, although the positive signal excursion is limited to V+/4, the negative excursion is three times as large, at 3V+/4.

To alter I_K, we changed the cathode resistor