Subject: Re: Fixed/cathode bias and AC
Posted by Thermionic on Wed, 20 Jul 2005 05:26:06 GMT
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Howdy manualblock,A note here on grid leak bias. "Grid leak bias" and "grid bias" are different. Grid leak bias uses the time constant of a resistor and capacitor to charge and maintain a negative voltage on the grid. Grid bias, also called fixed or adjustable bias (no, there's no contradiction there, it just seems like it) uses an actively applied negative DC voltage on the control grid to set the operating point. It's called fixed because it's "fixed" and unchanging, completely independent of the tube's operation. It's called "adjustable" because the negative voltage can be varied to set the desired operating point.Cathode bias and grid bias each have advantages and disadvantages. Cathode bias takes away from the plate to cathode voltage, is higher distortion, is only truly practical for Class A operation, can create a lot of waste heat in certain instances, and yields less power than grid bias. But, most agree it's sweeter sounding, and as you mentioned is self-regulating. Some people will most definitely prefer the sound of one or the other, depending on personal tastes. By bypassing the cathode resistor, what you are actually doing is eliminating the effect of the AC signal on the cathode. Grid bias has a firmer sound, lower distortion, is easily adjustable, yields more power, and allows for full power output in Class AB operation. But, it adds complexity to the circuit with the necessary bias supply, and a failure of the bias supply will instantly cause the power tubes to go thermonuclear. Plus, the bias must of course be adjusted properly for best performance. Most all guitar amps are Class AB and high powered, so they're grid biased, and some audiophiles prefer the harder, cleaner sound of grid bias as well.Barring the phenomenon known as "rectification effect," if the stage is operating in true Class A, the signal has just about zero effect on the stage's current draw, since the tube never cuts off and the AC signal's average voltage is zero. The nominal current draw remains quite constant from idle to clipping. The plate current swings high and the plate voltage low on the positive alternation of the input signal. It's a positive voltage on the grid, which "neutralizes" the negative bias voltage, thereby reducing the bias and increasing conduction. On the negative alternation of the input signal, the negative signal voltage is added to the negative bias voltage to make the grid more negative. That of course increases the bias, thereby decreasing conduction, and making the plate current swing low and the plate voltage swing high. Here is Ohm's Law at work again, with the voltage going high with decreased current across the plate resistance, and voltage swinging low with increased current across the plate resistance. An interesting phenomenon is that a Class A stage actually runs cooler at it's full, unclipped output than it does at idle. The actual amplified signal wattage goes into the load, so instead of burning up all that power as heat, it's subtracted from the waste heat.If the stage is biased so that it never goes into cutoff on the negative swing of the AC signal input cycle at the full, unclipped output, it is said to be Class A operating class. If the stage is biased so that it still conducts for appreciably more than 180 degrees before going into cutoff on the negative swing of the AC signal input cycle at the full, unclipped output, it is said to be Class AB operating class. If the stage is biased so that it conducts for exactly 180 degrees before going into cutoff on the negative swing of the AC signal input cycle at the full, unclipped output, it is said to be Class B operating class.Bias method and output stage topology are independent of operating class, and vice versa. You can have a grid biased Class A stage or a cathode biased Class AB stage, or a push pull Class A stage. You can have a single ended Class AB or Class B stage, although they're obviously not useful for audio because they don't amplify the full signal. They're used in radio transmitters.Thermionic