10.5.4 Push-pull class-AB operation, push-pull class-D

A push-pull class-A power stage operates in push-pull class-A mode for small drive levels, and for high drive levels in push-pull class-B mode – that far, literature agrees. In detail, however, differences appear and we find three definitions that we will designate *old*, *alternative*, and *new*. According to the **old definition**, the class-AB operation is a class-B operation with a somewhat enlarged bias-current; there is a distinction between AB_1 (without grid-current) and AB_2 (with grid-current). A specific guideline where to set the operating point does not exist; it may be located (in the output characteristic) "somewhere between" the A-operating point and the B-operating point. This has often led to defining the location of the AB-operating point exactly in the middle between the two (A- and B-) operating points. Example: if the bias-current is 50 mA for class-A operation and 10 mA for class-B operation, then it must be 30 mA for class-AB (according to the datasheet).

The literature from "back in the day" does not specify whether the bias-voltage at the grid of the class-AB circuit is generated "automatically" via a resistor at the cathode, or via a separate voltage source. The **alternative definition** seeks to be more precise. In the class-AB amplifier, the operating point can shift dependent on the input signal: with increasing drive level, the cathode-current will become more and more asymmetric (due to the non-linearity of the characteristic). Consequently, the voltage-drop across the cathode resistor (bridged by a capacitor) increases and shifts the average grid/cathode-voltage more into the negative. That way, class-A operation changes into class-B operation as drive levels increase (**Fig. 10.5.13**). The alternative definition moreover designates all those power stages with the term **push-pull class-D amplifier** that generate their bias voltage at the grid (exclusively) via a separate voltage source, and that feature an increased bias current relative to the class-B operation [e.g. H. Schröder, W. Knobloch]. This definition does not generally consider the polarizations of the coupling capacitor also leading to a drive-level dependent shift of the operating point.

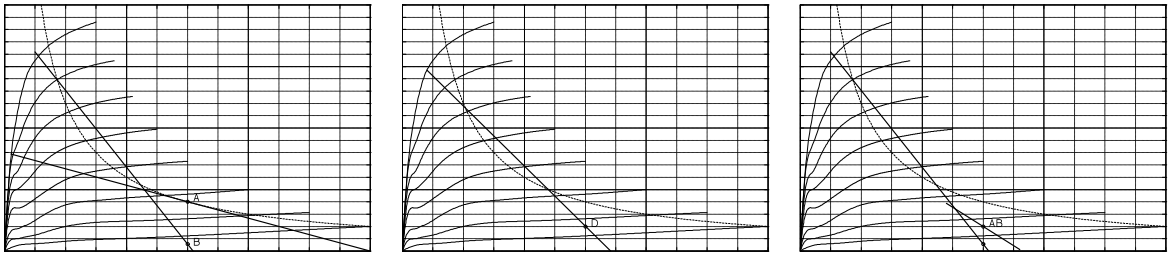

Fig. 10.5.13: Output characteristics and operating point: push-pull class-A and –B amplifiers (left), push-pull class-D amplifier according to the alternative definition (center), push-pull class-AB amplifier according to the alternative definition (right).

Under the moniker class-D operation, the **new definition** considers something entirely different: it designates a switching amplifier (using pulse-width modulation PWM) with the term D. According to the new definition, class-AB operation is a class-B operation with increased bias-current and a fixed operating point. Presumably, this "new" terminology came in when bipolar transistors started to supersede power tubes. Setting the operating point for transistor circuits is done according to different criteria compared to tubes; there is no drive-dependent operating point anymore, and the meaning of the terms changed.

In contrast to HiFi power amplifiers, the minimization of distortion does not have priority in typical guitar amps. For this reason, we see a domination of old-school class-AB power amps with the bias-current set according to special criteria (Chapter 10.5.8). The AC-30 also belongs to this group, and *not* to the group of push-pull class-A circuits (Chapter 10.5.12).

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