AX 1 Full-wave gas-filled rectifying valve

The AX 1 is a full-wave gas-filled rectifying valve for use in the smaller class of amplifiers.

FILAMENT RATINGS

Heating: direct, by A.C.
Filament voltage: \( V_f = 4.0 \text{ V} \)
Filament current: \( I_f = 2.4 \text{ A} \)

MAXIMUM RATINGS

Secondary (A.C.) voltage of the power transformer on no load: \( V_{tr} = \text{max.} \ 2 \times 500 \text{ V}_{ef} \)
D.C. output: \( I_o = \text{max.} \ 125 \text{ mA} \)
Voltage drop in the valve: \( V_{arc} = \text{max.} \ 15 \text{ V} \)
Capacitance of the capacitor across the input of the smoothing circuit: \( C = \text{max.} \ 64 \mu \text{F} \)

When a capacitor is connected across the input of the smoothing circuit:

The ohmic resistance in the D.C. circuit, with \( C = 64 \mu \text{F} \): \( R_t = \text{min.} \ 200 \text{ ohms} \)
The ohmic resistance in the D.C. circuit, with \( C = 32 \mu \text{F} \): \( R_t = \text{min.} \ 150 \text{ ohms} \)
The ohmic resistance in the D.C. circuit, with \( C = 10 \mu \text{F} \): \( R_t = \text{min.} \ 100 \text{ ohms} \)

KEY TO SYMBOLS

The ohmic resistance \( R_t \) in the D.C. circuit, when the smoothing circuit commences with a capacitor, constitutes the ohmic resistance of the secondary winding of the transformer together with that of the transformer primary, i.e. \( R_t = R_a + n^2 \ R_p \). If the first component of the smoothing circuit is a choke, however, this resistance value must be augmented to the extent of the ohmic resistance of that choke:

\[
R_t = R_L + R_a + n^2 \ R_p
\]

The voltage delivered may be calculated from the expression:

\[
V_o = 0.45 \ V_{tr} - I_o R_t - V_{arc}, \quad \text{in which} \quad V_{tr} = \text{the effective alternating voltage of the secondary winding of the transformer, for example} \ V_{tr} = 2 \times 500 \text{ V.}
\]

The inductance of the choke should be at least equal to \( \frac{R_a}{1,000} \) or \( \frac{V_o}{V_i} \) (\( V_o \) in volts and \( I_o \) in mA), where \( I_o \) is taken to be the lowest value occurring; in an amplifier having two output valves in a balanced output stage, this will be the current flowing in the amplifier without excitation. From this it will be seen that with a 12-henry choke, the characteristics begin to flatten out only at \( I_o = 30 \text{ mA} \) approx. At lower current values the loading curves rise steeply, owing to the effect of the smoothing capacitor. A choke having a higher inductance will produce straight characteristics down to lower current values, for instance 42 henries — 10 mA.

Fig. 4 shows the loading characteristics of the AX 1 used in a circuit in which a capacitor is the first smoothing element, and comparison of these with the corresponding curves for a high vacuum valve such as the AZ 4 shows clearly that the former are
very much flatter with a low value of the internal resistance \( R_t \); also that the direct voltage is higher for the same alternating input. The direct voltages obtained from a smoothing circuit in which a capacitor is the first component are, further, higher than those in a circuit containing a choke as the first smoothing element.

**Fig. 3**

Loading curves (D.C. voltage as a function of the current delivered) for various values of the resistance \( R_t = (R_L + R_a + n^2 R_p) \), in a smoothing circuit commencing with a choke. The voltages at lower current values with a choke of 12 or 42 henries are shown by broken lines.

**Fig. 4**

Loading curves (D.C. voltage as a function of the delivered current) for various values of the total resistance \( R_t = (R_s + n^2 R_p) \), in a smoothing circuit commencing with a capacitor.