EBL 21 Double-diode output pentode

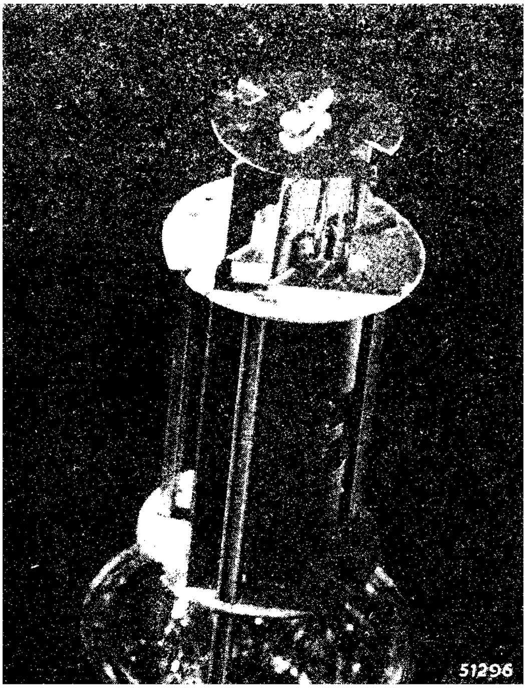

Fig. 1
Internal assembly of the double diode pentode EBL 21.

The EBL 21 is a double-diode output pentode. The sensitivity of the pentode system is extremely high; the mutual conductance is 9.5 mA/V. The maximum anode dissipation is 11 W.

Since the dimensions of the electrode system are considerably smaller than those of the earlier EBL 1, the heater current consumed is accordingly lower: at 6.3 V the heater current of the EBL 21 is only 0.8 A, as against 1.18 A in the case of the EBL 1. In many cases it will be possible, in order to increase the A.F. sensitivity of the receiver, to couple an A.F. amplifier between the diode and the pentode of the EBL 21; this is only possible for a valve of this class when the diode-anode employed for the detection is sufficiently free from ripple to allow of adequate A.F. gain. In the design of the EBL 21 it was made a condition that an A.F. gain factor of 60 between the detector diode and the grid of the output pentode should be obtainable on normal feed by means of a mains-operated heater transformer [1]). In this way the triode section of the ECH 21, coupled as A.F. amplifier, or the pentode EF 22, may be interposed between the diode and pentode sections of this valve, in the second instance with more or less intensive feedback. A great deal of care has accordingly been paid to the design of the diode section of the valve. Efficient screening and a careful choice of sequence in the electrode connections have resulted in a minimum of ripple voltages at the diode anode d_2 used for detection.

The EBL 21 is also very suitable for Class AB push-pull output

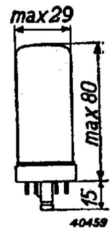

Fig. 2.
Dimensions in mm.

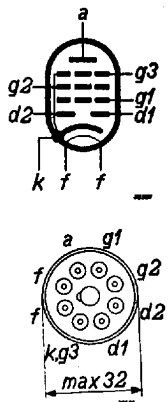

Fig. 3
Arrangement and connections of the electrodes.

[1]) This figure should be used for guidance only, since a higher gain is possible if greater ripple be permitted. When power is obtained from a vibrator, a gain factor of 15 should be regarded as the limit, since in this case a greater amount of ripple must be expected.

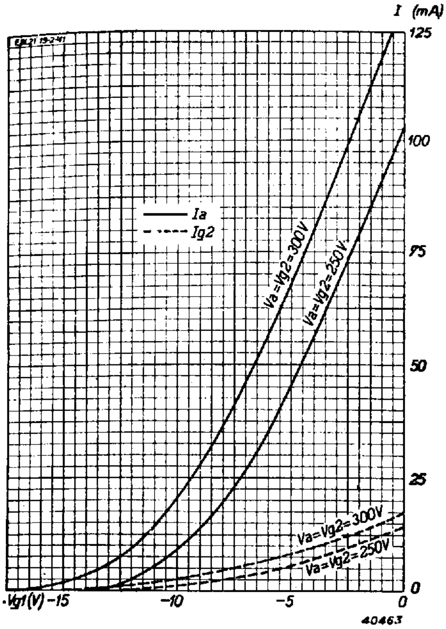

Fig. 4
Anode and screen current as a function of grid bias at $Va = Vg_2 = 250$ V and $= 300$ V.

stages. Two of these valves in conjunction with a triode heptode ECH 21 coupled as A.F. amplifier and phase inverter give a very high quality output stage having an output of about 13 W. This is an ideal final stage for very high grade receivers. Moreover, 4 diodes of the EBL 21 are then available for employment, for instance, in a 3 diode circuit. To prevent interaction between the diode and pentode sections, the capacitances between the diode anodes and the anode and grid of the pentode have been suppressed as much as possible (see capacitance values included in the operating data). Technical data of this valve are given below:

HEATER RATINGS

Heating: indirect; alternating current; parallel supply.

Heater voltage. . . . . . $V_f = 6.3$ V
Heater current. . . . . . $I_f = 0.8$ A

CAPACITANCES

a) Pentode section
$C_{ag_1} < 1.4$ pF

b) Diode sections
$C_{d_1k} = 1.8$ pF
$C_{d_2k} = 2.0$ pF
$C_{d_1d_2} < 0.15$ pF

c) Between diode and pentode
$C_{d_1g_1} < 0.1$ pF $\quad C_{d_1a} < 0.06$ pF
$C_{d_2g_1} < 0.05$ pF $\quad C_{d_2a} < 0.02$ pF

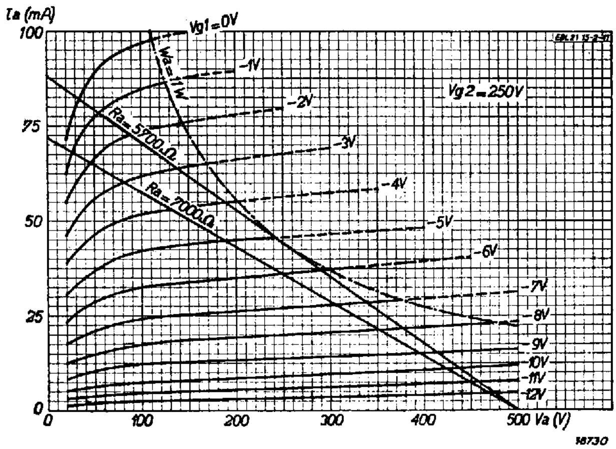

Fig. 5
Anode current as a function of anode voltage at $Vg_2 = 250$ V, with grid bias as parameter. In the figure the load lines in respect of $Ra = 5700$ Ohms (11 W operation) and $Ra = 7000$ Ohms (9 W operation) are also shown.

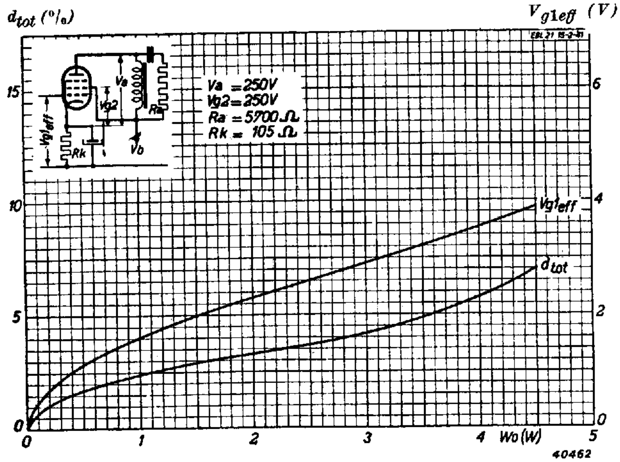

Fig. 6
Total distortion and required alternating grid voltage as a function of output power at $Va = Vg_2 = 250$ V and Ra = 5700 Ohms (11 W operation).

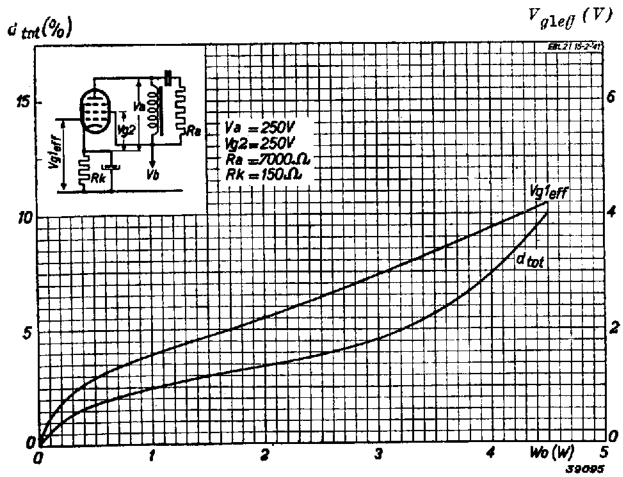

Fig. 7
Total distortion and required alternating grid voltage as a function of output power at $Va = Vg_2 = 250$ V and Ra = 7000 Ohms (9 W operation).

OPERATING DATA FOR THE PENTODE SECTION employed as single output valve.

Anode voltage	V_a	= 250 V	250 V
Screen grid voltage	V_{g2}	= 275 V	250 V
Cathode resistance	R_k	= 125 Ohms	150 Ohms
Grid bias	V_{g1}	= —6.2 V	—6 V
Anode current	I_a	= 44 mA	36 mA
Screen grid current	I_{g2}	= 5.8 mA	4.5 mA
Mutual conductance	S	= 9.5 mA/V	9.0 mA/V
Internal resistance	R_i	= 50,000 Ohms	50,000 Ohms
Optimum load	R_a	= 5700 Ohms	7000 Ohms
Output power at max. modulation	W_o	= 5.5 W	4.5 W
Total distortion	d_{tot}	= 10 %	10 %
Required alternating grid voltage for max. modulation	V_{g1eff}	= 4.5 V	4.2 V
Sensitivity (W_o = 50 mW)	V_{g1eff}	= 0.30 V	0.35 V
Gain factor: screen grid — grid 1	μ_{g2g1}	= 23	23

OPERATING DATA for Class AB push-pull output (2 valves)

Anode voltage	V_a	= 300 V
Screen grid voltage	V_{g2}	= 300 V
Cathode resistance	R_k	= 130 Ohms
Optimum load	R_{aa}'	= 9000 Ohms
Standing anode current	I_{ao}	= 2 × 30 mA
Anode current at max. modulation	I_{amax}	= 2 × 36 mA
Standing screen grid current	I_{g2o}	= 2 × 3.8 mA
Screen grid current at max. modulation	I_{g2max}	= 2 × 6.5 mA
Max. output power	W_{omax}	= 13.2 W
Total distortion at max. output power	d_{tot}	= 1.8 %
Required alternating grid voltage, per grid	V_{g1eff}	= 7.0 V
Sensitivity (W_o = 50 mA)	V_{g1eff}	= 0.3 V

MAXIMUM RATINGS for the pentode section

Anode voltage, in cold condition	V_{ao}	= max. 550 V
Anode voltage	V_a	= max. 300 V
Anode dissipation	W_a	= max. 11 W
Screen grid voltage, in cold condition	V_{g2o}	= max. 550 V
Screen grid voltage	V_{g2}	= max. 300 V
Screen grid dissipation, unmodulated valve (V_{g1eff} = 0 V)	W_{g2}	= max. 1.7 W
Screen grid dissipation at max. modulation (W_o = max.)	W_{g2}	= max. 3.5 W
Cathode current	I_k	= max. 60 mA
Grid current commences at (I_{g1} = + 0.3 μA)	V_{g1}	= max. —1.3 V
Max. external resistance between control grid and cathode	R_{g1k}	= max. 1 M Ohm
Max. external resistance between heater and cathode	R_{fk}	= max. 5000 Ohms
Max. potential between heater and cathode	V_{fk}	= max. 50 V

MAXIMUM ratings for the diode section

Peak voltage on diode 1	V_{d1}	= max. 200 V
Peak voltage on diode 2	V_{d2}	= max. 200 V
Max. direct current through resistor of diode 1	I_{d1}	= max. 0.8 mA
Max. direct current through resistor of diode 2	I_{d2}	= max. 0.8 mA
Diode current commences (I_{d1} = + 0.3 μA)	V_{d1}	= max. —1.3 V
Diode current commences (I_{d2} = + 0.3 μA)	V_{d2}	= max. —1.3 V

APPLICATIONS

The following points should be borne in mind in the applications of this valve. (I) Grid bias should be obtained exclusively by use of a cathode resistance. If required, so-called semi-automatic bias may be applied, but only when the cathode current of this valve exceeds 50 % of the total current flowing through the resistance used to provide the bias: the grid leak should then be correspondingly lower in value than the indicated maximum value. (II) Leads to the electrodes should be kept as short as possible. (III) To avoid parasitic oscillation, which, due to the high mutual conductance, very quickly sets in, a damping resistance of, say, 1000 Ohms may be included in the control grid lead; this resistance is to be mounted as closely as possible to the electrode concerned and must not be bypassed by a condenser.

For use of the EBL 21 with feedback, in conjunction with the ECH 21, see also p. 17, in connection with the ECH 21.

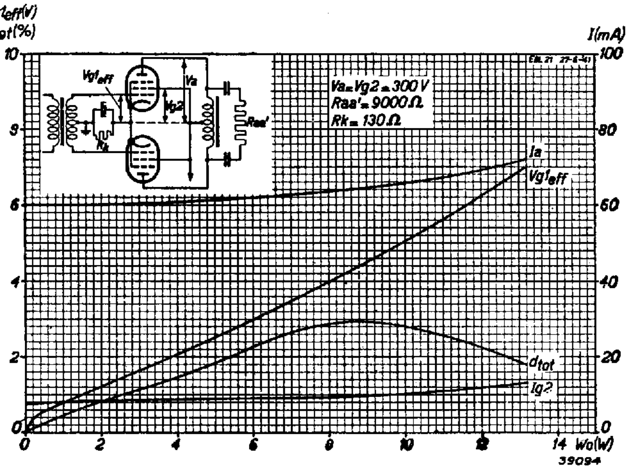

Fig. 8
Total anode and screen current, total distortion and required alternating grid voltage (per grid) as a function of output power of two valves EBL 21 in a class AB push-pull circuit, at $Va = Vg_2 = 300$ V.