CBL 1 Double-diode output pentode

The CBL 1 is a combination of double-diode and steep-slope pentode for A.C./D.C. receivers, both units being housed in a common envelope; the cathode is also common to both.
The pentode unit is comparable with the high-mutual-conductance output pentode CL 4.
In view of the considerable heater power required, the heater voltage, with a current of 200 mA, is 44 V. The two diodes are mounted below the pentode section, on each side of the cathode, with the anodes, which are almost semi-cylindrical in shape, level with each other; the diodes are, therefore, electrically identical. Further, the diode unit is separated from the pentode section by a screen and, to ensure that the grid of the pentode cannot be affected in any way by the diodes, and also to prevent hum, the control-grid connection is taken out to a top cap on the envelope.

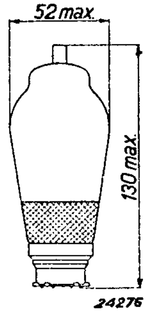
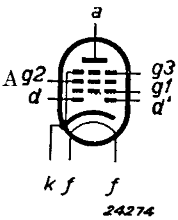


Fig. 1
Dimensions in mm.

HEATER RATINGS

Heating: indirect by A.C. or D.C., series supply.
Heater voltage . . . . V_f = 44 V
Heater current . . . . I_f = 0.200 A



CAPACITANCES

C_{ag1}	< 1.0 μμF	$C_{d'f}$	< 0.5 μμF
$C_{d'a}$	< 0.2 μμF	C_{df}	< 1 μμF
C_{da}	< 0.4 μμF	$C_{d'k}$	= 3.5 μμF
$C_{d'g1}$	< 0.15 μμF	C_{dk}	= 3.6 μμF
C_{dg1}	< 0.15 μμF	$C_{d'd}$	< 0.25 μμF

OPERATING DATA

Anode voltage	V_a	= 200 V
Screen-grid voltage	V_{g2}	= 200 V
Cathode resistor	R_k	= 170 ohms
Grid bias	V_{g1}	= −8.5 V
Anode current	I_a	= 45 mA
Screen-grid current	I_{g2}	= 6 mA
Mutual conductance	S	= 8 mA/V
Internal resistance	R_i	= 40,000 ohms
Load resistor	R_a	= 4,500 ohms
Output power with 10 % distortion	W_o	= 4 W
Alternating input voltage for 4 W output	V_i	= 5 V_{eff}
Sensitivity (W_o = 50 mW)	V_i	= 0.5 V_{eff}

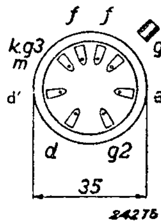


Fig. 2
Arrangement of electrodes and base connections

MAXIMUM RATINGS

Pentode section:

V_{ao}	= max. 550 V
V_a	= max. 250 V
W_a	= max. 9 W
V_{g2o}	= max. 550 V
V_{g2}	= max. 250 V
W_{g2} ($V_i = 0$)	= max. 1.2 W
W_{g2} (W_o = max)	= max. 2 W
I_k	= max. 70 mA
V_{g1} ($I_{g1} = + 0.3\ \mu$A)	= max. —1.3 V
R_{g1k}	= max. 1 M ohm
R_{fk}	= max. 5,000 ohms
V_{fk}	= max. 175 V [1])

[1]) Direct voltage or effective value of alternating voltage

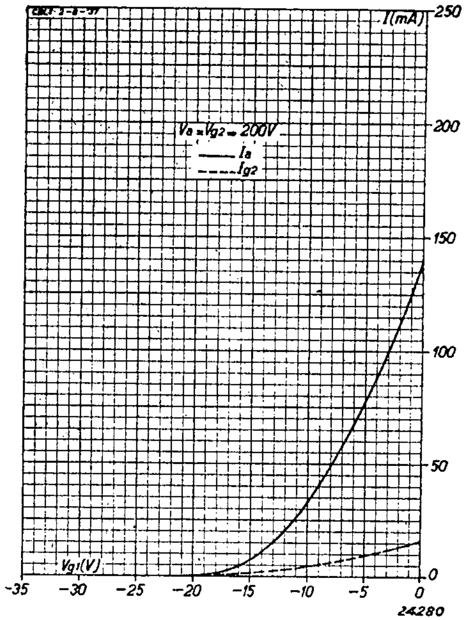


Fig. 3
Anode and screen current as a function of the grid bias at $V_a = V_{g2} = 200$ V.

Diode section:

Voltage on anode of diode	V_d	$= V_d'$	= max. 200 V
Diode current	I_d	$= I_d'$	= max. 0.8 mA
Diode voltage at diode current start ($I_d = I_d' = + 0.3\ \mu$A)	V_d	$= V_d'$	= max. -1.3 V

The characteristics relating to the increase in the voltage ($\triangle$ V) across the grid leak, as plotted against theun modulated R.F. voltage, and for the A.F. voltage V_{LF} across the grid leak as a function of the 30 % modulated R.F. voltage applied to one of the diodes, are exactly the same as those of the EB 4, so for these data the reader is referred to the last-mentioned valve.

Grid bias must be provided only by means of a cathode resistor; semi-automatic bias is also permissible, but the cathode current of the valve must then be definitely in excess of 50 % of the total current passing through the resistor producing the voltage drop.

In general, the capacitance of the decoupling capacitor should be at least 2 μF, but for better reproduction of the lower audio frequencies an electrolytic capacitor of 25 tot 50 μF capacitance is better. Leads to the valve contacts should be kept as short as possible and a resistor of about 1000 ohms in the control-grid lead will often be found necessary.

It should be observed that any A.F. amplification between the detector diode and the pentode section of the valve may possibly give rise to trouble due to hum or microphony. Any such amplification should therefore not exceed at most 15 times.

Tables I and II provide an idea of the power delivered, having regard to the voltage drop across the output transformer. The theoretical circuit diagrams employed to obtain the values given in these tables are depicted in the figures relating to the EL 2 valve.

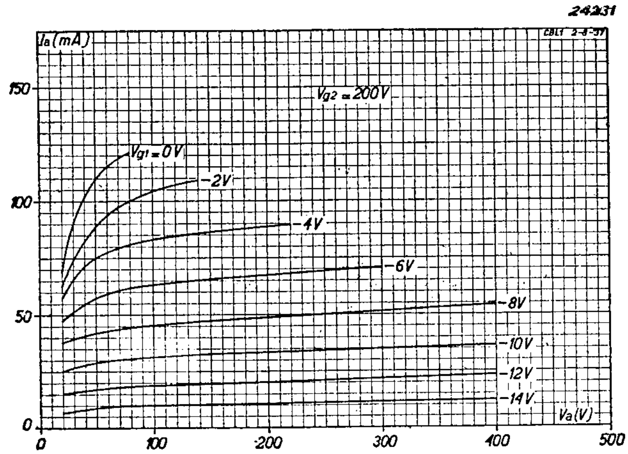


Fig. 4
Anode current as a function of the anode voltage at $V_{g_2} = 200$ V, for different values of grid bias.

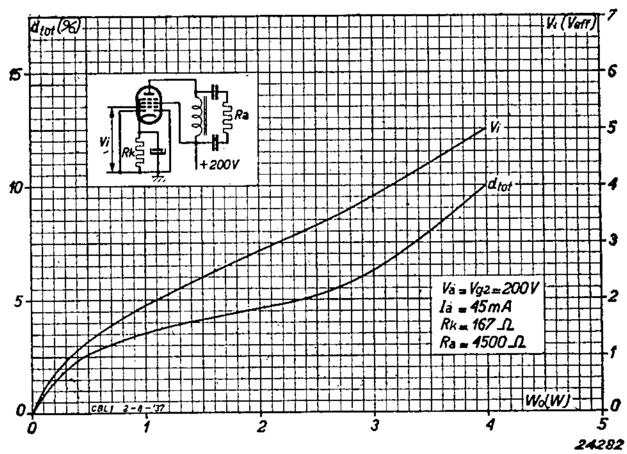


Fig. 5
Alternating grid voltage and total distortion as functions of the output power.

TABLE I

Output power and grid input voltage as functions of the voltage drop in the output transformer, on an effective anode voltage of 200 V D.C.

$I_a = 45$ mA

Effective D.C. volts on the anode Va (V)	Supply voltage Vb (V)	Screen-grid series resistor Rg_2 (ohm)	Voltage drop across output transf. Vtr (V)	With 10 % distortion: Ext. anode res. Ra (ohm)	With 10 % distortion: Alt. grid volts Vi (Veff)	With 10 % distortion: Output power Wo (W)	With 5 % distortion: Ext. anode res. Ra (ohm)	With 5 % distortion: Alt. grid volts Vi (Veff)	With 5 % distortion: Output power Wo (W)	Loss in power in output transf. $\frac{Wtr \times 100}{Wo}$ (%)
200	200	0	0	4,500	4.4	4.0	4,500	2.7	2.1	—
200	210	1,800	10	4,500	4.3	3.7	4,500	2.5	1.8	10
200	220	3,400	20	4,500	4.25	3.6	4,500	2.4	1.6	20
200	230	5,000	30	4,500	4.2	3.5	4,500	2.3	1.5	30
200	250	8,500	50	4,500	4.1	3.3	4,500	2.3	1.5	50

TABLE II

Output power and grid input voltage as functions of the voltage drop in the output transformer when the screen and supply voltage = 200 V.

$I_a = 45$ mA

Effective D.C. volts on the anode Va (V)	Supply voltage Vb (V)	Screen-grid voltage Vg_2 (V)	Voltage drop across output transf. Vtr (V)	With 10 % distortion: Ext. anode res. Ra (ohm)	With 10 % distortion: Alt. grid volts Vi (Veff)	With 10 % distortion: Output power Wo (W)	With 5 % distortion: Ext. anode res. Ra (ohm)	With 5 % distortion: Alt. grid volts Vi (Veff)	With 5 % distortion: Output power Wo (W)	Loss in power in output transf. $\frac{Wtr \times 100}{Wo}$ (%)
200	200	200	0	4,500	4.4	4.0	4,500	2.7	2.1	0
190	200	200	10	4,200	4.4	3.5	4,200	2.5	1.85	11
180	200	200	20	4,000	4.3	3.4	4,000	2.6	1.75	22
170	200	200	30	3,800	4.3	2.9	3,800	2.7	1.65	35
150	200	200	50	3,350	4.2	2.6	3,350	2.9	1.65	66

Note: The loss of power due to the resistance of the output transformer is calculated on the assumption that $R_{prim} = n^2 R_{sec}$.