ELL 1 Double Output Pentode

This valve was specially designed for car radio receivers and consists of two output pentode units enclosed in a single envelope, each unit having an anode dissipation of 4.5 W. From the point of view of its operation from the car battery, both the heater and the anode current have been kept as low as possible; in consequence, the mutual conductance of each unit invidually is not so very high, viz. 1.7 mA/V. The two valve units have been housed in a common bulb for use in balanced circuits, in order that the power supplied to the anode shall be utilized to the best possible advantage; with 3.5 % distortion, the output power is 4.5 W.
The two cathodes, screen grids and suppressors are inter-connected within the valve.

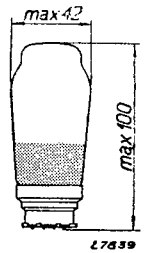

Fig. 1
Dimensions in mm.

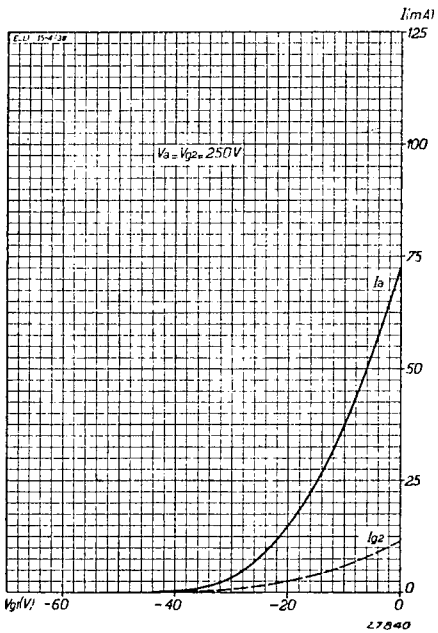

Fig. 3
Anode and screen-grid currents of a single pentode unit of the ELL 1 as a function of the grid bias, at $Va = Vg_2 = 250$ V.

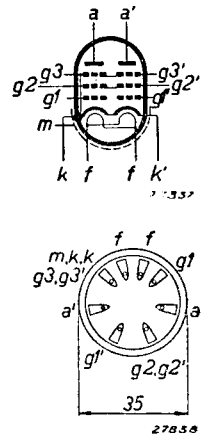

Fig. 2
Arrangement of electrodes and base connections.

HEATER RATINGS

Heating: indirect by battery current, rectified A.C. or D.C.; parallel supply.
Heater voltage . . . . . $V_f = 6.3$ V
Heater current . . . . . $I_f = 0.45$ A

CAPACITANCES

Anode-grid system 1 . . . . . $C_{ag_1} < 1.3$ $\mu\mu$F
Anode-grid system 2 . . . . . $C_{a'g_1'} < 1.3$ $\mu\mu$F

STATIC RATINGS (PER SYSTEM)

Anode voltage	V_a	= 250 V
Screen-grid voltage	V_{g2}	= 250 V
Grid bias	V_{g1}	= —19.5 V
Anode current	I_a	= 15 mA
Screen-grid current	I_{g2}	= 2.5 mA
Mutual conductance	S	= 1.7 mA/V
Internal resistance	R_i	= 110,000 ohms

OPERATING DATA FOR BALANCED CIRCUIT

Anode voltage	V_a	= 250 V
Screen-grid voltage	V_{g2}	= 250 V
Common cathode resistor	R_k	= 560 ohms
Grid bias	V_{g1}	= —19.5 V
Anode current (without signal)	I_{ao}	= 2 × 15 mA
Anode current at max. modulation	$I_{a\,max}$	= 2 × 17 mA
Screen current (without signal)	I_{g2o}	= 2 × 2.5 mA
Screen current at max. modulation	$I_{g2\,max}$	= 2 × 5 mA
Load resistor between anodes	R_{aa}	= 16,000 ohms
Output power	W_o	= 4.5 W
Total distortion	d_{tot}	= 3.5 %
Alternating input voltage per grid	V_i	= 19 V_{eff}

MAXIMUM RATINGS

Anode voltage in cold condition	V_{ao}	= max. 550 V
Anode voltage	V_a	= max. 250 V
Anode dissipation (per system)	W_a	= max. 4.5 W
Screen-grid voltage in cold condition	V_{g2o}	= max. 550 V
Screen-grid voltage	V_{g2}	= max. 275 V
Screen dissipation per system ($V_i = 0$)	W_{g2}	= max. 0.7 W
Screen-grid dissipation per system (W_a = max.)	W_{g2}	= max. 1.5 W
Cathode current per system	I_k	= max. 30 mA
Grid voltage at grid current start ($I_{g1} = +0.3\,\mu A$)	V_{g1}	= max. —1.3 V
External resistance between heater and cathode	R_{fk}	= max. 5,000 ohms
Voltage between heater and cathode	V_{fk}	= max. 50 V

The data and characteristics given with respect to this valve refer only to a resistance-free source of voltage; in general, car radios are driven by the car battery by means of a vibrator and the latter, together with the transformer and anti-static circuit, have a fairly high resistance which will somewhat reduce the maximum obtainable output power; the internal resistance, therefore, should be as low as possible. In the case of an internal resistance in the supply unit of, say, 1,600 ohms, with the pre-amplifier valves taking 20 mA, the following values will furnish an output of 4.75 W, with 3 % distortion:

Internal resistance of the anode-feed source	R_b	= 1,600 ohms
Current consumption of amplifying valves	I_q	= 20 mA
Anode voltage	V_a	= 250 V
Screen voltage	V_{g2}	= 250 V
Cathode resistor	R_k	= 600 ohms
Anode current (without signal)	I_{ao}	= 2 × 15 mA
Anode current at max. modulation	$I_{a\,max}$	= 2 × 16.5 mA

Screen current (without signal)	I_{g2o}	= 2 × 2.5 mA
Screen current at max. modulation	$I_{g2\,max}$	= 2 × 4.7 mA
Load resistor between anodes	$R_{aa'}$	= 16.000 ohms
Output power	W_o	= 4,75 W
Distortion	d_{tot}	= 3 %
Alternating input voltage, per grid	V_i	= 18 V_{eff}

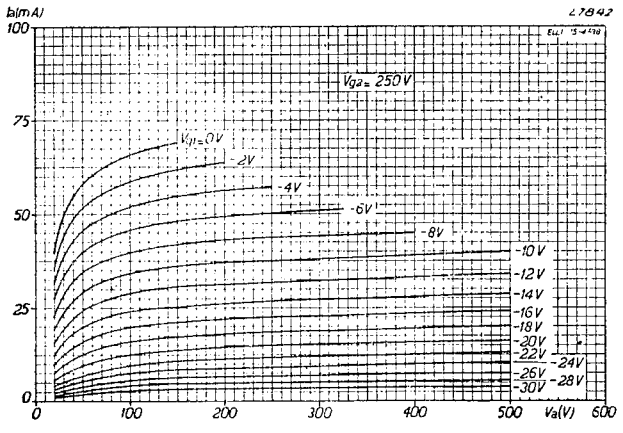

Fig. 4
Anode current of one pentode unit of the ELL 1 as a function of the anode voltage for different values of grid bias, at Vg_2 = 250 V.

The output obtainable in respect of other values may be estimated from the above figures.

The maximum anode voltage is 250 V, which on an average car battery voltage of 6.3 V must definitely not be exceeded; actually the use of car batteries may give rise to considerably greater overloads than are usually met with in the case of mains operation, since, when the battery is charging, voltages of 8 to 9 V may occur, with consequent detriment to the life of the valves. With automatic bias, however, over-voltages on the anode and screen grid of 20 % are permissible. The maximum screen voltage of this valve being 275 V, the voltage drop across the output transformer is allowed for, and there is no necessity for a reduction in anode voltage.

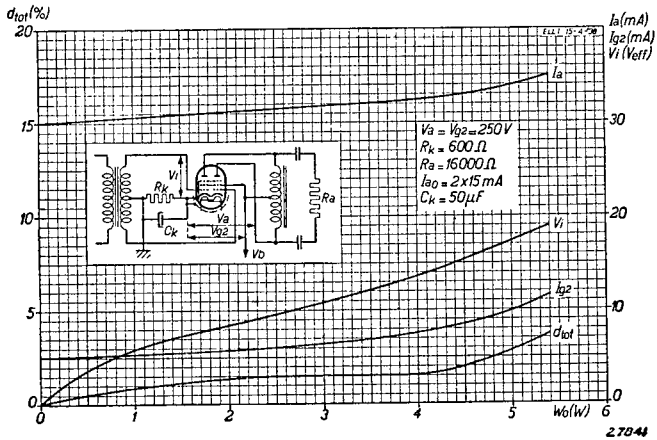

Fig. 5
Total distortion *d*tot, alternating grid voltage Vi, total anode current Ia and total screen current Ig_2, as functions of the output power of the ELL 1 when used in a balanced output stage with automatic grid bias.