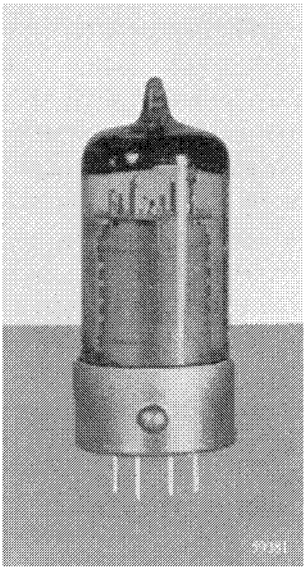
EL 42 Low-consumption output pentode



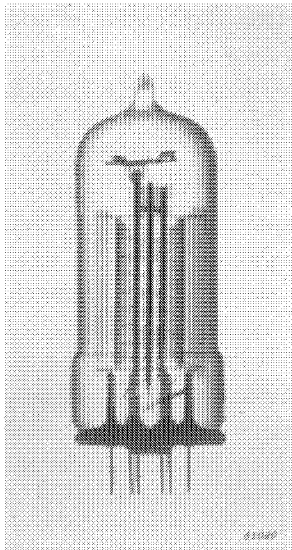


Fig. 1
Normal and X-ray photographs of the EL 42 (approximately actual size).

The EL 42 is an indirectly heated output valve intended primarily for use in receivers in cases where low current consumption is important. Every effort has been made to ensure the lowest possible consumption of heater current, which is, in effect, only 200 mA, the power required by the heater being 1.26 W. Notwithstanding the low consumption, the slope of this valve is quite good, viz. 3.2 mA/V, with adequate sensitivity (approx. 0.8 V_{RMS} A.C. grid voltage to produce an output of 50 mW).
As the EL 42 is employed mainly for car radio and vibrator-driven sets, the voltage source will usually be an accumulator, of which the voltage, in practice, is subject to considerable fluctuation ; it is advisable, therefore, to arrange for a working point that will give, in absence of an input voltage, an average anode dissipation of 6 W when the supply voltage is 7 V. Variations in the voltage between 5.5 and 8 V will then be permissible without risk of under-running or overloading the valve. Further, the maximum permissible anode dissipation may then be allowed to exceed its limit by as much as 15% as a result of tolerances of the components in the circuit and in consequence of the automatic gain control. (see page 2).
The maximum output power of the individual EL 42 is 2.8 W with 225 V on anode and screen grid, at which level the grid input is 8 V_{RMS}.
The EL 42 is also suitable for use in push-pull output stages; a Class A amplifier with anode and screen grid operating at 250 V, and with automatic bias, will deliver an output of 7 W with a distortion of 5,5 %.

In class B, the maximum output for the same anode potential is 6.5 W with 5% distortion, and, in this connection, the ECC 40 as phase inverter will be found very advantageous ; one of the triode systems of this valve is then used for that purpose, whilst the other can serve as rectifier to provide bias for the output valves.
As the amount of space in car-radio sets is usually restricted, the dimensions of the EL 42 have been kept at a minimum ; this valve is no larger than the pre-amplifier valves.

TECHNICAL DATA OF THE OUTPUT PENTODE EL 42

Heater data

Heating : indirect, A.C. or D.C., parallel feed

Heater voltage	V_f	=	6.3 V
Heater current	I_f	=	0.2 A

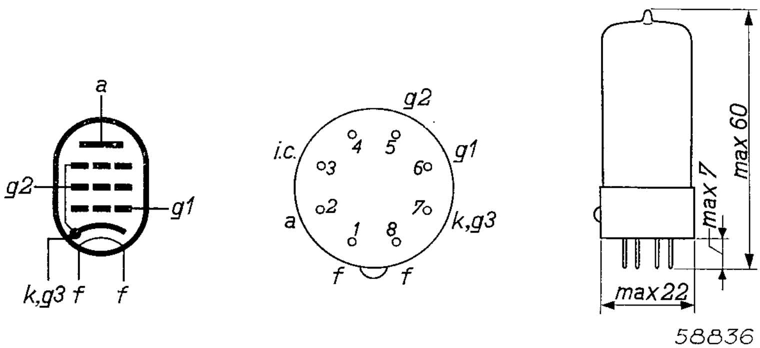


Fig. 2
Electrode arrangement, electrode connections and maximum dimensions in mm of the EL 42.

Capacitances (cold valve)

Input capacitance	C_{g1}	=	4.3 pF
Output capacitance	C_a	=	6.2 pF
Anode - control grid	C_{ag1}	<	0.2 pF
Control grid - heater . .	C_{g1f}	<	0.2 pF

Operating characteristics of the EL 42 used as Class A output amplifier (see Figs. 6 and 7)

Anode voltage	V_a	=	200	225	V
Screen grid voltage	V_{g2}	=	200	225	V
Cathode resistor	R_k	=	360	360	Ω
Anode current	I_a	=	22.5	26	mA
Screen grid current	I_{g2}	=	3.5	4.1	mA
Mutual conductance	S	=	3.2	3.2	mA/V
Internal resistance	R_i	=	90	90	kΩ
Amplification factor, screen grid with respect to control grid	μ_{g2g1}	=	11	11	
Matching resistance	R_a	=	9	9	kΩ
Output power	W_o	=	2.1	2.8	W
Total distortion	d_{tot}	=	11	12	%
A.C. grid voltage	$V_i(W_o = \text{max.})$	=	6.8	8.0	V_{RMS}
Sensitivity	$V_i(W_o = 50\text{ mW})$	=	0.8	0.75	V_{RMS}

Operating characteristics of two valves EL 42 as Class A push-pull amplifier (see Figs. 8 and 9)

Anode voltage	V_a	=		200		V
Screen grid voltage	V_{g2}	=		200		V
Common cathode resistor	R_k	=		310		Ω
Matching resistance	R_{aa}	=		15		kΩ
A.C. grid voltage	V_i	=	0	0.75	9.6	V_{RMS}
Anode current	I_a	=	2×16	—	2×17	mA
Screen grid current	I_{g2}	=	2×2.6	—	2×5.6	mA
Output power	W_o	=	0	0.05	4.1	W
Total distortion	d_{tot}	=	—	—	5.5	%

Anode voltage	V_a	=		250		V
Screen grid voltage	V_{g2}	=		250		V
Common cathode resistor	R_k	=		310		Ω
Matching resistance	R_{aa}	=		15		kΩ
A.C. grid voltage	V_i	=	0	0.7	12.5	V_{RMS}
Anode current	I_a	=	2×20	—	2×21.5	mA
Screen grid current	I_{g2}	=	2×3.2	—	2×6.7	mA
Output power	W_o	=	0	0.05	7.0	W
Total distortion	d_{tot}	=	—	—	5.5	%

Operating characteristics of two valves EL 42 as Class B push-pull amplifier (see Figs. 10 and 11)

Anode voltage	V_a	=		200		V
Screen grid voltage	V_{g2}	=		200		V
Control grid voltage	V_{g1}	=		—17		V
Matching resistance	R_{aa}	=		16		kΩ
A.C. grid voltage	V_i	=	0	1.5	12	V_{RMS}
Anode current	I_a	=	2×5	—	2×16	mA
Screen grid current	I_{g2}	=	2×0.8	—	2×4.6	mA
Output power	W_o	=	0	0.05	4.0	W
Total distortion	d_{tot}	=	—	—	3.5	%

Anode voltage	V_a	=		250		V
Screen grid voltage	V_{g2}	=		250		V
Control grid voltage	V_{g1}	=		—22.5		V
Matching resistance	R_{aa}	=		16		kΩ
A.C. grid voltage	V_i	=	0	1.7	16	V_{RMS}
Anode current	I_a	=	2×5	—	2×20	mA
Screen grid current	I_{g2}	=	2×0.8	—	2×6.5	mA
Output power	W_o	=	0	0.05	6.5	W
Total distortion	d_{tot}	=	—	—	5	%

Limiting values

Anode voltage when biased to cut-off	V_{a_o}	= max.	550	V
Anode voltage	V_a	= max.	300	V
Anode dissipation	W_a	= max.	6	W
Screen grid voltage, biased to cut-off	V_{g2_o}	= max.	550	V
Screen grid voltage	V_{g2}	= max.	300	V
Screen grid dissipation without input signal	$W_{g2}(V_i{=}0)$	= max.	1	W
Screen grid dissipation on full load	$W_{g2}(W_o{=}\text{max.})$	= max.	2	W
Cathode current	I_k	= max.	35	mA
Grid current starting point	$V_{g1}(I_{g1}{=}+0.3\mu A)$	= max.	—1.3	V
External resistance between control grid and cathode	R_{g1}	= max.	2	MΩ
External resistance between cathode and heater	R_{fk}	= max.	20	kΩ
Voltage between cathode and heater	V_{fk}	= max.	100	V

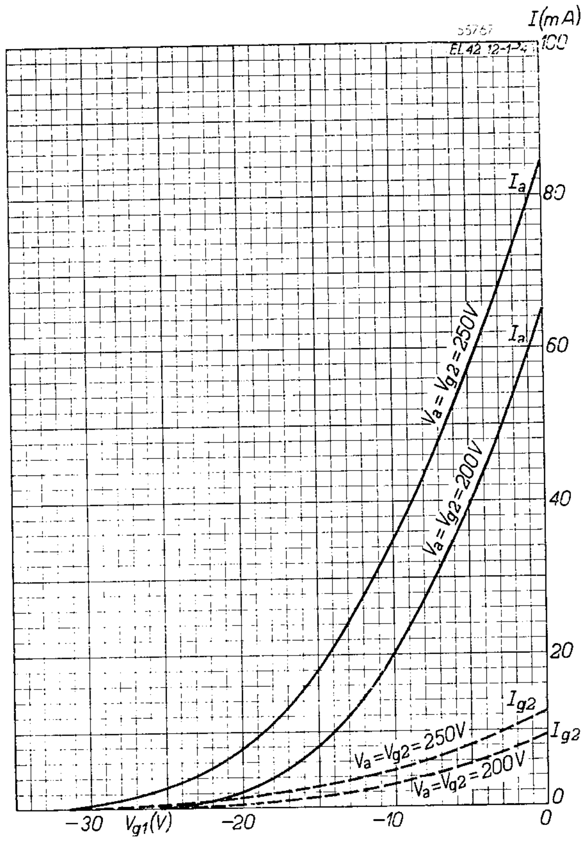


Fig. 3
Anode current I_a and screen grid current I_{g2} as a function of the grid bias V_{g1}.

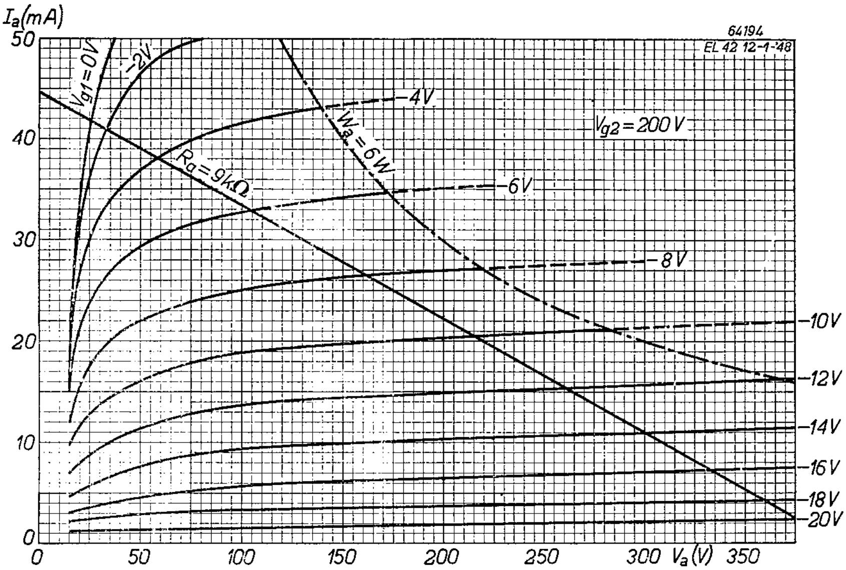


Fig. 4

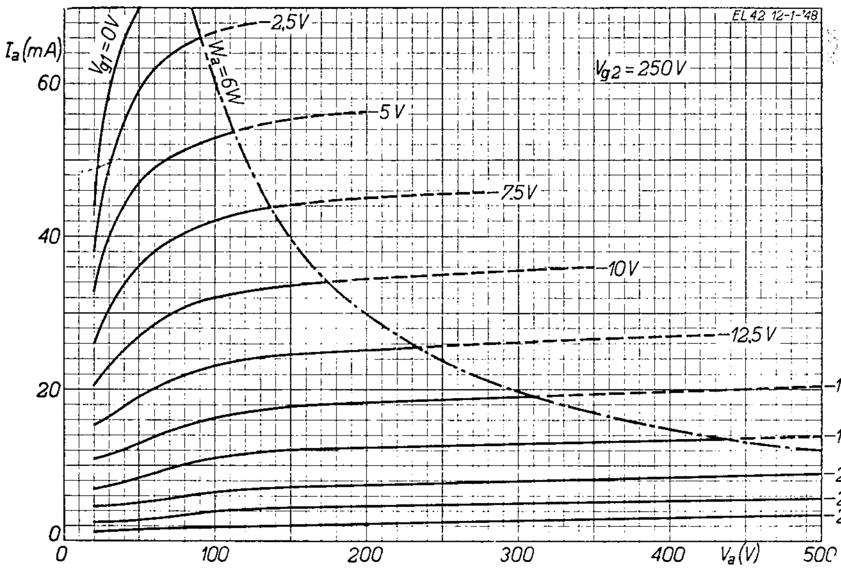


Fig. 5

Anode current I_a as a function of the anode voltage V_a with grid bias V_{g1} as parameter. The dot-dash line represents the maximum anode dissipation ($W_a = 6$ W). In Fig. 4 the screen grid voltage $V_{g2} = 200$ V ; in Fig. 5 $V_{g2} = 250$ V.

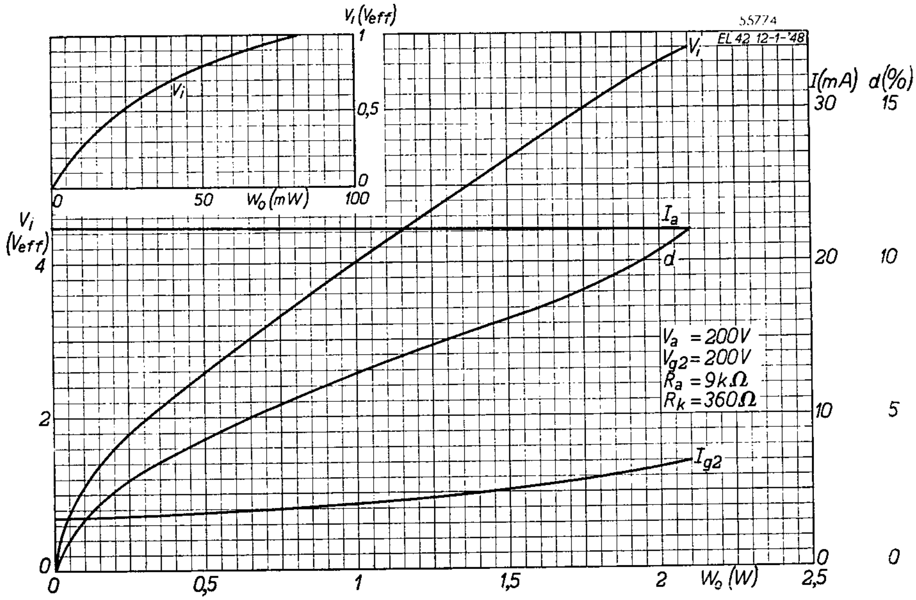


Fig. 6

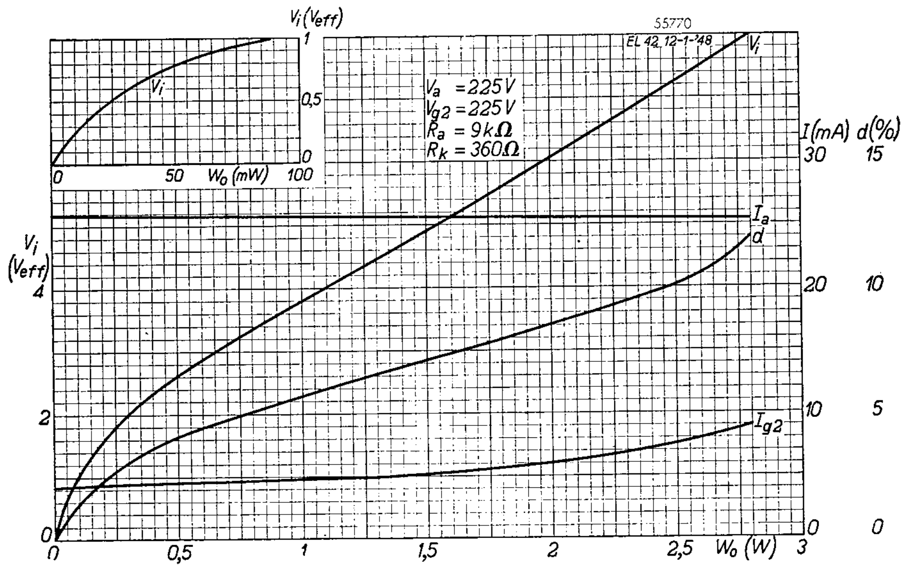


Fig. 7

Anode current I_a, screen grid current I_{g2}, distortion d and required A.C. grid voltage V_i, as functions of the output power W_o. Anode-load resistance $R_a = 9$ kΩ; cathode resistor $R_k = 360$ Ω. In Fig. 6 both anode and screen grid voltage are 200 V; in Fig. 7, 225 V. In the inset the required A.C. grid voltage V_i is shown as a function of the output power W_o at low values of the latter.

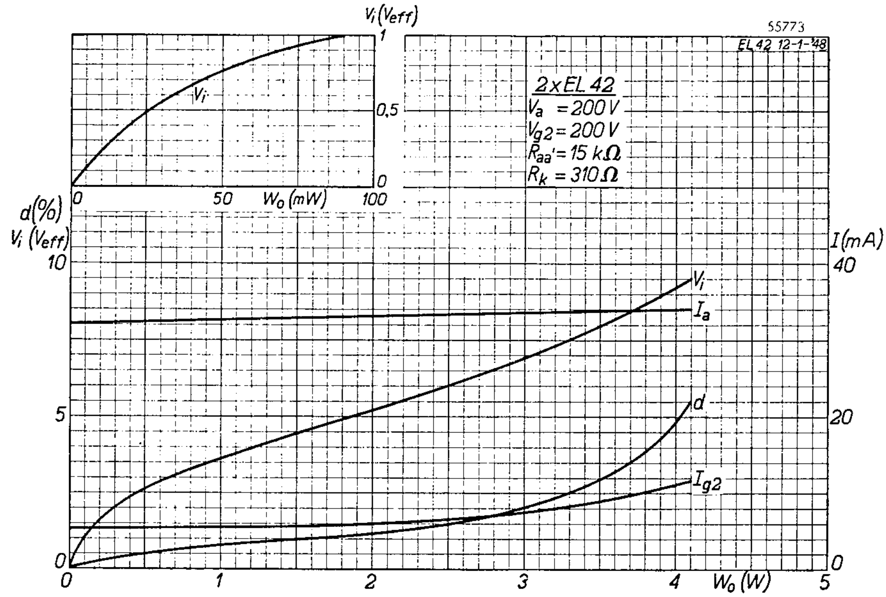


Fig. 8

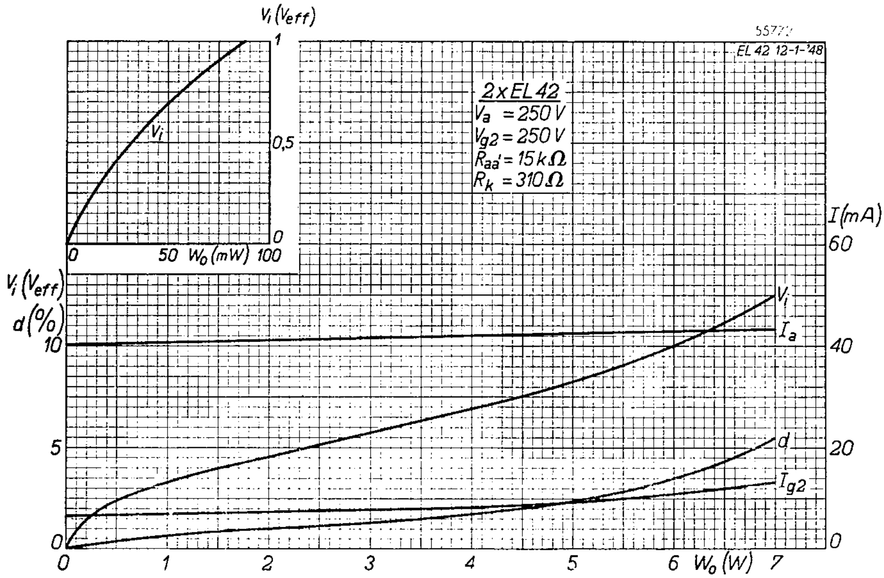


Fig. 9

As Fig. 6, but for 2 valves EL 42 in Class A push-pull, with $V_a = V_{g2} = 200$ V (Fig. 8) and $V_a = V_{g2} = 250$ V (Fig. 9). In both cases the load resistance between the two anodes is 15 kΩ and the common bias resistor 310 Ω.

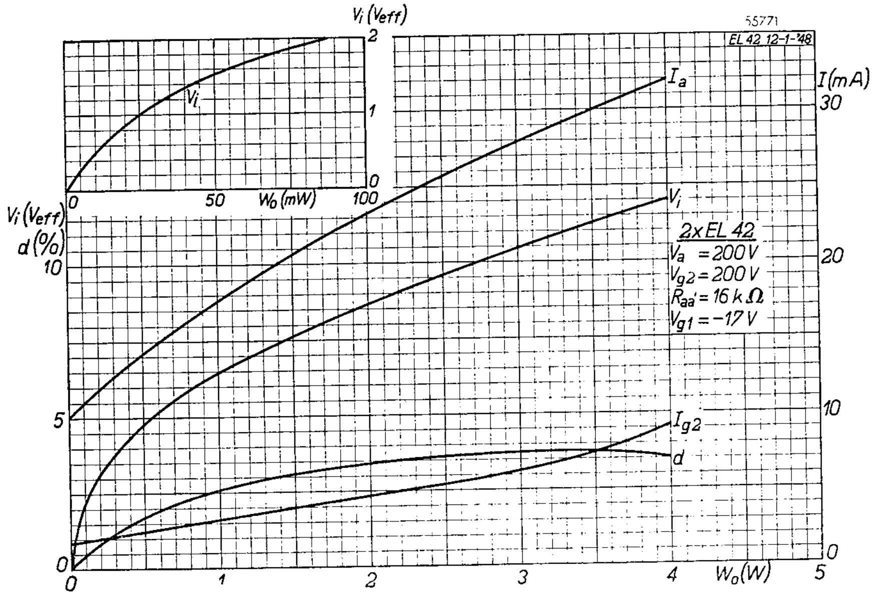


Fig. 10

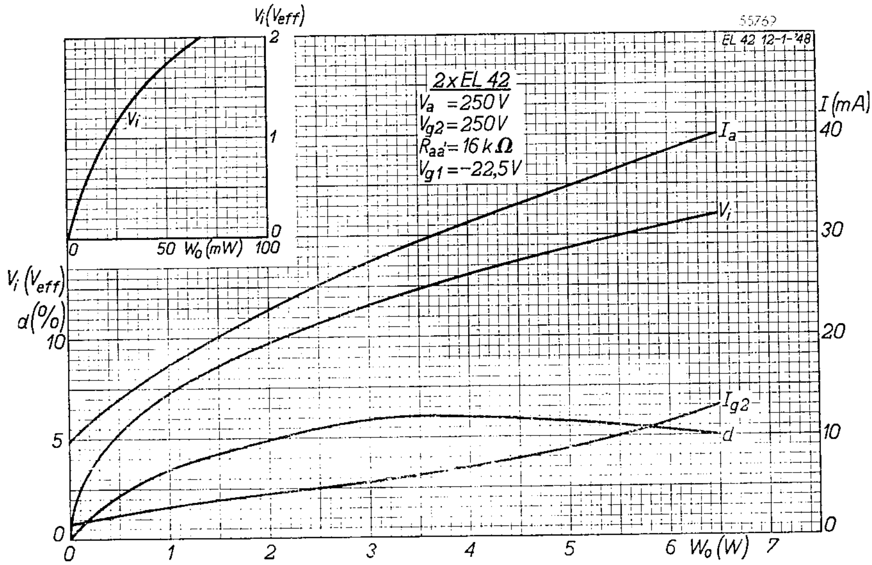


Fig. 11

As Fig. 6, but for 2 valves EL 42 in Class B push-pull, with $V_a = V_{g2} = 200$ V (Fig. 10) and $V_a = V_{g2} = 250$ V (Fig. 11). In both cases the load resistance between the two anodes is 16 kΩ. In Fig. 10 the grid bias is $V_{g1} = -17$ V, whilst in Fig. 11 $V_{g1} = -22.5$ V.