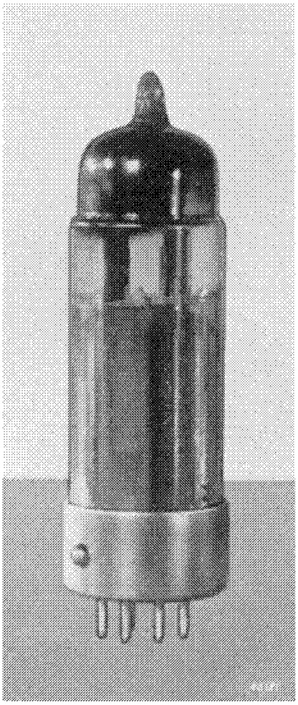
UL 41 9 W output pentode



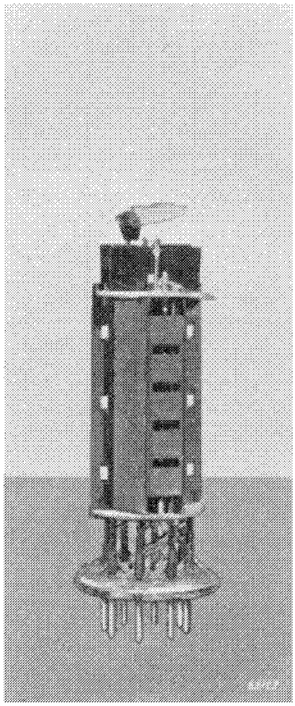


Fig. 1. The UL 41, showing the electrode system (approximately actual size).

The UL 41 is an output pentode with a high mutual conductance and a maximum permissible anode dissipation of 9 W. It is designed for use in A.C./D.C. receivers for a nominal voltage range of 110—250 V. Despite the fact that such a supply voltage range implies large variations in the actual voltage applied to the valve, the circuit of the output valve needs no alteration. A bias resistor of 165 ohms is suitable for all voltages; no extra resistor is needed in the screen grid circuit for the higher voltages, and the optimum load is always roughly 3000 ohms.
The mutual conductance of this valve is 9.5 mA/V at 170 V, or 8 mA/V at 100 V (anode and screen grid voltage). At 170 V, which is obtained from a line voltage of 220 V, the maximum output is 4.7 W, whilst at 100 V (line voltage approx. 110 V) the output is 1.25 W.
The high mutual conductance of the valve has two advantages. Firstly, only a small input signal is required to modulate the valve fully; for example, at $V_a = V_{g2} = 100$ V the required input is 3.8 V_{RMS}, or at $V_a = V_{g2} = 170$ V the input is 7.2 V_{RMS}. This is particularly important in small receivers having no A.F. pre-amplifier, but a highly sensitive output valve is also

an advantage in larger sets because the reserve of gain can be used for feedback, to reduce distortion. Secondly, the grid bias is very low. Since the total available D.C. voltage is divided between grid bias and anode voltage, more voltage is available for the anode and screen grid, this being highly important when the receiver is to be operated on low voltage mains. If two UL 41 valves are used in class AB push-pull, with automatic grid bias, the output is 9 W with 5% distortion at an applied voltage of 170 V, or 2.2 W with 4% distortion at 100 V.
As already mentioned, the maximum permissible anode dissipation of the UL 41 is 9 W. The full implications of this statement will be found in the description of the EL 41

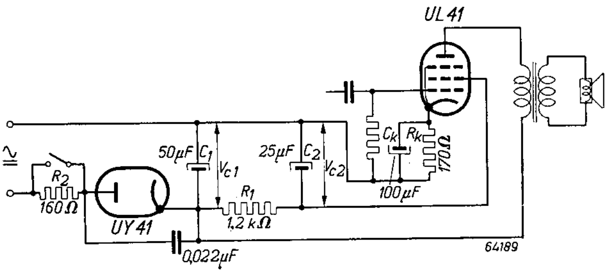


Fig. 2. The UL 41 used in a simple A.C./D.C. receiver; the illustration also shows the appropriate power supply circuit.

Fig. 2 shows the UL 41 used in a simple A.C./D.C. receiver circuit with the appropriate rectifier section. The smoothing filter consists of capacitors C_1 and C_2 and a resistor of 1200 ohms. If the anode voltage of the UL 41 were taken from the fully smoothed side of this filter, an excessive voltage drop would take place across the resistor, for which reason the anode feed is taken from C_1. In actual practice this circuit has proved to be very satisfactory and, in most cases, is sufficiently free from hum. If necessary, a hum-bucking winding can be included in the speaker transformer.
In order to avoid parasitic oscillation, it is advisable to keep the screen and control grid leads as short as possible; under adverse conditions, a 1 kΩ resistor may be included in the control grid circuit and/or a 100 Ω resistor in the screen grid line. These resistors should be connected as closely as possible to the valve, without decoupling.

TECHNICAL DATA OF THE OUTPUT PENTODE UL 41

Heater data

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

Heater current	I_f	=	100 mA
Heater voltage	V_f	=	45 V

Capacitances (cold valve)

Input capacitance	C_{g1}	=	11 pF
Output capacitance	C_a	=	8.3 pF
Anode - control grid	C_{ag1}	<	1 pF
Heater - control grid . .	C_{g1f}	<	0.1 pF

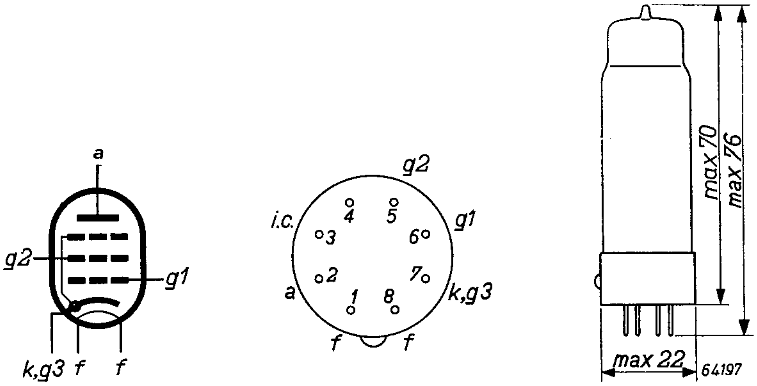


Fig. 3
Electrode arrangement, electrode connections and maximum dimensions in mm.

Operating characteristics as single valve in Class A circuit

Anode voltage	V_a	=	100	170 V
Screen grid voltage	V_{g2}	=	100	170 V
Grid bias	V_{g1}	=	—5.7	—10.4 V
Anode current	I_a	=	29	53 mA
Screen grid current	I_{g2}	=	5.5	10 mA
Mutual conductance	S	=	8.0	9.5 mA/V
Amplification factor, grid 2 with respect to grid 1	μ_{g2g1}	=	10	10
Internal resistance	R_i	=	18	20 kΩ
Optimum load	R_a	=	3	3 kΩ
Output with 10% distortion .	$W_0(d=10\%)$	=	1.25	4.0 W
Required A.C. input voltage at 10% distortion	$V_i(d=10\%)$	=	3.8	6.0 V_{RMS}
Output at grid current starting point	W_o $(I_{g1}=+0.3\mu A)$	=	1.25	4.7 W
Sensitivity	V_i $(W_0=50mW)$	=	0.55	0.5 V_{RMS}

UL 41

Operating characteristics of two valves in Class AB push-pull

Anode voltage	V_a	=	100		V
Screen grid voltage	V_{g2}	=	100		V
Common bias resistor	R_k	=	100		Ω
Optimum load	R_{aa}	=	4.0		kΩ
A.C. input voltage	V_i	=	0	4.6	V_{RMS}
Anode current	I_a	=	2×25	2×27	mA
Screen grid current	I_{g2}	=	2× 5	2×6.8	mA
Output power	W_0	=	0	2.2	W
Distortion	d_{tot}	=	—	4	%

Anode voltage	V_a	=	170		V
Screen grid voltage	V_{g2}	=	170		V
Common bias resistor	R_k	=	100		Ω
Optimum load	R_{aa}	=	4.0		kΩ
A.C. input voltage	V_i	=	0	9.3	V_{RMS}
Anode current	I_a	=	2×46	2×49	mA
Screen grid current	I_{g2}	=	2× 9	2×16.5	mA
Output power	W_0	=	0	9.0	W
Distortion	d_{tot}	=	—	5	%

Limiting values

Anode voltage, valve biased to cut-off	V_{a_0}	= max.	550	V
Anode voltage	V_a	= max.	250	V
Anode dissipation	W_a	= max.	9	W
Screen grid voltage, valve biased to cut-off	V_{g2_0}	= max.	550	V
Screen grid voltage	V_{g2}	= max.	250	V
Screen grid dissipation, no input signal	$W_{g2}(V_i=0)$	= max.	1.75	W
Screen grid dissipation, at max. output	$W_{g2}(W_0=\text{max})$	= max.	4.0	W
Cathode current	I_k	= max.	75	mA
Grid current starting point	$V_{g1}(I_{g1}=+0.3\mu A)$	= max.	—1.3	V
External resistance between control grid and cathode (with bias resistor)	$R_{g1}(R_k=165\Omega)$	= max.	1	MΩ
External resistance between heater and cathode	R_{fk}	= max.	20	kΩ
Voltage between heater and cathode	V_{fk}	= max.	150	V

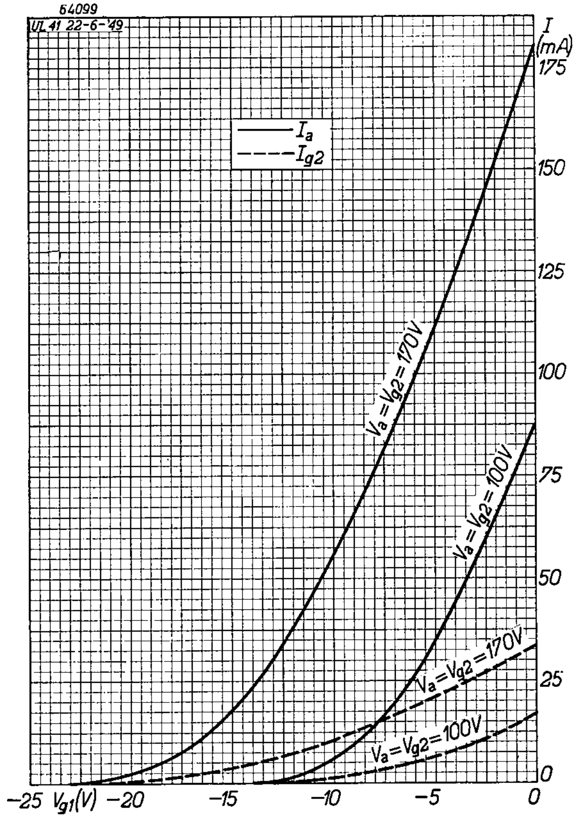


Fig. 4
Anode current (I_a) and screen grid current (I_{g2}) of the UL 41 at anode and screen grid voltages of 100 V and 170 V.

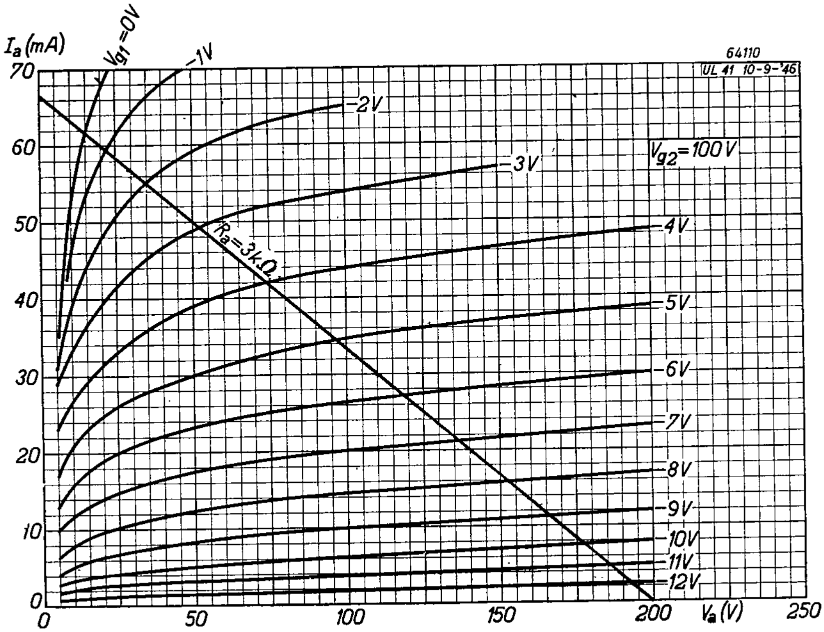


Fig. 5

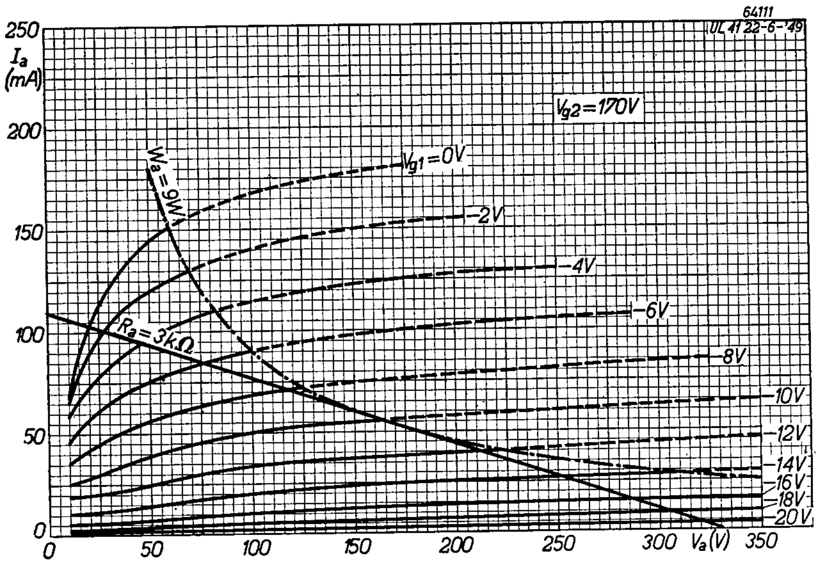


Fig. 6

I_a/V_a characteristics at $V_{g2} = 100$ V (Fig. 5) and 170 V (Fig. 6). The straight line represents a load resistance of 3 kΩ. The dot-dash curve in Fig. 6 indicates the maximum permissible anode dissipation ($W_a = 9$ W).

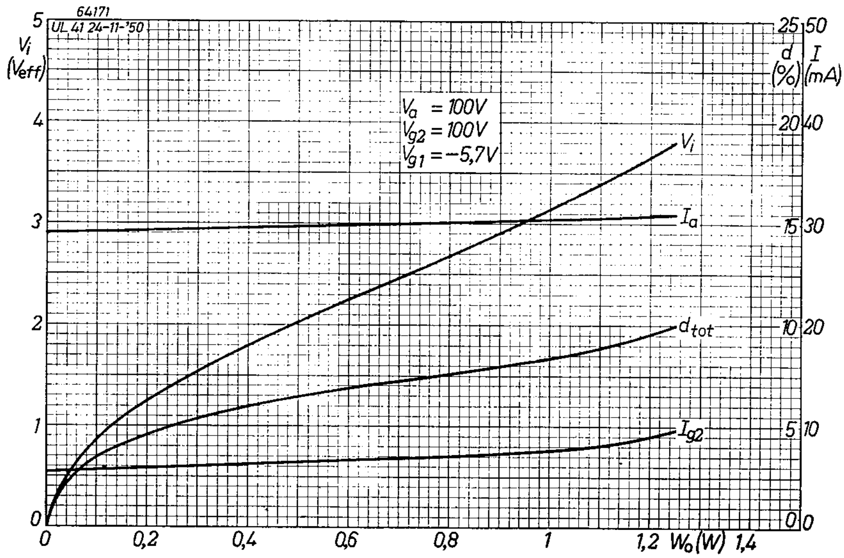


Fig. 7

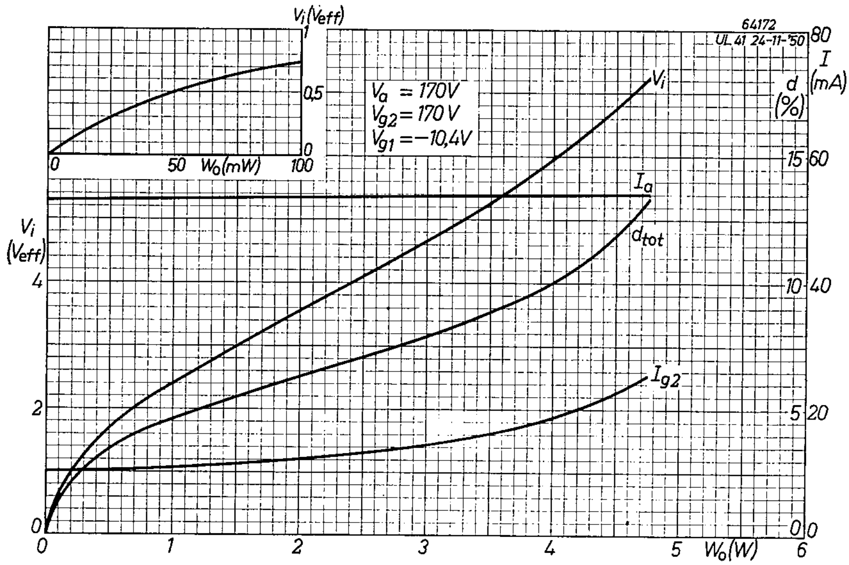


Fig. 8

Anode current (I_a), screen grid current (I_{g2}), A.C. input voltage (V_i) and distortion (d_{tot}) as functions of the output power (W_0). Fig. 7 : anode and screen grid voltages = 100 V. Fig. 8 : anode and screen grid voltages = 170 V. The curve in the inset is the lower end of the V_i-curve.

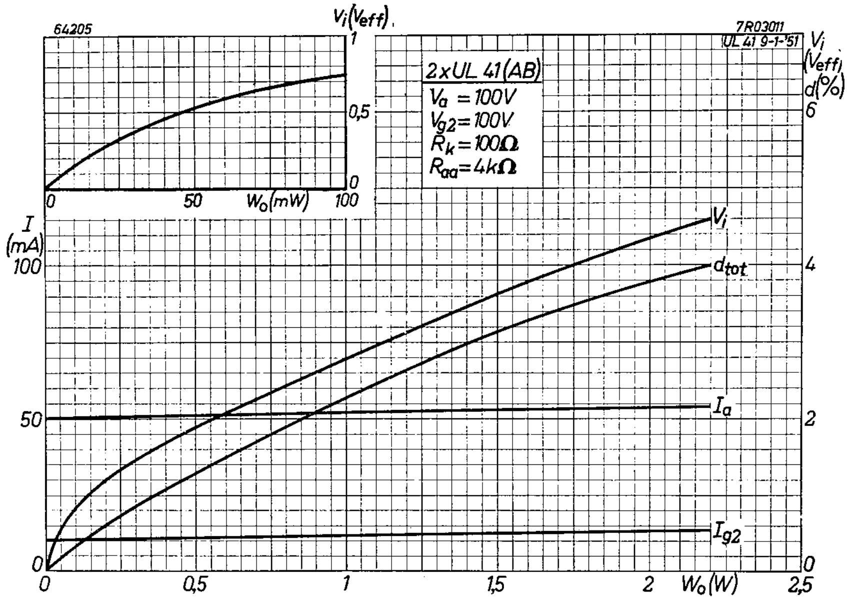


Fig. 9

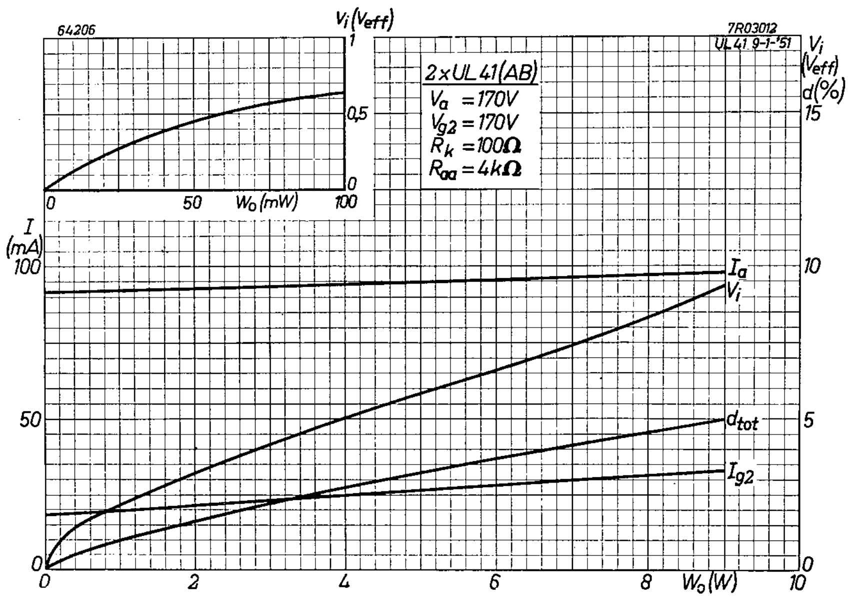


Fig. 10

Anode current (I_a), screen grid current (I_{g2}), A.C. input voltage (V_i) and distortion (d_{tot}) as functions of the output (W_0) for two valves UL 41 in Class AB push-pull. Fig. 9 : anode and screen grid voltages = 100 V; Fig. 10: anode and screen grid voltages = 170V. The curves in the insets are the lower ends of the V_i-curves.

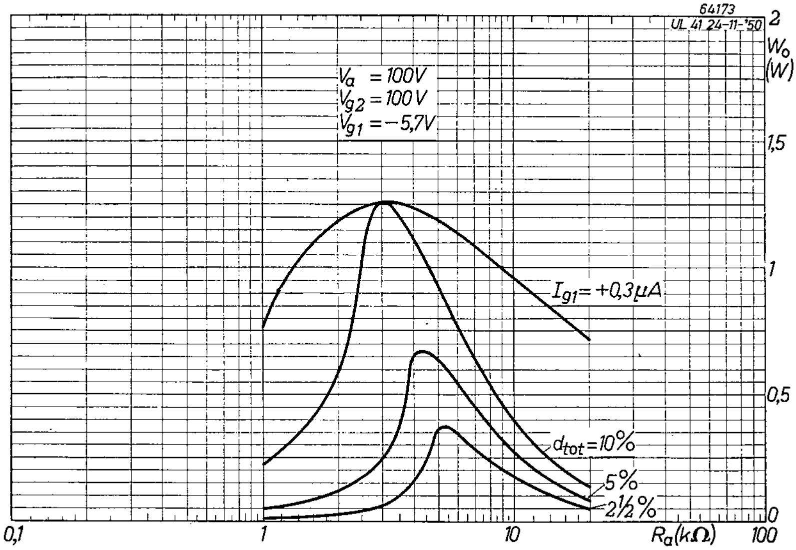


Fig. 11

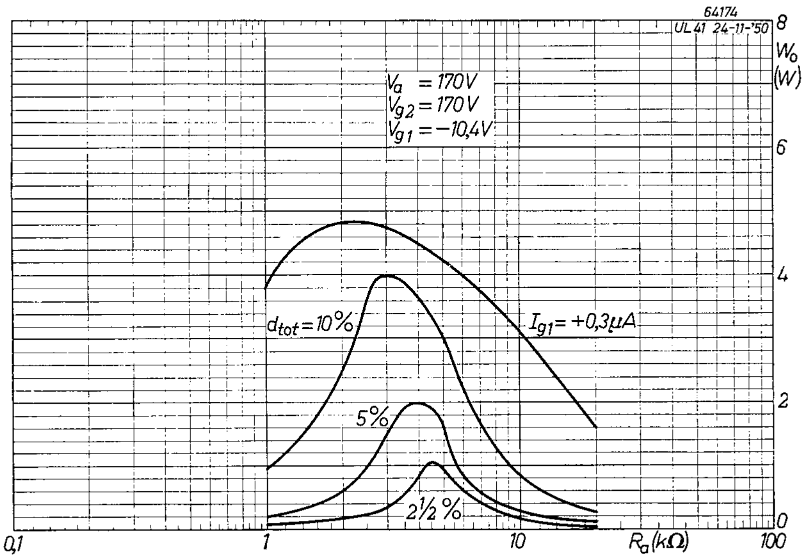


Fig. 12

The output (W_0) with 2.5, 5 and 10% distortion and also at the grid current starting point, as function of the load (R_a). Fig. 11 : $V_a = V_{g2} = 100$ V ; Fig. 12 : $V_a = V_{g2} = 170$ V.

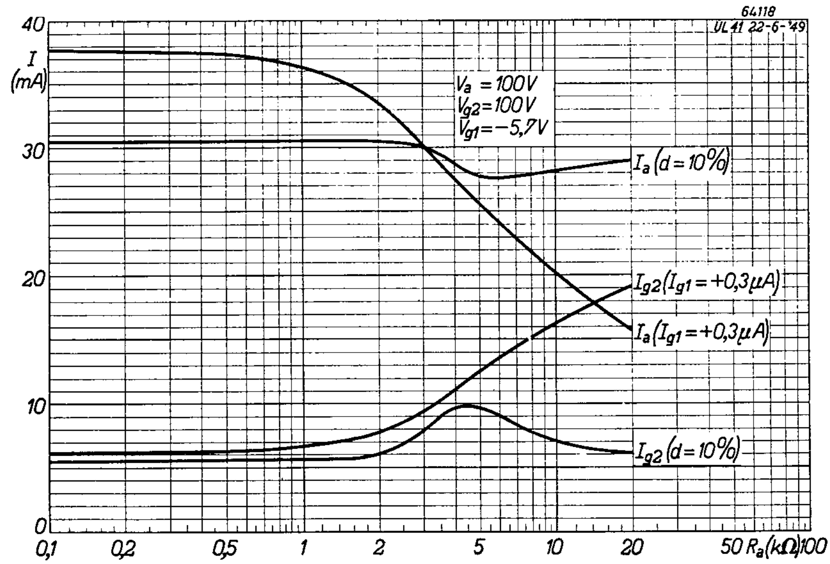


Fig. 13

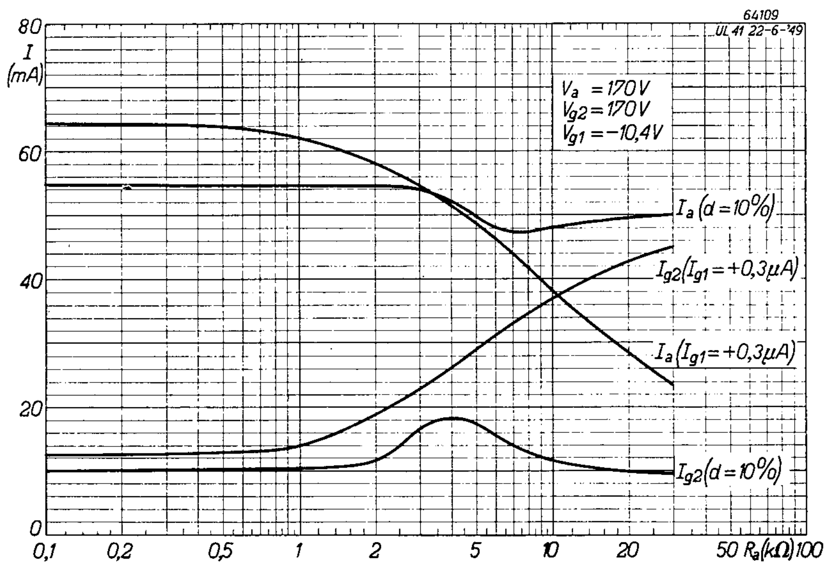


Fig. 14

Anode current (I_a) and screen grid current (I_{g2}) as functions of the load (R_a), with valve loaded to an extent such that *a*) the output is subject to 10% distortion ($d = 10\%$), and *b*) grid current commences to flow ($I_{g1} = +0.3$ μA). Fig. 13 : $V_a = V_{g2} = 100$ V; Fig. 14 : $V_a = V_{g2} = 170$ V.