DLL 21 Double output pentode

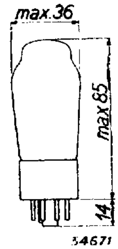
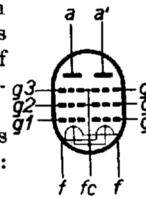


Fig. 1
Dimensions in mm.



In many instances the output stage of a battery receiver, especially where a fairly large output is required, will consist of two triodes or pentodes or, alternatively, a double triode or pentode in a push-pull circuit: in order to keep the anode current as low as possible, the circuit is then usually of the Class B type.

As far as the possible saving in current is concerned, it is immaterial whether two triodes or two pentodes are employed, and it is of no more importance whether two separate valves or two valve-systems in a common envelope are used; the ultimate choice between two individual pentodes or triodes, or two such valves in one, is governed by the requirements laid down in respect of quality of reproduction and filament current consumption, as well as by considerations affecting the layout of the receiver.

If the advantages and disadvantages of individual or double triodes or pentodes are weighed up, these may be summarised as follows:

Advantages of an output stage with two triodes or a double triode

1a) When two triodes are used, or one double triode, it is usual to select a type of valve that requires no grid bias in Class B circuits. The full battery voltage is then available for the anode, and two triodes therefore give a slightly greater output.

2a) The absence of screen grid feed and grid bias tends to simplify construction of the receiver.

3a) A triode, or a double triode, is a simpler valve than a pentode or double pentode.

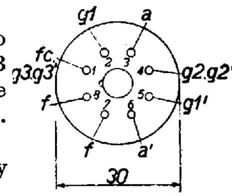


Fig. 2
Arrangement and sequence of contacts.

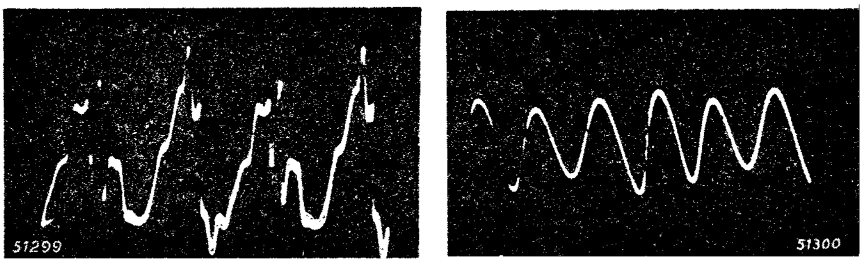


Fig. 3

a. Oscillogram showing the distortion occurring in a Class B output stage of two triodes in which grid current is flowing.

b. Oscillogram showing the distortion ocurring in an output stage of 2 pentodes without grid current. It will be seen that the distortion is caused almost exclusively by the third harmonic.

In both oscillograms the fundamental frequency has been filtered out.

Disadvantages of an output stage with two triodes or a double triode

1b) Since the anode voltage available in a battery set is on the low side, it is not possible to obtain satisfactory efficiency when it is stipulated that the valve must

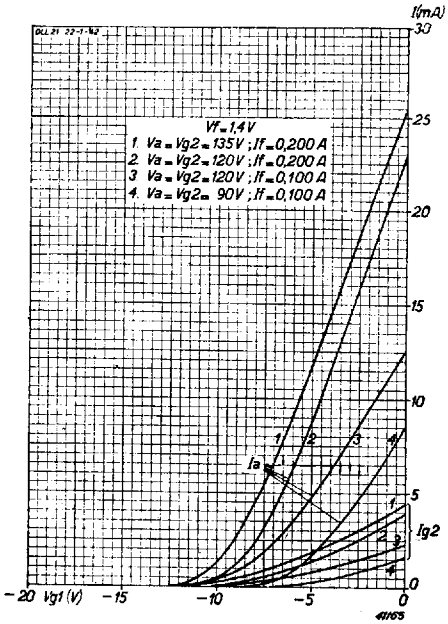


Fig. 4
Anode and screen current of one pentode section of the DLL 21 as a function of the grid bias at $Vf = 1.4$ V, in respect of different values of anode and screen voltage and filament current.

not run into grid current. When triodes are employed the valve must therefore be modulated in the region of positive grid current, which, even when a driver stage is included, generally leads to distortion. The distortion in an output stage comprising two triodes running into grid current, as well as that of a stage consisting of two pentodes without grid current, may be ascertained from the oscillograms shown in Figs. 3a and b. In both these oscillograms the fundamental frequency has been filtered out, in order to give a true picture of the actual distortion. Whereas in the case of the two pentodes the distortion is almost wholly due to the 3rd harmonic, much higher harmonics occur in the case of the two triodes with grid current.

2b) With a double triode, driver stage must be employed to supply the grid current for the output stage and, since the object of this stage is to provide power, it is usual to use a valve operating on a relatively high filament current.

3b) The last stages must consist of two valves, a driver and an output valve.

From these considerations the following conclusions may be drawn:

If the filament current of a receiver does not need to meet very stringent requirements, as when supplied by an accumulator, the choice between triodes and pentodes is governed firstly by the required quality of reproduction.

Since quality is not such an important factor in the cheaper types of receiver, however, it will often be preferable to employ triodes for the output stage, in order to simplify construction. On the other hand, if high quality reproduction is demanded the pentode is normally given preference. The K-series of valves, designed in the first place for accumulator feeding, includes therefore a double triode: there

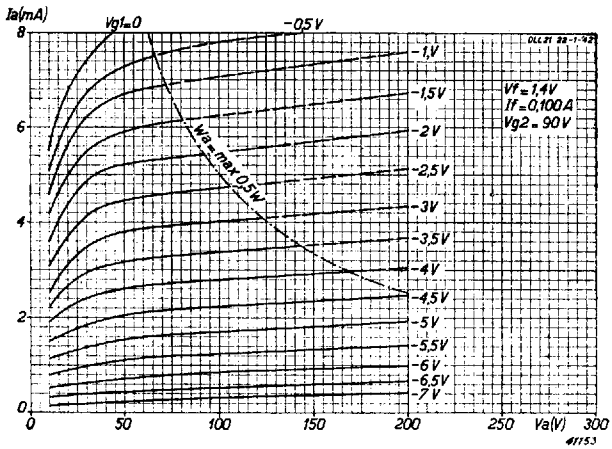


Fig. 5
Anode current of one of the sections of the DLL 21 as a function of the anode voltage, at $Vg_2 = 90$ V, $Vf = 1.4$ V and $If = 100$ mA, with Vg_1 as parameter.

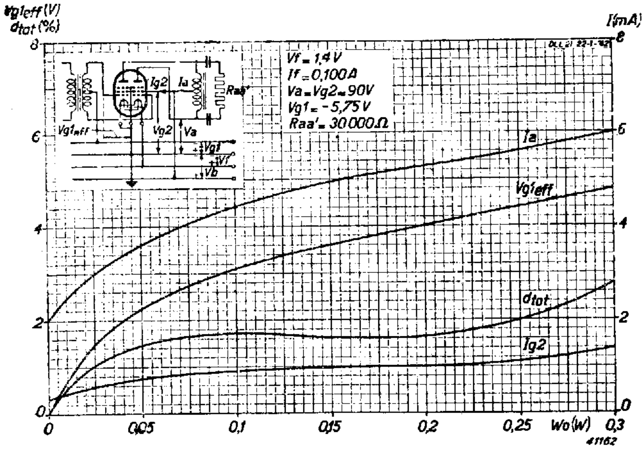


Fig. 6
Total anode current and screen current, total distortion and required alternating grid voltage per grid as function of output power of the DLL 21 used as Class B amplifier at $Vb = Va = Vg_2 = 90$ V; $Vf = 1.4$ V and $If = 100$ mA.

would be room for a double pentode for quality receivers, but since in this class of receiver it is not so necessary to limit the number of valves there is no reason why two separate pentodes cannot be used. When dry batteries are used the situation is, however, very different, as a saving in filament current is then of the first importance. The 1.4 V range of valves has therefore been made to include a double pentode for use in low-priced sets, so that this range offers both a single and a double pentode, but no double triode. The double pentode is the DLL 21, each half-section of which has two filaments, the arrangement of the contact pins being such (see Fig. 2) that either one or both filaments can be employed, as demanded by circumstances; it is thus possible to feed the filament in the following different ways:

A. feed voltage 1.4 V, current 100 mA,

B. feed voltage 1.4 V, current 200 mA,

C. feed voltage 2.8 V, current 100 mA.

The last mentioned method of wiring is of especial importance in connection with the application of the valve in AC/DC-battery receivers.

When the filament is connected as in A) (100 mA, on 1.4 V), the valve delivers 300 mW at an anode and screen voltage of 90 V, the distortion in that case being 2.8 %. At an anode and screen voltage of 120 V the output is 600 mW at 3 % distortion. The required alternating grid voltage is extremely low, with consequent low distortion also in the preceding stage; at 90 V the voltage in question is 4.8 V per grid and at 120 V only 6.8 V.

With the filament connected as in B) or C) (200 mA at 1.4 V and 100 mA at 2.8 V respectively), the output power is 1.2 W at an anode and screen voltage of 120 V, or 1.5 W at 135 V.

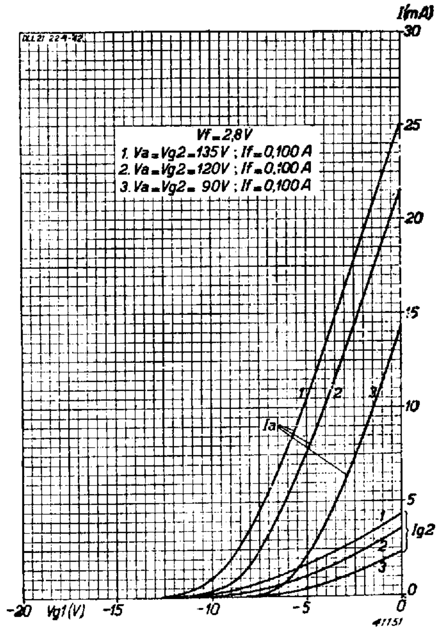


Fig. 7
Anode and screen grid current of one pentode section as function of grid bias at $Va = Vg_2 = 90$ V, 120 V and 135 V, $Vf = 2.8$ V and $If = 100$ mA.

FILAMENT RATINGS

Heating: direct from a battery, rectified A.C. or direct current: series or parallel.

Filament voltage (fc, g_3, g_3'/f)	V_f	= 1.4 V
Filament current	I_f	= 0.100 A

or

Filament voltage (fc, g_3, g_3'/f, f)	V_f	= 1.4 V
Filament current	I_f	= 0.200 A

or

Filament voltage (f/f)	V_f	= 2.8 V
Filament current	I_f	= 0.100 A

CAPACITANCES

Anode—grid	C_{ag1}	< 0.6 pF
Anode—grid	$C_{a'g1'}$	< 0.6 pF

OPERATING DATA: valve employed as Class B amplifier

Filament voltage	V_f	=	1.4 V	
Filament current	I_f	=	0.100 A	
Anode voltage	V_a	=	90 V	120 V
Screen grid voltage	V_{g2}	=	90 V	120 V
Grid bias	V_{g1}	=	—5.7 V	—8.7 V
Standing anode current	I_{ao}	=	2 × 1 mA	2 × 1 mA
Anode current at max. modulation	$I_{a\,max}$	=	2 × 3.0 mA	2 × 4.15 mA
Standing screen current	I_{g2o}	=	2 × 0.16 mA	2 × 0.16 mA
Screen current at max. modulation	$I_{g2\,max}$	=	2 × 0.7 mA	2 × 1.1 mA
Optimum value of matching resistance (between anodes)	$R_{aa'}$	=	30,000 Ohms	30,000 Ohms
Output power at max. modul.	W_o	=	0.3 W	0.6 W
Total distortion	d_{tot}	=	2.8 %	3 %
Required alternating grid voltage per grid	$V_{g1(eff)}$	=	4.8 V	6.8 V

Filament voltage	V_f	=	1.4 V	
Filament current	I_f	=	0.200 A	
Anode voltage	V_a	=	120 V	135 V
Screen grid voltage	V_{g2}	=	120 V	135 V
Grid bias	V_{g1}	=	—8.2 V	—9.4 V
Standing anode current	I_{ao}	=	2 × 2 mA	2 × 2 mA
Anode current at max. modulation	$I_{a\,max}$	=	2 × 7.5 mA	2 × 8.8 mA
Standing screen current	I_{g2o}	=	2 × 0.35 mA	2 × 0.35 mA
Screen current at max. modulation	$I_{g2\,max}$	=	2 × 2 mA	2 × 2.3 mA
Optimum value of matching resistance (between anodes)	$R_{aa'}$	=	15,000 Ohms	15,000 Ohms
Output power at max. modulation	W_o	=	1.2 W	1.5 W
Total distortion	d_{tot}	=	5 %	3.8 %
Required alternating grid voltage	$V_{g1(eff)}$	=	7.0 V	7.6 V

Filament voltage	V_f	=	2.8 V	
Filament current	I_f	=	0.100 A	
Anode voltage	V_a	= 90 V	120 V	135 V
Screen voltage	V_{g2}	= 90 V	120 V	135 V
Grid bias.	V_{g1}	= —5.9 V	—8.1 V	—9.5 V
Standing anode current . .	I_{ao}	= 2 × 1 mA	2 × 1.5 mA	2 × 1.5 mA
Anode current at max. modul.	$I_{a\,max}$	= 2 × 4.4 mA	2 × 7.1 mA	2 × 8.2 mA
Standing screen current . .	I_{g2o}	= 2 × 0.2 mA	2 × 0.25 mA	2 × 0.25 mA
Screen current at max. modul.	$I_{g2\,max}$	= 2 × 1.3 mA	2 × 1.9 mA	2 × 2.4 mA
Optimum value of matching resistance (between anodes)	R_{aa}'	= 20,000 Ohms	15,000 Ohms	15,000 Ohms
Output power at max. modul.	W_o	= 0.5 W	1.1 W	1.5 W
Total distortion	d_{tot}	= 2.9 %	2.8 %	3.6 %
Required alternating grid voltage.	V_{g1eff}	= 4.9 V	6.4 V	7.4 V

MAXIMUM RATINGS

Anode voltage	V_a	= max. 135 V
Anode dissipation (per section).	W_a	= max. 0.5 W
Cathode current (per section) . . .	I_k at (I_f = 200 mA, V_f = 1.4 V) / (I_f = 100 mA, V_f = 2.8 V)	= max. 25 mA
	at I_f = 100 mA, V_f = 1.4 V	= max. 12 mA
Screen grid voltage	V_{g2}	= max. 135 V
Screen dissipation (per section).	W_{g2} ($V_{g1\,eff}$ = 0 V)	= max. 0.1 W
	(W_o = max.)	= max. 0.4 W
Grid current commences at	V_{g1} (I_{g1} = + 0.3 μA)	= max. —0.2 V
Max. external resistance between grid and cathode	R_{g1f}	= max. 1 M Ohm
Minimum limit for filament voltage. . .	V_f	= min. 1.1 V
Maximum limit for filament voltage . .	V_f	= max. 1.5 V

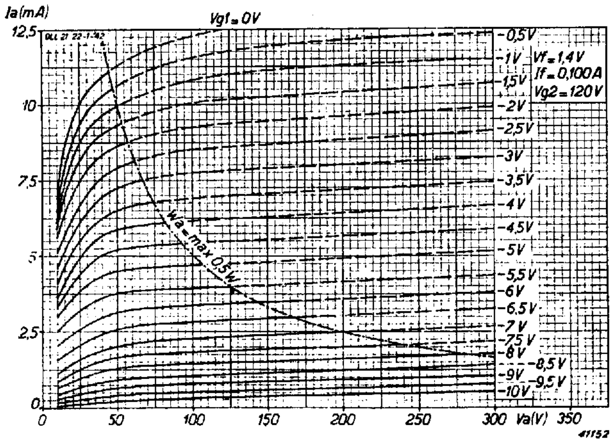


Fig. 8
Anode current of one pentode section as function of anode voltage at Vg_2 = 120 V, Vf = 1.4 V and If = 100 mA, with Vg_1 as parameter.

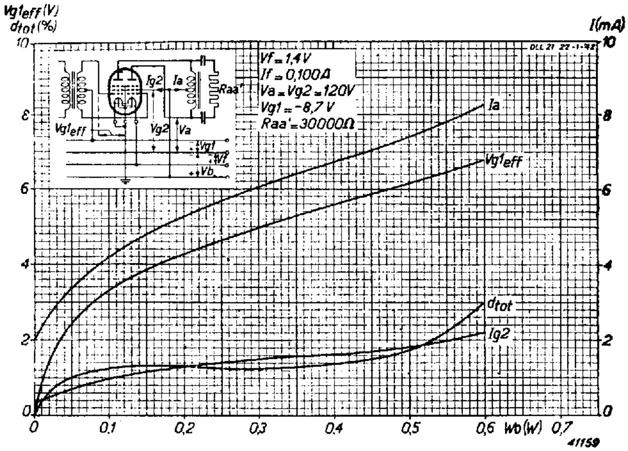


Fig. 9
Total anode current and screen current, total distortion and required alternating grid voltage per grid as function of output power, at $Vb = Va = Vg_2 = 120$ V, $Vf = 1.4$ V and $If = 100$ mA, in push-pull circuit.

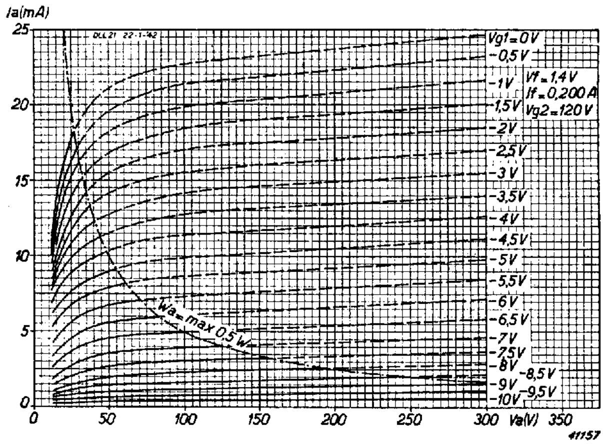


Fig. 10
Anode current of one pentode section as function of anode voltage, at $Vg_2 = 120$ V, $Vf = 1.4$ V and $If = 200$ mA, with Vg_1 as parameter.

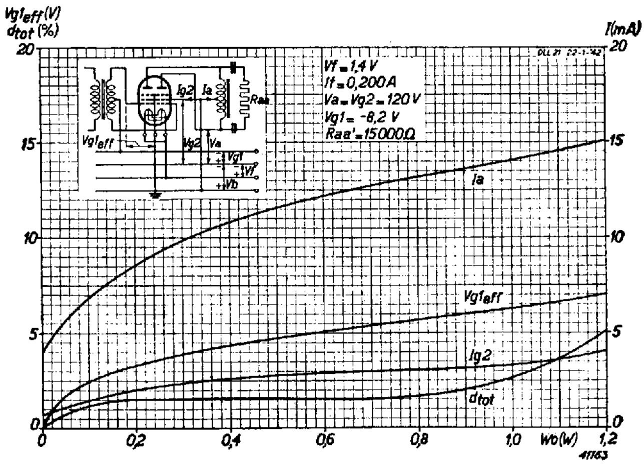


Fig. 11
Total anode current and screen current, total distortion and required alternating grid voltage per grid, as function of output power, at $Vb = Va = Vg_2 = 120$ V, $Vf = 1.4$ V and $If = 200$ mA in class B circuit.

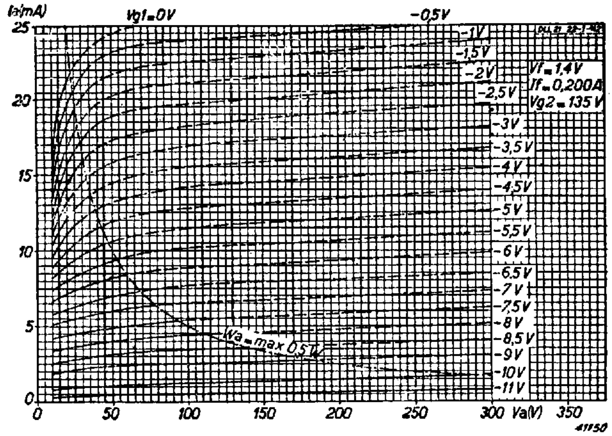


Fig. 12
Anode current of one pentode section as function of anode voltage at Vg_2 = 135 V, Vf = 1.4 V and If = 200 mA, with Vg_1 as parameter.

APPLICATIONS

The DLL 21 was designed for Class B output stages, or, with the two sections connected in parallel, for Class A operation, but in view of the comparatively high anode current the latter arrangement will seldom be adopted. In Class B circuits grid bias should be derived from a battery. If a resistance were included in the negative side of the H.T.battery for automatic biasing purposes the voltage would increase too much on strong signals and distortion become excessive.
When employed in conjunction with a dry battery for the filament feed, the valve will usually be connected as in A) above (i.e. 1.4 V, 100 mA).

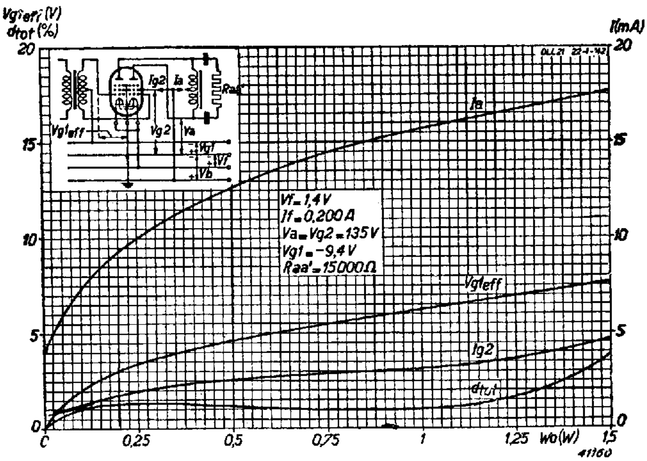


Fig. 13
Total anode current and screen grid current, total distortion and required alternating grid voltage per grid, as function of the output power at $Vb = Va = Vg_2$ = 135 V, Vf = 1.4 V, If = 200 mA in Class B circuit.

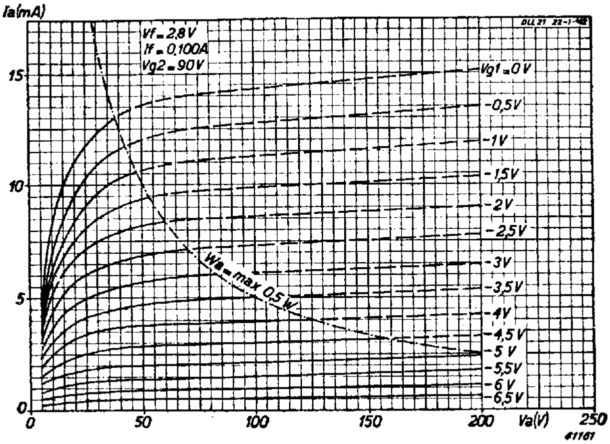


Fig. 14
Anode current of one pentode section as a function of anode voltage at $Vg_2 = 90$ V, $Vf = 2.8$ V and $If = 100$ mA, with Vg_1 as parameter.

Arrangement B) (1.4 V, 200 mA) is adopted when the valve is to be fed from an accumulator through a resistance, whilst C) (2.8 V, 100 mA), as already stated, is suitable for AC/DC-battery sets. When connected in this manner the DLL 21 delivers an output, at an anode voltage of 135 V, which approximates that of a mains driven receiver. If the set is to be battery fed and the current accordingly limited as much as possible, the set will be switched over very often to the 1.4 V, 100 mA (A) method of wiring. It should be noted that not only the filament but also the loudspeaker should be suitably matched in this case if the receiver is to give its maximum performance.

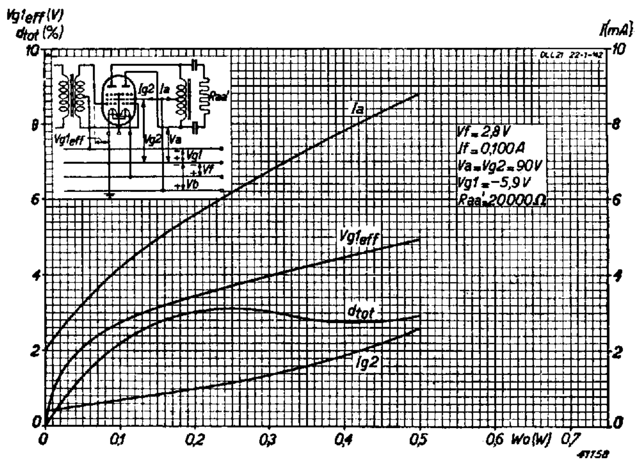


Fig. 15
Total anode current and screen grid current, total distortion and required alternating grid voltage per grid as function of the output power, at $Vb = Va = Vg_2 = 90$ V, $Vf = 2.8$ V and $If = 100$ mA, in Class B circuit.

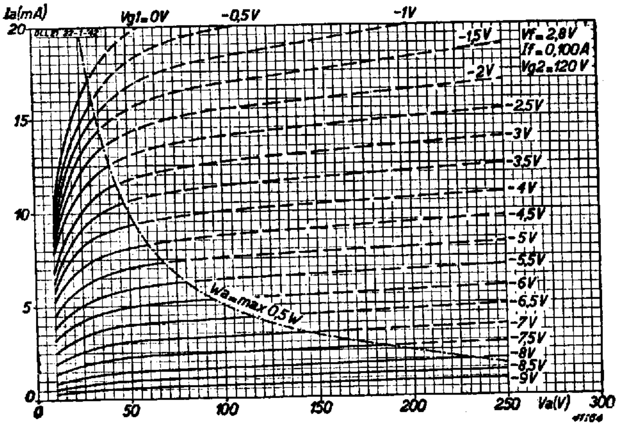


Fig. 16
Anode current of one pentode section as a function of anode voltage at $Vg_2 = 120$ V, $Vf = 2.8$ V and $If = 100$ mA, with Vg_1 as parameter.

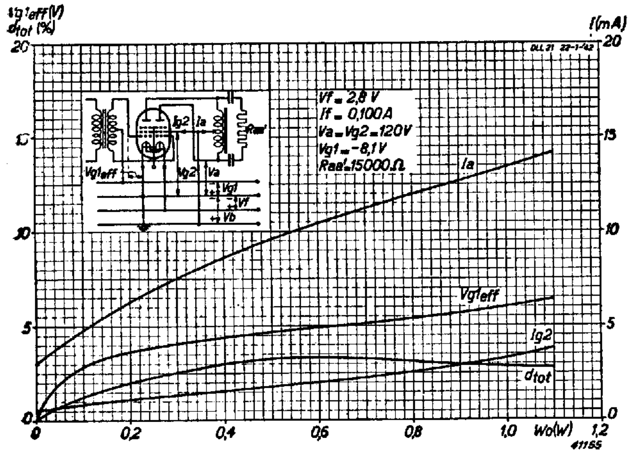


Fig. 17
Total anode current and screen grid current, total distortion and required alternating grid voltage per grid as function of output power, at $Vb = Va = Vg_2 = 120$ V, $Vf = 2.8$ V and $If = 100$ mA, in Class B circuit.

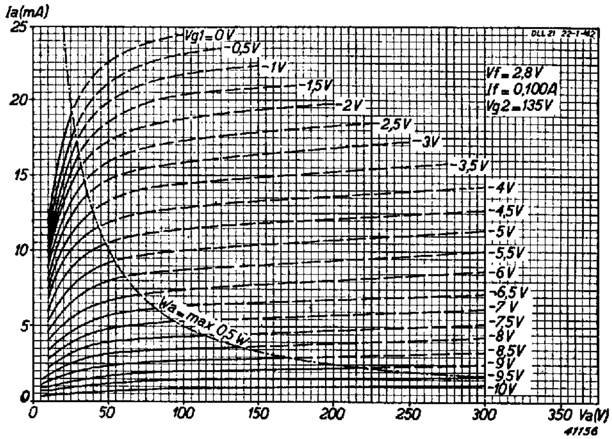


Fig. 18
Anode current of one pentode section as a function of anode voltage at $Vg_2 = 135$ V, $Vf = 2.8$ V and $If = 100$ mA, with Vg_1 as parameter.

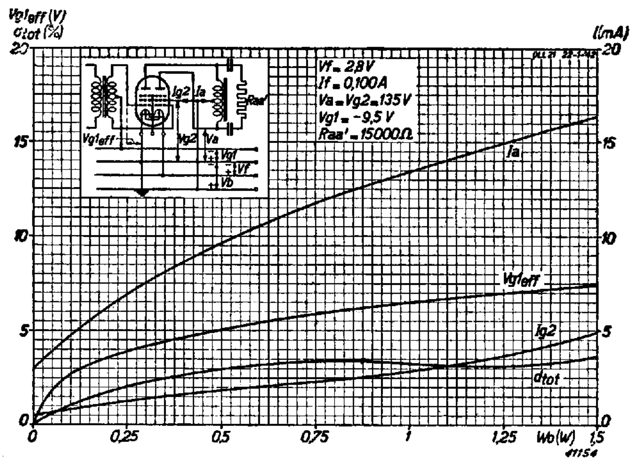


Fig. 19
Total anode current and screen grid current, total distortion and required alternating grid voltage per grid as function of output power at $Vb = Va = Vg_2 = 135$ V, $Vf = 2.8$ V and $If = 100$ mA, in Class B circuit.