ECH 4 Triode–heptode

The ECH 4 is a triode-heptode of which the electrical characteristics are similar to those of the "all-glass" valve ECH 21. The triode and heptode units both have their own separate external connections and can therefore be used for individual purposes.
For details of the various applications of this valve reference may be made to the particulars of the ECH 21 on p. 15. The electrical data are summarised below for easy reference and the characteristics are the same as those of the ECH 21.

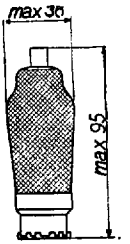
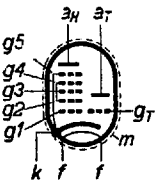


Fig. 1
Dimensions in mm.

HEATER RATINGS

Heater feed: indirect, by A.C.; parallel feed.

Heater voltage	V_f	= 6.3 V
Heater current	I_f	= 0.35 A



CAPACITANCES

a) heptode section:

C_{g1}	= 5.6	pF	C_{g1g3}	< 0.2	pF
C_a	= 9.2	pF	C_{g3}	= 8.9	pF
C_{ag1}	< 0.002	pF	C_{g1f}	< 0.00[illegible]	pF

b) triode section:

C_g	= 6.0	pF	C_{ak}	= 2.5	pF
C_a	= 5.4	pF	C_{ag}	= 2.1	pF
C_{gk}	= 3.0	pF	C_{gf}	< 0.3	pF

c) between heptode and triode and both combined:

C_{gTg1H}	< 0.1	pF	$C_{(gT+g3)g1H}$	< 0.25	pF
$C_{(gT+g3)}$	= 14	pF	$C_{(gT+g3)aH}$	< 0.1	pF

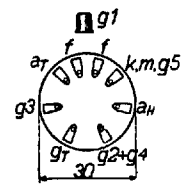


Fig. 2
Arrangement of electrodes and contacts.

OPERATING DATA: HEPTODE SECTION EMPLOYED AS MIXER VALVE (3rd grid connected to triode grid)

Anode and supply voltage	$V_a = V_b$	=	250 V
Screen grid resistance	$R_{(g2+g4)}$	=	24,000 Ohms
Cathode resistance	R_k	=	150 Ohms
Grid leak: 3rd grid and triode grid	$R_{(g3+gT)}$	=	50,000 Ohms
Current to 3rd grid and triode grid	$I_{(g3+gT)}$	=	190 μA
Grid bias	V_{g1}	= —2[1]	—24.5[2] V
Screen grid voltage	$V_{(g2+g4)}$	= 100	250 V
Anode current	I_a	= 3	— mA
Screen grid current	$I_{(g2+g4)}$	= 6.2	— mA
Internal resistance	R_i	= 1.4	> 3 M ohms
Conversion conductance	S_c	= 750	7.5 μA/V
Equivalent noise resistance	R_{eq}	= 55,000	— Ohms

[1]) Valve not controlled.
[2]) Mutual conductance controlled to 1/100.

OPERATING DATA: HEPTODE SECTION EMPLOYED AS I.F. AMPLIFIER
(3rd grid not connected to triode grid)

Anode and supply voltage	$V_a = V_b$	=	250 V	
Voltage on 3rd grid	V_{g3}	=	0 V	
Screen grid resistance	$R_{(g2+g4)}$	=	45,000 Ohms	
Grid bias	V_{g1}	= —2[1]	—36[2]	—44[3] V
Screen grid voltage	$V_{(g2+g4)}$	= 90	—	250 V
Anode current	I_a	= 5.3	—	— mA
Screen grid current	$I_{(g2+g4)}$	= 3.5	—	— mA
Mutual conductance	S	= 2200	22	2.2 μA/V
Internal resistance	R_i	= 0.9	>10	>10 M ohms
Gain factor, in respect of screen-control grid	μ_{g2g1}	= 18	—	—
Equivalent noise resistance	R_{eq}	= 7500	—	— Ohms

[1]) Valve not controlled.
[2]) Mutual conductance controlled to 1/100.
[3]) Mutual conductance controlled to 1/1000 (limit of control).

STATIC RATINGS FOR THE TRIODE SECTION

Anode voltage	V_a	= 100	V
Grid bias	V_g	= 0	V
Anode current	I_a	= 12	mA
Mutual conductance	S	= 3.2	mA/V
Gain factor	μ	= 22	

OPERATING DATA: TRIODE SECTION EMPLOYED AS OSCILLATOR VALVE (triode grid connected to third grid of heptode)

Supply voltage	V_b	= 250	V
Anode resistance	R_a	= 20,000	Ohms
Grid leak	$R_{(gT+g3)}$	= 50,000	Ohms
Current through grid leak to be adjusted to	$I_{(gT+g3)}$	= 190	μA
Anode current	I_a	= 4.5	mA

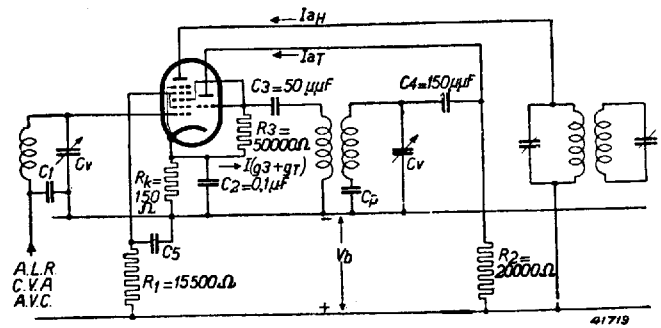


Fig. 3
Circuit diagram showing the ECH 4 employed as mixer valve.

OPERATING DATA: TRIODE SECTION EMPLOYED AS A.F. AMPLIFIER VALVE, Resistance-Capacitance coupled (triode grid not connected to third grid of heptode)

Supply voltage . . .	V_b	=	250		250		250	V
Anode resistance. . .	R_a	=	0.2		0.1		0.05	M Ohms
Grid bias.	V_g	=	−2	−4	−2	−4	−2	−4 V
Anode current . . .	I_a	=	1	0.9	2	1.7	3.5	3 mA
Alternating output voltage.	$V_{o\,eff}$	=	7.5	7.5	7.5	7.5	7.5	7.5 V
Total distortion. . .	d_{tot}	=	2.5	2.0	2.1	1.6	2.1	1.5 %
Voltage gain	$\frac{V_{o\,eff}}{V_{g1\,eff}}$	=	13	12	14	13	14	13

OPERATING DATA FOR THE ECH 4 EMPLOYED AS PHASE INVERTER for the modulation of a push-pull output stage

(with negative feed-back; see fig. 4. Triode grid not connected to third grid of heptode)

Supply voltage	V_b	=	250 V					
Anode resistance, heptode..	R_{aH}	=	0.2 M Ohms					
Anode resistance, triode. .	R_{aT}	=	0.1 M Ohms					
Screen grid resistance . . .	$R_{(g_2+g_4)}$	=	0.25 M Ohms					
Cathode resistance	R_k	=	650 Ohms					
Neg. control voltage on grid of heptode	V_R	=	0	−5	−10	−15	−20	V
Combined anode current: heptode and triode . . .	$I_{aH}+I_{aT}$	=	2.5	2.45	2.35	2.25	2.15	mA
Screen grid current	$I_{(g_2+g_4)}$	=	0.75	0.58	0.43	0.32	0.24	mA
Alternating input voltage .	$V_{g_1 eff}$	=	0.10	0.33	0.66	1.0	1.6	V
Voltage gain	$\frac{V_{o\,eff}}{V_{g_1 eff}}$	=	100	30	15	10	6	
Alternating output voltage.	V_{oeff}	=	10	10	10	10	10	V
Total distortion.	d_{tot}	=	0.80	3.70	4.50	6.20	7.50	%

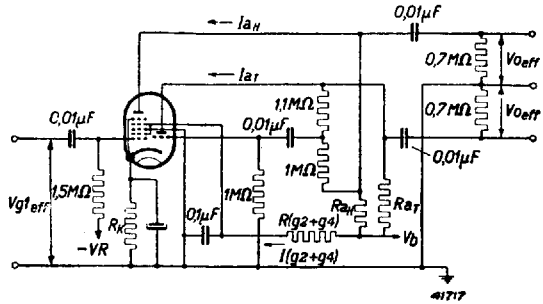


Fig. 4
Circuit diagram showing the ECH 4 employed as phase inverter with negative feed-back, to illustrate the above description and symbols.

MAXIMUM RATINGS FOR THE HEPTODE SECTION

Anode voltage in cold condition	V_{ao}	= max. 550 V
Anode voltage	V_a	= max. 300 V
Anode dissipation	W_a	= max. 1.5 W
Screen grid voltage in cold condition	$V_{(g2+g4)o}$	= max. 550 V
Screen grid voltage, valve uncontrolled (I_a=3 mA)	$V_{(g2+g4)}$	= max. 100 V
Screen grid voltage, valve controlled (I_a<1 mA)	$V_{(g2+g4)}$	= max. 300 V
Screen grid dissipation	$W_{(g2+g4)}$	= max. 1 W
Cathode current	I_k	= max. 15 mA
Grid current commences at (I_{g1} = + 0.3 μA)	V_{g1}	= max. —1.3 V
Grid current commences at (I_{g3} = + 0.3 μA)	V_{g3}	= max. —1.3 V
Max. external resistance between grid 1 and cathode	R_{g1k}	= max. 3 M Ohms
Max. external resistance between filament and cathode	R_{fk}	= max. 20,000 Ohms
Max. external resistance between grid 3 and cathode	R_{g3k}	= max. 3 M Ohms
Max. voltage between filament and cathode (D.C. voltage or effective value of alternating voltage)	V_{fk}	= max. 50 V

MAXIMUM RATINGS FOR THE TRIODE SECTION

Anode voltage in cold condition	V_{ao}	= max. 550 V
Anode voltage	V_a	= max. 100 V
Anode dissipation	W_a	= max. 0.5 W
Grid current commences at (I_g = + 0.3 μA)	V_g	= max. —1.3 V
Max. external resistance in grid circuit	R_{gk}	= max. 3 M Ohms