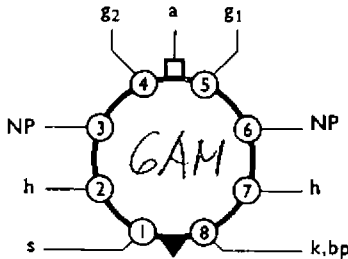


Beam tetrodes with oxide coated cathodes, the TT21 and TT22 are identical except for their heater ratings. They are designed for use as r.f. power amplifiers with full ratings at frequencies up to 30Mc/s and are also useful as audio output valves and pulse modulators.

**BASE CONNECTIONS AND VALVE DIMENSIONS**



Base: Octal  
Bulb: Dome top tubular  
Top ~~cap~~ ~~GT2~~  
Max. overall length: 131mm  
Max. seated length: 110mm  
Max. diameter: 52mm

HEATER	TT21	TT22	
$V_h$	6.3	12.6	V
$I_h$	1.6 (approx)	0.8 (approx)	A

**MAXIMUM RATINGS (Absolute)**

	*C.C.S.	†I.C.A.S.	
$V_a$	1.25	1.25	kV
$V_a (I_a=0)$	3.5	3.5	kV
$V_{g2}$	600	600	V
$-V_{g1}$	200	200	V
$p_a$	37.5	45	W
$p_{g2}$	6	6	W
$p_{g1}$	2	2	W
$I_k$	230	230	mA
$i_k(pk)$ (r.f.)	2	2	A
$i_a(pk)$ (pulse)	7.5	7.5	A
$V_{h-k}$	150	150	V
$R_{g1-k}$ (fixed bias)	100	100	kΩ
$R_{g1-k}$ (cathode bias)	220	220	kΩ
$T_{bulb}$	250	250	°C

\*Continuous Commercial Service is defined as that type of service in which long life and reliability of performance under continuous operating conditions are the prime considerations.

†Intermittent Commercial and Amateur Service is defined as that type of service where minimum size, light weight and maximum power output are more important than long life.

Intermittent operation implies that no 'on' period exceeds 5 minutes and an 'on' period is followed by an 'off' period of the same or longer duration.

**CAPACITANCES**

$C_{a-g1}$ : 0.25pF;

$C_{g1}$  - all less a: 17pF;

$C_a$  - all less g1: 13.5pF

from JEDEC release #3838, Aug. 6, 1962

# TT21 TT22

## CHARACTERISTICS

$V_a$	250	V
$V_{g2}$	250	V
$I_a$	140	mA
$g_m$	11	mA/V
$r_a$	12	k $\Omega$
$\mu_{g1-g2}$	8	—

## OPERATING DATA

### A.F. POWER AMPLIFIER

The TT21 may be used as an alternative to the KT88 in any existing audio designs.

### A.F. POWER AMPLIFIER—CLASS AB1—CATHODE BIAS

Push-Pull Ultra-Linear Connection with 43% Taps

Maximum Permissible Conditions—C.C.S.

$V_{a,g2}$	600	V
$p_a$	37.5	W
$p_{g2}$	6	W

#### Typical Operation

$V_{a(b)}$	500	V
$V_{a,g2}$	425	V
$I_{a+g2(o)}$	$2 \times 87$	mA
$I_{a+g2(max)}$	$2 \times 100$	mA
* $R_k$	$2 \times 525 \pm 5\%$	$\Omega$
$v_{in(g1-g1)}(pk)$	90	V
$R_{L(a-a)}$	6	k $\Omega$
$P_{out}$	50	W
$D_{tot}$	1	%

\*Separate bias resistors essential.

### A.F. POWER AMPLIFIER—CLASS AB1—FIXED BIAS

Push-Pull Ultra-Linear Connection with 43% Taps

Maximum Permissible Conditions—C.C.S.

$V_{a,g2}$	600	V
$p_a$	37.5	W
$p_{g2}$	6	W

#### Typical Operation

$V_{a(b)}$	560	V
$V_{a,g2}$	550	V
$I_{a+g2(o)}$	$2 \times 50$	mA
$I_{a+g2(max)}$	$2 \times 150$	mA
* $-V_{g1}$	80 (approx)	V
$v_{in(g1-g1)}(pk)$	120	V
$R_{L(a-a)}$	4.5	k $\Omega$
$P_{out}$	100	W
$D_{tot}$	5	%

\*Must be separately adjusted on each valve. Bias supply should have an adjustment range of  $\pm 25\%$ .

When it is inconvenient to use either the TT21 or the KT88 in the ultra-linear connection, conditions similar to those given above may be used for tetrode connection. However, there is no advantage in setting the fixed screen voltage supply in excess of about 300V.

## A.F. POWER AMPLIFIER—CLASS AB1—FIXED BIAS

Push-Pull Tetrode Connection—Intermittent Operation only

Maximum Permissible Conditions—I.C.A.S.

$V_a$	1·25	kV
$V_{g2}$	600	V
$P_a$	45	W
$P_{g2}$	6	W

### Typical Operation

$V_{a(b)}$	1·25	kV
$V_{g2}$	300	V
$I_{a(o)}$	$2 \times 28$	mA
$I_{a(max)}$	$2 \times 130$	mA
$I_{g2(o)}$	$< 2 \times 1$	mA
$I_{g2(max)}$	$2 \times 13$	mA
$R_{L(a-a)}$	15	k $\Omega$
* $-V_{g1}$	45 (approx)	V
$V_{in(g1-g1)(pk)}$	71	V
$P_{out}$	200	W
$D_{tot}$	7	%

\*Must be separately adjusted on each valve. Bias should have an adjustment range of  $\pm 25\%$ .

## R.F. POWER AMPLIFIER—CLASS C TELEGRAPHY

Maximum Permissible Conditions

	C.C.S.	I.C.A.S.	
$V_a$	1·25	1·25	kV
$V_{g2}$	600	600	V
$-V_{g1}$	200	200	V
$I_a$	200	200	mA
$P_a$	37·5	45	W
$P_{in}$	200	220	W
$P_{g2}$	6	6	W
$P_{g1}$	2	2	W

### Typical Operation—C.C.S.

$V_a$	500	800	1000	1250	V
$V_{g2}$	300	300	300	300	V
$-V_{g1}$	115	115	115	115	V
$I_a$	192	182	175	160	mA
$I_{g2}$	20	20	20	20	mA
$I_{g1}$	8·5	7	5·5	4·5	mA
$P_a$	37·5	37·5	37·5	37·5	W
$P_{g2}$	6	6	6	6	W
$P_{out}$	58·5	108·5	137·5	162·5	W
Efficiency	61	75	78	81	%
*PL	52	95	115	132	W
$P_{out}$ (driver)	2·1	1·9	1·8	1·6	W

\*Measured at 30Mc/s.

# TT21 TT22

## Typical Operation—I.C.A.S.

			*	*		
$V_a$	500	800	1000	1000	1250	V
$V_{g2}$	300	300	300	300	300	V
$-V_{g1}$	115	115	115	60	115	V
$I_a$	200	200	190	175	175	mA
$I_{g2}$	20	20	20	20	20	mA
$I_{g1}$	9	9	7.5	4	6	mA
$p_a$	40	43	45	45	45	W
$p_{g2}$	6	6	6	6	6	W
$P_{out}$	60	117	145	130	174	W
Efficiency	59	74	76.5	74.5	79.5	%
$\dagger P_L$	52	103	126	106	146	W
$P_{out}$ (driver)	2.1	2.1	2	0.65	1.9	W

\*These operating conditions demonstrate the effect of reduced bias and driving power on power output.

†Measured at 30Mc/s.

## R.F. POWER AMPLIFIER—CLASS C—ANODE MODULATED (Carrier Conditions) Maximum Permissible Conditions

	C.C.S.	I.C.A.S.	
$V_a$	1	1	kV
$V_{g2}$	600	600	V
$-V_{g1}$	200	200	V
$I_a$	160	180	mA
$p_a$	25	30	W
$P_{in}$	130	150	W
$p_{g2}$	6	6	W
$p_{g1}$	2	2	W
Modulation	100	100	%

## Typical Operation—C.C.S.

$V_a$	550	700	850	1000	V
$V_{g2}$	300	300	300	300	V
$-V_{g1}$	115	115	115	115	V
$I_a$	160	150	140	130	mA
$I_{g2}$	20	20	20	20	mA
$I_{g1}$	5	3.5	3	2.5	mA
$p_a$	25	25	25	25	W
$p_{g2}$	6	6	6	6	W
$P_{out}$	63.5	80	95	105	W
Efficiency	72	76	80	81	%
* $P_L$	54	70	82	87	W
$P_{out}$ (driver)	1.5	1.4	1.2	1.1	W
$P_{mod}$	50	60	68	75	W

\*Measured at 30Mc/s.

## Typical Operation—I.C.A.S.

$V_a$	550	700	850	1000	V
$V_{g2}$	300	300	300	300	V
$-V_{g1}$	115	115	115	115	V
$I_a$	180	175	165	150	mA
$I_{g2}$	20	20	20	20	mA
$I_{g1}$	6.5	5.5	5	3.5	mA
$P_a$	30	30	30	30	W
$P_{g2}$	6	6	6	6	W
$P_{out}$	69	92	110	123	W
Efficiency	70	75.5	78.5	82	%
* $P_L$	61	82	94	101	W
$P_{out}$ (driver)	1.8	1.7	1.5	1.2	W
$P_{mod}$	55	68	80	85	W

\*Measured at 30Mc/s.

## R.F. POWER AMPLIFIER—CLASS AB1—S.S.B.

### Maximum Permissible Conditions

	C.C.S.	I.C.A.S.	
$V_a$	1.25	1.25	kV
$V_{g2}$	600	600	V
$-V_{g1}$	200	200	V
$P_a$	37.5	45	W
$P_{g2}$	6	6	W
$P_{g1}$	2	2	W

### Typical Operation

$V_a$	800	1000	V
$V_{g2}$	300	300	V
* $-V_{g1}$	38	40	V
$V_{g1}(pk)$	38	40	V
$I_a(o)$	40	35	mA
$I_a(max)$	122	116	mA
$I_{g2(o)}$	0	0	mA
$I_{g2(max)}$	11	8.5	mA
$I_{g1(max)}$	0	0	mA
$P_a(o)$	32	35	W
$P_a(max)$	31	34.5	W
$P_{g2(o)}$	0	0	W
$P_{g2(max)}$	3.3	2.55	W
† $P_{out}$	67	80	W
$Z_a$	2.8	3.6	k $\Omega$
Efficiency	63	69	%
† $P_L$	55	65	W

\*Adjust to obtain specified value of  $I_a(o)$ .

†Peak envelope power output or single tone power output.

‡Measured at 30Mc/s.

# TT21

# TT22

## PULSE MODULATOR SERVICE

### Maximum Permissible Conditions

$V_a$	3.5	kV
$V_{g2}$	600	V
$-V_{g1}$	200	V
$P_a$	37.5	W
$P_{g2}$	6	W
$P_{g1}$	2	W
$i_{a(pk)}$	7.5	A

### Typical Operation

$V_a$	3.5	kV
$V_{g2}$	600	V
$-V_{g1}$	150	V
$V_{g1(pk)}$	380	V
$i_{a(pk)}$	6	A
$i_{g2(pk)}$	2.1	A
$i_{g1(pk)}$	2.3	A
$R_a$	460	$\Omega$
$t_p$	2	$\mu s$
PRF	1500	p/s

## INSTALLATION

The valve may be mounted either vertically or horizontally.

When a pair of valves is mounted vertically it is recommended that the centres of the valve sockets are not less than 4in. apart and that pins 4 and 8 of each valve are in line.

When a pair of valves is mounted horizontally it is recommended that the centres of the valve sockets are not less than 4in. apart and that pins 4 and 8 of each valve are in the same vertical line.

Free air circulation around the valve is desirable.

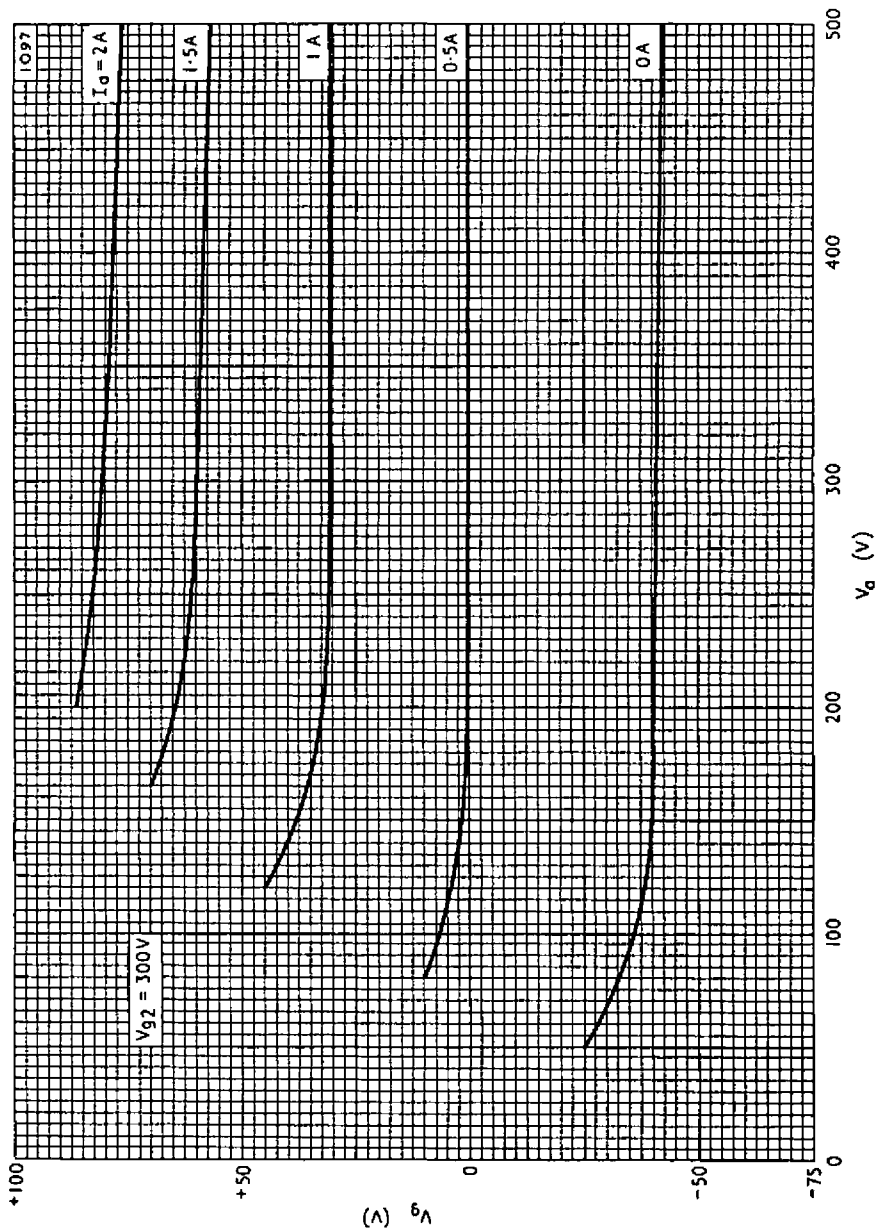


Fig. 1. Constant anode current curves at  $V_{g2} = 300V$ .

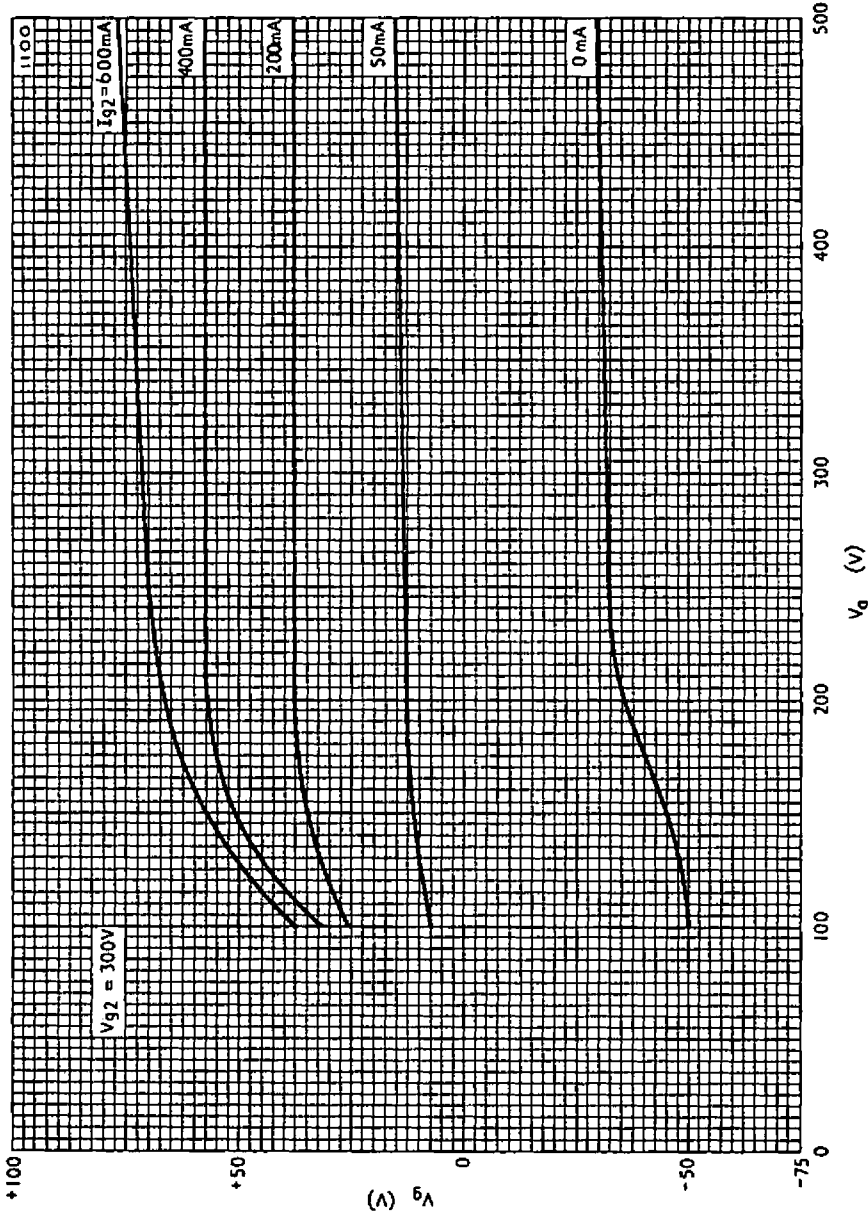


Fig. 2. Constant screen current curves at  $V_{g2} = 300V$ .



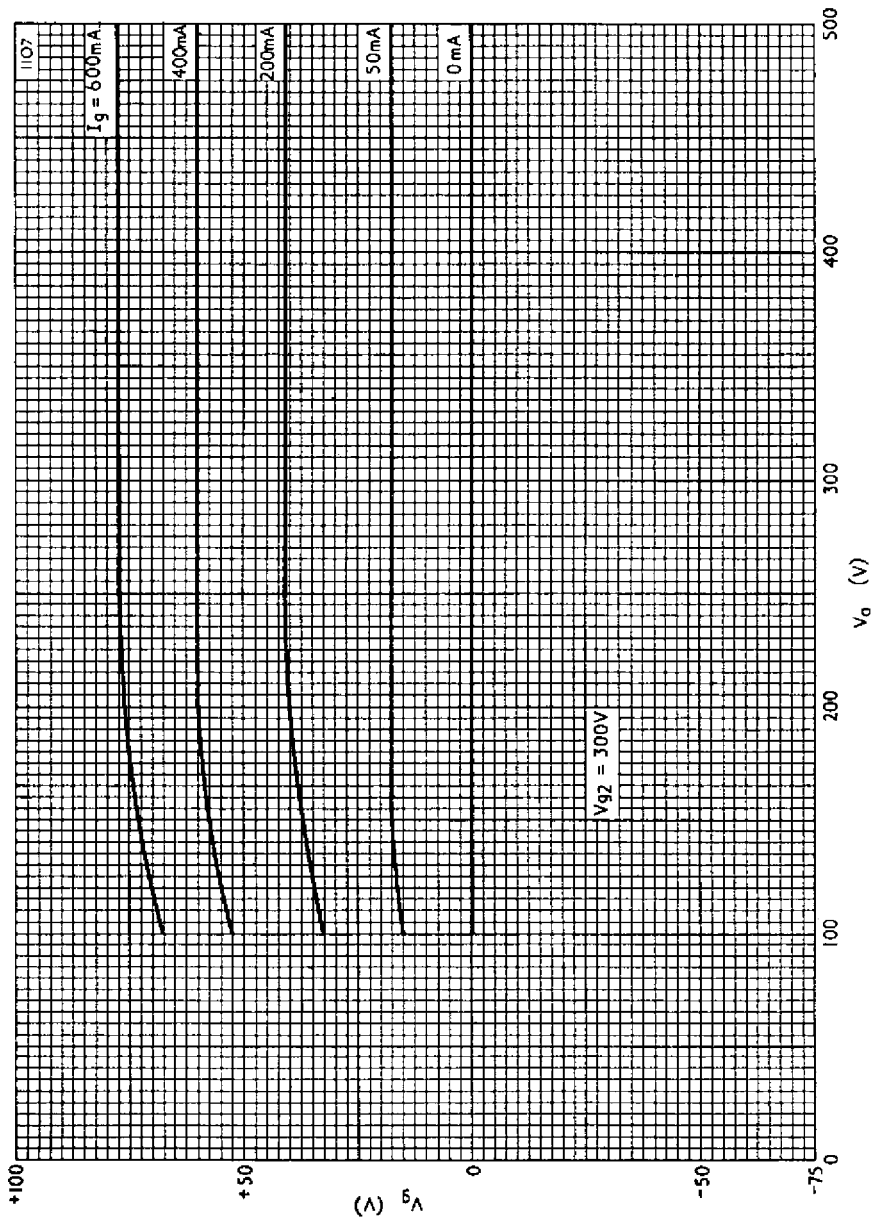


Fig. 3. Constant grid current curves at  $V_{g2} = 300V$ .

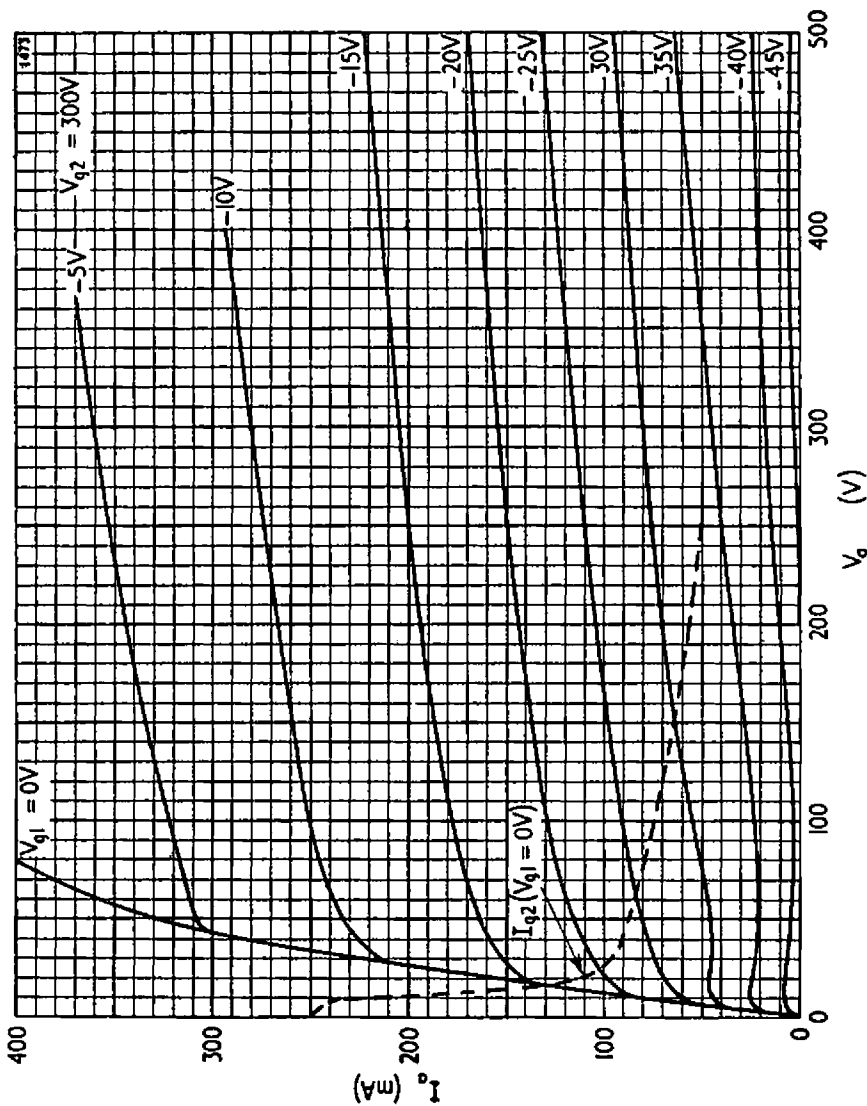


Fig. 4. Anode current curves at  $V_{g2} = 300V$  and  $V_{g1}$  negative.

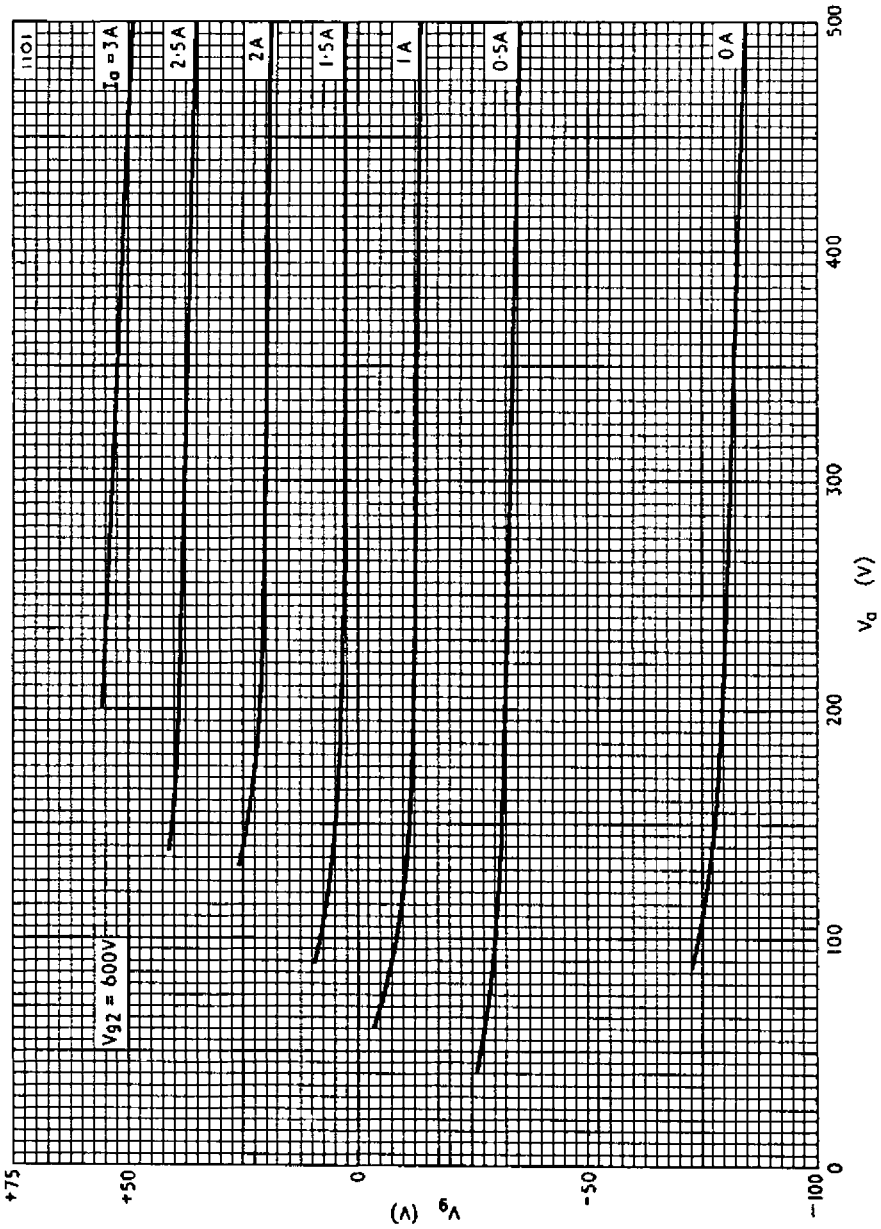


Fig. 5. Constant anode current curves at  $V_{g2} = 600V$ .

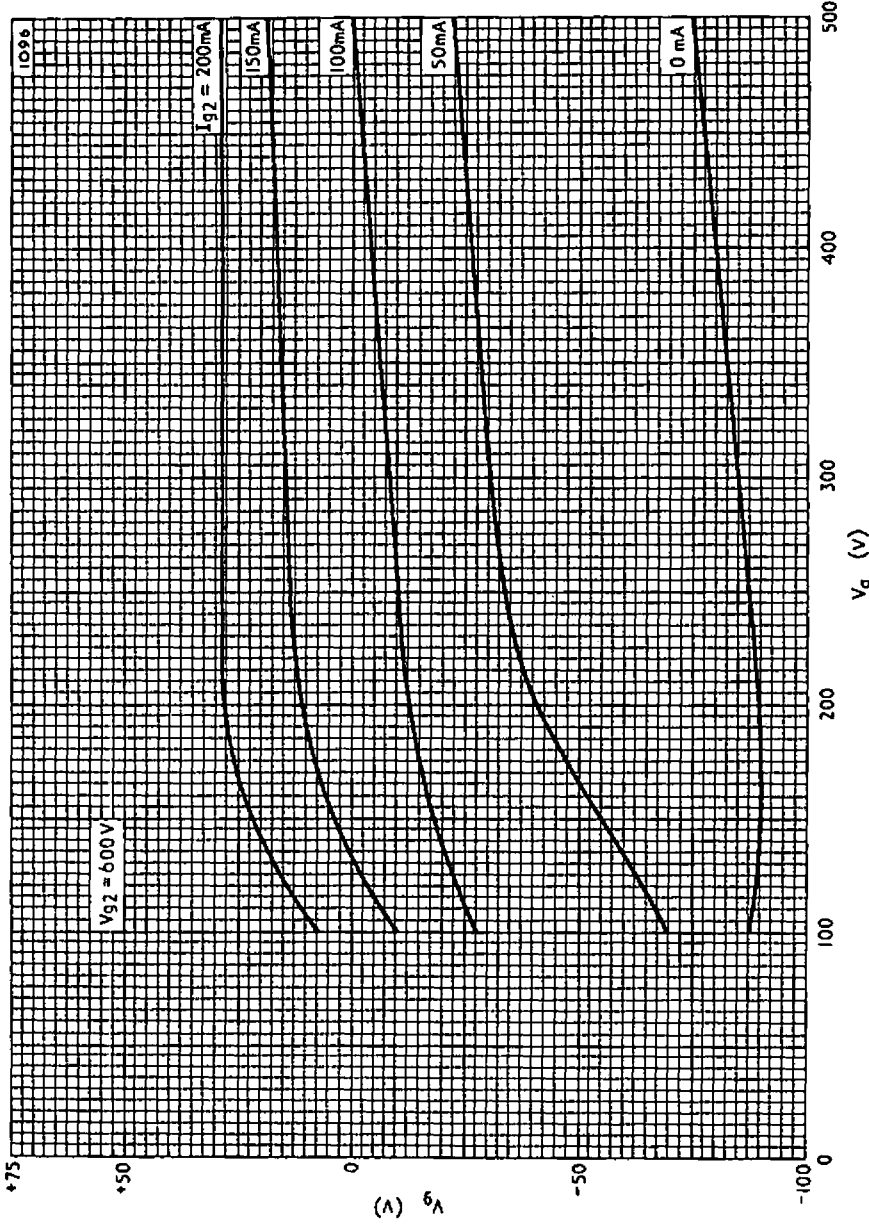


Fig. 6. Constant screen current curves at  $V_{g2} = 600V$ .

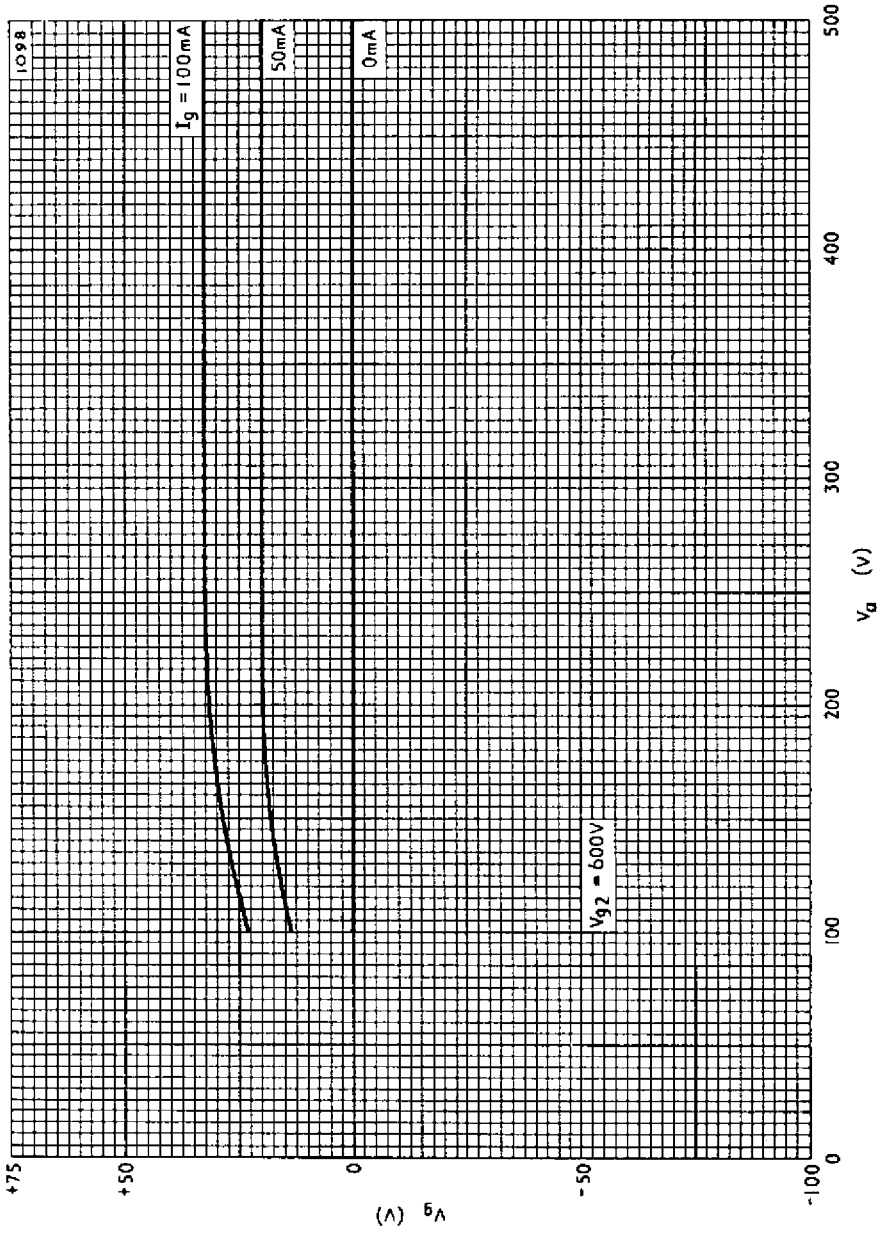


Fig. 7. Constant grid current curves at  $V_{g2} = 600\text{V}$ .

TT21  
TT22

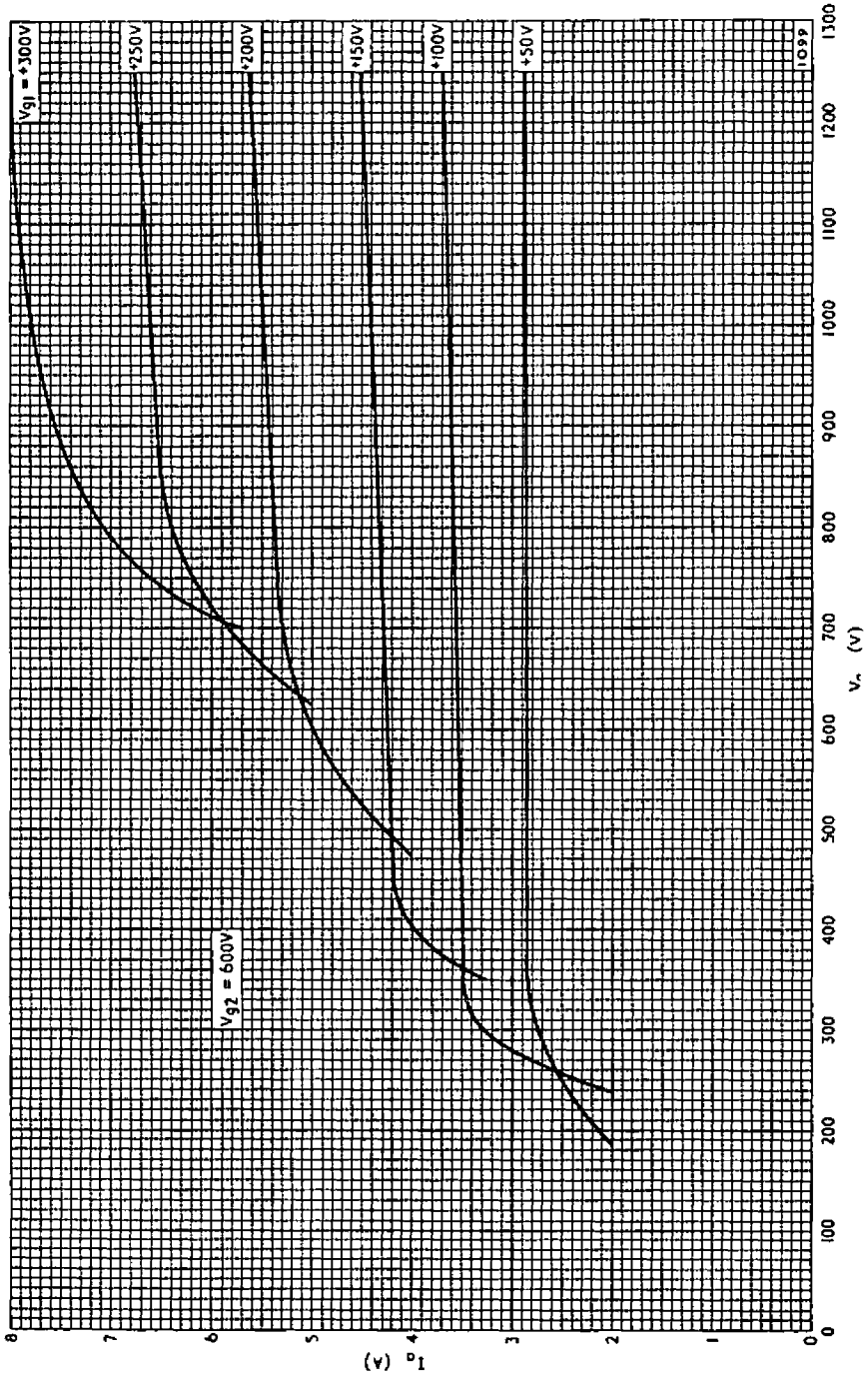


Fig. 8. Anode current curves for pulse modulator applications.

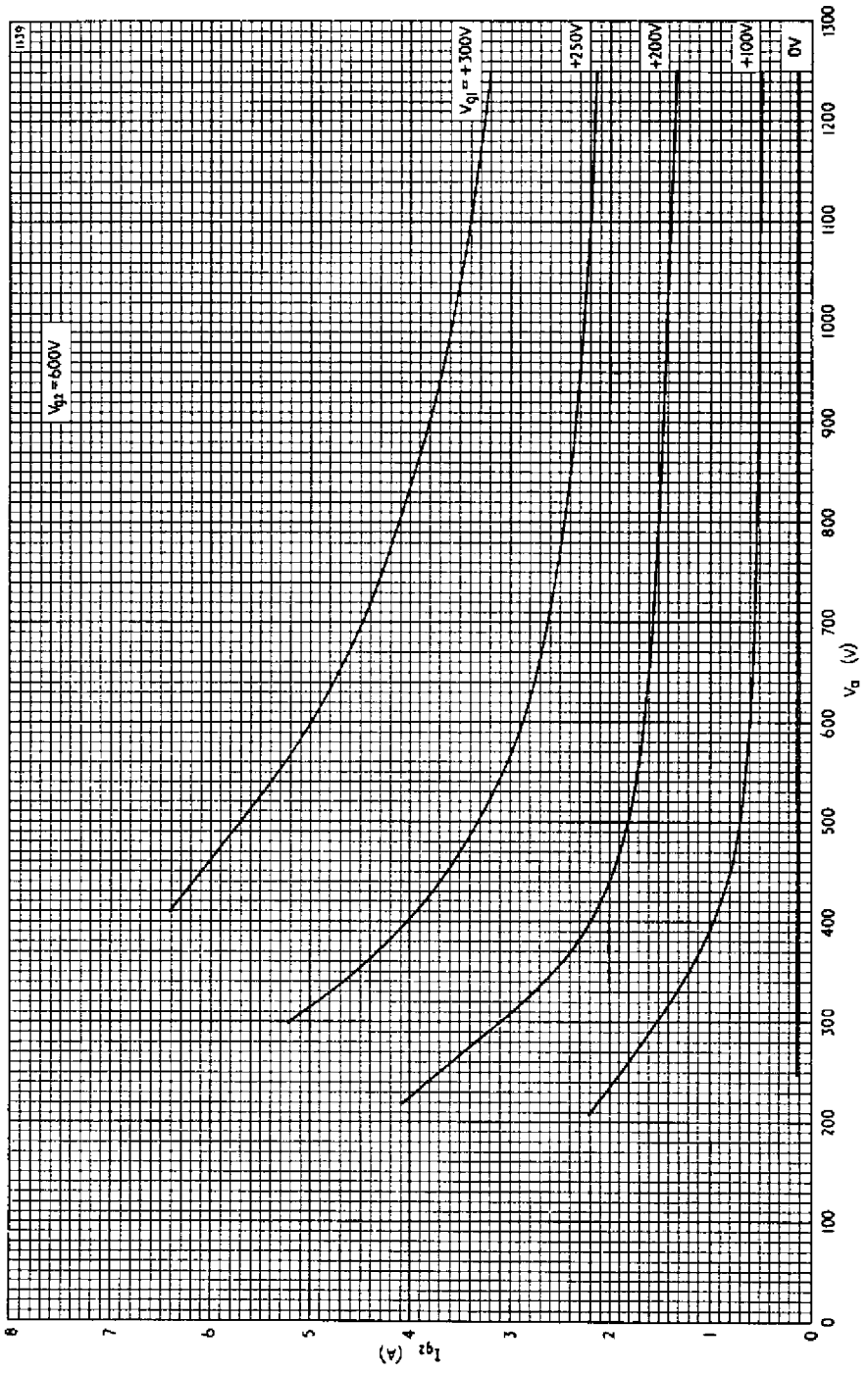


Fig. 9. Screen current curves for pulse modulator applications.

TT21  
TT22

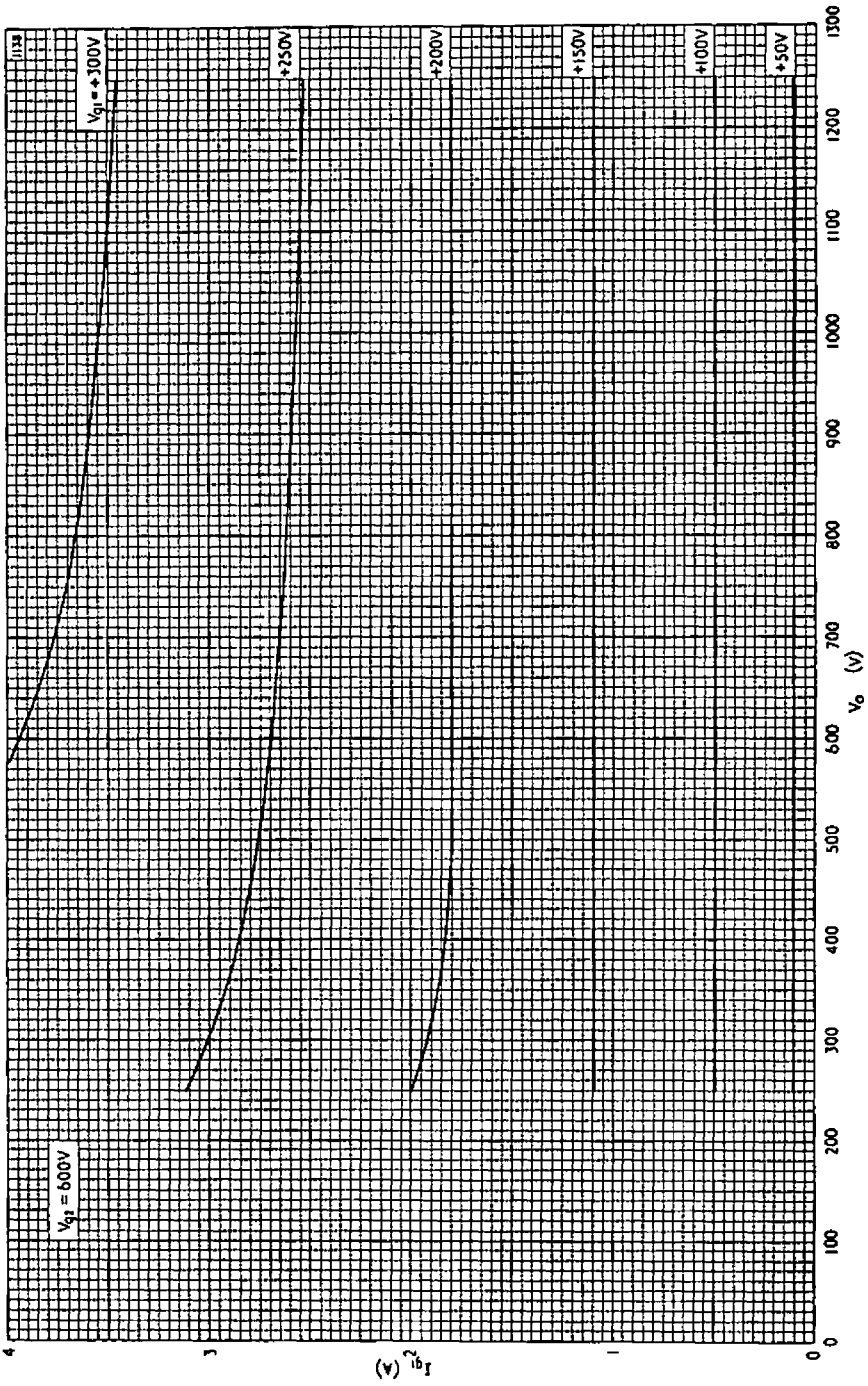


Fig. 10. Grid current curves for pulse modulator applications.



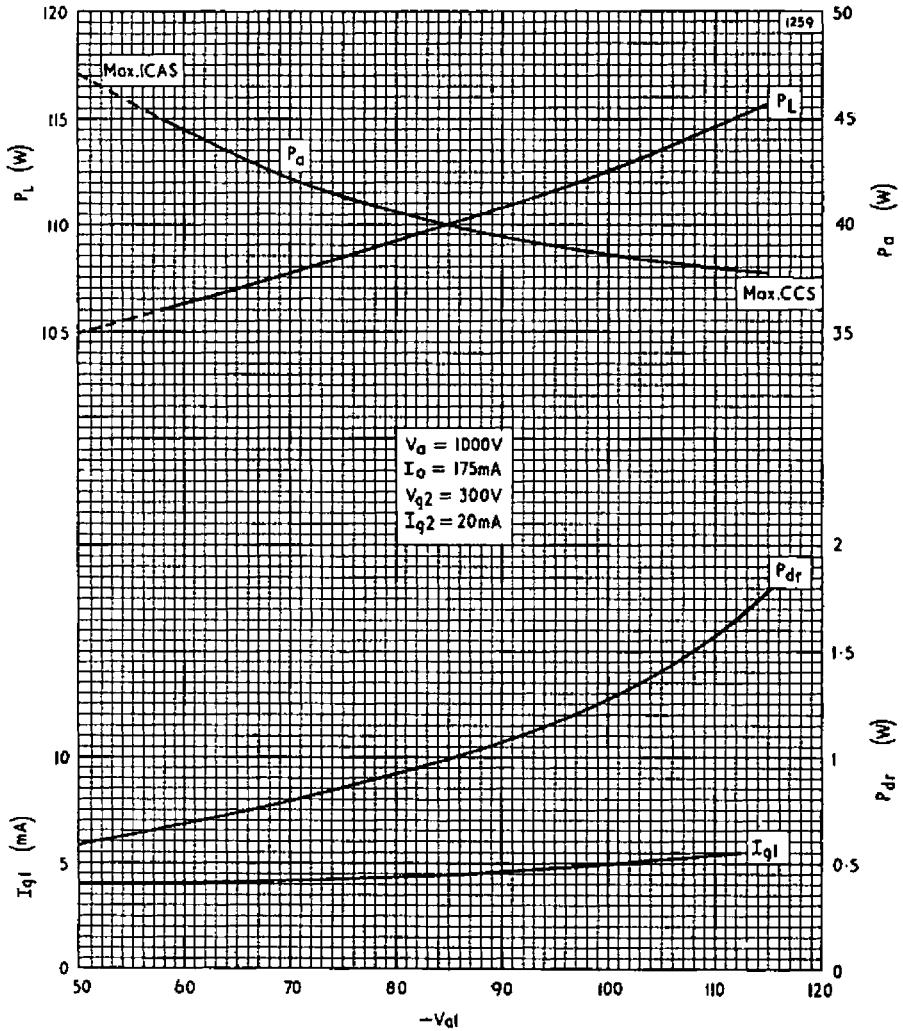


Fig. 11. Class C telegraphy. Bias variation curves.

# TT21 TT22

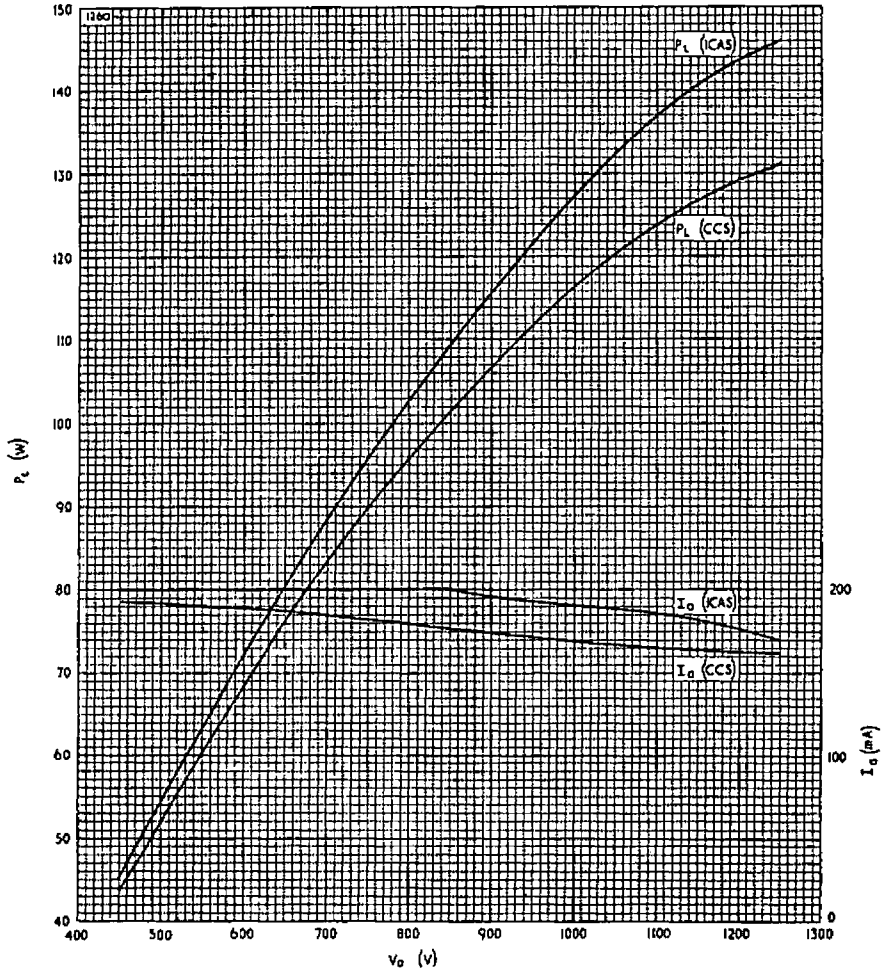


Fig. 12. Class C telegraphy. Power output/anode voltage curves.

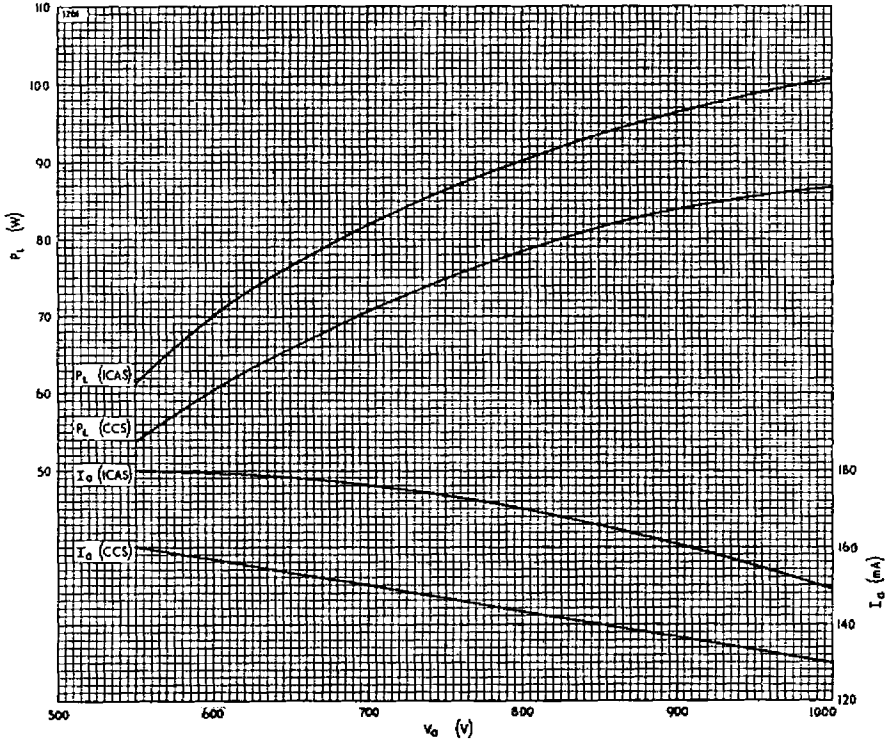


Fig. 13. Anode modulated class C telephony.  
Power output/anode voltage curves.