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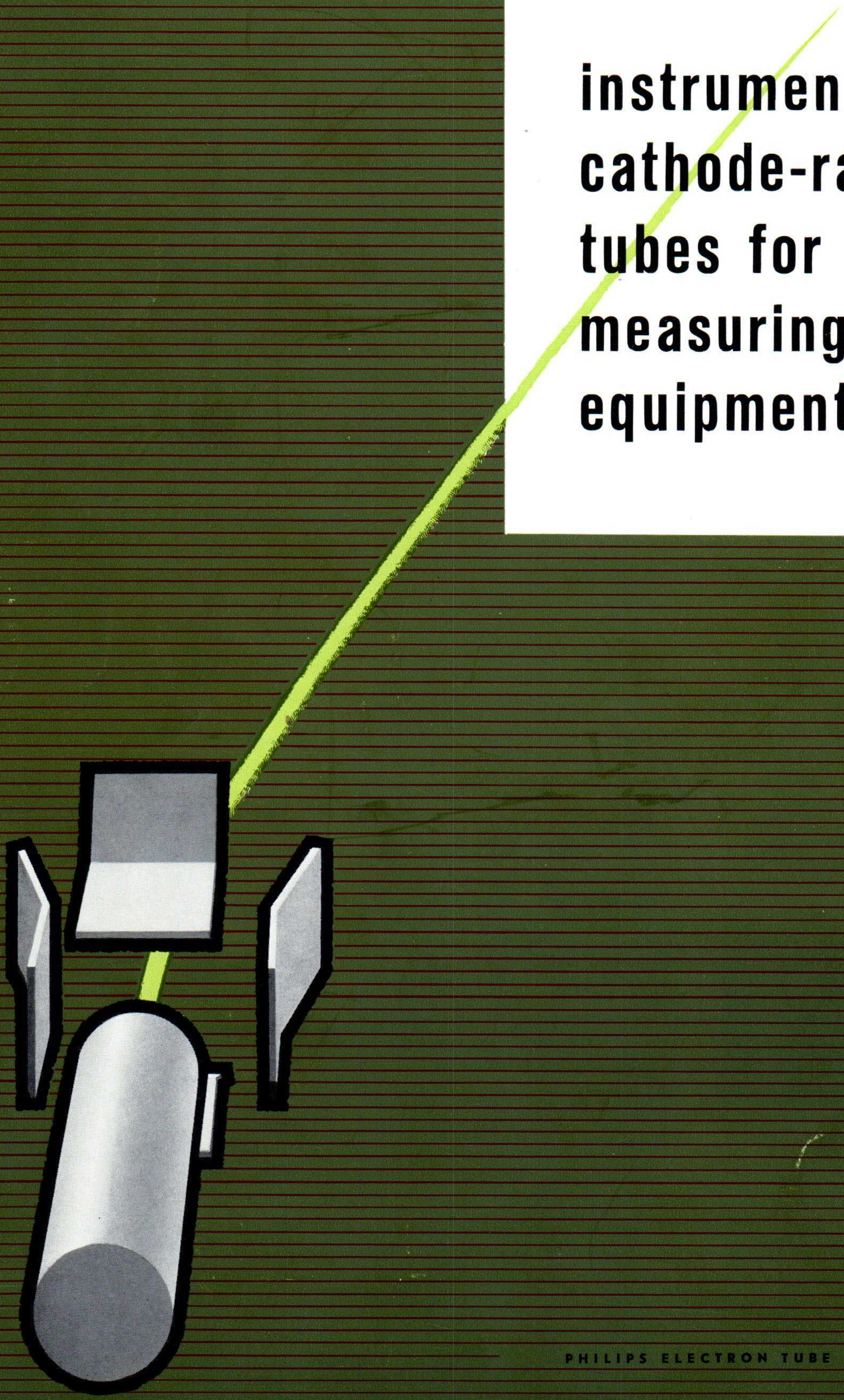
instrument cathode-ray tubes for measuring equipment



PHILIPS ELECTRON TUBE DIVISION

CATHODE-RAY TUBES FOR MEASURING EQUIPMENT

The continued penetration of electronics into various branches of industry and science is reflected in the ever increasing number of electronic measuring equipments used. An important part of such equipments is the oscilloscope tube, which in many fields is becoming indispensable as a measuring instrument, replacing or complementing a pointer-scale instrument.

The demands made on oscilloscope tubes may be stated as follows:

— high accuracy and freedom of distortion;

— high frequency response;

— high sensitivity;

— high brightness, and suitability for photographic recording;

— in some cases: low heater power consumption.

Elimination of distortion; control of astigmatism

From the tube data it can be seen that the pattern distortion tolerances are very narrow; e.g. for type D 13-21.. the maximum deviation from a horizontal line is only 1.25% and the deviation from a vertical line only 0.6%. This has been achieved mainly by the very close tolerances on the deflection system components and the extremely careful assembly of it. Apart from this, means have been provided to control the geometry also electrically, in that the isolation shield inserted between the two pairs of deflection plates has been connected to a separate pin. By varying the potential of this shield, it is possible to control "pin-cushion" or "barrel" pattern distortion. In addition, the separation of the accelerator electrode and the isolation shield allows a variation of the voltage at the acceleration electrode (which may be necessary to control astigmatism), without the deflection sensitivity being influenced. Since in various types grids No. 2 and No. 4 have also been separated, the astigmatism control will not affect the brightness setting either.

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Metal-backed screens; GP-phosphor

A great technical achievement is the realisation of a metal-backing having a "cross-over" point at approximately 2.5 kV. This means that at 2.5 kV there is no difference in brightness between a metal-backed tube and a tube without metal-backing, but at 4 kV and 5 kV there will be a considerable difference in brightness. The first tube in our range with this extra feature is the D 13-15.. Other tubes with normal metal-backing are D. 13-10, D 13-20 BE, D 13-21.., D 13-16.., D 13-17.. and D 13-19..

The recently developed GP-phosphor, which combines excellent properties for both visual observation and photographic recording, is available for many types.

The two types D 13-16.. and D 13-17.., which have been designed especially for wide-band oscilloscopes, feature sectioned y-plates and deflection beam blanking. They can be used in oscilloscopes with frequency ranges of 0 to 100 Mc/s and 0 to 250 Mc/s respectively.

Type 13-23.. is a flat-faced tube with metal-backed screen, helical post-deflection acceleration, and side connections to the x- and y-plates. The latter are intended to be included in a resonant circuit that can be tuned to frequencies of from 300 to 900 Mc/s by means of adaptor units outside the tube. The tube D 13-23 GH incorporates deflection blanking, and is intended for high-frequency, narrow-bandwidth display.

Double-gun tubes

The continually growing interest in simultaneous display of two phenomena on one cathode-ray tube has led to the design of two 10-cm double-gun types, the E 10-10.. and E 10-12.. These permit the construction of high-precision, respectively inexpensive, double-beam oscilloscopes.

For transistorised oscilloscopes two types of tube are available: D 10-11.. and D. 7-11. They are provided with a 6.3V/0.095A heater.

Fig. 1

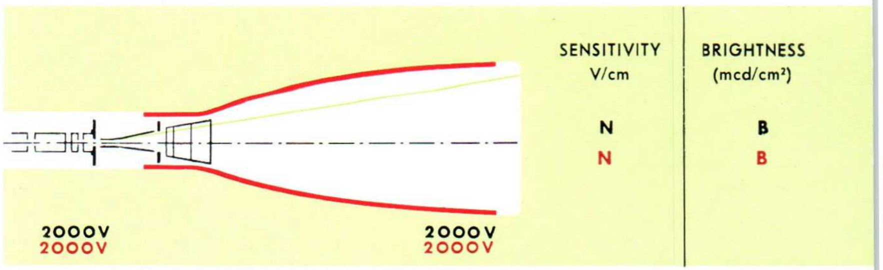


Fig. 2

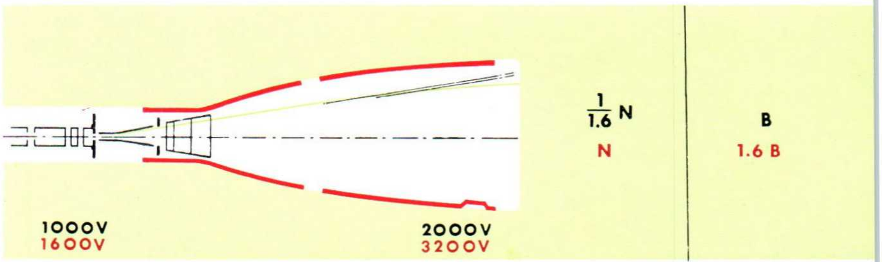
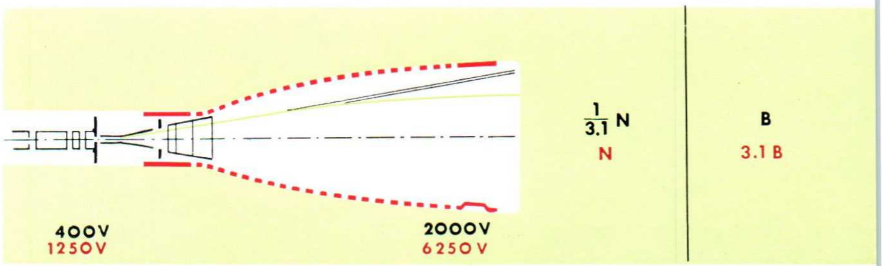


Fig. 3



PRINCIPLE OF POST-DEFLECTION ACCELERATION

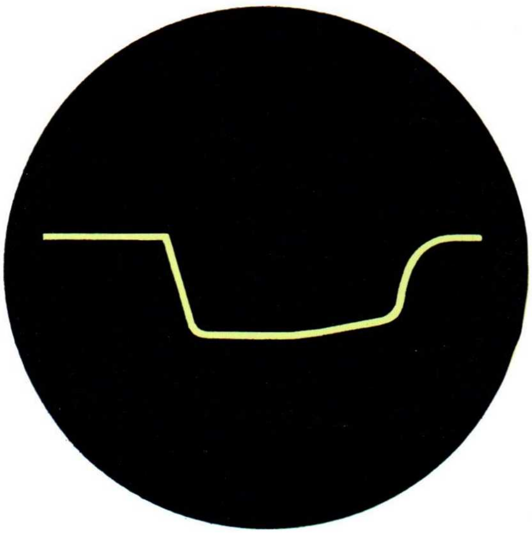
To evaluate the influence of the various post acceleration methods the following systems are compared:

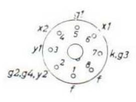
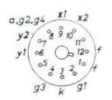
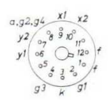
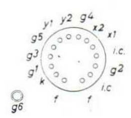
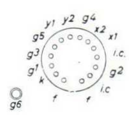
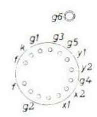
(a) tube without post acceleration (Fig. 1);

(b) tube with conventional one-step post acceleration; the ratio of post-acceleration voltage to acceleration voltage is max. 2 (Fig. 2);

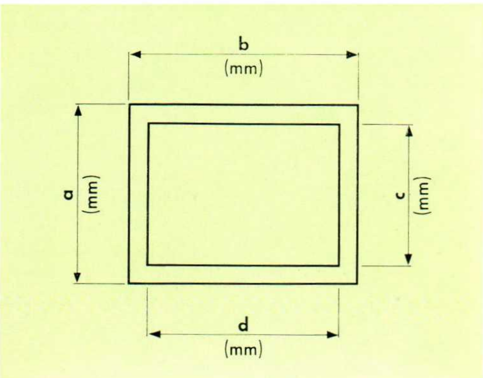
(c) tube with modern helical post-acceleration electrode (in the example given in Fig. 3 the ratio of post-acceleration voltage to acceleration voltage is 5).

It can be seen from the figures that, when the voltages are adjusted for a given brightness B, the application of post acceleration results in an increased sensitivity N. Notably a helical post-acceleration electrode shows a considerable improvement in this respect. Conversely, in the same instances the brightness will be appreciably increased when the sensitivity is kept constant.

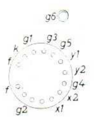
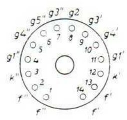
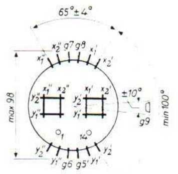


	D. 3-91	D. 7-31	D. 7-32	D. 7-11	D. 7-78	D 10-11..
acceleration voltage (maximum)	1000	800	800	2100	2100	2200
post acceleration voltage (maximum)				5000	5000	5000
acceleration voltage (typical)	500	500	500	1200/300	1200/300	1000
post acceleration voltage (typical)				1200	1200	4000
ratio of post deflection acceleration voltage to acceleration voltage (typical)				4	4	4
deflection factor M_y (vertical) [1]	45	21	21	3.65	3.65	9.8
deflection factor M_x (horizontal) [1]	53	37	37	10.7	10.7	27.5
vertical scan [1]	full	full	full	45	45	60
horizontal scan [1]	full	full	full	60	60	full
line width [1]	0.6	0.5 [2]	0.5 [2]	0.65 [8]	0.65 [8]	0.35 [8]
heater voltage	6.3	6.3	6.3	6.3	6.3	6.3
heater current	550	300	300	90	300	90
pattern distortion [3] (see below)						
maximum length	105	172	172	285	285	320
screen diameter	3	7	7	7	7	10
symmetric/asymmetric deflection	asymmetric [7]	asymmetric	asymmetric	symmetric	symmetric	symmetric
tube holder — base	English loctal 8 p.	duodecal 12 p.	duodecal 12 p.	all-glass 14 p.	all-glass 14 p.	all-glass 14 p.
tube holder — holder	5902/20 [4] 40213 [5]	5912/20 [4]	5912/20 [4]	40467	40467	55566
tube holder — mounting ring						
mu-metal screen	55525	55530	55530	55532	55532	
post deflection acceleration connector				55563	55563	55560
side contacts						
available screen versions	H	G	G	B, H, N, P	B, H, N, P	BE, GH, GM, GP
						

Pattern distortion limits



type	a	b	c	d
D. 7-31/7-32	43.2	43.2	40	40
D. 7-11/7-78	40.8	40.8	39.2	39.2
D 10-11/10-12..	50	60	48.4	58.4
E 10-10..	60	60	57.6	57.6
E 10-12..	60	60	57	57

D 10-12..	E 10-10.. (each gun)	E 10-12.. (each gun)	units
2200	1500	1200	V
5000	6000	3300	V
1000	1000	1000	V
4000	4000	3000	V
4	4	3	
9.8	max. 8	max. 8	V/cm
27.5	max. 20	max. 20	V/cm
60	70 [6])	70 [6])	mm
full	80	80	mm
0.35 [8])	0.4 [8])	0.5 [8])	mm
6.3	6.3	6.3	V
300	300	300	mA
320	410	410	mm
10	10	10	cm
symmetric	double gun; symmetric	double gun; symmetric	
all-glass 14 p.	all-glass 14 p.	all-glass 14 p.	
55566	55566	55566	
55560	55563	55563	
	55561	55561	
BE, GH, GM, GP	GH	BE, GH, GM, GP	
			

1 measured under typical operating conditions

2 measured on a circle of 35 mm diameter, with 0.5 μA screen current

3 under typical operating conditions, if possible optimally adjusted for astigmatism, barrel-pattern or pin-cushion distortion, a nominally rectangular raster may be inserted into the frame bounded by concentric rectangles, the dimensions of which are given in the columns

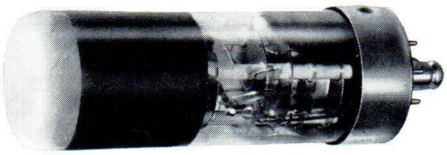
4 synthetic resin

5 ceramic

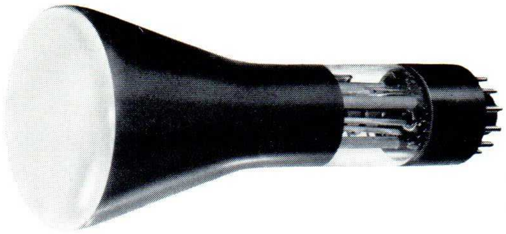
6 for each vertical deflection system the useful scan is min. 70 mm; the overlap of the two scans is max. 50 mm

7 in vertical direction

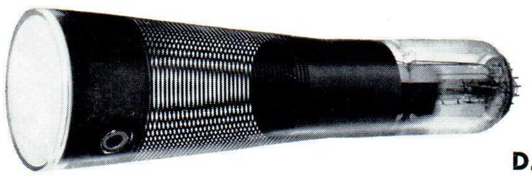
8 shrinking raster method, screen current 10 μA



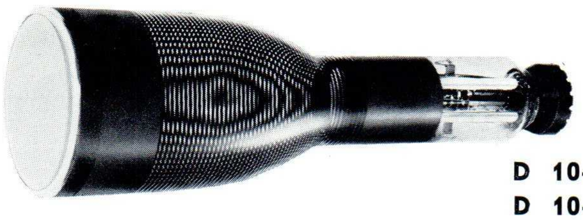
D. 3-91



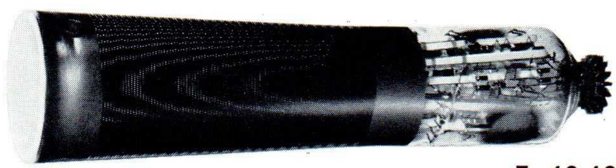
D. 7-31
D. 7-32



D. 7-11
D. 7-78

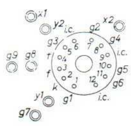
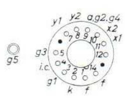


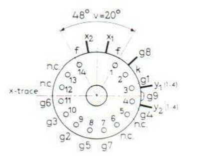
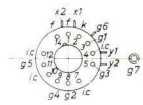
D 10-11..
D 10-12..



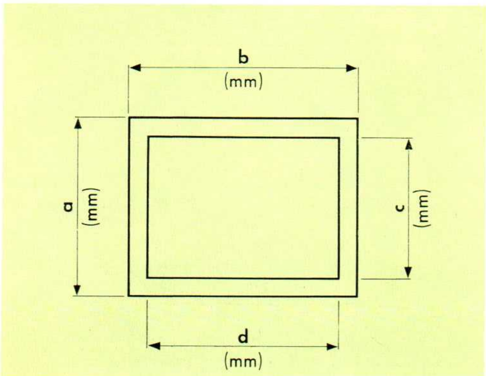
E 10-10..
E 10-12..

	D. 13-10	D. 13-34	D 13-15..	D 13-16..	D 13-17..	D 13-19..
acceleration voltage (maximum)	3300	2600	2200	2500	2500	2200
post acceleration voltage (maximum)	17300	6000	8800	16000	16000	12000
acceleration voltage (typical)	1500	1500	2000	1670	1670	1670
post acceleration voltage (typical)	15000	3000	4000	10000	10000	10000
ratio of post deflection acceleration voltage to acceleration voltage (typical)	10	2.3	4	10	10	6
deflection factor M_y (vertical) [1]	2.7	13.2	5.9	6.0	5.0	16.9
deflection factor M_x (horizontal) [1]	11.2	23.6	22.6	max. 18	max. 18	30
vertical scan [1]	60	100	60	60	40	60
horizontal scan [1]	100	100	100	100	100	100
line width [1]	0.6 [2]	0.3 [6]	0.5 [6]	0.7 [2]	0.7 [2]	0.4 [6]
heater voltage	6.3	6.3	6.3	6.3	6.3	6.3
heater current	550	600	300	300	300	300
pattern distortion [3] (see below)						
maximum length	526	430	468	605	605	452
screen diameter	13	13	13			
symmetric/asymmetric deflection	symmetric	symmetric	symmetric	sectioned y-plates symmetric	sectioned y-plates symmetric	symmetric
tube holder — base	B12F	diheptal 12 p.	diheptal 12 p.	all-glass 14 p.	all-glass 14 p.	diheptal 12 p.
tube holder — holder	55562 [5]	5914/20 [4]	5914/20 [4]	55566	55566	5914/20 [4]
tube holder — mounting ring		40638	40638			40638
mu-metal screen	55552	55550	55551			
post deflection acceleration connector	55563	55560	55563	55563	55563	55563
side contacts	55563		55561	55561	55561	55561
available screen versions	B, H ,N, D	B, G, P	BE, GH, GM, GP	BE, GH, GM, GP	BE, GH, GM, GP	BE, GH, GM, GP

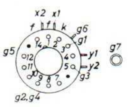
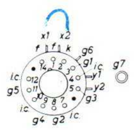
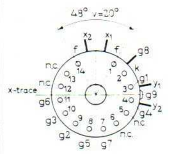



Pattern distortion limits



type	a	b	c	d
D. 13-10	51	81.6	49	78.4
D. 13-34	81.6	81.6	78.4	78.4
D 13-15..	60	100	58.5	98
D 13-16..	60	100	58.2	98
D 13-17..	40	100	38.8	98
D 13-19..	60	100	58.2	98
D 13-20..	40	80	39	78
D 13-21..	40	100	39	98.8
D 13-23..	50	100	48.2	98

D 13-20..	D 13-21..	D 13-23..	units
4400	2200	2000	V
24000	12000	10000	V
4000	1670	1300	V
24000	10000	6000	V
6	6	5	
16	6.7	[7])	V/cm
74	30	max. 14	V/cm
40	40	50	mm
100	100	100	mm
0.2 [6])	0.6 [2]) 0.4 [6])		mm
6.3	6.3	6.3	V
300	300	300	mA
468	468	605	mm
13	13	13	cm
symmetric	symmetric	symmetric	
diheptal 12 p.	diheptal 12 p.	all-glass 14 p.	
5914/20 [4])	5914/20 [4])	55566	
40638	40638		
55551	55551		
55563	55563	55563	
55561	55561	55561	
BE	BE, GH, GM, GP	GH	
			

1 measured under typical operating conditions

2 shrinking raster method, screen current 25 μA

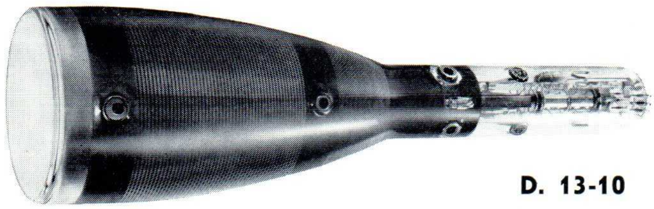
3 under typical operating conditions, if possible optimally adjusted for astigmatism, barrel-pattern or pin-cushion distortion, a nominally rectangular raster may be inserted into the frame bounded by concentric rectangles, the dimensions of which are given in the columns

4 synthetic resin

5 ceramic

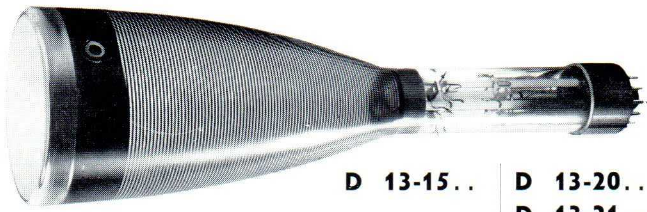
6 shrinking raster method, screen current 10 μA

7 dependent on the frequency, and on the adaptors used

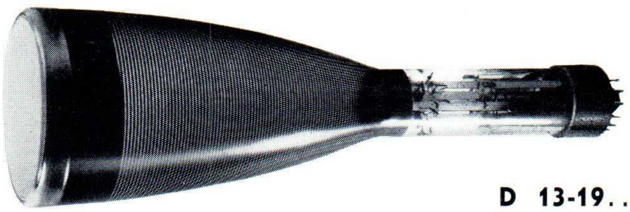


D. 13-10

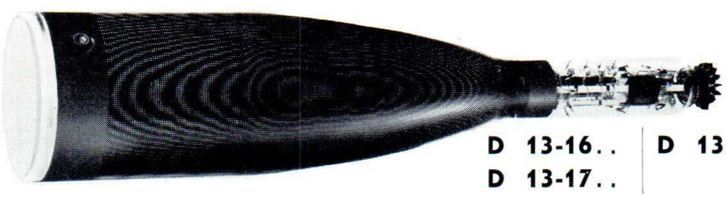
D. 13-34



D 13-15.. | D 13-20.. D 13-21..



D 13-19..



D 13-16.. D 13-17.. | D 13-23..

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