CORRESPONDENCE

Letters to the Editor on technical subjects are always welcome. In publishing such communications the Editors do not necessarily endorse any technical or general statements which they may contain.

Networks with Maximally Flat Delay

SIR,—Mr. T. C. Nuttall has drawn my attention to some arithmetical errors in my paper "Networks with Maximally-Flat Delay" in the October issue. Tables 1 and 2, $n = 6$, are affected; the corrected values are:

Table 1(a)	1(b)	2
− 4·2484	− 1·5836	8·4967
$\pm j$0·8675	$\pm j$0·3142	18·8011
− 3·7357	− 1·3529	7·4714
$\pm j$2·6263	$\pm j$0·9511	20·8528
− 2·5159	− 0·9111	5·0319
$\pm j$4·4927	$\pm j$1·6270	26·5140

The numerical example following Table 4 will require corresponding changes, but the errors are not large enough to make any practical difference.

W. E. THOMSON.

Dollis Hill, N.W.2.
10th October 1952.

Precision Voltage Source

SIR,—The recent paper by V. H. Attree concerning a "Precision Voltage Source" (*Wireless Engineer*, Vol. 29, p. 226) describes an interesting application of an incandescent lamp as a nonlinear circuit element. There are two small points in connection with the use of a lamp as such an element which are overlooked in the paper of Mr. Attree and in others cited by him.

Mention is made of the fact that a sinusoidal current in the lamp leads to a nonsinusoidal voltage across it. In addition to a sinusoidal component of voltage, there are also cosinusoidal components at both the frequency of the current and three times this frequency. If the frequency is sufficiently low, or the current sufficiently large, these cosinusoidal components are no longer of equal amplitude, as is often and incorrectly stated. The fundamental cosinusoidal component becomes smaller and ultimately vanishes as frequency approaches zero. If the frequency becomes higher or the current becomes smaller, the amplitudes of the two components do approach equality.

A more important comment for precision applications has to do with the statement which is made implying that the resistance of a lamp is dependent only upon the r.m.s. value of the current in it. If by resistance is meant the ratio of the amplitude of the fundamental sinusoidal voltage to that of the sinusoidal current (and this is the quantity of importance in the bridge circuit described), the statement is not quite correct. There is a fluctuation in temperature of the lamp, occurring at twice the fundamental frequency. When combined with the sinusoidal current, this fluctuation leads to a small additional sinusoidal component of voltage.

The additional voltage produces a small increase in the apparent resistance of the lamp. Its resistance with a sinusoidal current, therefore, is slightly larger than its resistance with a direct current, if the r.m.s. values of the two currents are identical. The small increase approaches zero as the current becomes sufficiently small or the frequency becomes sufficiently high. A further change in the apparent resistance is produced by a similar mechanism if a third-harmonic component is present in the current in the lamp.

These points are discussed in two papers, the first in the *Journal of Applied Physics*, 1952, Vol. 23, p. 658, and the second scheduled to appear soon in the *Review of Scientific Instruments*.

W. J. CUNNINGHAM.

Yale University,
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2nd October 1952.

Screen Dissipation of Pentodes

SIR,—Many applications of modern valve circuitry demand information not readily obtainable from the characteristics given in the manufacturer's catalogue.

A typical presentation of a valve's characteristics is shown in Fig. 1. The maker also states that the maximum permissible anode and screen dissipations are 2·5 W and

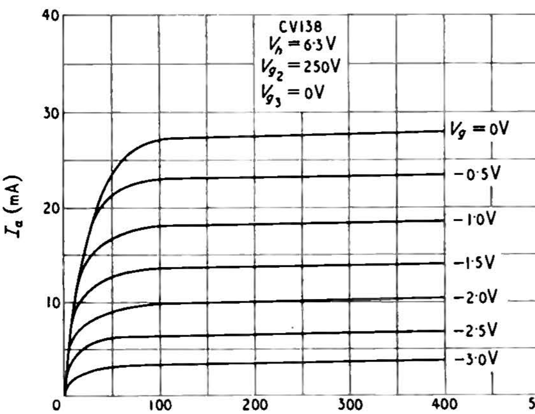

Fig. 1

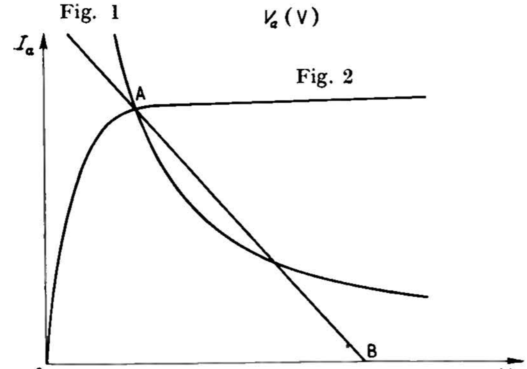

Fig. 2

0·9 W respectively. A common use for such a valve would entail operation under the following 'quiescent' conditions: anode load and voltage as small as possible, grid bias zero, positive h.t. supply about 300 V. We can suppose for the sake of simplicity that the 'active' condition of the valve, cut-off, lasts for a very short time and is repeated at relatively long intervals. In such a case the load line for the valve is found by joining points

A and B as in Fig. 2. A is the intersection of the $V_g = 0$ curve and the 2·5-W power hyperbola, B is the h.t. voltage on the axis of abscissae. If the screen dissipation is evaluated, it will be found to be excessive.

It will be seen that optimum conditions will obtain when the dissipating powers of the anode and screen are fully exploited simultaneously. This means that the working area in the V_a–I_a plane will be limited by the axes, the anode-power line and a screen-power line. It is instructive to discover how this area is affected by the choice of screen voltage. A fixed voltage is applied to the screen of the valve, and anode and screen currents measured for those pairs of anode and grid voltages which load the screen to its maximum value. The results are shown in Fig. 3.

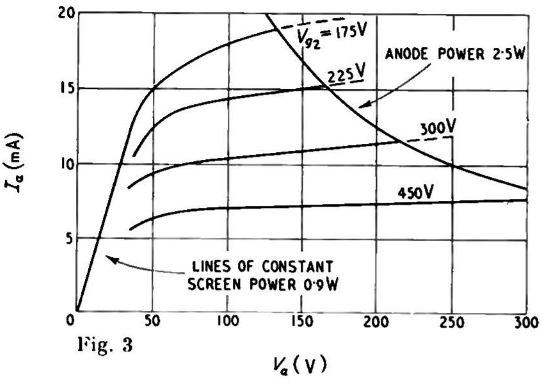

Fig. 3

Moving to the right along a screen-power line, the grid-bias is approaching zero. Numerical values of bias have been omitted to avoid confusion. The useful working area increases as the screen voltage is reduced. The greatest area is obtained when the intersection of the anode- and screen-power lines occurs at $V_g = 0$. For a screen voltage slightly less than the optimum the power lines intersect at a positive value of bias and for a rather lower voltage the screen is fully loaded with zero volts on the anode. The optimum value of screen voltage can be found experimentally by connecting the control-grid to cathode and adjusting anode and screen voltages till these electrodes are fully loaded. Once found this value may be used to plot a set of curves similar to those in Fig. 1, but whose range of validity is completely defined. Such a diagram is shown in Fig. 4.

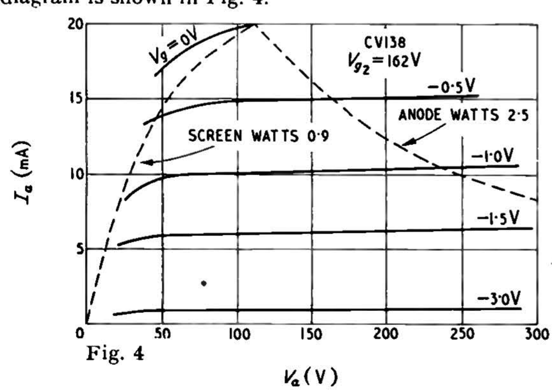

Fig. 4

It is suggested that valve users would find these last curves most useful and that valve makers could at least quote the optimum value of screen voltage.

SIDNEY C. DUNN.

London, N.4.
25th August 1952.

I.E.E. MEETINGS

12th November. "Radio Telemetering," by E. D. Whitehead, M.B.E., B.Sc., and J. Walsh, B.Sc.

17th November. "The Field of Application of Metal Rectifiers," Discussion to be opened by S. A. Stevens, B.Sc.(Eng.).

18th November. "Harmonic Response Testing Apparatus for Linear Systems," by D. O. Burns, B.Sc.(Eng.), and C. W. Cooper, B.Sc.(Eng.). "A Simple Connection Between Closed-Loop Transient Response and Open-Loop Frequency Response," by J. C. West, B.Sc., and J. Potts, B.Sc.

24th November. "Recent Progress in Radar Duplexers with special reference to Gas-Discharge Tubes," by P. O. Hawkins.

3rd December. "A Survey of Present Knowledge of Thermionic Emitters," by D. A. Wright, M.Sc.

These meetings will be held at the Institution of Electrical Engineers, Savoy Place, London, W.C.2, and will commence at 5.30.

STANDARD-FREQUENCY TRANSMISSIONS

(Communication from the National Physical Laboratory)

Values for September 1952

Date 1952 September	Frequency deviation from nominal: parts in 10⁸ — MSF 60 kc/s 1029-1130 G.M.T.	Frequency deviation from nominal: parts in 10⁸ — Droitwich 200 kc/s 1030 G.M.T.	Lead of MSF impulses on GBR 1000 G.M.T. time signal in milliseconds
1	0·0	−3	−64·5
2	+0·1	−2	−64·2
3	+0·1	−4	−64·3
4	+0·1	−4	−63·4
5	+0·2	−5	−63·2
6	+0·1	−5	−63·0
7	+0·1	−4	−62·7
8	+0·1	−4	−62·6
9	+0·2	−2	−63·4
10	+0·2	−4	−61·9
11	+0·2	−3	−62·1
12	+0·2	−3	−61·2
13	+0·4	−4	−61·5
14	+0·4	−3	−61·1
15	+0·4	−3	−59·7
16	+0·3	−3	−59·9
17	+0·4	−2	−59·8
18	+0·5	−2	−59·3
19	+0·5	−2	−57·9
20	+0·5	−2	−56·3
21	+0·6	−2	−55·2
22	+0·6	−2	−54·0
23	+0·6	−2	−55·4
24	+0·6	−1	−53·0
25	+0·6	0	−52·2
26	+0·6	0	−50·9
27	+0·7	0	−49·9
28	+0·7	0	−48·3
29	NM	0	NM
30	+0·7	0	−45·8

The values are based on astronomical data available on 1st October 1952.

NM = Not measured.