Correspondence

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

Background Noise

To the Editor, The Wireless Engineer.

SIR,—I write in connection with Mr. D. A Bell's letter published in your April issue. It is there stated that I have used certain results to condemn the whole thermal hypothesis of valve fluctuations. This statement is not in accord with my views. My results were interpreted as rebutting the thermal hypothesis as it then stood; the rebuttal does not necessarily apply to the modified thermal hypothesis now proposed.

Llewellyn's original hypothesis held that a space charge limited valve of any type generated a fluctuation current,

$$\overline{i}^2 = \frac{4kT}{\rho}\,\mathrm{df},$$

where T was taken as T_c, the absolute temperature of the cathode. The experiments of Pearson and myself showed that with diodes $T_c/2$ was a more suitable value, and this modification to the hypothesis was made, but without convincing theoretical justification. My later experiments with triodes showed that then T was many times T_c. Attempts had been made to explain such results as due to the coexistence of the (Llewellyn) thermal fluctuation and a residual shot effect due to incomplete space charge.

My experiments showed that such an attempt led to the conclusion that the thermal contribution was negligible compared with the (supposedly residual) shot contribution. It was therefore argued that valve noise was due to shot effect and that thermal agitation fluctuations in the anode stream were non-existent or negligible. According to Bell, however, the new thermal hypothesis is limited to diode valves, on the ground that space charge limitation is necessarily incomplete in any other type. The above line of argument, involving measurements with triodes, is no longer admissible as a refutation of the thermal hypothesis: it has, however, served its purpose, for the hypothesis it condemned is now rejected.

As to the probable validity of this new limited thermal hypothesis, the writer is undecided. Experiment does not confirm it, nor does it confirm any other hypothesis so far propounded. On the theoretical side the decision must rest with the pure physicist rather than the engineer.

As to its technological suitability as a method of interpreting observed results, the writer has very marked views. For if the alternative shot interpretation be used, self-consistent results with a given multi-electrode valve can be obtained when that valve is used as a diode, triode, tetrode and pentode. Since the temperature of the anode stream is at present indeterminate in all but the diode connection, and is vastly different for each connection, thermal interpretation is meaningless: it is also technologically inconvenient since the thermal equation does not lend itself so easily to the computation of signal/noise ratio.

It may be noted that if the modified thermal hypothesis is to be proved experimentally the agreement obtained must be very good to be convincing, for an effective temperature of $T_c/2$ exists in the retarding field according to the simple shot hypothesis. Approximate support for the thermal hypothesis in the space charge régime may thus merely represent a shot fluctuation tending towards its necessary value in the retarding field region.

For the reasons outlined in this letter, the writer would have preferred to express the results of Messrs. Percival and Horwood in terms of the shot expression. Their use of the thermal interpretation, however, in no way detracts from the value of their work, for they have quoted the equivalent grid resistances R_n and these are the same on both hypotheses.

F. C. WILLIAMS,
Electrotechnics Department,
The University of Manchester.

Critical Distance Valves and Beam Tetrodes

To the Editor, The Wireless Engineer.

SIR,—In the April 1938 issue of *The Wireless Engineer*, there appears a letter written by Mr. J. H. Owen Harries on the subject of Critical Distance Valves and Beam Tetrodes, in which reference is made to a recent paper of ours*. We trust that we have misunderstood Mr. Harries' remarks, but it appears to us that he believes our interest in this subject to be other than purely technical. Since this is not the case, we shall confine our remarks to the technical aspect of Section (9) of his letter.

Mr. Harries criticises our "endeavour to explain the operation of beam tetrodes in terms of the usual space-charge effect," and then states that "certain properties of secondary radiation are studiously ignored."

It may be pointed out that our discussion of the beam tetrode is presented merely as an example of the applicability of the general theory which was the principal subject of the paper. In considering the operation of such tubes, it would appear to us that the following factors must be considered in a complete analysis of the problem: (1) the space-charge effect of the primary electron stream upon the potential distribution between accelerator grid and anode, (2) the distribution of forward velocities of the electrons, including both temperature distribution and the effects of deflection by intermediate electrodes, and (3) the space-charge effect of the secondary electrons emitted from the anode and the accelerator grid. In our paper we mention these factors and others. It is true that in our analysis only the space-charge

* "Effects of Space Charge in the Grid Anode Region of Vacuum Tubes." Bernard Salzberg and A. V. Haeff, *RCA Review*, Vol. 2, No. 3, pp. 336–374 (January, 1938).

effects of the primary electron stream are considered quantitatively. It is our belief based on theoretical considerations and experimental results that the other factors are not of primary importance in determining the operation of the tubes which we discussed. Certainly a quantitative treatment of all factors influencing the operation of beam tetrodes would be highly desirable.

We shall await with great interest the promised publication of Mr. Harries' explanation of the mechanism of the critical distance.

BERNARD SALZBERG.
A. V. HAEFF.
R.C.A. Manufacturing Co. Inc.
Harrison, N.J.

Short-wave Transmitters with Spherical Circuits

To the Editor, The Wireless Engineer.

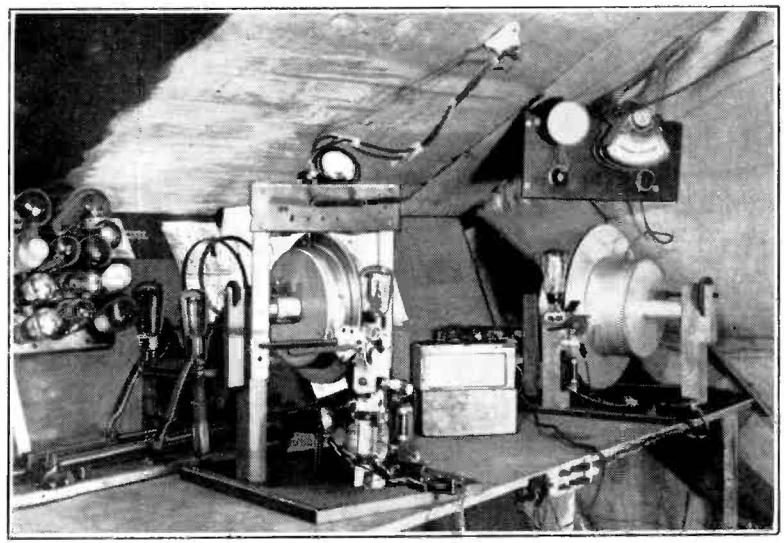
SIR,—I read with much interest the Editorial by Prof. G. W. O. Howe in the March issue of your journal dealing with Hollmann's experiments on Kolster's circuits, and I write as I feel sure that you must be unaware of the experiments which have been carried out on the same lines in this country by three British Radio Amateurs, namely, G5VY, G6JI and G8SK during the past two years.

I was privileged to be among those present at a meeting of the Walthamstow and District Radio Society on July 4th, 1936, when Mr. Vickery (G5VY) gave a lecture-demonstration of what he described as "A High Q transmitter," using two spun aluminium "hats" for inductance and capacitance on a wavelength of 56 Mc/s based on the Kolster theory.

Since then three of these transmitters have been constructed for 5 metres and two for 2½ metres all giving excellent results—ordinary valves (without de-capping) being used as oscillators—and the following is a brief outline of some of the results obtained with them.

Efficiencies of some 70 per cent. on 5 metres with inputs of from 6 to 10 watts. The 5-metre oscillators have been used to drive a push-pull P.A. stage, and the resultant signals are as stable as crystal-controlled transmitters on lower frequencies. The 2½-metre oscillator has been modulated and is regularly received on schedule at a distance of 6½ miles on a super-het. receiver without the use of special antennae at either end.

The photograph shows two of Mr. Vickery's transmitters in which the spun aluminium "hats" are plainly visible; the transmitter on the right operates at 56 Mc/s, that on the left at 112 Mc/s. The first of the series of transmitters utilising Kolster circuits was made early in 1935.



L. J. FITZGERALD.
London, E.11.

Deflection Valves for Ultra Short and Decimetre Waves

To the Editor, The Wireless Engineer.

SIR,—Recently a good deal of publicity has been given to the idea of using "deflection valves" which employ a beam of electrons which is deflected with the object of producing extremely high frequency oscillations. Mr. F. M. Colebrook's article in your issue for April last, pages 198 to 201, entitled "Ultra Short and Decimetre Waves," expresses the viewpoint of the Radio Research Board with regard to this matter.

The prior history of this technique is not well known and the following notes may be of interest to your readers.

1. One of the earliest types of electron discharge tube is the cathode-ray oscillograph. The history of the development of this device is given in a paper by McGregor Morris and Mines (*Journ. I.E.E.*, Nov. 1925, Vol. 63, No. 347, pp. 1056 to 1107).

2. Parallel with the development of the ordinary short stream 3/2 law (control grid) valve (based on the work of Fleming, de Forest and Langmuir), another type of amplifier and frequency multiplying valve was suggested. The first inventor appears to be Robert von Lieben. He described, in German Patent No. 179807, dated 1906, a valve employing a jet of cathode rays (which he speaks of as being similar to that used by Wehnelt for other purposes in 1905) which was deflectable over two hollow cylindrical anodes. The jet current to one of these cylinders was used to energise an output load. This valve appears to be one of the earliest types