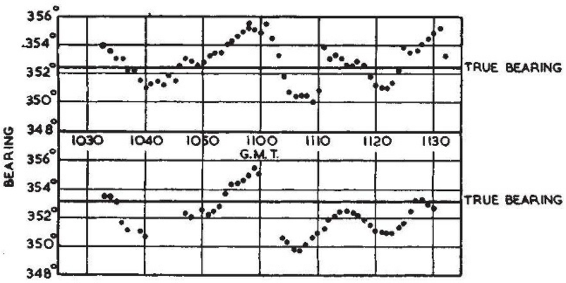

Bearing of Fraserburgh Transmitter, December 8, 1948; 11·03 Mc./s. Upper curve, bearings taken at Sunnymeads; lower curve, bearings taken at Winkfield

For the distance of transmission involved, bearing deviations of the magnitude shown would be produced by tilts of about 4° from the horizontal, and correspond to a lateral displacement of the reflexion point of about 20 km. Since the distance between the receivers is 10 km., the mid-points of the two trajectories will be 5 km. apart. These experiments, therefore, show that the effective ionospheric tilts observed must be substantially uniform over distances of at least this magnitude.

The direction finders used at the two sites were not identical, but both used spaced-loop aerial arrangements known to be free from polarization error. The systematic difference in bearings of 0·7° which would be expected at the two sites due to their separation is not clearly shown and is probably obscured by fixed errors, such as site errors.

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[1] Ross, W., and Bramley, E. N., *Nature*, **159**, 132 (1947).
[2] Ratcliffe, J. A., *Nature*, **162**, 9 (1948).

Amplitude Modulation of Centimetre Waves

WE have found that a beam of electrons injected into a tube containing an inert gas will cause attenuation of a radio-frequency field traversing the tube, provided that the electrons have sufficient energy to ionize the gas. A device using this effect would assist the study of microwave absorption in gases. The effect has therefore been investigated with the object of producing an attenuator with electronic control.

The initial requirement was an attenuator for 1·2-cm. waves which would introduce at least 20 db. attenuation, have small insertion loss, and would have a response-time fast enough to follow a 75 kc. square wave. The preliminary investigations at 3·2 cm. have been highly successful and indicate that this type of valve may have many applications.

In the first successful type, a beam of electrons is fired axially through one of the capacitive posts of a resonant structure (loaded Q approximately 2) in a wave-guide. The other capacitive post was choke-mounted and held positive to accelerate further the electrons across the gap. A maximum attenuation of 30 db. was obtained with this type of valve. At a pressure of 2 mm. of neon, or less with argon, the response-time was adequate to reproduce quite faithfully a 75-kc. square wave, and also a 2-μ sec. pulse. In a very brief trial, quite intelligible speech modulation was obtained; but no effort has yet been made to produce faithful reproduction.

It was thought that a far greater effect could be achieved if the radio-frequency wave had a long interaction path with the discharge; moreover, the mechanism of the attenuation could be better studied with a simple co-axial device similar to a noise diode. Such a tube, coupled to a standard wave-guide by means of chokes, has been made. With this tube the maximum attenuation achieved is 50 db., while the attenuation appears, under certain conditions, to be linear with current from zero to 15 db. It has been found that the relationship between attenuation and current is independent of the incident signal-level over a range of 50 db., the maximum incident power being 100 mW.

It was noticed that, under certain conditions, what appear to be plasma oscillations are observed as a modulation of the radio-frequency signal emerging from the tube. Frequency of oscillation is of the order of 1 Mc./s., the actual frequency depending upon the nature of the gas and its pressure. The conditions for their existence appear to be very critical.

From the evidence so far available, the loss is entirely absorption, the standing wave increasing from 1·2 at zero attenuation to 1·5 at 50 db. Furthermore, it is necessary that the gas should be ionized, that is, that electrons make inelastic collisions with the gas atoms during transit from cathode to anode. At voltages below the first resonance potential there is no detectable attenuation. Work is continuing to establish the mechanism of attenuation, and to find the upper limit of response-frequency of this type of attenuator.

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Use of Radioactive Cobalt for Sphere Gap Irradiation

IN many cases where sphere gaps are used for voltage measurement, and particularly where the impressed voltage wave is a short impulse, it is important to provide adequate external irradiation, or the behaviour of the test gap may be erratic and the measurements accordingly inaccurate. If a sufficient supply of initiating electrons is provided, the statistical time-lags of the test gaps are reduced, so that accurate measurement of rapidly changing voltages (lasting some microseconds or less) is possible. Irradiation of sphere gaps (*a*) by an ultraviolet lamp (for example, mercury in quartz[1-]), (*b*) by radium (usually inserted in a metal capsule and placed inside one of the spheres[1,3 4]), or (*c*) by polonium (deposited as a very thin layer on one of the electrodes[3,6]) has been successfully used by many workers.