since this is equivalent to a reduction of the cathode sensitivity. The value for the cathode sensitivity for the tube used was 26 μamp./lumen, and for this value one would expect under ideal conditions a resolution of about 10 per cent. Due to the fact that neither the tube, crystal nor associated electronics were specially selected for spectrometry, the actual resolution was found to be 17 per cent, when the tube was used conventionally. With feedback the resolution worsened to 20 per cent at one end of the plateau and 24 per cent at the other for the curves of Fig. 2. While this is obviously unsatisfactory, it must be remembered that at the cathode sensitivity of 26 μamp./lumen of the present tube, the resolution worsens very rapidly with decreased cathode sensitivity[1]. With a tube of, say, 100 μamp./lumen sensitivity the resolution varies only slowly with cathode sensitivity, and the introduction of feedback should make little or no difference to it.

In conclusion, it should be remarked that the stability of the feedback resistor chain and to a lesser extent of the bias battery must be of a high order. This, however, is a small price to pay if a relatively simple power supply may be used in place of the ultra-stable supplies at present required for precision work.

It is hoped to publish a fuller account of this work in the near future.

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Coherence and Band-width of a Gas Discharge Harmonic Generator

Recent work has shown that a microwave gas discharge is an efficient harmonic generator[1–3]. These results are of interest since they show promise of producing a reasonable quantity of power in the 1-mm. wave-length region. This would be extremely useful for spectroscopy, especially if the radiation were narrow-band and coherent. Two experiments have been performed to see whether this is so.

Fig. 1 is a diagram of the first experiment, designed to measure coherence. The two harmonic generators were simple neon-filled discharge tubes in wave-guide mounts as previously described[3]. The gas discharge was maintained in both tubes by power from a 2 kW. 3-cm. klystron amplifier, arranged to give pulses of 3-m.sec. duration. By suitable tuning of the discharge tube mounts the fourth harmonic (in the 8-mm. band) was selected. It was passed through low-Q wave-meters to remove other harmonics present. The two 8-mm. band signals were combined in the magic-T and fed to a single crystal detector. By adjusting the 8-mm. wave-guide attenuator and phase shifter a minimum in the output signal could be maintained. This was less than 0·25 mV. across the crystal detector. The corresponding maximum when the two signals were added in phase (by adjusting the phase shifter to give a maximum with the attenuators unaltered) was 50 mV. Hence the coherent signal/noise ratio was at least 100/1.

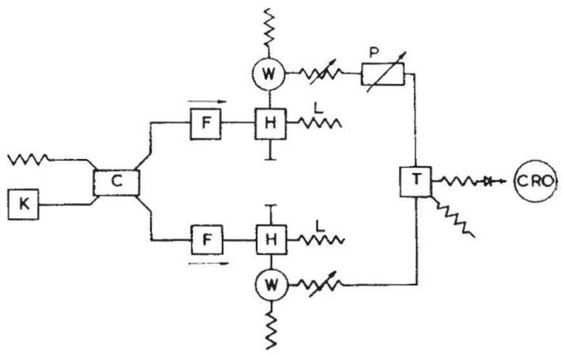

Fig. 1. Block diagram of the experimental apparatus. K, 2-kW. X-band klystron; C, 3 d.b. directional coupler; F, X-band ferrite isolator; H, harmonic generator; L, X-band water load; W, low Q wave-meter (Q-band); T, magic-T; P, phase shifter

This cancellation experiment also indicated that the signal was narrow-band since the length of 8-mm. guide before the magic-T made the system dispersive. The second experiment confirmed this. The output from one of the harmonic generators was fed into an 8-mm. superhet receiver. The local oscillator frequency was swept so that the input spectrum could be displayed on a cathode-ray oscillograph. This gave a pulse 1 Mc./s. wide which corresponded closely to the measured intermediate frequency band-width of the receiver. Hence the band-width of the signal was less than 1 Mc./s.

These experiments show that the harmonic generator output is coherent and narrow-band. It is a true line source comparable to a reflex klystron.

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Transistor Modulators for Low-level Direct Current Signals

We have considered in some detail the problem of using germanium and silicon transistors as choppers in thermocouple-amplifier and other low- and medium-impedance applications. In the past, several circuits have been described using asymmetrical transistors with switching drives which are symmetrical or asymmetrical with respect to the emitter and collector of the transistor. Many of these circuits require careful adjustment and/or selection of transistors to reduce the equivalent input drift with temperature to an acceptable level.

A circuit has been developed in our laboratories, in which a symmetrical transistor is used with a symmetrical drive, giving drift-rates of not greater than 1·5 μV./° C. over a temperature-range of −40° C. to + 100° C. with no adjustment or selection whatsoever.