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NASA TECH BRIEF

Automatic Frequency Control of Voltage-Controlled Oscillators

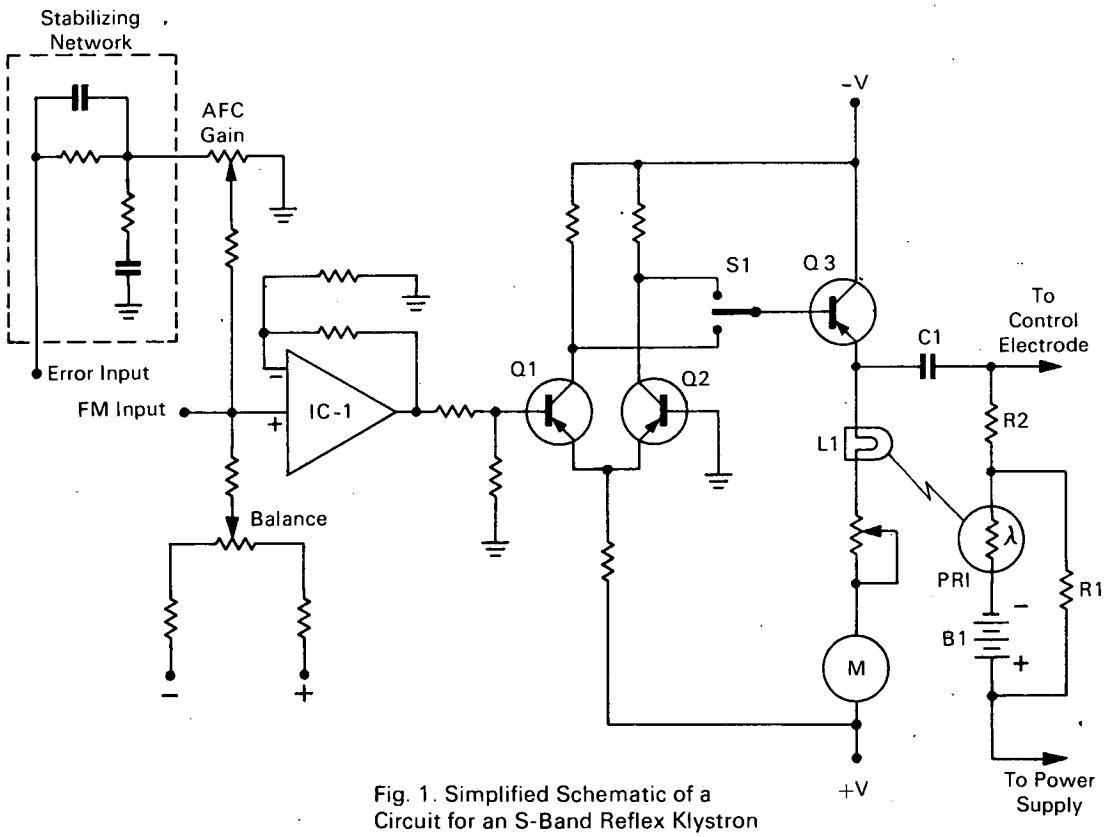

Fig. 1. Simplified Schematic of a Circuit for an S-Band Reflex Klystron

The problem:

Development of a method of use of an error voltage, referenced to ground, for simple and inexpensive control of the voltage on an electrode that is far off ground potential.

The solution:

Use of optical-capacitive coupling for isolation of control voltages, such as the high-voltage level of a klystron's control electrode that is not referenced to ground, to serve as error voltages that are referenced to system ground so that the magnitude and sense of the correction voltage may be transferred thereto.

How it's done:

The electrode voltage is controlled by a photo-resistor voltage divider whose value approximates the potential of the control electrode. The photo-

(continued overleaf)

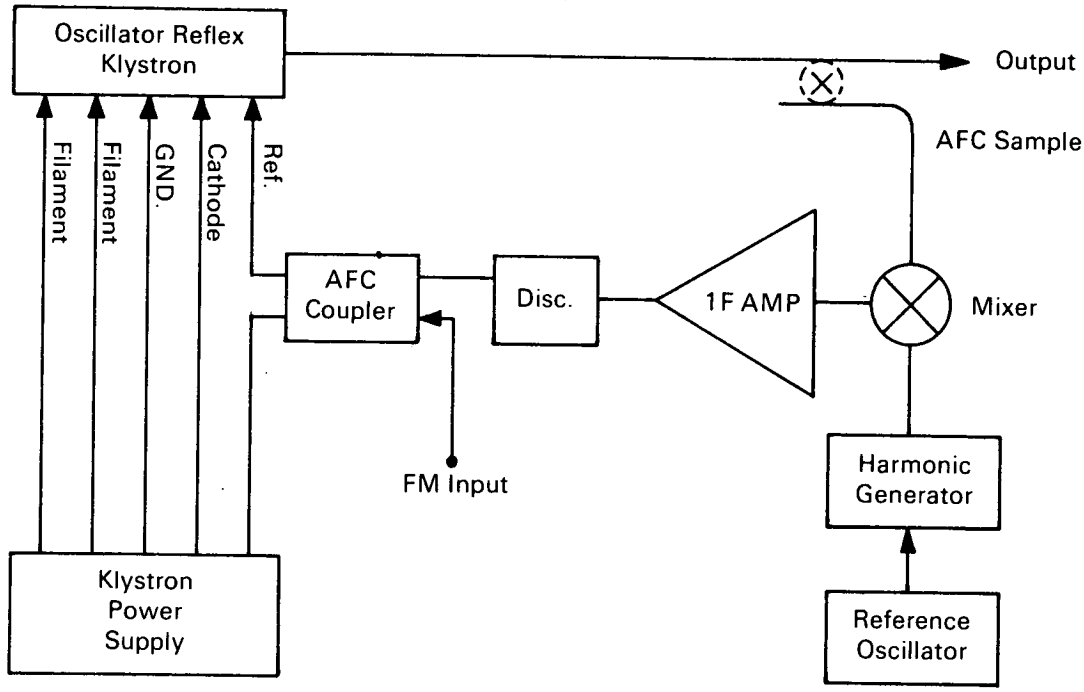

Fig. 2. Connection of a Circuit (Fig. 1) to a System

resistor's resistance is controlled by a lamp isolated from it electrically. Increase in the current through the lamp decreases the resistance of the photoresistor and so changes the voltage of the control electrode. Because the lamp has a relatively long time constant, a coupling capacitor is used to transfer the fast components of the error signal.

Figure 1 shows a circuit built to stabilize the frequency of an *S*-band reflex klystron. The error input was derived from a discriminator that compared the klystron frequency with a harmonic of a stable crystal oscillator. The error signal is applied to a stabilizing network (lead lag). It is then applied to a summing junction of an integrated-circuit operational amplifier (such as type-709). Transistors Q1 and Q2 form an emitter-coupled differential pair for inversion of phase without shifting of the base operating point of Q3; Q3 is an emitter-follower driving the lamp L1 and the coupling capacitor C1. Meter M indicates lamp current and acts as an error indicator.

Figure 2 shows how this automatic-frequency-control circuit is connected to a system. Available photoresistor-lamp combinations have various characteristics of both lamp and photoresistor. In this particular circuit a type-CK1104 was used as an optical coupler.

This circuit can be used for control of frequency of laboratory oscillators and signal-generators; and it would be useful in many system applications such as microwave carrier systems, and for stabilizing the pump frequencies of parametric amplifiers.

Notes:

1. Designers of microwave equipment may be interested.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   NASA Pasadena Office
   4800 Oak Grove Drive
   Pasadena, California 91103
   Reference: TSP69-10569

Patent status:

This invention is owned by NASA, and a patent application has been filed. Royalty-free, nonexclusive licenses for its commercial use will be granted by NASA. Inquiries concerning license rights should be made to NASA, Code GP, Washington, D.C. 20546.

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