Oscilloscope Calibration at Kilomegacycle Per Second Frequencies[1]

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A source of radio-frequency voltage of over 100 volts peak-to-peak at a frequency of approximately 1200 megacycles was needed for calibrating the sweep of a high speed oscilloscope.

Ordinary vacuum tube circuits were not considered adequate to provide the amount of voltage required. This paper describes a cavity resonator built for the purpose. In this type of device it is desirable to make the characteristic impedance of the cavity as low as practicable and the characteristic impedance of the output line as high as practicable. This maximizes the number of reflections in the cavity. The cavity was designed for an impedance of two ohms while the output line was a 100-ohm coaxial cable. The cavity was designed to give a frequency of 1200 megacycles; the dimensions were calculated[2] using a value of 2.3 for the dielectric constant of teflon. The finished cavity oscillated at 1204 megacycles, as measured with Lecher wires, using the cavity as a shorted quarter-wave stub.

The construction of the cavity is shown in Fig. 1. The inner conductor is grounded by striking the end of the cavity, which shorts the inner to the outer conductor. The inner conductor, being negatively charged, immediately rises to ground potential at the shorted end. This positive signal is tapped off to trigger the sweep circuit, and the signal is propagated down the inner conductor. Upon hitting the end terminated in 100 ohms, most of it is reflected to travel back and reflect again from the shorted end. The output is capacitively coupled in order to keep the charging voltage off the coaxial line and the CRT deflection plates. The coaxial cable in the plate circuit holds the unblanking level across the 100 ohm cathode resistor for the desired length of sweep. The length of this coaxial cable will depend on how long the unblanking signal is desired and its velocity factor. The cavity is silver-plated to reduce ohmic losses.

In use, the cavity is charged to approximately 800 volts negative. This voltage is adequate to ensure that there still will be some oscillations by the time the sweep tube has fired and the sweep has started. The 2D21 sweep tube used in the circuit fires in approximately 2.1×10^{-8} seconds with 1500 volts on the plate; this tube can handle 2800 volts without the grid losing complete control. All connections to the cavity should be as short as possible, as much cable in the signal circuits introduces dispersion and noise. The time constant of the decay of this cavity is approximately 1×10^{-8} seconds.

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[1] Supported in part by the Air Force Office of Scientific Research.

[2] Reference Data for Radio Engineers, 3rd Ed. ( ), Federal Telephone & Radio Corp., New York, N.Y.

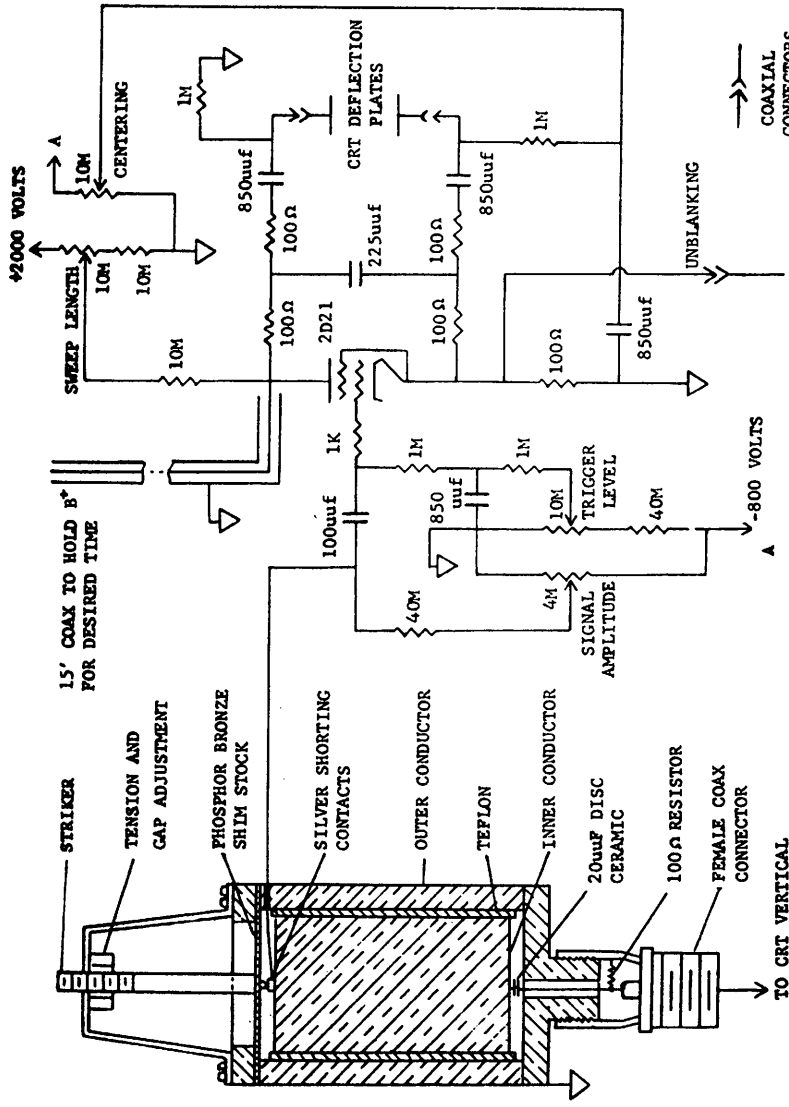

Figure 1. Resonance Cavity and Circuit.