

## VII. TRAVELING-WAVE TUBES

### A. THREE-CM TRAVELING-WAVE AMPLIFIER TUBES

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The construction of auxiliary apparatus for use with 3-cm traveling-wave tubes has been completed. This apparatus includes the air-core electromagnet and the associated waveguide fixtures mentioned in the last progress report.

Two completed tubes have been obtained. Although no extensive measurements have been made as yet, preliminary tests indicate a net gain of a few db.

In order to throw some light on the effects of various modes and the presence of dielectric support rods, an experimental investigation of 3-cm propagation along a cold helix has been started. For this purpose, an Esterline-Angus meter records the standing wave which is measured by a screw-driven probe moving along the helix.

### B. SEVEN-MM TRAVELING-WAVE OSCILLATOR

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Work has begun on the design of an oscillator for the region about 7 mm based on the traveling-wave principle. An iris-loaded, circular waveguide will be used to provide the slow waves, and an electron beam will be projected along the center of the tube. It is intended to use internal feedback to produce oscillations. The output waveguide will be loosely coupled to the slow waveguide, so that most of the energy will be reflected back to the cathode end of the slow guide, where it will be re-reflected, etc. The tube will be almost 40 wavelengths long, and oscillation will be possible at any frequency for which the round-trip phase shift is a multiple of  $2\pi$  radians. Oscillation will occur, however, only when the electron velocity is roughly synchronous with the wave velocity. Thus, the oscillator will be voltage tunable over a small range of frequencies (probably 1 or 2 per cent).

Present effort is being devoted entirely to the solution of the various mechanical problems involved. The most difficult problem is the construction of the loaded waveguide. This is a tube 0.407 in. I.D. with thin diaphragms or irises 0.003 in. thick with a 0.210-in. diameter hole, separated by rings, 0.407 in. O.D., 0.375 in. I.D., and 0.006 in. thick. The problem is to stack about 150 of these in the tube and braze them in place so that all the irises are parallel and equally spaced. Since we changed from copper to harder metals such as Monel or mild steel, progress

along this line has been encouraging. The proposed form of the tube is shown in Fig. VII-1.

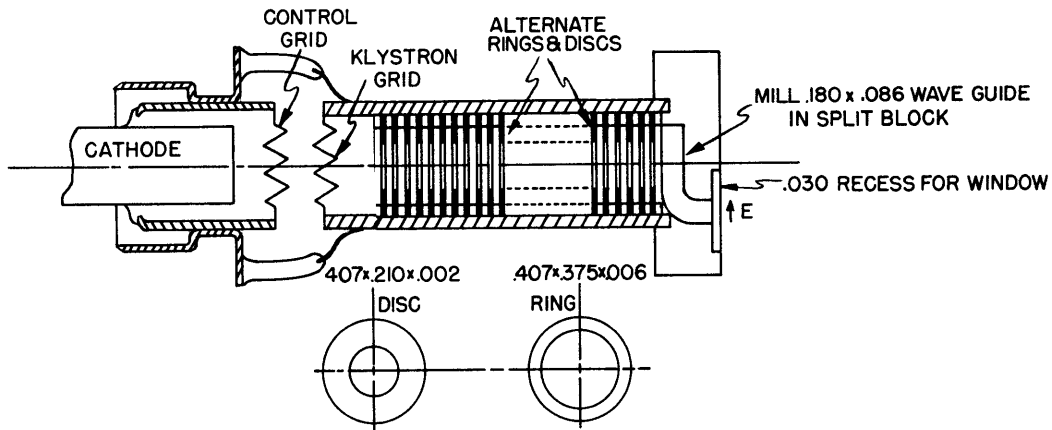


Fig. VII-1. Loaded-waveguide traveling-wave oscillator.

An incidental development has been made of a coaxial copper-gold diffusion seal that allows a copper tube to be sealed to another within as little as  $\frac{1}{2}$  in. from a glass feather-edge seal, Fig. VII-2. One of the copper parts to be sealed is gold-plated, and the parts are assembled as shown with an Invar collar. Heating in air with a rough vacuum inside the tube, to  $400^{\circ}\text{C}$  makes an excellent vacuum-tight bond without affecting the glass seal. A number have been made with no particular effort to keep the copper clean, and all have worked.

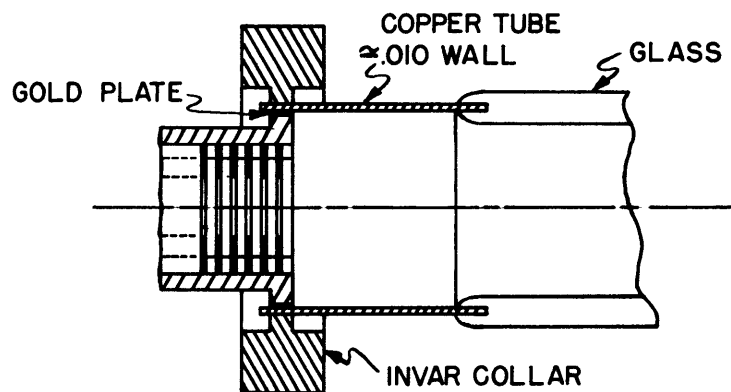


Fig. VII-2. Copper-gold diffusion seal.