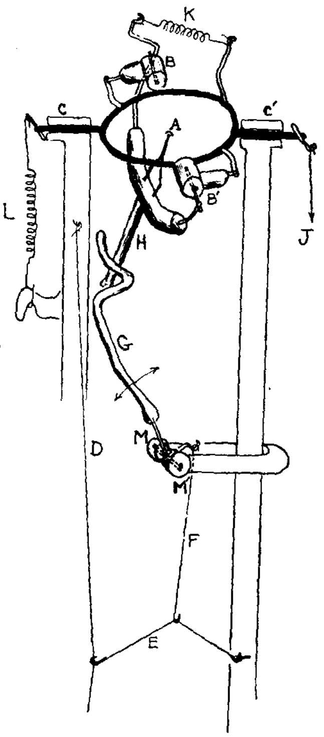

FIG. 1. Sketch of gimbals showing method of producing motion about one axis, BB'.

produce rotation about CC' is similar. The expansion wire D, through which the heating current is passed, is #39 Nichrome, 13 cm long, and hooked at the center by one end of the linkage wire E. At the center of E, a second linkage wire F is connected to the arm G so as to produce rotation about the axis MM'. The arm H is caused to follow G by a torque about the axis BB' produced by spring K. In the same manner, the expansion of a hot wire allows upward motion of the wire J against the torque about the axis CC' produced by the spring L.

Flexible leads, not shown, bring heating current and high voltage to the emitter point. The device was fabricated using standard tube construction technique. Special attention was paid to high-voltage insulation, since up to 13 kv is applied between the field emitter and the gimbal ring. It was also designed so that the wire systems may be outgassed by passing current through them. The gimbal system was operated in a sealed-off tube at a pressure of 3×10^{-7} mm Hg.

The author is gratefully indebted to several people who gave important assistance in this work, notably to Dr. L. Marton and Dr. J. Arol Simpson, whose suggestions are embodied in the design. The glass blowing was performed by John J. Madine, without whose skill and patience the work would have been impossible. The support of the Office of Scientific Research, Air Research and Development Command is gratefully acknowledged.

Modification to the Automatic Ionization Chamber*

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THE automatic ionization chamber has been described previously.[1,2] It has proven quite reliable in service and has many desirable features, especially for balloon-borne equipment. A disadvantage has been that the time of discharge was dependent upon the potential applied to the quartz fiber. Thus, during the

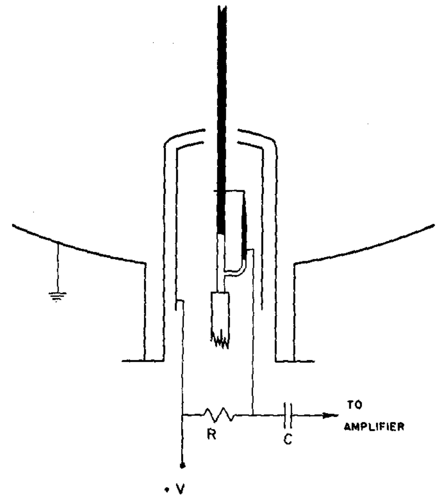

FIG. 1. The inner cylinder is maintained at the same potential as the fiber except when a recharging occurs.

comparison of the instrument to be used with the standards, careful measurement of the potential used on the standards was required. Furthermore, care was required to make sure that the battery used during the flight remained constant in potential.

It has now been found that the time between rechargings can be made nearly independent of the potential of the fiber by inserting a metal conductor inside and insulating it from the outer conductor surrounding the quartz fiber, and making the potential of this inner conductor the same as that of the fiber. The construction is shown diagrammatically in Fig. 1. In practice the insulation between the two cylinders consists of three equally spaced glass tubes running nearly the full length of the inside cylinder, held in place by nickel wires passing through the tubes and spotwelded to the cylinder at each end.

The degree to which the time for discharge is made free of the battery potential is shown in Fig. 2. The ionization chamber was baked out at 350°C for several hours before admitting argon whose impurities were less than 12 parts per million. The steep rise of the curve at the low voltages means that the change of potential of the collector before recharging was such that the electric field had nearly vanished and not all the ions were collected. The ionization was approximately 3600 ions cm^{-3} sec^{-1} in argon at 8 atmos pressure. The slope of the curve at the higher potentials of 0.005% $volt^{-1}$, is due to the fact that the region

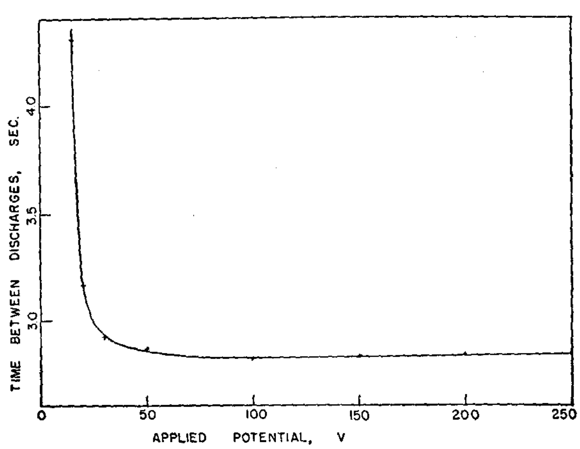

FIG. 2. The dependence of the time between rechargings upon the applied potential V (Fig. 1) is about 0.005% $volt^{-1}$ at the higher potentials.

around the fiber is not completely surrounded by a conductor of its own potential, but the fiber can "see" conductors at another potential in the downward direction. This is not, however, of much consequence for it is seen that the requirements on the constancy of the battery potential are very slight. This value of 0.005% volt^{-1} is to be compared with the average value of 0.7 given in reference 1.

* Assisted by the joint program of the Office of Naval Research and U. S. Atomic Energy Commission. Reproduction in whole or in part is permitted for any purpose of the United States Government.
[1] H. V. Neher, Rev. Sci. Instr. 24, 99 (1953).
[2] H. V. Neher and Alan R. Johnston, Rev. Sci. Instr. 25, 517 (1954).

Convenient Microwave Harmonic Generator

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A SIMPLE scheme for generating second harmonic power in the microwave region using readily available components is presented in this note. The performance of this method has equalled or exceeded more elaborate and expensive types of second harmonic generators used in this laboratory, such as windowed 1N26 mounts, or those described by Johnson and King.[1] Figure 1 shows the necessary components.

The principle of operation is simple. Fundamental power is incident on the tee and splits. That portion which goes to the right in the figure is reflected by the wave-guide-beyond-cut-off section. That portion which goes to the left is incident on a nonlinear element, a silicon crystal diode, and harmonics are generated. The second harmonic is by far the strongest harmonic present, and it travels back to the tee (where some power is lost) and then on to the output waveguide. A short circuit (such as the taper) at critical positions in one arm of a T-junction can prevent power transfer between the other two arms. At these distances, or near them because of limitations of the matching transformer (E/H tuner), poor performance may possibly be encountered, and will be curable by a change in length from junction to taper.

The particular apparatus in use here doubles from 1.2 cm to 6 mm (50 kMc) with a conversion loss of about 20 db. The fundamental wave-guide components are designed for K-band. An H-plane tee will work for the apparatus pictured, but an E-plane tee was experimentally found to be much better. It was also found that the fundamental power should be fed into the arm shown rather than one of the main arms. The explanation of these facts probably lies in the degree of match attainable with the tuner for the various configurations, since there appears to be no fundamental reason why all permutations of arms in both types of junctions should not work about equally well. The detector mount is simply a standard commerical mount with a variable shorting plunger behind the crystal. The value of bias resistance is rather

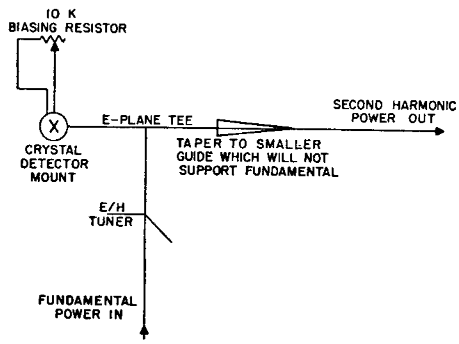

Fig. 1. Schematic diagram of harmonic generator.

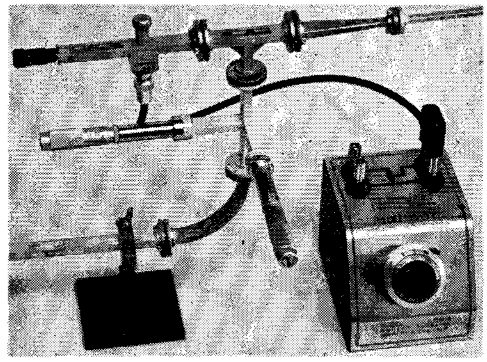

Fig. 2. Photograph of harmonic generator.

critical and should be set for maximum second harmonic power. The crystal is a 1N26. Crystal selection is important because there is a wide variation in behavior at the harmonic frequency even among crystals of the same type, due perhaps to small differences in construction which are less important at the fundamental frequency. The physical position of the crystal cartridge in its mount is critical, but the position for best output can be easily found. The tapered section to smaller wave guide is necessary to suppress the fundamental power in the output.

The apparatus which supplies 1.2-cm power terminates with a Sperry Type SMK-40 multiplier klystron which makes available 600 mw of power. The harmonic generator is normally operated with only 100 mw incident on it since it was felt unwise to subject the crystals to more power. Other sources may of course be used.

About 40 type 1N26 crystals were available to choose from. With 100 mw incident, most of the crystals generated several hundred microwatts of second harmonic. The best one generated 2 mw for a conversion loss of 17 db.

[1] Johnson, Slager, and King, Rev. Sci. Instr. 25, 213 (1954); King and Gordy, Phys. Rev. 93, 407 (1954).

Plastic Capillary Tubes for X-Ray Powder Samples

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PLASTIC capillary tubes for x-ray powder specimens are commonly prepared by dipping annealed copper wires into a polymer solution, allowing the coated wires to dry, stretching them to loosen the coating, and removing and cutting the plastic tubes to the requisite length.[1–6] When tried by the authors, the procedures described in the literature for making tubes of parlodion[4] and "Peel-It"[6] did not give consistently good results, the most common failing being inability to loosen the plastic sheath from the wire. Preliminary coating of the wire with lubricants such as anhydrous sodium stearate or graphite does not necessarily facilitate the freeing of the tubes, besides which it is objectionable because of the possible production of unwanted diffraction lines.

The following procedure has given consistently good results in the production of 0.6-mm parlodion tubes. For annealing in a muffle furnace, straightened 6-in. pieces of 22-gauge bare copper wire are placed in an 18-in. length of Pyrex tubing of $1\frac{1}{2}$ in. diameter, which is closed at both ends by bored corks through which extend 3-in. pieces of $\frac{1}{4}$-in. glass tubing. Commercial grade Linde water-pumped nitrogen is admitted at one end of the annealing tube and the flow rate fixed at 5–6 l per minute. After flushing the system for five minutes the temperature is allowed to rise slowly over a period of about 90 minutes to 700°C, whereupon the annealing tube is removed from the furnace and allowed to cool to room temperature.