In the second case, the air cavity was assumed to be divided into two parts by a plane through the middle of the F holes and considered as two parallel resonating cavities. The formula for calculating the resonance frequency in this case was developed from the analogy to similar electrical circuits with parallel connections. In this electrical case for resonance the current is all in phase with the electromotive force and the wattless component is zero. This condition for two parallel circuits with reactances X_1, X_2 and impedances Z_1, Z_2 is expressed as follows:

$$I_1 \sin \theta_1 + I_2 \sin \theta_2 = \frac{EX_1}{Z_1Z_1} + \frac{EX_2}{Z_2Z_2} = 0.$$

When the analogous acoustical terms are substituted in the above equation and the proper violin data are substituted for the constants its solution gives the resonance frequency $F = 334$ vib. per sec., a value which falls within the upper limit of the resonance band found by experiment. This suggests that this resonance band is due to multiple resonance between the limits of the above frequencies.

After investigating many violins of both old and modern makes, it was found that this strong resonance band occurs in all models approximately between the same frequency limits. This result must be so, for the reason that violin makers have always thought that they must keep the size of the F holes and volume of the inside of the violin the same, regardless of other modifications in models.

A NEW FOCUSING DEVICE FOR ELECTRON DIFFRACTION

WILLIAM I. CALDWELL, Purdue University

Up to the present time all the methods used to study crystal structure by electron diffraction have been adaptations of x-ray methods. Although these methods have been successful they all possess inherent difficulties. These difficulties arise from the low penetrating power of the electrons and from the short wave lengths of the electrons at moderate velocities. An attempt has been made to find a method that will obviate, in so far as possible, these difficulties.

The diffraction of radiation by powdered crystals is usually considered as the summation of a large number of Bragg reflections. However, the work of Brentano[1] suggested another viewpoint which, it can be shown, is applicable to all diffraction methods. Brentano's reasoning was somewhat as follows:

Let ABCD (Fig. 1) be a section of a toroid, the surface generated by rotating the arc of a circle ABC about its chord AC. EF is tangent

[1] Phy. Soc. London 38:184, 1926.

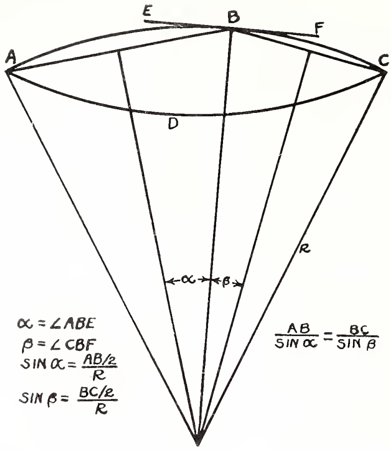

Fig. 1.

to the surface at B. $<ABE = \alpha, <FBC = \beta$. A line drawn from A to any point on the surface will make a constant angle with a line from C to the same point. Since this is constant, radiation from A incident upon crystals on the toroid will be focused at C if $n\lambda = 2d \sin\left(\frac{\alpha + \beta}{2}\right)$.

Let R be the radius of the toroid. From the illustration it is seen that $\sin \alpha = AB/2R$ and that $\sin \beta = CB/2R$.

It follows that $AB/\sin \alpha = BC/\sin \beta$.

Obviously this condition must be fulfilled by any method for sharp diffraction patterns to result.

Brentano's focusing condition suggested at once a possibility for a new electron diffraction method. In this method, figure 2, the surface of a toroid is used to hold the crystalline meterial with a point source of electrons at one end of its axis and a fluorescent screen or collector at the other. By changing the accelerating voltage of the electrons through

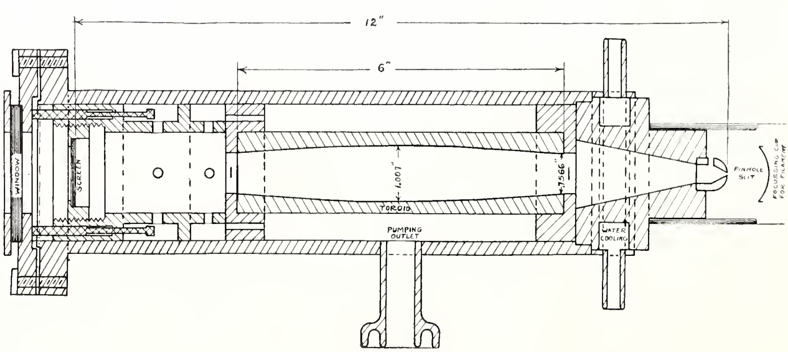

Fig. 2.

a suitable range the wave length of the beam will change and the different planes will in turn produce point patterns. By observing the accelerating voltages at which the point patterns are produced, the crystal structure can be determined. This method has the advantage that the intensities can be measured directly with an immobile collector, also that of great intensity since the electrons are focussed at a point instead of being distributed in a ring. The low penetrating power of the electrons will not cause difficulties as the electrons will be reflected instead of being transmitted.

A camera has been built on this principle, figure 2.

MAGNETIC EFFECT ON A VIBRATING QUARTZ CRYSTAL EXCITED PIEZO-ELECTRICALLY

SAMUEL H. CORTEZ, Indiana University

INTRODUCTION

Work carried on during the last few years has been quite exhaustive in determining the various properties of quartz. Its wide use in oscillators of constant frequency has necessitated a knowledge of the various factors which control its natural frequency. Much work has been done and many articles have been written regarding temperature effects.[1] None, to the knowledge of the writer, has appeared regarding a magnetic effect. It was therefore thought advisable to investigate this possibility.

DESCRIPTION OF APPARATUS

The apparatus used in investigating the magnetic effect consisted of four vacuum tube circuits and an electromagnet. One of the vacuum tube circuits acted as a piezo-electric oscillator, the improved Pierce circuit being used. Two of the vacuum tube circuits were Hartley oscillators, one for radio frequencies, the other, using an iron core coil, for audio frequencies. The other radio circuit was a three stage amplifier and detector. The piezo-electric oscillator was coupled inductively to the Hartley radio frequency oscillator, which was in turn inductively coupled by means of a coil and an input transformer to the audio amplifier detector. A loud speaker was connected to the output terminals of the amplifier. By adjusting the frequency of the Hartley oscillator to within 1,000 cycles of the frequency of the piezo-electric oscillator, a beat frequency electric current was produced which, after passing through the amplifier, was converted by means of the loud speaker to acoustic energy in the form of a sound wave whose frequency was the same as that of the beat frequency current. A telephone receiver was connected in the plate circuit of the Hartley audio oscillator which

[1] Paul Vigoureux. Quartz Resonators and Oscillators, p. 19.