

housing to the adjacent mercury reservoir. Tygon tubing was employed for both the vent and the fill lines between the switch and mercury reservoir.

Power from a 20-kw induction heater (Westinghouse type CF-712) was delivered through a pair of mercury switches to a work coil and appropriate load for evaluation purposes. A pair of mercury switches is required for each work coil. Any number of work stations can be used.

For test purposes a load drawing 140 rf amp through one pair of switches was maintained for one hour with satisfactory results. The oscillator anode voltage was 7 kv. With rf currents of 90 and 120 amp, the mercury reaches equilibrium temperatures of 39 and 44°C respectively. From cooling curves of the mercury, the rate of heat addition to the switch was computed under the conditions specified above; the losses in the individual switch units were 48 and 71 watts, respectively.

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¹ Holden, Speiser, and Johnston, *J. Am. Chem. Soc.* **70**, 3897 (1948).

² Speiser, Ziegler, and Johnston, "Induction Heating Applied to High Temperature Thermodynamics," Fall Meeting of the American Chemical Society, New York City, 1947.

³ Edwards, Speiser, and Johnston, *Phys. Rev.* **73**, 1251 (1948).

⁴ Speiser, Ziegler, and Johnston, *Rev. Sci. Instr.* **20**, 385 (1949).

⁵ Henschen, Edwards, and Johnston, *Rev. Sci. Instr.* **22**, 987 (1951).

⁶ L. E. Bollinger, *Austral. J. Instr. Tech.* **11**, 138 (1955).

Integrating Attachment for the Weissenberg Camera*

C. E. NORDMAN, *Department of Chemistry, University of Michigan, Ann Arbor, Michigan*

AND

A. L. PATTERSON, *Institute for Cancer Research and Lankenau Hospital Research Institute, Philadelphia 11, Pennsylvania*

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IN a recent communication¹ we have described an integrating mechanism for the Buerger precession camera in which the integrating motion of the film during x-ray exposure is produced by the continuous motion of eccentric cams. An analogous mechanism for the Weissenberg camera has now been devised, thus producing a modified version of the original integrating x-ray diffraction camera of Wiebenga and Smits.²

In the integrating attachment (Fig. 1) the film is carried in a tube supported by two ball bearings which permit both axial and angular motion. Figure 2 is a detail sketch of one of the bearings. The twelve stainless steel balls of each of the two bearings are located in radially drilled holes in a loose fitting brass retainer ring. The outside diameter of the retainer ring is

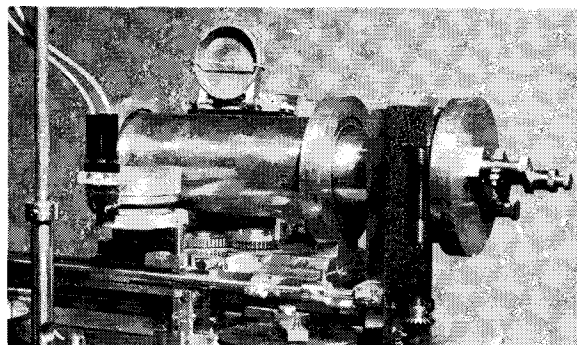


FIG. 1. Integrating attachment mounted on a commercial Weissenberg camera.

greater than the diameter of the lip in the support. Similarly, the inside diameter of the retainer ring is less than the outside diameter of the main part of the film tube. This limits the axial motion of the tube in one direction. Together the two ball bearings allow the tube an axial play of a few millimeters.

Two flat, vertical shelves are attached to the bottom side of the film tube, one parallel to the axis of the tube, the other perpendicular to it. Two horizontal eccentric cams, geared to each other through an idler in an 8 to 9 ratio, are attached to the base plate of the film holder. By means of a diagonally directed spring between the base plate and the tube the vertical shelves on the latter are made to bear against the eccentric cams. This serves to position the tube in the axial as well as angular direction. As the cams revolve at a constant speed both the angular and axial positions of the tube change at a constant speed. Successive exposures of the same diffraction spot will then lie on a line describing a saw-tooth Lissajous curve over a small rectangular area on the film.¹ The result is an area of effectively uniform photographic density, provided cam throw, speed and phasing are properly chosen. The integrating mechanism is driven by a 1/60 rpm, 4-w synchronous motor attached to the base plate of the film holder and geared to the idler between the two cam gears. The period of the integrating motion is 12 hr. Power is supplied to the synchronous motor by means of two flexible leads made from braided voice coil wire. The leads, which are about 10 in. long, are suspended above the motor at the midpoint of the traverse of the film holder, and connected to the motor by means of banana plugs.

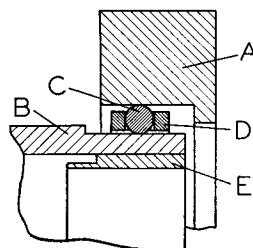


FIG. 2. Ball bearing suspension of film tube; (A) support, (B) film tube, (C) stainless steel ball, (D) ball retainer ring, (E) film retainer ring.

Thus, the integrating attachment can readily be removed for film loading and is interchangeable with the standard film holder.

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¹ Nordman, Patterson, Weldon, and Supper, *Rev. Sci. Instr.* **26**, 690 (1955).

² E. H. Wiebenga and D. W. Smits, *Acta Cryst.* **3**, 265 (1950).

Letters to the Editor

Prompt publication of brief reports of NEW ideas in measurement and instrumentation or comments on papers appearing in this Journal may be secured by addressing them to this department. No proof will be sent to the authors. Communications should not exceed 500 words in length. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Slit Design for Axially Focusing Beta-Ray Spectrometers

DAVID B. BEARD

Missile Systems Division, Lockheed Aircraft Corporation,
Palo Alto, California

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SINCE the publication of the author's article¹ on axially focusing beta-ray spectrometers, interest has been expressed in the detailed design of one of the novel entrance geometries suggested in the article. If we consider the projection of the electron's path on the source plane perpendicular to the axis of the instrument

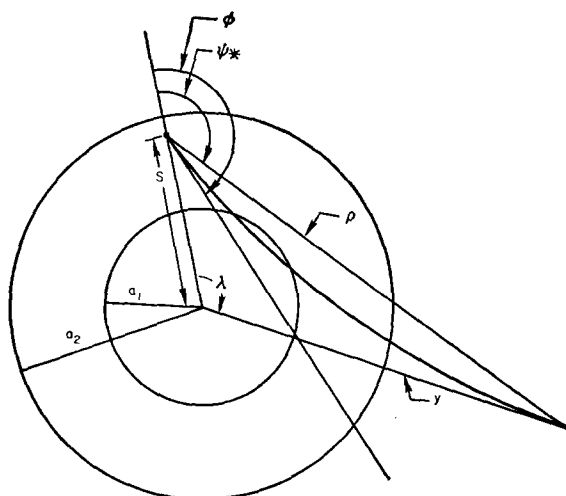


FIG. 1. Projection of electron trajectory from source point radius, S , to a given point on plane perpendicular to the axis of the instrument. y and λ are the radial and angular positions of the given point. ρ and ψ^* are the positions from the source point, S . φ is the projected direction of the initial velocity vector. All angles are taken with respect to the source point radius.

as shown in Fig. 1, we obtain in the notation of I: y is the projected radial distance of the electron from the instrument axis, and λ is the projected angular position of the electron from the source point radius, S .

$$\sin\lambda = (\rho/y) \sin(\pi - \psi^*) = (\rho/y) \sin\psi^*. \quad (1)$$

In the notation of I near the source ($Z \ll D \cos\alpha$), $\psi^* = \varphi$, the projected angular direction of the electron's initial velocity vector. By the law of cosines

$$y^2 = \rho^2 + S^2 + 2\rho S \cos\varphi. \quad (2)$$

Differentiating Eq. (1) with respect to φ yields

$$\begin{aligned} \frac{\partial\lambda}{\partial\varphi} &= (\rho/y \cos\lambda) (\cos\varphi + \rho S \sin^2\varphi/y^2) \\ &= (\rho/y^2) (y^2 - \rho^2 \sin^2\varphi)^{-1/2} (y^2 \cos\varphi + \rho S \sin^2\varphi) \\ &= (\rho/y^2) (\rho + S \cos\varphi). \end{aligned} \quad (3)$$

As an example of the change in rotation angle, λ , resulting from a small change in φ , $\Delta\varphi$, at two different values of Z , one finds

$$\Delta\lambda = \frac{\partial\lambda}{\partial\varphi} \Delta\varphi = 0.008\Delta\varphi$$

for

$$\varphi_0 = 117^\circ, \alpha = 23^\circ, Z/a_1 = 1.10,$$

where a_1 is the inner radius of the source ring; $\Delta\lambda = 0.955\Delta\varphi$ for $Z/a_1 = 4.50$. The fins depicted in I, if they were placed between these two values of Z , could thus control the variation in φ if the variation in λ permitted by the space between the fins were restricted to $0.95\Delta\varphi_m$ where $\Delta\varphi_m$ is the maximum allowed value of $\Delta\varphi$. The random example given in I of $\Delta\varphi_m (= \Delta\chi_m) = (2A_1)^{-1}$ is smaller than the optimum choice of $\Delta\varphi_m$. For the example suggested in I of $D = 30$ in., $P = 2000$, $a_1 = 100$ mils resulting in an intensity of over 5 times that of a disk source at the same resolution $\Delta\varphi_m$ could be at least 0.20 radians. This means that the blades of the fin plate assembly must be approximately 0.34 in. long, 0.1 in. deep, and 20 mils apart for this example. Larger separations are possible, but the performance of the instrument declines going from peak intensity/(half-width)³ = $0.28A_1K$ for $\Delta\varphi_m = A_1^{-1}$ to $0.08A_1K$ for $\Delta\varphi_m = 2.5A_1^{-1}$. A larger optimum choice of $\Delta\varphi_m$ would result, however, if the ratio a_2/a_1 were reduced from the value of 2 chosen in the example. a_2 is the outer radius of the source ring.

A sectored source would permit the fin plates to be shortened on the source side of the assembly. Electron scattering must, of course, be examined, but the experience of Birkhoff *et al.*² with a similar geometry indicates this is not a serious problem. Included in the intensity estimate is a factor of 50% to account for the effect of the finite thickness of fins to stop electrons of several Mev energy at incident angles ranging from