The theory also leads to the expectation that superconductivity will be found only in those metals in which conducting energy bands are nearly empty; also that the upper limit of the critical magnetic field will be greater for those elements with lower Fermi levels, or more dense band-forms. In fact the "left-hand" group with high H_m are d-band conductors, while those with small H_m (the right-hand group) are p-band conductors in agreement with the theory.

The theory is consistent with the general principles recently laid down by Mendelssohn in his paper on the "z-state."[4]

[1] J. Frenkel, Phys. Rev. **43**, 907 (1933).
[2] Bethe and Frölich, Zeits. f. Physik **85** (1933).
[3] W. Band, "Diamagnetism and superconductivity of a collective electron assembly," Proc. Camb. Phil. Soc. to be published.
[4] Mendelssohn, Proc. Phys. Soc. **57**, 371 (1945).

On Increasing the Effectiveness of a Betatron

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December 29, 1945

BOTH halves of the cycle of an x-ray betatron can be utilized by employing dual injectors and dual targets. The injectors are mounted back to back either outside or inside the equilibrium orbit. One target is located outside the orbit, and the other target is located inside the orbit. Electron beams are sent in opposite directions on successive half-cycles. The particular target which is on the side of the orbit toward the injectors consists of a slight projection from the injector assembly (as used by Kerst). This projection is cleared by each beam on its first revolution following injection. The arrangement is shown in Fig. 1.

For nuclear disintegration studies this scheme doubles the intensity of the output at the position of the intersection of the two x-ray beams. For radiation therapy the crossfire presents advantageous dosage distribution within the body of the patient. For limited applications in radiography the intersection could conceivably serve in the manner of a focal region.

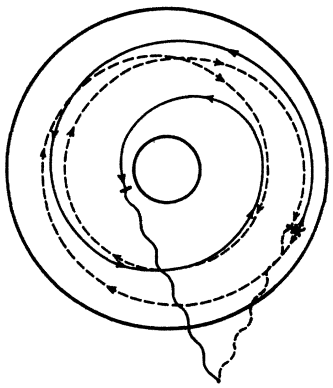

FIG. 1. Dual injector and target arrangement.

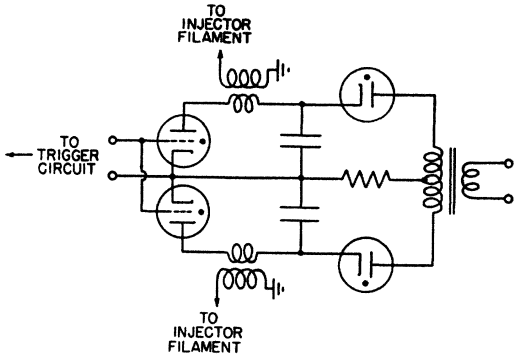

FIG. 2. Injection pulsing system.

For causing the beams to strike their respective targets it is sufficient to use a single pair of orbit-shift coils just inside the orbital radius (one coil above the doughnut and one below) together with a standard pulsing system. It is only necessary to pulse the coils once each half-cycle instead of once each full cycle. Inasmuch as the main flux reverses with each half-cycle while the orbit-shift coils are always pulsed in the same direction, the net result is that the orbit is alternately expanded and contracted on successive half-cycles.

A suitable pulsing system for firing alternate injectors on successive half-cycles is shown in Fig. 2. Both thyratrons are triggered by a single trigger unit; hence a single control adjusts the phase of both injectors.

A Method for Measuring Effective Contact e.m.f. between a Metal and a Semi-conductor[1]

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RECTIFYING action can often be achieved by making a contact of small area between a metal and a semi-conductor. This rectification is interpreted in terms of a potential barrier which is caused by the difference in work functions of the metal and semi-conductor. If the barrier is thin enough, its height can be appreciably lowered by image force and by the quantum-mechanical tunnel effect. The contact e.m.f. also can vary from point to point over the contact area. Consequently, only an effective contact e.m.f. can be readily measured. But this effective contact e.m.f. is one important parameter in the theory and practice of semi-conductor rectifiers.

If the potential barrier acts like a diode in that most electrons (or holes) are stopped by the potential rather than by collisions, then Bethe[2] has shown that the current can be written as

$$j = j_0 \exp\left(-\frac{e\varphi}{kT}\right)\left[\exp\left(\frac{eV}{kT}\right)-1\right],$$

where V is the voltage applied across the contact (taking