to some compound of zero-valent iron different from $Fe(CO)_5$ and $Fe_3(CO)_{12}$, as could be again demonstrated by the Kalousek commutator.

This work will be described in detail elsewhere.

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March 12.

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Improving the Characteristics of the Cyclotron Beam

Reports[1] of existing fixed-frequency cyclotrons indicate that near the maximum energy the ratio between internal and external beam current is about five to one, with the maximum current limited by heating of the septum by the stray beam. If the internal beam could be more accurately aligned at the deflector and the stray beam removed, a larger external beam, better focused and with less energy-spread, could be produced.

In the cyclotron, groups of particles leaving the ion source become bunched in phase[2] and, given a stable dee voltage, would follow nearly the same path, arriving at the deflector after the same number of turns. It is not usual to provide such stability, and many cyclotrons operate with quite a large mains ripple. This produces a range of conditions at the deflector. For example, if there is a 6 per cent ripple on the dee voltage, different groups of particles may do between 66 and 74 turns. The energy and position of particles within a single group are nearly the same. Due to precession of the particle orbits, however, the energy and position, and hence the extraction efficiency, may differ widely from one group to the next.

Theory indicates that stabilization of the dee voltage to some 0·25 per cent would improve the characteristics of the beam. The reduction in both energy-spread and angular spread would then make it easier to focus on remote targets, while selection of the optimum particle group would give increased extraction efficiency. There would be a further advantage; a beam which follows a single path to the deflector makes it possible to place beam-defining slits on the dee interface. By intercepting the stray particles, particularly those which would strike the sides of the deflector, these slits should collimate the beam and increase the extraction efficiency still further.

A vertical slit has been tried near the ion source on the Medical Research Council's 45-in. cyclotron and found to produce a corresponding narrowing of the beam at larger radii. The sides of the slit can be made to intercept any portion of the first turn without impeding the succeeding one, while the proximity of the slit to the dees seems to have no adverse effects. It is expected that in the final arrangement the slit near the ion source will be about $\frac{1}{4}$ in. wide by $\frac{3}{4}$ in. high and situated at $1\frac{1}{4}$ in. radius, with a second slit $\frac{1}{8}$ in. wide, giving finer adjustment, placed just before the deflector. The beam current striking the two sides of this second slit could provide a convenient way of stabilizing the voltage.

The theory, which will be submitted for publication elsewhere, is based upon numerical plots of the first turns, precession calculations, study of the extraction conditions, and upon calculations[3] on the phase excursion through the machine. Some confirmation of the correctness of the theory is apparent in a report[4] on experiments with the internal beam of the University of Birmingham cyclotron. In this report stops are suggested for the reduction of beam pulse-length.

This work was done in connexion with the construction of the Medical Research Council's 45-in. cyclotron. I wish to thank Mr. J. W. Gallop for his interest and encouragement and also Mr. D. D. Vonberg and Mr. P. J. Waterton for many helpful discussions.

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Adsorption Spectrum of Nitrogen on Tungsten

It has recently been shown[1] that even at low coverages of a fraction of a monolayer, nitrogen is simultaneously adsorbed on tungsten in different states of binding, of which three have so far been isolated. The temperatures above which these individual species are unstable have been estimated semi-quantitatively as 800° K. for state α, 2,000° K. for β and 200° K. for γ. In order to define the spectrum of binding energies of the molecular species adsorbed on the surface, it is necessary to measure the concentration of adsorbed entities as a function of sorbent temperature. We have now been able to do this by a simultaneous recording of the rise in pressure and the increase in electrical resistance when the tungsten

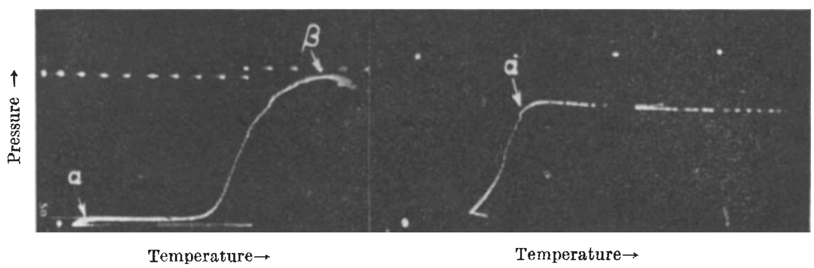

Fig. 1 (*a*). Desorption of nitrogen from tungsten with increasing temperature; filament initially at 298° K. Temperature range 298°–2,000° K. The instantaneous pressure is proportional to the amount of gas desorbed

(*b*). Desorption of nitrogen from tungsten initially at 298° K. Temperature range 298°–1,000° K.