As has been pointed out by Professor Sir Joseph Larmor,[1] and as is evident from these equations, a necessary but not sufficient condition for the absence of second order radiation is that the magnetic moment of the atom shall remain constant.

It is easily shown from these conditions that in the case of a circular orbit in which any even number of electrons are uniformly spaced, the odd conditions are all satisfied. If, however, the electrons are limited to two, none of the even conditions are satisfied, the second order radiation amounting to

$$\frac{8}{5}\beta^2\frac{e^2f^2}{\pi c^3}.$$

If there are four electrons in the ring, the second condition is satisfied, but the fourth and higher even conditions are not, and so on. All conditions are satisfied only when a uniform density of charge is distributed around the ring.

A paper containing the details of the work summarized in this abstract is about to be submitted to the PHYSICAL REVIEW for publication.

YALE UNIVERSITY.

A MAGNETIC FALL OF POTENTIAL METHOD FOR TESTING SHORT BARS OF IRON.

BY ARTHUR WHITMORE SMITH.

THE normal magnetization curves (B–H) for bars of iron 6 x 6 mm. in cross section, and 15 cm. in length, have been accurately determined. In testing short bars it is necessary to use a method in which each part of the iron is subjected to equal values of the magnetic intensity, H. This is the case when the iron is in the form of a thin ring, and when test samples can be obtained only as short bars the conditions of a ring circuit (*i.e.*, without ends or air gaps) should be approximated as nearly as possible.

In the present case the test bar is clamped into a yoke of slightly larger section, which carries the flux out one end of the bar and around to the other end. There are two magnetizing coils. One coil is wound over the yoke, and the other coil is around the bar. Each coil carries a current which can be varied without changing the current in the other coil. When these currents are adjusted so that each coil supplies the magnetomotive force needed to carry the magnetic flux through its part of the circuit, and no more, there is no leakage of magnetic flux at any point along the circuit, and the disturbance due to the end effect is not present.

The difficulty is in knowing just when this condition has been reached. The case is analogous to an electric circuit in which the applied e.m.f. is distributed along the circuit with just enough e.m.f. in each element of resistance to keep the current flowing in that element. All of the points in such a circuit will be at the same potential, although a current is flowing, and a voltmeter joined in parallel with a portion of the circuit will indicate no difference of potential.

[1] Phil. Mag., 42, 595, 1921.

The arrangement that corresponds to a voltmeter consists of a solenoid of many turns of fine wire wound on a fiber core 10 cm. in length. Each end of this solenoid is covered with a plate of soft iron, which extends, on one side, about 5 cm. beyond the side of the coil. These plates are clamped against the test bar at points about 10 cm. apart. The solenoid, with its end plates, thus forms a magnetic shunt in parallel with the middle 10 cm. of the bar. The turns of wire around the bar that are displaced by the plates are wound as near as possible to their proper location to give a uniform winding. The flux through the solenoid is measured with a fluxmeter-galvanometer by the usual method of reversals. No flux through the solenoid indicates that the m.m.f. supplied to the bar is just sufficient to carry the flux through the bar.

This apparatus was used with a bar of ingot iron which had been annealed from 1000° C. in a stream of hydrogen. A ring of the same iron, annealed as nearly as possible in the same way, was also measured for a comparison check. The magnetization curves for the ring and for the bar are practically identical, the small differences being less than might be expected from two rings of the same iron. The agreement is equally good for the smaller values of the flux, where other methods require large corrections.

University of Michigan,
December 10, 1921.
Revised January 12, 1922.

A New Method for the Determination of the Magnetic Susceptibilities of Gases.

By Jakob Kunz and E. C. Fritts.

It has been shown by A. P. Carman and W. Hyslop[1] and by R. Whiddington[2] that the thermionic valve in the heterodyne method of electric oscillations gives an exceedingly sensitive and accurate method for the determination of capacities and dielectric constants. The same method is now applied for the measurement of magnetic susceptibilities of gases. In this case the self-induction of a soil in a vacuum is changed by the introduction of the gas, whose susceptibility has to be measured. We hope to measure in this way not only the magnetic susceptibilities of the ordinary and noble gases, but even of metal vapors and of dissociated gases.

University of Illinois.

A Sine Galvanometer for Determining in Absolute Measure the Horizontal Intensity of the Earth's Magnetic Field.

By S. J. Barnett.

A brief historical statement with reference to the measurement of the horizontal intensity of the earth's magnetic field by magnetic and electrical

[1] Physical Review, 15, p. 243, 1920.
[2] Phil. Mag., 40, p. 634, 1920.