electric accelerating fields are to be obtained by replacing the usual "dee" assembly and acceleration chamber by a cavity resonator, similar to types now commonly employed in radar. The use of such a cavity becomes practical only in an iron-less device, because of the limitation imposed by the air-gap in present accelerators.

The maximum orbit radius is to be small. This requires a large guiding magnetic field, but at the same time greatly reduces the volume through which this field must be maintained. It, therefore, appears practicable to immerse the entire accelerator in a liquified gas, such as hydrogen or nitrogen. Cooling the assembly materially reduces ohmic resistance losses in the field windings, and thus simplifies the problem of passing large current pulses. It has also the advantage of increasing the "Q" of the resonator.

Although many of the commoner types of cavity resonators[7] exhibit electric field configurations adapted to producing resonance acceleration, the type describable as a "sphere (or spheroid) and reentrant cones"[8] seems particularly suitable. In such a cavity, the electric field lines appear as arcs of circles, terminating on the surfaces of the reentrant cones. Small slots are to be made at points in the conical surfaces, through which the accelerated particles are to pass in their circular orbits. Injection may conveniently be accomplished from a point external to the accelerating fields by placing the injector gun within one of the cones. A target may also be conveniently located within the cones. It will probably be necessary to partially "open-circuit" the cavity walls for low frequency currents generated by the guide field. This can readily be done.

Within a resonator such as described, it should be possible to obtain exceptionally high accelerating potential drops, of the order of several hundred thousand volts. This follows from the fact that a cavity resonator is an extremely efficient device, often exhibiting an electrical "Q" greater than 100,000 and consequently requiring a relatively small energy input to produce large internal fields. The upper limit of attainable electric fields within an evacuated cavity should be very high, and will probably be imposed by field emission effects. In the use of such a resonator, it is convenient to employ the cavity itself as the frequency controlling element of a power oscillator, thus eliminating problems of accurate frequency control.

Some small advantage may also be gained from enclosing the particle orbits within a closed conducting surface, in that this will minimize that part of the radiation losses contributed by low order harmonics. It has been shown,[5,6] however, that these harmonics contribute only slightly to the total radiative dissipation.

The conditions for "resonant" increase of energy[1,2] can be satisfied at all times during an acceleration cycle, provided the amplitude of the resonance electric field is increased simultaneously with the rise of the magnetic field. It can be shown that under these conditions the effect of the magnetic component of the cavity field will be negligible throughout the cycle, provided adequate focusing forces are established by the guide field.

To provide the necessary pulses of current through the field windings, three methods could be employed: (a) a "pulse transformer" excited from a d.c. source, (b) a short-circuited d.c. generator (following Kapitza's technique), or (c) a bank of high capacity storage batteries of the type used in submarines. A large ignitron and delay-line extinguishing circuit would serve as the switching element. The limits on the particle yield of the accelerator will be set by the available power and by the allowable rate of heat dissipation from the field windings.

Some design calculations have been made for a 500-Mev electron accelerator.

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Nuclear Induction

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THE nuclear magnetic moments of a substance in a constant magnetic field would be expected to give rise to a small paramagnetic polarization, provided thermal equilibrium be established, or at least approached. By superposing on the constant field (z direction) an oscillating magnetic field in the x direction, the polarization, originally parallel to the constant field, will be forced to precess about that field with a latitude which decreases as the frequency of the oscillating field approaches the Larmor frequency. For frequencies near this magnetic resonance frequency one can, therefore, expect an oscillating induced voltage in a pick-up coil with axis parallel to the y direction. Simple calculation shows that with reasonable apparatus dimensions the signal power from the pick-up coil will be substantially larger than the thermal noise power in a practicable frequency band.

We have established this new effect using water at room temperature and observing the signal induced in a coil by the rotation of the proton moments. In some of the experiments paramagnetic catalysts were used to accelerate the establishment of thermal equilibrium.

By use of conventional radio techniques the induced voltage was observed to produce the expected pattern on an oscillograph screen. Measurements at two frequencies ν showed the effect to occur at values H of the z field such that the ratio H/ν had the same value. Within our experimental error this ratio agreed with the g value for protons, as determined by Kellogg, Rabi, Ramsey, and Zacharias.[1]

We have thought of various investigations in which this effect can be used fruitfully. A detailed account will be published in the near future.

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