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Testing Accelerator

UNIVERSITY OF CALIFORNIA
RADIATION LABORATORY

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MINUTES OF MTA PROGRESS MEETING HELD DECEMBER 5, 1950

Russell H. Ball

Berkeley, California

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MINUTES OF MTA PROGRESS MEETING
HELD DECEMBER 5, 1950

Present: UCRL: Baker, Brobeck, Brown, Cork, Farly, Gordon, Hanson, Judd, Kilpatrick, Latimer, Lawrence, Lofgren, Longacre, Martin, Martinelli, McMillan, Norton, Panofsky, Reynolds, Serber, Sewell, Twitchell, Van Atta, Wallace

CRDC: Chaffe, Cope, Crandall, Hansen, Hildebrand, Maker, Powell, Waithman

AEC: Ball, Killough

Los Alamos: John Wheeler

Baker said they have 4 bias probes in the bottom of the B-1 cavity to act as de-ionizers in the hope that they would circumvent ion locking, but they have not yet shown any beneficial effect. They may possibly be placed in the wrong locations. It is observed that the region above the sphere de-ionizes first. When voltage is put on the probes the lower region also clears but glow discharge can still be seen in the central region of the cavity.

Baker said a means has been devised to overcome the ion locking problem in the B-1 test cavity. This is accomplished with the system diagrammed in Figure 1.

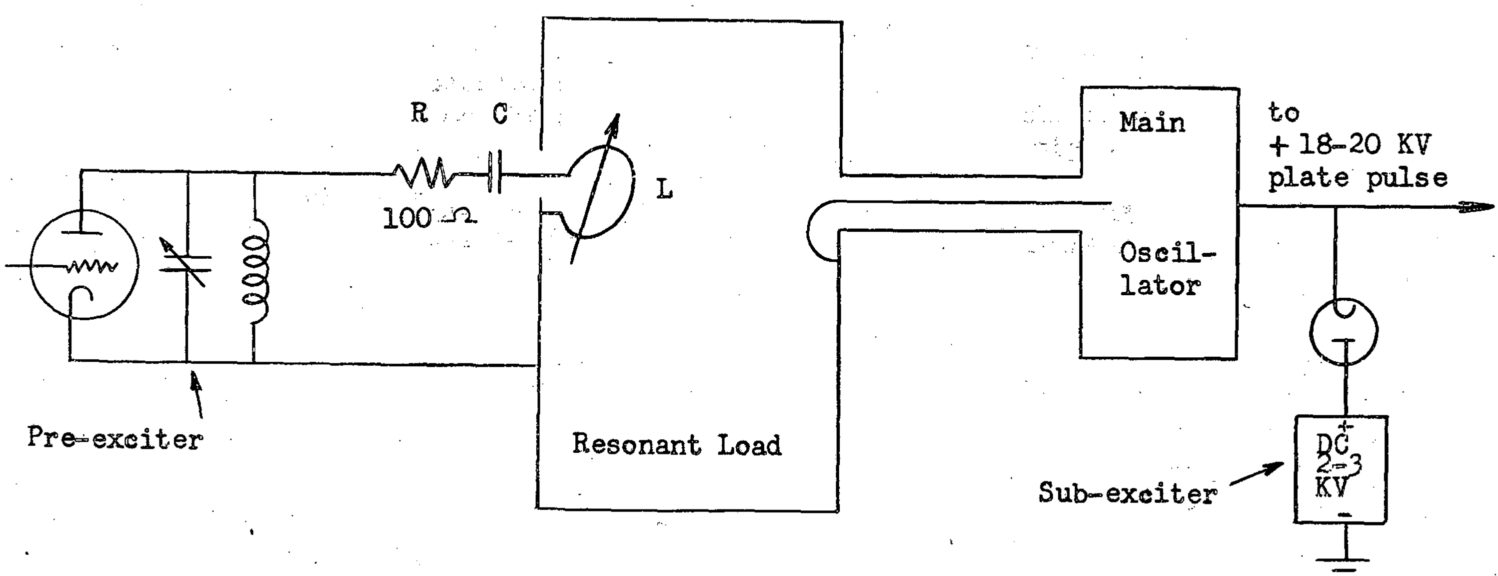

Figure 1

The pre-exciter is an ordinary Hartley type self-excited oscillator that will come up to full power in 1-2 microseconds after a voltage pulse is applied to the plate. This oscillator will work into a load of about 100 ohms. The capacity of the condenser C is chosen so that at the resonant frequency of the load $X_C = X_L$ where X_L is the inductive reactance due to the coupling loop. Under this condition the pre-exciter is feeding into a pure resistive load. There will thus be no net reactance reflected back to the pre-exciter and consequently there will be no tendency for the oscillator frequency to shift. If the frequency of the pre-exciter is adjusted to resonant frequency of the cavity as much as 100 amps of RF current can be supplied through the resistance to the coupling loop. With the appearance of a back emf at the coupling loop the oscillator and cavity lock together and the power buildup becomes very rapid. Breaking through the ion locking region requires a minimum build up time of 100 microseconds. Ion locking occurs at 150 KV on the sphere of the resonant load at a pressure of 0.05 μ amps. Once sufficient RF voltage appears in the load operation can be maintained by the main oscillator provided the voltage gradient in the load is not permitted to fall below the value at which ion locking occurs. This is prevented by the sub-exciter which maintains a minimum voltage of 2-3 KV on the plate of the main oscillator. With the above arrangement the pre-exciter will be required only after complete loss of voltage in the cavity such as will accompany sparking.

The pre-exciter has a coupling loop, the area of which can be varied up to a maximum of about three square feet. A loop of large area is used in order to supply the pre-exciter with sufficient "leverage" to break through the ion locking region. If this large loop remains in the tank after pre-excitation has been achieved one will have either to insulate against the high voltage (ca 100 KV) induced in the loop by the full intensity E-M field in the cavity or to provide for means of shorting out the intense currents induced in the loop if it is shorted out.

Panofsky suggested using a TR box to short out the coupling loop and thus eliminate the necessity of providing for removal of the loop after pre-excitation, which would otherwise be required since insulation of the pre-exciter from the induced voltage of about 100 KV is not practical.

The next limitation on the power level for the B-1 cavity will be the X-ray intensity. It is not known how severe the X-ray problem will be, but at the present voltage of 1,000,000 volts in the cavity the X-ray level is rather high. The X-ray production may largely be due to the presence of dust in the cavity since prolonged operation, especially sparking, appears to noticeably reduce the X-ray level of the cavity.

Longacre said the electron model of Mark I has been running well. In order to overcome multipactoring they have been using extra bias on the dirft tubes and higher current in the focusing magnets than is required to model the operation of Mark I. The phase acceptance angle under these conditions is greater than 180°, due to the bias present on the first drift tube which effectively produces a DC lens in the first gap. This shows that one can achieve rf acceleration with a large phase acceptance angle and obtain a monoenergetic beam of very small diameter. Extrapolation of this beam to full-scale gives a 5-inch diameter at half intensity at a distance of 20 feet from the end of the accelerator. These figures are somewhat qualitative since present operation is not under scaled conditions. Panofsky said that placing of electrodes around the midpoints of the gaps to eliminate multipactoring would probably do no good since the diameter of the drift tubes is large compared to the gap spacing so that there would be little field penetration into the gap where the multipactoring occurs. The focusing magnets are now being run at 4 times their rated current.

Sewell said that on the electron model of the cyclotron they can accelerate to 70 Kev which models the relativistic behavior of deuterons up to an energy of 250 Mev and that they are now interested in determining the maximum currents that can be obtained. It has therefore been proposed to convert the XC magnet to a Thomas-type cyclotron for proton acceleration. Protons have been chosen rather than deuterons since they can be accelerated with this small machine to a higher beta and it is the beta which determines the contour of the pole faces. When converted, the XC cyclotron is expected to give protons between 20 and 30 Mev which corresponds to a beta of about 0.2. This proton cyclotron will be required for accurate determination of heavy particle beam currents attainable since this information cannot be obtained from an electron-accelerating model. The machine will be pulsed in order to minimize the radiation hazard and to reduce the requirements for the power supply. Due to the odd shape of the pole base of the XC magnet considerable shimming of the magnet faces will be required. The "hills" of the pole faces will be built up of quarter-inch and half-inch steel plates. It is hoped to have this cyclotron in operation in April 1951.

Hansen said that 11 of the support rings are in place at Livermore. The 12th is being assembled on the ground. The 14th ring has been returned to the shop due to a poor welding job. The steel erection is about 35% complete. The east-west tunnel on the south side of the building has its slab poured and the side walls and top are being poured this week. The building steel has been shipped from Los Angeles and it is hoped that erection of this steel can begin the first of next week. Thomas and Rosendahl have the pipe fabrication well along. They will probably start assembling the cavity about the 15th of December. The foundation slab for the power supply building will be poured today. The contract with Oscar Krenz for fabrication of the liner has been pretty well worked out. They are now working with Oscar Krenz to suggest methods of doing the work and assisting them in a search for more shop area either in Livermore or some place in Berkeley. A determination of where this work can be done depends upon final methods chosen for fabrication. There are some furnaces available in Berkeley but they may not be large enough to accommodate a full liner section so as to allow a simultaneous soldering of the full compliment of the cooling tubes to each section. They are working on the idea of a chain torch to solder all the tubes in one pass. Bids have been received on the transmission lines. Berkeley Steel Construction Company is the low bidder, with a bid of about $60,000. Since they are not well pleased with some of this company's past work they will have to utilize a rigid inspection system if this contractor is chosen. The contract has been let for the

7-foot shielding blocks. Hildebrand said that CR&D and UCRL have decided on the specifications for the L-1 test cavity oscillator power supply. It will supply 34 kilovolts at 15 megawatts at a pulse rate of 4 per second. It will be capable of testing tubes at plate voltages up to 34 kilovolts. Hildebrand said that the bidding date for the injector power supply for Livermore had to be extended about 10 days due to delays in mail delivery in the east due to recent severe storms in that area. These bids are now due in on December 11.

Panofsky said that the wide aperture calculations look rather good. A model test has been conducted of the first 4 drift tubes of Mark I using an input area increased by a factor of $3\frac{1}{2}$. Calculations of trajectories using these larger apertures is now beginning.

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