

at an improper phase, so the output current is thereby decreased.) A program to develop an energy stabilizing circuit has therefore been undertaken. The "error signal" is generated by the proton bunches, when they pass through a "catcher cavity" near the input end of the accelerator. One merely measures the phase of the r.f. in the catcher cavity relative to that in the accelerator. The energy stabilizer returns the phase difference to zero.

The second improvement is the use of electrostatic strong focusing lenses of the Christofilos-Brookhaven⁽¹⁴⁾ type. A quadrupole electrode system has been installed in each drift tube and when it is used, the grids are removed. Under these conditions, the external average beam has been increased to $1/2 \mu$ amp. If the focusing voltage could be raised to its designed value, the current would have been about 1μ amp. The increase in current with focusing voltage comes from the larger phase angle at which the defocusing forces are counter balanced by the electrostatic focusing forces. Unfortunately, sparking in the lenses limited the voltage to the lower value. Deterioration of the cables has forced us to abandon the strong focusing feature, and return to grids, but it is clear that the difficulties would not have occurred if the machine had been designed for strong focusing at the start. It is surprising that enough space was available inside the drift tubes to make the test as successful as it was.

IX. ACKNOWLEDGMENTS

The design and construction of the linear accelerator was in every sense a cooperative affair, and contributions from a large number of men are involved. The list of authors of this article has been arbitrarily restricted to those who had the responsibility for the major design features, and who were members of the group for the period of two years during which the most intensive work was done. (The first 32 Mev beam was observed less than two years after the decision to build the machine, and another six months elapsed before reasonably steady operation was reached. At the moment, the beam is used on the average of 12 hours