PHASE CHARACTERISTICS OF ACCELERATOR GUIDE WITH THE COUPLERS

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In a multiple-feed electron linear accelerator, a series of separately fed accelerator guides is usually phased by adjusting the phase-shifters placed on the input waveguides of the accelerator guides.

However, for very long accelerator, it may be impractical to use a number of the high power adjustable phase-shifters because of the economical reasons and of the complication of machine operation. The P.F. injector linac consists of 40 accelerator units, and the unit consists of one klystron and 4 accelerator guides.

In order to abbreviate high power phase-shifters, it is required to fabricate the 4 wave guide-accelerator guide assemblies in correct phase length. In the waveguide-accelerator guide assemblies, the most of the phase errors arise from imperfect tuning of the waveguide-accelerator guide couplers. Thus it is necessary to match the impedance and tune the phase at the same time for each of the accelerator couplers. The tolerable phase error and V.S.W.R. of each assembly are less than ±2° and 1.10 respectively. To fabricate a number of the assemblies having such the tolerance without hand finishing, high precision machining of the couplers is required.

As the coupler a door-knob type shown in Fig.1 is chosen, because it does not deflect the beam and is easy in mechanical adjustment.

Adjustment is performed by varying the following three parameters; (1) height of the door-knob coupler (h), (2) position of the short plunger (ℓ), and (3) hole diameter of the coupler disk (2a). Of the three parameters h and ℓ are mainly effective for phasing of the coupler, and 2a is dominant for impedance matching and coupling. Adjusting procedure is as follows; (1) rough adjustment is made by means of "Pulsed RF method", (2) fine adjustment is made by means of "Nodal Shift method". For 2/3 π mode, the phase shift of 120° per cavity is required not only for each cavity of the accelerator guide, but also for coupler cavities.

Consequently, it is necessary to find out the suitable combination of h,ℓ, and 2a of the couplers in order to obtain the correct matching and 120° phase shift at the same time. In a door-knob type coupler, the requirement for various size cavities is able to obtain by adjustment of three paraemeters. Fig.2 shows phase shift per cavity as detune cavities from coupler cavity to the successive accelerator cavities. Fig.3 shows the measured frequency dependence of the V.S.W.R. of the coupler. The coupler have a V.S.W.R. of about 1.04 at operating frequency (2856 MHz).

Reference

1) G.A. Loew et al., "The Stanford Two-Mile Accelerator", Ch.6, Edited by R.B. Neal, W.A. Benjamin, Inc. 1968.

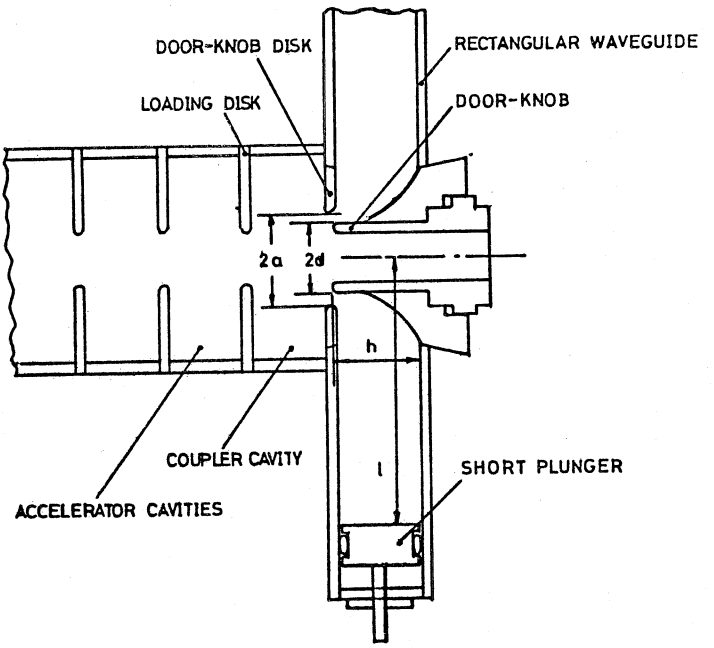

FIG.1 CROSS-SECTIONAL VIEW OF JUCTION BETWEEN RECTANGULAR WAVEGUIDE AND THE PERIODIC STRUCTURE.

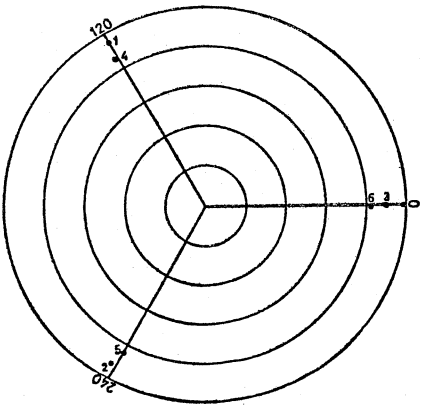

FIG.2 NODAL SHIFT PLOT..

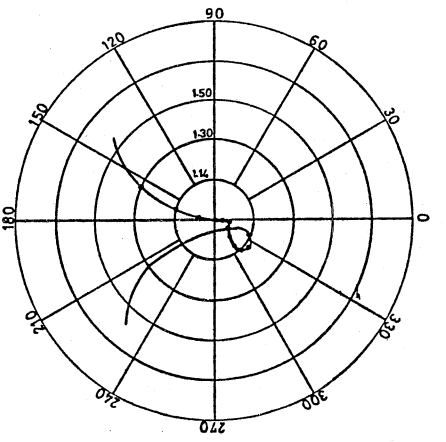

FIG. 3 THE FREQUENCY DEPENDENCE OF COPLERS.