STATUS REPORT OF THE EREVAN ELECTRON SYNCHROTRON

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General description of the 6 Gev Erevan Electron Synchrotron and its main parameters were given in Article 1. The accomplishment of the main accelerator parts was fulfilled in May 1967 and the complex setting in motion works started.

Up to now the ring magnet circuit set right for 1300 amps DC and 1360 amps AC what corresponds to the nominal accelerator energy. The proper circuit frequency was chosen to be 48.3 cps to diminish current amplitude pulsations due to difference with the net frequency. Besides that a special capacity filter was used for the same aim and the ignitron rectifier voltage stabilization was achieved with accuracy $\pm$ 0.02%.

According to the measurements the circuit current amplitude pulsations do not exceed 0.05% for net frequency change within the limits 49-51 cps.

The curve shape stabilization of the magnet current is provided by maintaining the DC value with the accuracy $\pm$ 0.02% and the duration of negative current with the accuracy not worse than $\pm$ 1% for 10 hours' work of the system. The electromagnet sectors which have rms struggling of the field values 0.08% and of the gradient values 0.12% (for half-sectors) at the injection field level 66 gauss put into design positions with rms deviations from most probably circumference of the order 200μ. The expected distortion of the orbit makes for this condition $\pm$ 3.5 mm.

The linear accelerator provides 200 mamps electron current with pulse duration 1.1 sec. The energy spectrum measurements at the linac output show that 40% of the whole current gets inside $\pm$ 0.5% interval. The beam dimensions at the linac output are equal to 4 x 6 mm^2 at half-height level with 1.5 mrad angular divergence.

The fourlens system provides the beam focusing in the 10 mm spot at the vacuum chamber input. About 80% of the electron current reaches the pulsed inflector. The beam of electrons on the injection path when going through the fringing field of the magnet experienced an additional focusing. This effect is corrected by magnet deflector shims according to measurements of the fringing fields along the injected beam trajectory.

The high-frequency system provides the peak power 520 kw sufficient for acceleration up to 6 Gev by using two parallel transmitters. The two transmitters' power addition and its delivery to 24 accelerating cavities is fulfilled by the special coaxial wave-guide system with no essential losses. The high-frequency field amplitudes for different cavities differ from mean value not more than $\pm$ 20%. The phase differences between the cavities are not more than $\pm$ 5%.

The coaxial wave-guide system structure makes the separate cavities uncoupled.

The reflected power for the cavities out of tune is dissipated in the special ballast resistances and does not disturb the regimes of the transmitters and other cavities. There is a mechanism for automatic tuning of the cavity proper frequency in the range 10 kcps by using the ratio between direct and reflected power.

The cavities' cooling is fulfilled by the water at a temperature of 35 $\pm$ 1°C.

The main difficulty in putting the accelerating system into operation was the resonance discharge arising at the loop as well as between the drift tubes at the excitation level of the order of several watts. A rise in the resonance discharge was prevented by taking the loop out of the vacuum volume and with the help of a disk on which the constant voltage + 10 kv is given and which is placed in the cavity neutral plane.

The one-turn aircore monitors are used for beam control[2]. There are 22 r-and-z-position monitors and 7 intensity monitors in the ring. The positon monitors' sensitivity equals 8-25 v/mm. mamps depending on their longitudinal length. The intensity monitors' sensitivity equals accordingly 0.4-2 mv/mamps. The monitors' signal is amplified by a preamplifier with the factor 1800 used for the first several turns indication as well as for beam indication on the injection path.

The resonance amplifier with the factor 1500 is used for the circulated beam control. The system allows the beam position to be measured with the accuracy 10% $\pm$ 1 mm for the circulated beam current 1 mamp or for single pulsed current 10 mamps.

The vacuum system with titanium and turbomolecular pumps provides at present the pressure $2\text{-}6 \cdot 10^{-6}$ torr for different parts of the ring. Although there was no radiation damage to the chambers during the first experiments with the beam, at the present time the ceramic chamber is manufactured. The existing model of the chamber is the stainless steel laminated tube vacuum sealed by epoxy resin with fiberglass. Because the choke's oil cooling system has not been finished, it has been decided to carry out tuning work in a 30% regime of AC without DC. For that regime the derivative of the magnetic field injection corresponds to the nominal value.

The first beam turn was obtained in June 1967. The preliminary tuning of the electronic-optical devices of the injection path and of the orbit correction system permitted to obtain at the end of the first turn a beam current of the order of 20 ma.

After choosing the initial conditions (injection field,

deflector current, inflector voltage) 6 turns betatron regime was obtained, which corresponds completely to the width of the magnetic field's useful region. To obtain the betatron regime it has been required to introduce a correction of the orbit radial position by means of 24 pairs of "beam-bump" type windings as well as a correction of the 5th harmonic of the median plane.

On July 30 the acceleration of electrons up to energy of 1 Gev was achieved. Then by increasing step by step the AC in the electromagnet up to 700 a and the DC up to 450 a there has been achieved an energy 2.7 Gev for circulating beam current about 4 mamps. The acceleration has been carried out at constant amplitude of the cavity voltage during the whole cycle. It has been found necessary to increase the gradient in the focusing (F) sectors of the magnet blocks up to 4% with the help of the pole windings.

At present preparatory works are being carried out to increase the energy and the intensity of the accelerated beam as well as to eject the beams from the accelerator.

REFERENCES

[1] "International Conference on Accelerators," Moscow, Atomizdat, 1963, p. 285

[2] Proceedings of this Conference, M-3.

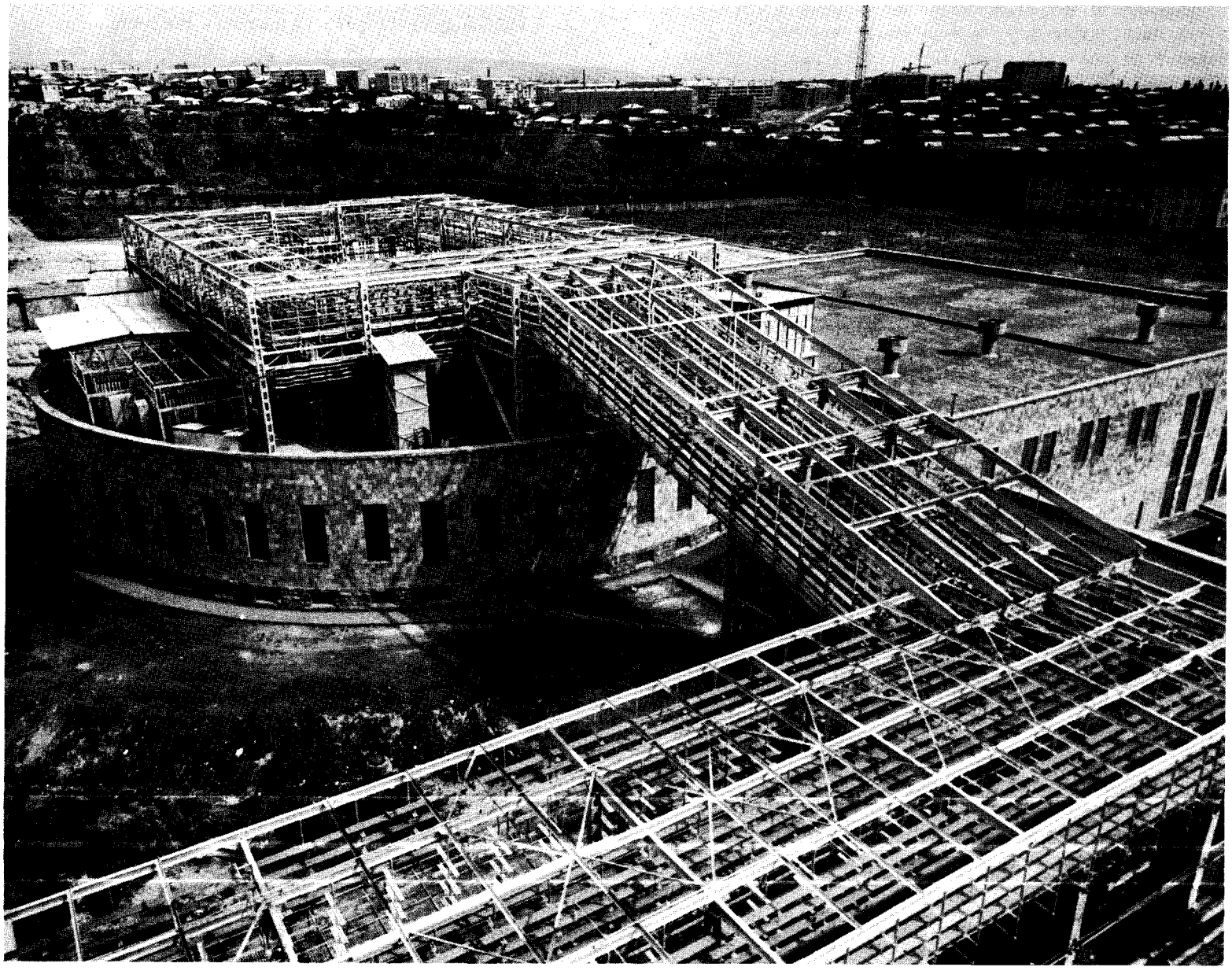

Fig. 1 Airview of the Erevan synchrotron main building.

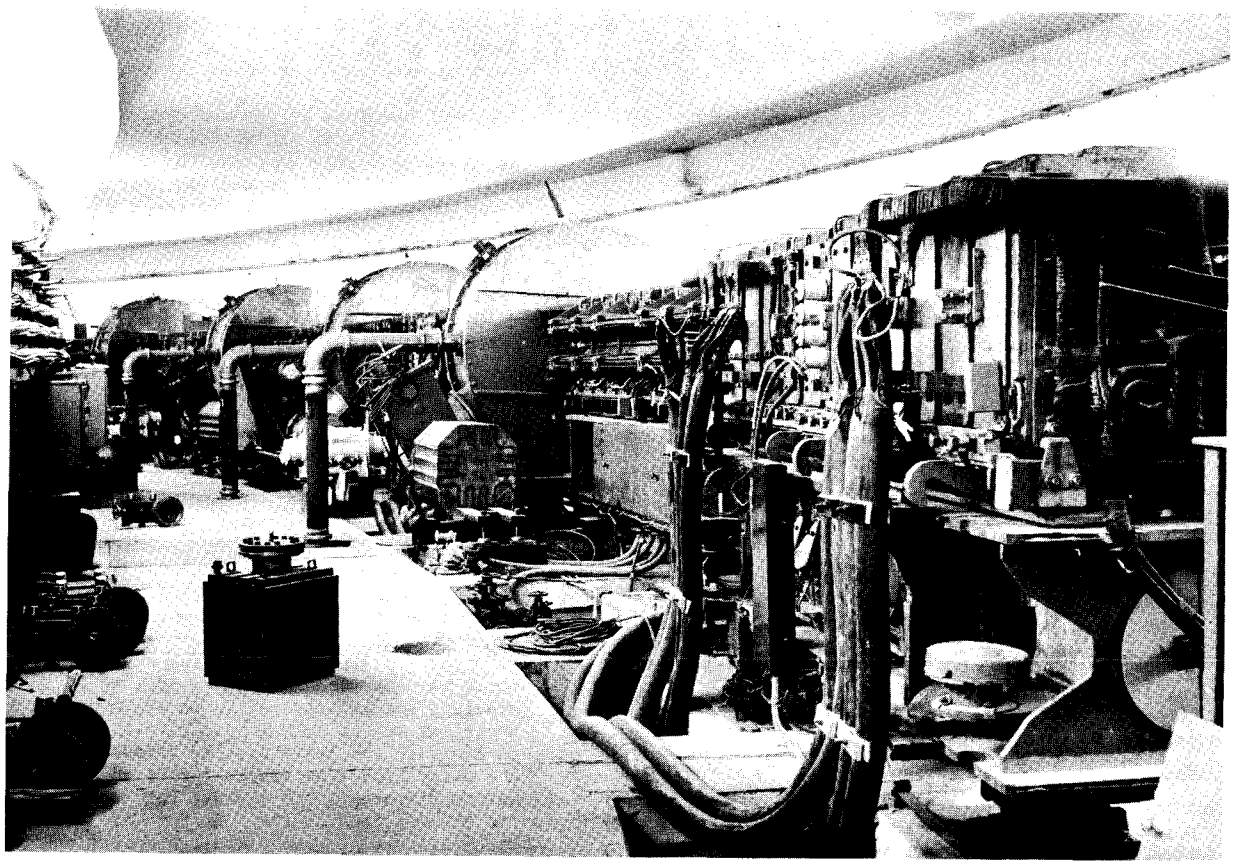

Fig. 2 Ring tunnel.

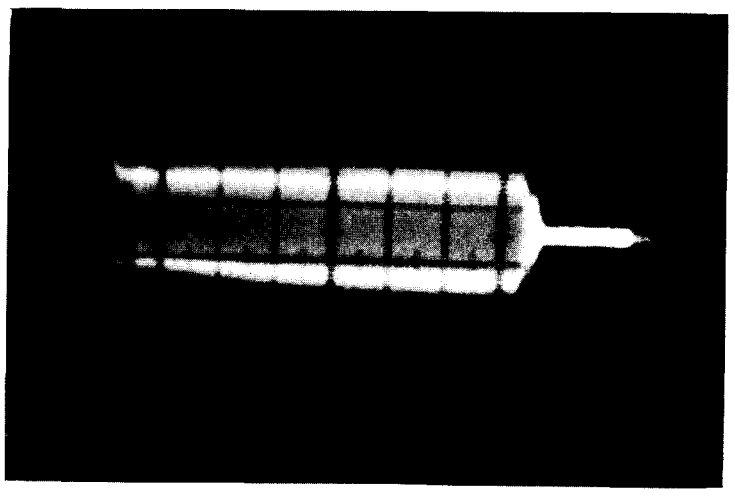

Fig. 3 The accelerated beam.
(Energy 2.7 Bev. Circulating current 5 mamps.
Time interval 7.5 msec.)