THE MULTIBEAM LINEAR ION ACCELERATOR: CALCULATION AND EXPERIMENT

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The accelerating structure consisting of cylindrical screen with electrodes of coil types radialy disposed, which the current-conductive annuluses with tubes of driftage disposed azimuth of annulus are attached has been suggested. By way computer simulation were received the base-frequency of structure, shunt-impedance, distribution of field in the accelerating gaps. The experimental researched of frequencies generation coil in screen and field distribution functions were made.

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This linac is a continuation of high-current linear ion accelerator [1] based on a multibeam accelerating resonator.

The resonator comprises a cylindrical screen with end flanges. The screen comprises supporting elements as spiral holders connected with each other by potential electrodes with current-carrying rings so that drifting channels are arranged with regular intervals by azimuth. Thus, the system is performed as a double line which leads to inconveniences in operation: e.g. the presence of a long electrode results in non-uniform field distribution, and the need of fastening rings to a conductor causes a complication in coaxial adjustment of drift channels. The technical result consists in that in the offered structure high-frequency and constructive functions are separated: current-carrying rings installed on the external screen by means of ceramic holders that allows one to avoid a long potential electrode, thus relieving a non-uniform field and complicated adjustment.

In fig.1 the accelerating resonator with spiral electrodes is shown.

The accelerating resonator cavity comprises cylindrical screen 1 with end flanges 2, fixed with constructive elements 7, 8. Current conducting rings 3 with drift tubes 4 are arranged on them in regular intervals by azimuth on the above-said cavity mounted perpendicularly to the axial direction. Each ring is fixed on the external surface of the screen by means of ceramic rods 6. The supply of RF current to a surface of a ring is made by means of spiral electrode 5.

To analyze a similar structure we note the following: a spiral gives main contribution to the eigenfrequency of the resonator. Loading with current-conducting rings results only in capacitor reduction of the frequency which can be calculated in the approximation of a static field, i.e. as $(l/\lambda)=1$, where l is the geometrical period of the system, when the field in a gap considered to be static and analysis could be made by solving the Laplace equation. In Fig.2 shown are the potential distributions on radial and longitudinal cross-sections as an equipotential scheme, obtained by solving a static task. Fig.3 shows the calculated field distribution in the accelerating gap. Note, that in case of spiral electrodes, the current-conducting rings actually have a common potential and uniform field distribution in the gap that conforms to experimental results. In case of accelerator working on mode H_{211} the field distribution along the axis is observed to be non-uniform.

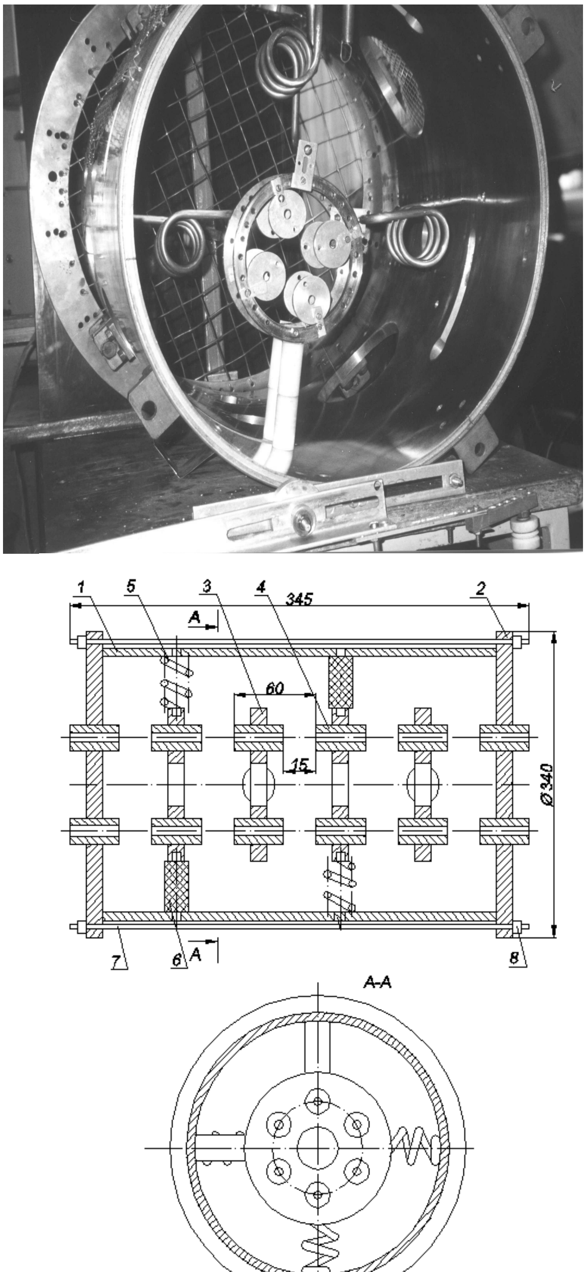
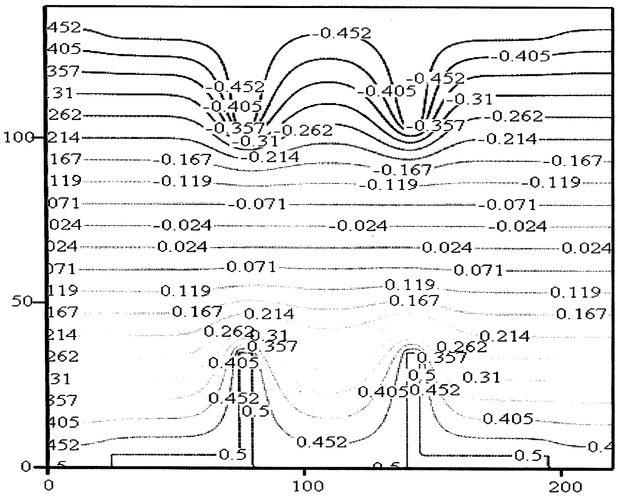


Fig.1. Accelerating resonator with spiral electrodes



r, mm

Fig. 2. The equipotential scheme of a static task

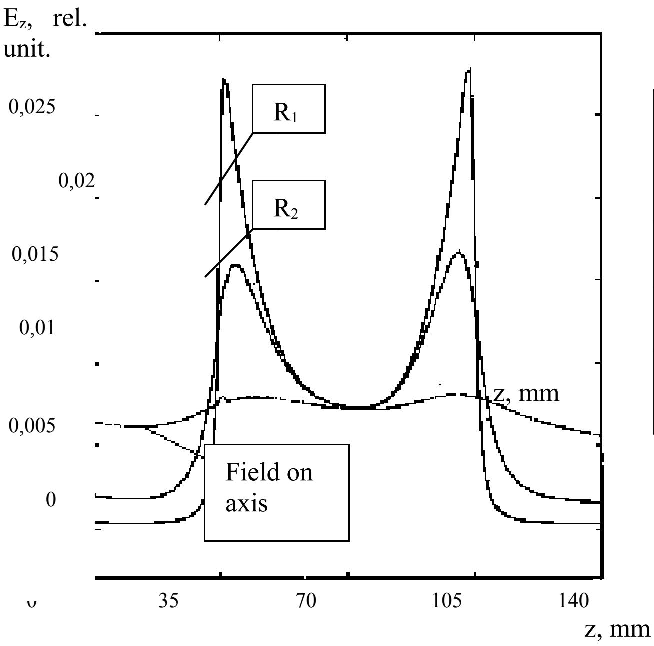


Fig. 3. Field distribution along the axis z (R_1>R_2)

To examine the system the model of resonator which was loaded with four spiral electrodes and current-conducting rings was made. The number of drift channels in each ring was equaled to four. At the first stage of experiment the following problems were set:

1 - examine the influence of spiral electrodes with each other (for this purpose the resonator was sequentially loaded with one, two, three and four spirals and a frequency shift was analyzed);

2 - determine the resonance frequency of a structure loaded with drift tubes .

The proper value of the wave number was investigated on three various spirals and comparison with the values obtained according to the methods of [2] were made. Values are given in table.

№	Diameter of a spiral, cm	Radius of a coil of a spiral, cm	Length of a spiral, cm	Operating wavelength, m	The error, %
1	5	0.5	7.5	$\lambda_{calc.}$= 5.25 $\lambda_{exper.}$=5.42	3
2	5	0.5	6	$\lambda_{calc.}$= 4.73 $\lambda_{exper.}$=4.92	3.8
3	5	0.5	11	$\lambda_{calc.}$= 7.63 $\lambda_{exper.}$=7.89	4

Loading simultaneously with several spirals has showed an insignificant change of a working frequency that allows one to draw a conclusion on equality of the frequencies of a spiral and a resonator.

Accelerating cell was simulated for the first variant. A gap capacity was defined according to the solution of the Laplace equation said above. Experimental value of the working frequency was determined: f_{exper}=33.14 MHz (λ_{exper}=9 m). The calculated value of the wavelength was $\lambda_{calc.}$=8.46 m. Thus, it is possible to conclude that the offered structure allows one to make a step in development of small-sized industrial accelerators.

REFERENCES

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СИЛЬНОТОЧНЫЙ ЛИНЕЙНЫЙ УСКОРИТЕЛЬ ИОНОВ: РАСЧЕТ И ЭКСПЕРИМЕНТ

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Предлагается ускоряющая структура, состоящая из цилиндрического экрана с радиально расположенными электродами спирального типа, к которым крепятся токопроводящие кольца с трубками дрейфа, расположенными по азимуту кольца. Путем численного моделирования были получены рабочая частота, шунтовой импеданс, распределение поля в ускоряющих зазорах. Проведены экспериментальные

исследования частот возбуждения спирали в экране и распределения поля.

ПОТУЖНОСТРУМОВИЙ ЛІНІЙНИЙ ПРИСКОРЮВАЧ ІОНІВ: РОЗРАХУНОК І ЕКСПЕРИМЕНТ

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Пропонується прискорююча структура, що складається з циліндричного екрану з радіально розташованими електродами спірального типу, до яких кріпляться струмопровідні кільця з трубками дрейфу, розташованими по азимуту кільця. Шляхом чисельного моделювання були отримані робоча частота, шунтовий імпеданс, розподіл полів в прискорюючих зазорах. Проведено експериментальні дослідження частот збудження спіралі в екрані і розподілу полів.