EXPERIMENTAL STUDY OF ACCELERATING FIELD DISTRIBUTION OPTIMIZATION IN THE H-STRUCTURE WITH COMB HOLDERS

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We have suggested to perform the tuning the structure accelerating field distribution at the wave similar to H, by changing the inductivity of the holder of a single drift tube. Changing the angle of bend of the adjacent drift tube holders along different sides relatively to the comb holder plane allows one to increase and decrease the field amplitude in the gap between them. The value R_{ch} ≈90 MOhm/m has been obtained for the structure under consideration that is higher than that obtained by known methods of tuning.

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In low-energy proton accelerators the accelerating structures are a cylindrical cavity loaded with pairs of comb holders with drift tubes fastened on them are used. In the structure the H_{11n} wave is excited, where *n* equals to the number of field variations along the cavity axis. Usually, the H_{111} mode is used if the magnetic flow is total for all the pairs of comb holders. It is possible to use other modes, in which *n* equals to the number of pairs of holders. For H-structures there are different methods of tuning permitting to obtain the uniform accelerating field distribution along the flight channel [1,2]. However, it results in the considerable decrease of the shunt resistance of a structure. The initial value of the shunt resistance for the structure with the sinusoidal field distribution along the structure channel is ≈ 140 MOhm·m^{-1}. The shunt resistance value decreases up to 30...40 MOhm·m^{-1} after tuning due to the increase of reference high-frequency power losses at structure surfaces and to the increase of the volumetric charge between face surfaces of drift tubes, the value of the shunt resistance decreases to 30...40 MOhm·m^{-1}.

It is possible to decrease considerably high frequency losses if tuning is made by varying the holder inductivity of each separate drift tube and simultaneously to change its connection over the magnetic field with the adjacent drift tube holders. Then after defining the holder position during tuning the free arc end is removed.

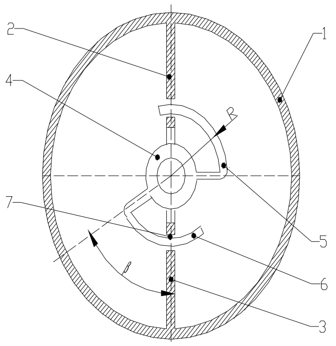

Fig.1 Cross section of the accelerating H-structure:
1 – cylindrical cavity body; 2, 3 – plates of counter comb holders; 4 – drift tubes; 5, 6 – holders of single drift tubes with the changing angle of bend β

Fig.1 shows the cross section of an accelerating structure. Plates of counter comb holders 2 and 3 with drift tubes 3 fastened on them are placed, on opposite walls of a cylindrical body of the cavity 1. Holders 5 and 6 of separate drift tubes are made in the form of the straight cylindrical support fastened perpendicularly to the external cylindrical drift tube surface, and that is the extension of the arc of radius R. The second end of the arc is fastened to the support plate of the comb holder with the possibility of moving so, that it is possible to change the angle of bend β of the support. It is neces-

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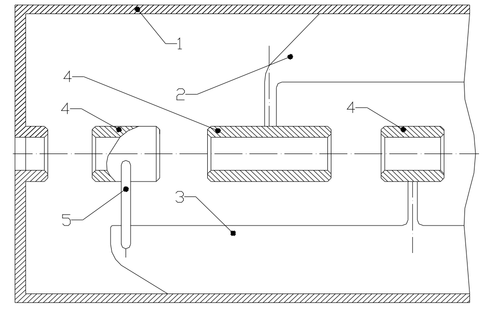
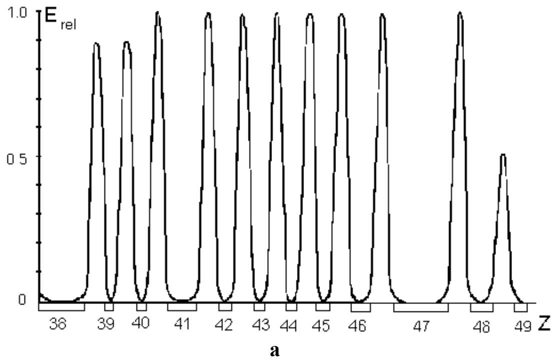


tubes will be changed. It gives the possibility to increase or decrease the electric field amplitude in clearances on both sides of drift tubes. In particular, we observe it at last accelerating intervals of the structure shown in Fig.2, where the drift tube 4 is placed on the holder 5 with the possibility of turning relatively to the structure axis.

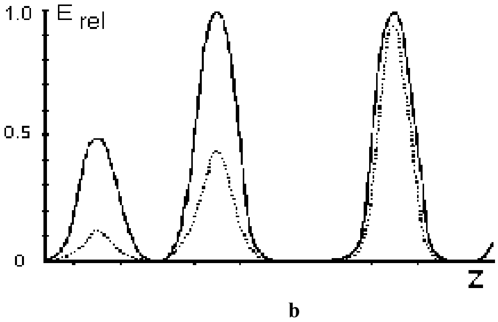
Fig.2,b shows the electric field amplitude distribution in the channel of flight between drift tubes at ends of comb holders before tuning (dotted curve) and after tuning of the holder 5 at the angle β=8 (solid curve). The field amplitude varies insignificantly about 25% in the next clearance.

Our studies have been carried out on the accelerating structure model presenting the copper cylindrical cavity of 968 mm long and 160 mm in diameter loaded by three pairs of holders with 47 drift tubes and two half tubes placed on the bottoms of the cavity. The drift tube location along the cavity axis, their lengths, the diameter of the flight hole and the external diameter have been determined by calculations of dynamics of accelerating particles with alternative phase focusing [3].

The preliminary tuning of the electric field distribution along the flight channel has been done by means of selection of the length and slopes of comb holders. The operating frequency of the cavity equals to 264.5 MHz.



a



b

Fig.2. Longitudinal cross-section of an output part of the accelerating H-structure model: 1 – cylindrical cavity body (a); 2, 3 – support plates of counter comb holders;
4 – drift tubes; 5 – holders of drift tube with the possibility to turn around the structure axis; Relative electrical field distribution between drift tubes before tuning – dotted curve and after tuning – solid curve (b)

Fig.3. Field distribution along the flight channel formed by drift tubes of the third pairs of comb holders after varying the angle of bend of single drift tube holders 39, 40, 43, 45, 46 and 48

The initial shunt resistance of the structure with the sinusoidal field distribution along the cavity length is 143 MOhm·m^{-1}. The further tuning has been carried out by changing the field amplitude in clearances between the separate drift tubes.

The field distribution along the flight channel formed by drift tubes placed on the third pair of comb holders is shown in Fig.3. The value of accelerating intervals between drift tubes in this part of a structure is constant and equals to 7.6 mm. The external diameter of tubes is 30 mm, the internal one is 14 mm. For the 38-th, 39-th and 40-th tubes the external diameter is 27 mm, and the internal one is 11 mm. The diameter of supports is 5 mm. The angles of bend of supports of tubes are for the 39-th (+48°), 42-th – (+40°), 43-d –(–15°), 45-th – (+30°), 46-th – (–45°), 48-th – (+80°). The field in clearances between 38-th, 39-th and 40-th tubes is 0.9·E_{max}, that has been given by the calculations of dynamics of particles. The shunt resistance of a structure is ≈90 MOm·m^{-1}, that is higher than that for earlier methods of tuning.

Thus, varying the inductivity of supports of single drift tubes it is possible to optimize the electric field distribution in clearances along the flight channel of an accelerating structure for the H-wave and to obtain the shunt resistance higher than that for other known methods of tuning. The method of tuning proposed here is simple and effective one.

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ЭКСПЕРИМЕНТАЛЬНОЕ ИЗУЧЕНИЕ ОПТИМИЗАЦИИ РАСПРЕДЕЛЕНИЯ УСКОРЯЮЩЕГО ПОЛЯ В *H*-СТРУКТУРЕ С ГРЕБЕНЧАТЫМИ ДЕРЖАТЕЛЯМИ

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Предлагается проводить настройку распределения ускоряющего поля структуры на волне, аналогичной *H,* изменением индуктивности держателя одиночной трубки дрейфа. Изменение угла поворота держателей соседних трубок дрейфа в разные стороны относительно плоскости гребенчатого держателя дает возможность как увеличивать, так и уменьшать амплиту-

ду поля в зазоре между ними. Для рассматриваемых структур получено значение $R_ш$ ≈90 МОм·м$^{-1}$, что больше, чем при известных методах настройки.

ЕКСПЕРИМЕНТАЛЬНЕ ВИВЧЕННЯ ОПТИМІЗАЦІЇ РОЗПОДІЛУ ПРИСКОРЮЮЧОГО ПОЛЯ В *H*-СТРУКТУРІ З ГРЕБІНЧАСТИМИ УТРИМУВАЧАМИ

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Пропонується проводити настройку розподілу прискорюючого поля структури на хвилі, аналогічній *H*, зміною індуктивності утримувача одиночної трубки дрейфу. Зміна кута повороту утримувачів сусідніх трубок дрейфу в різні боки щодо площини гребінчастого утримувача дає можливість як збільшувати, так і зменшувати амплітуду поля в зазорі між ними. Для структур, що розглядаються, отримано значення *Rш* ≈ 90 МОм·м$^{-1}$, що більш, ніж при відомих методах настройки.

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