POLYCYLINDRICAL RESONATORS IN THE ACCELERATING TECHNIQUE

F.A.Vodopianov

Moscow Radiotechnical Institute, Russia Academy of Sciences
Warshawskoe shosse, 132, Moscow

Abstract

An expedience of accelerating devices fulfilment in a polycylindrical form is considered. In n-cylinder resonator the tuning frequency is in n-times smaller of a usual coaxial resonator selffrequency. It can possible to use this property at construction of a smaller q accelerators. But more important maybe a possibility to construct a much smaller length accelerating arrangements at the same frequencies. Loaded by ferromagnetic or high ε materials polycylindrical resonators accumulate very hign electrical energy at a quasiconstant voltage and can accelerate a very large particles current during a large pulse duration.

in a design of the modern many-kilometer length arrangements.

The allocated in the special speces of ring accelerators polycylindrical resonators have not a limit in radial dimensions and therefore accelerating part can be fulfiled with a very short length. Besides the polycylinder resonators can be fulfiled in this case with the tuning of cylinder cavities on mead partially frequencies of whole frequency diapason. In this form the resonators achieve a high impedance in wide frequency band without dinamic detuning. The ferrite loading of tuned cavities can be useful as the means of the quality factor and inductive impedance enlargement.

The illustrative construction

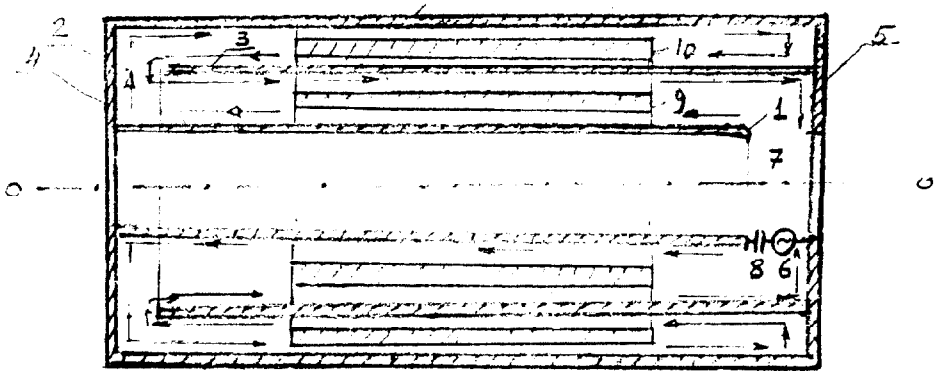

Fig. 1. An illustrative construction of a polycylindrical resonator

The Fig. 1. represents a two-cylinder resonator. The transition to n-cylindrical resonator can achieve by adding the singly connected to discs 4 and 5, n-1 cylinders. The power source 6 can be connected directly to gap 7, to a break between a tube 2 and one of the discs 4 or 5, to a primary loop one of the cores or to an exiting rod.

Polycylindrical resonators in the resonant accelerators

The polycylindrical resonators appliance in the linear accelerators gives a possibility to using a low-frequency high-power tubes or to fulfil an accelerator much smaller length. The last possibility seems important

Polycylindrical resonators for the forming of a quasiconstant accelerating voltage

Only due to skineffect the current of a source 6 on Fig. 1 flows throughout marked by arrows long way. This way exists to a moment when an electric field penetrates the cylinders walls on a whole their thickness. After this will be open other ways, in particulas the way throughout a whole tube 1, discs 4 and 5 - way of short circuiting of a source 6 on a small active resistance of a tube 1. The time interval duration from the including moment of constant voltage to a short cirquit can possible to evaluate at a wall thickness Δ mm by $\tau \sim 10^{-2}(\Delta/6{,}7)^2$, as a half period at a skinlayer transparency. It is easily to check that short cirquting through a tube 1 is excluded at the usual values

of Δ and $\tau = 3 \cdot 10^{-9} n \sqrt{\mu \varepsilon}$ - the time of a pulse propagate along n parts of a coaxial line. At n = 100, l_{res} = 1 m and at small voltage $\tau \sim 10$ mcs in case $\mu = 1000$, $\varepsilon = 1$ and $\tau \sim 3$ mcs at $\mu = 1$ $\varepsilon = 81$. But at high voltages the limiting factor a core saturation leads to $\tau = S \cdot {}^{B}/Um = n \cdot \Delta r \cdot l_{res}/Um$, Δr is a core thickness at one part of the line Um - a gap voltage. For a maximum value ΔB realization from - Bm to + Bm at - constant Bm on a whole core thickness usually last is small at a large core radius. As a result is a large empty space around accelerating camera. In the polycylindrical resonator the core thickness is small and therefore even in the vicinity of camera the saturation along a radius is the same. This permits to make a resonator loaded by permalloy on a whole volume. It is the real gain we can obtain from an experiment or from an electronic calculation. But already now it is possible to predict the enlargement of τ or a length reducing in several times. A gradual polarisation process will have a place in a polycylindrical resonators with a high μ ferromarnetic as in high ε dielectric loading. In distinction from a ferromagnetic loading the dielectric one leads up to great a characteristic impedance lowering and to correspoding a current of feeding source loading. But a great accumulated energy gives a possibility to accelerate very large particles currents with a great durations. Therefore the dielectric loaded polycylindrical resonators can discover a new class of the future accelerators.

In the paper [1] the polycylindrical and polydisc resonators which have been made and tested at the Moscow Radiotechnical Institute (MRTI) of the Russia Academy of Sciences (RAS) are described.

1. V.M.Anishuk, A.A.Zavadzev, V.M.Pirojenko "Calculated characteristics of the polycylindrical and polydiscs resonators for an acceleration of the pulse electronic bunches" Collection of scientific papers of Radiotechnical Institute of the Russia Academy of Sciences, 1989.