MECHANICALLY TUNED ACCELERATING RESONATORS

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As an extenstion of the proposal [1] two types of mechanical variators of the accelerating gap capacity are considered. In the first of them the stationary plates placed on the end outer surface of the inner tube and the moving - inside of ring rotor of a reactive reductor type motor are placed. The rotor is installed in vacuum with the possibility to roll over inner surface of the outer tube with the stator on its outer surface. In the second variator the moving plates swing along the resonator axis direction in front of the inner tube and by means of the outer electromagnetic driver. The characteristics of the capacity variators in a HOM relationship are compared.

The some order current increase of the madern synchrophasotron in a comparison with the first such type accelerators current was achieved by means of the using boosters with a higher injecting energy and by means of increasing frequency following the accelerating cycles. The consequence of this means is an accelerating field frequency diapason narrowing, increasing of the accelerating voltage and a needed of accelerating stations power. The natural step to loss power decreaing is a discovery of the high quality factor resonators. One of such resonators with a wide range frequency tuning is the resonator with the UNF perpendicular magnetisation ferrite. Other method of the power loss decreasing is based on the using unloaded by ferrite mechanically tuned resonators [1]. The way to this suggestion open mentioned narrow frequency band of an accelerating voltage.

The mechanical change of resonator frequency can be achieved by two methods: by means of a resonator dimension changing and by means of a variator parameters changing. The first method found some practical realisation when only a small frequency variation was needed. The frequency variator connection is possible as in case of inside resonator placing [1] and in a case of outside placing by means of a connecting loop or rod type antenna. In [1] the innerresonator variator is descbed for the Triumph booster perameters having frequeency band 45+60 MGc and length 0,8 m. At the frequency 60 MGc in case D_0/D_1=2,71 the resonator selfcapacity is 25 pF. For decreasing frequency to 45 MGc the increasing capacity to ~ 60 pF is needed. This can be activied by means of rotating condenser (Fig. 1) or by means of vibrating one (Fig. 2) in both cases the resonator is coaxial type.

Roating plates 3 of conderser (Fig. 1) are fixed in ring ferrum withoutwinding rotor of a synchronous motor of a reactive reductor tupe. The rotor is inserted with a possibility of rolling on the bearing around inner side of outer tube. The plate 3'of large capacity serves for the sparking exluding. The stator with its winding is installed on an outer surfase of the external tube.

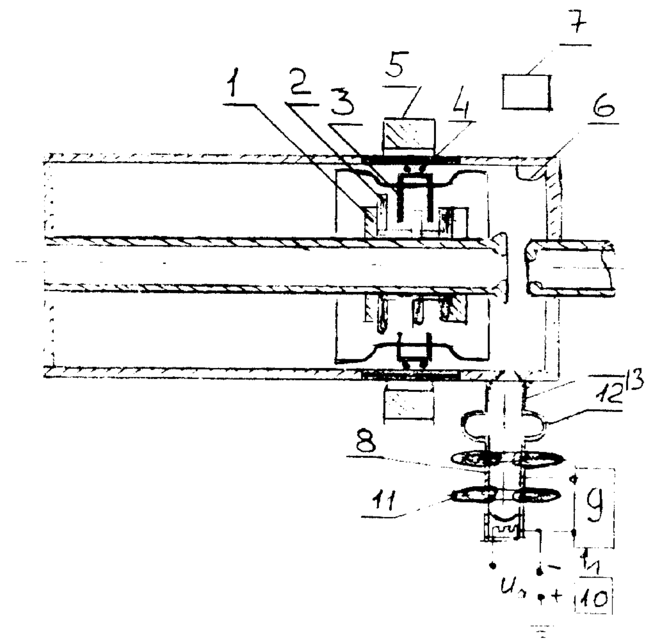

Fig. 1 Rotating condenser tuned resonator
1 - unmoved plates, 2 - isolators, 3 - rotating plates, 4 - rotor, 5 - stator, 6 - coupling loop, 7 - outer trimming device, 8 - electronic tube, 9 - HF modulator, 10 - HF source, 11 - accelerating tube, 12 - HF resonator, 13 - drift channel

The reactance 7, for examhle a small inductance with a ferrite core inserted by means of a loop 6, serves for an achievement of the rapid accurate tuning in the limits of of/f ~ ± 1% [1]. In this boundary can be included all the faults of the production and the installation of all resonators.

Universally adopted HF feeding of the resonator by an inserted into it power electron tube leeds to a symmetry distortion and to arising of the conditions of HOM oscillations. It seems to be expedient to suggest a new variant of HF feeding by means of electron beam gun with the bunched electron beam. Shown on Fig. 1 HF modulator 9, driven by an optical cable from grounded source 10, modulates an electron beam energy which transformed in density modulation of a beam during it transition through the accelerating tube 11, passive HF resonator 12 and drift channel 13.

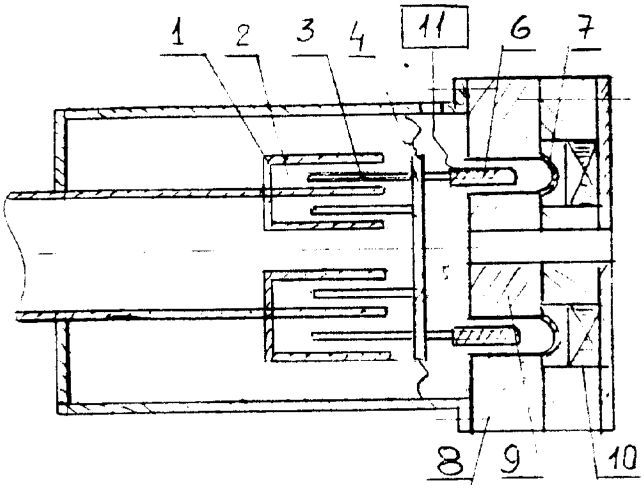

Fig. 2 Vibrating condenser tuned resonator
1 - unmoved plates, 2 - isolators, 3 - vibrating plates, 4 - elastic HF shorting ring, 5 - driving ring, 6 - single winding coil, 7 - vacuum joint, 8 - stell core, 9 - inner core, 10 - magnetisation coil, 11 - frequency disciminator signal amplifier

Shown in Fig. 2 variant has a stationary ring 2-3 plates stator 1, isolating rings 2, vibrating plates 3 fastened by means of a ring 4 on a forming HF volume elastic membrane 5. The ring vibrates together with the onewind coil of a like dynamic loudspeaker drive with a ferrum cores 8, 9 and a magnetization coil 10. The ring 6 is fed by current of the control amplitier 11. For a ficsation of the rings 6,4 axial position can be provided by installation 3 longitudinal setting small diameter plugs, sliding in the pits of the core 9 and on the resonator inner tube. Such system with the elastic membrane 5 is similar to logometer. The plates positioning is achieved by properly applied current to ring 6 from the initial frequency signal meter and amplitier.

This variant of condenser is more simple than the revolving plates condenser (Fig. 1). In addition there are less probability of parasitic HOM oscillations exitation, but the strong dynamic kicks lead to much shorter servise life. The absence of such kick in the Dubna phasotron frequency rotating variator has achieved its reliable work during approximately 25 years.

The innerresonator installation of the tuning condencers is reasonable in the casses of wide frequency bands. In a narrow frequency band case the involving by means of a loop or a rod of the outer reactances allows to solves the problem completely. It is very important to remark that in such cases the resonator can have a cilindrical form with much smaller length. The evaluations show possibility of gain with desxribed resonators in the cost and and HF power approximately to one order while in the driving power by several orders.

REFERENCES

[1] F.A. Vodopianov. Mechanically tuned accelerating resonators. - Particle Accelerators Conference. - Dubna, 1992.