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TRAVELLING WAVE TUBE INCLUDING TUNING SLIDE WITHIN ADJOINING WAVEGUIDE SECTION

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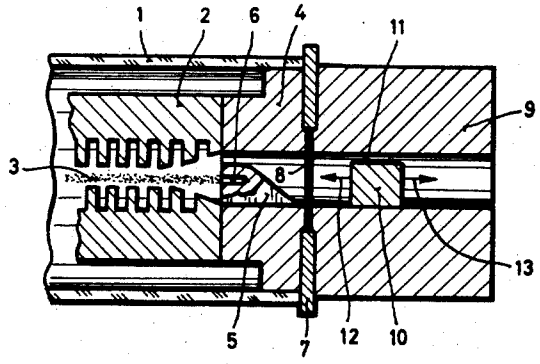

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TRAVELLING WAVE TUBE INCLUDING TUNING SLIDE WITHIN ADJOINING WAVE-GUIDE SECTION

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This invention is concerned with a traveling wave tube for generating millimeter waves, having a system for producing an electron beam and a delay line forming a line resonator, and having a trap for the electron beam.

A tube for generating mircowaves is already known, comprising a delay line, coupled with an electron beam, which is closed at both ends so as to reflect the electromagnetic wave, the delay line being thus adapted to resonate, that is, to form a line resonator. The high frequency energy is thereby decoupled from a hollow space resonator or wave guide in which is arranged the delay line. The delay line can in such tube be varied as to its geometric dimensions for the purpose of tuning-through over a broad frequency range. The hollow space resonator can moreover be detuned by means of a shunt slide which is disposed at the side of the resonator opposite the decoupling side thereof and separated from the vacuum vessel by a mica window.

The above indicated generator tube provides only for a very loose coupling between the delay line and the resonator. The tuning devices require a considerable structural expenditure since the mechanical detuning of the delay line must be effected over a vacuumtight membrane, calling in addition to the vacuumtight window at the decoupling point, for a further window required in the tube envelope for the shunt slide.

In order to avoid these disadvantages, the invention proposes, in connection with a travelling wave tube for generating millimeter waves, comprising an electron beam producing system and a delay line forming a line resonator as well as a trap for the electron beam, to firmly couple the delay line, at the collector side, over an intermediate member containing the trap and over a vacuumtight window, with a decoupling wave guide and to provide in the latter a tuning slide.

In the travelling wave tube according to the invention, the firm coupling between the delay line and the decoupling wave guide provides for optimum output decoupling and at the same time for broad detuning of the line resonator by the tuning slide. The firmer the coupling between the decoupling wave guide with the tuning side and the delay line, the stronger will a shifting of the tuning slide alter the resonance wave length of the line generator.

The decoupling wave guide is in the travelling wave tube according to the invention preferably of rectangular shape. The decoupling of the high frequency energy is advantageously effected over a gap between the tuning slide and the wall of the decoupling conductor. However, an apertured shutter in the tuning slide or a Lecher line branching off between the tuning slide and the vacuumtight window, could likewise be utilized for effecting the decoupling.

As an intermediate member, there is particularly adapted a wave guide having an opening which is cross sectionally the same as that of the decoupling wave guide and having disposed therein a narrow arcuately shaped longitudinal web extending in the direction of the delay line. The arcuately shaped longitudinal web has the shape of a keel similar, for example, to that of a sail boat, and is arranged so that the steep flank thereof faces in the direction of the electron beam. In the side of the longitudinal web which faces the electron, there is provided a bore for trapping the beam electrons.

Attention must be paid to keep losses in the vacuumtight window of the travelling wave tube according to the invention, as small as possible. Ceramic material or mica are particularly adapted for use as materials for the window. The delay line is advantageously made in the form of a double comb line with the teeth thereof staggered in the direction of the tube axis by a half period length of the geometric structure of the line.

An embodiment of the invention will now be explained with reference to the accompanying drawing which shows in simplified manner the collector end of a travelling wave tube made according to the invention.

The vacuum vessel or envelope 1 contains a delay line 2 made in the form of a double comb line with the teeth of one comb staggered with respect to the teeth of the other comb by one-half period length of the geometric structure of the line. The electrons of the beam 3 are propagated between the tips of the teeth of the two combs and impact upon the walls of the bore 6 in a longitudinally extending fin shaped member 5 of the intermediate member 4 which represents a tapered wave guide. The tapering of the intermediate member 4, which is a matching member, is effected by the arcuate keel-like shape of the narrow longitudinal member 5. In the terminal member 7 which closes the vacuum vessel 1 is provided a window 8, made, for example, of mica, such closure member forming the connection between the intermediate member 4 and the decoupling wave guide 9. Numeral 10 indicates the tuning slide, made of electrically conductive material, which is disposed within the likewise rectangular inner opening of the decoupling wave guide 9 and movable therein longitudinally of the delay line in the direction indicated by arrows 12 and 13. The decoupling of the high frequency energy is effected over the gap 11 between the tuning slide 10 and the wall of the decoupling wave guide 9.

The operatively effective line length of the line resonator formed by the delay line 2, which is at the cathode side likewise closed to provide reflection, can be altered by shifting the tuning slide 10. The resonance wave length of the individual oscillation ranges of the line resonator can thereby be detuned so that the traveling wave tube according to the invention can be operated within a very broad frequency band by means of electrical and mechanical through-tuning.

The invention is not inherently limited to the details of the described embodiment. It is, for example, particularly possible to utilize the tuning slide directly as a matching transformer in place of the intermediate member 4.

Changes may be made within the scope and spirit of the appended claims which define what is believed to be new and desired to have protected by Letters Patent.

We claim:

1. A travelling wave tube for generating millimeter waves, having an electron beam producing system and a closed delay line forming a line resonator which reflects the electromagnetic wave at each end thereof and having a trap for the electron beam, comprising at the collector side an intermediate member containing said trap, a decoupling wave guide, means forming a vacuumtight window for firmly coupling said delay line with said intermediate member and the latter with said decoupling wave guide, and means forming a tuning slide disposed within said decoupling wave guide.

2. A travelling wave tube according to claim 1, wherein said decoupling wave guide is of rectangular shape.

3. A travelling wave tube according to claim 2, where-

in the high frequency energy is decoupled over a gap formed between said tuning slide and the wall of the decoupling wave guide.

4. A travelling wave tube according to claim 3, wherein said intermediate member is a rectangularly shape wave guide with an arcuate fin shaped member formed therein which extends longitudinally in the direction of the electron beam, a bore being formed in said longitudinal web for trapping the electron beam.

5. A travelling wave tube according to claim 4, wherein said window between said intermediate member and said decoupling wave guide is made of a material selected from the class of materials including ceramics and mica.

6. A travelling wave tube according to claim 5, wherein said delay line is a double comb-like structure with the teeth of one comb member staggered in electron beam direction with respect to the teeth of the other comb member.

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