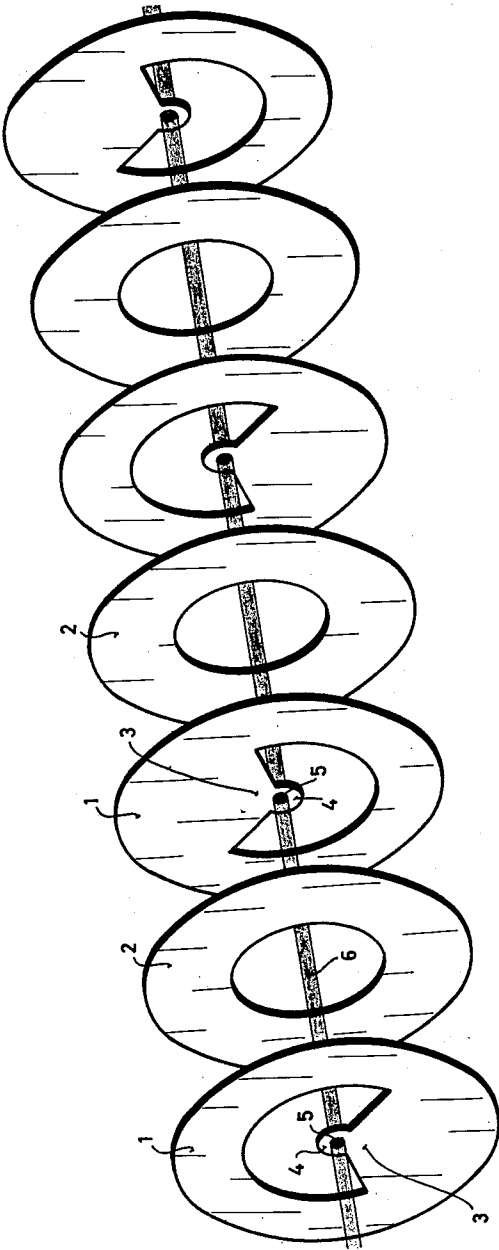


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TRAVELLING WAVE TUBE

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2 Claims. (Cl. 315-3.5)

This invention is concerned with a travelling wave tube comprising a delay line assembled of at least two types of metal sheet plates arranged in layers, wherein plates with symmetrical inner openings alternate with plates with asymmetrical inner opening, and wherein an electron beam is by means of a homogeneous magnetic field in bundled or focused manner guided through a central bore formed in the delay line.

Tubular delay lines for travelling wave tubes, assembled of metal sheet plates arranged in layers, are known. The plates form characteristic cross-sections of the tubular line by layerwise alternately disposing different types of plates. The metal sheet plates which have transverse walls extending into the region of reciprocal action are provided with openings formed therein which are, upon assembling of the delay line in the electron beam direction, placed in serial alignment, thus leaving in the delay line a central bore for the passage of the electron beam.

One of the customary expedients for guiding an electron beam in bundled or focused manner through the bore of the delay line of a travelling wave tube resides in placing the tube into a magnetic field which is homogeneous in the direction of discharge. If it is desired that the electron beam be concentrically propagated in the bore, the geometric axis of this magnetic field must be in alignment with the axis of the central bore of the delay line. In the case of travelling wave tubes for generating or for amplifying ultra high frequency waves, it is necessary to operate with high beam current density and with small dimensions of the bore. Since it is practically impossible to bring the axis of the electron current, which is determined by the magnetic field, into alignment with the geometric axis of the delay line, and therewith into alignment with the geometric axis of the bore, there results in travelling wave tubes provided with the above noted known delay line, considerable losses by leakage of electron current into the delay line. These losses reduce the efficiency of the tube and cause impermissible heating of the delay line.

The invention is based upon recognition of the fact that, if the described disadvantages are to be avoided, no transversely operating components of the magnetic field must effect the electron beam. The appearance of a transversal component of the magnetic field, in a travelling wave tube with a delay line assembled of at least two types of metal plates, comprising plates with symmetrical inner openings alternating layerwise with plates with asymmetrical inner openings, wherein an electron beam is by means of a homogeneous magnetic field guided in bundled or focused manner through a central bore formed in the delay line, is according to the invention prevented by making the plates with symmetric inner openings of magnetic material, especially soft iron and making the plates with asymmetric inner openings of non-magnetic material.

The effect of the structure made according to the invention is, that the alignment of the geometric axis of the delay line with the electron beam axis is restored, even in the case of a tube disposed inclined to the magnetic field axis, since the plates made of magnetic material, owing to symmetric inner opening thereof, effect shielding of all transverse components of the magnetic field.

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The invention shall now be explained with reference to the accompanying drawing showing in schematic manner an example of a delay line for a travelling wave tube.

There are provided dislike metallic plates of two different types as indicated by numerals 1 and 2, the plates 1 having rotation-asymmetrical inner apertures therein, and the plates 2 having rotation-symmetrical inner apertures therein. The plates are stacked layerwise with plates 1 of one type alternating with plates 2 of the other type, thus forming a hollow conductor or wave guide with an inner circular opening or channel, wherein transverse webs 3 formed by the alternate plates 1 extend symmetrically alternately from oppositely disposed wall portions to the center of the wave guide. The plates 1 extending on both sides of the respective plates 2 are for this purpose mutually displaced by 180°. The plates of the type 1 having the transverse webs 3 are provided with generally circular extensions 4 which are disposed in the vicinity of the reciprocal region and have openings 5 formed therein for the passage of the electron beam 6. The openings 5 must be disposed serially in alignment in the direction of discharge. The electron beam 6 is guided in bundled or focused manner through the bore formed by the openings 5, by a homogeneous magnetic field produced outside of the tube.

The plates of the type 2 are in accordance with the invention made of magnetic material and the plates of the type 1 are made of non-magnetic material to obtain alignment of the axis of the magnetic field with the desired electron beam axis. The rotation symmetry of the plates of the type 2 effects short circuiting of all transverse components of the magnetic field and, accordingly, there can occur only a magnetic field component extending accurately perpendicularly to the axis of symmetry of the plate type 2.

The invention is not inherently limited for use in connection with the illustrated embodiment but is applicable substantially in all cases in which delay lines are assembled of metal plates of different contour types of which at least one exhibits a symmetrically arranged inner opening.

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.

I claim:

1. A travelling wave tube having a delay line comprising a stacked assembly composed of first disklike plates made of magnetically soft material and having respectively a rotation-symmetrical inner aperture formed therein alternating with second disklike plates made of non-magnetic material and having respectively a rotation-asymmetrical inner aperture formed therein, each of said second plates having a central opening formed therein, said openings forming in the assembly a centrally extending bore through which an electron beam is guided in focused manner by a homogeneous magnetic field.

2. A travelling wave tube according to claim 1, wherein said delay line constitutes a wave guide, said first and second disklike plates representing the cross-sectional extent of said wave guide, said second disklike plates forming radially inwardly directed webs extending into the reciprocal space, said central openings being formed in said webs.

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