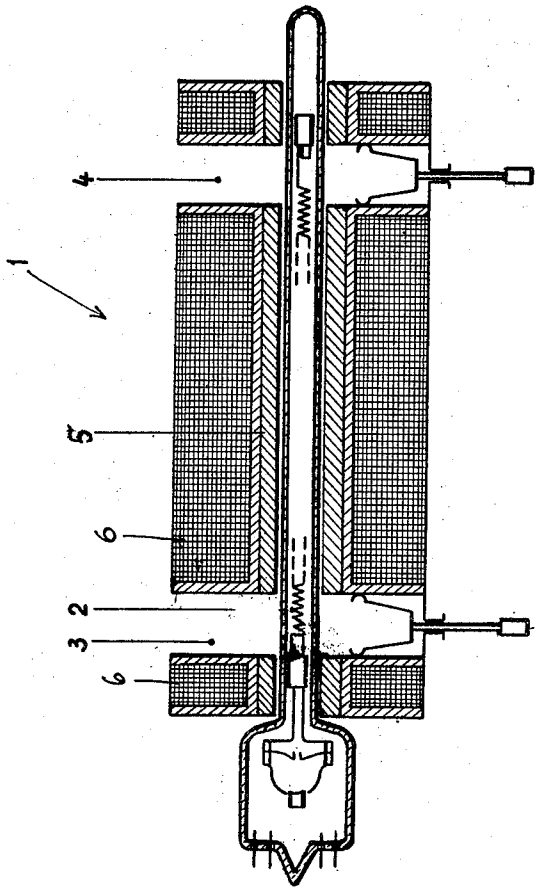
Nov. 5, 1957 W. KLEIN ET AL 2,812,469

TRAVELLING WAVE TUBE ARRANGEMENT

Filed Nov. 6, 1953



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United States Patent Office

2,812,469

Patented Nov. 5, 1957

2,812,469

TRAVELLING WAVE TUBE ARRANGEMENT

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Application November 6, 1953, Serial No. 390,688

Claims priority, application Germany November 7, 1952

3 Claims. (Cl. 315—3.5)

This invention relates to travelling wave tubes using a helix and particularly to a magnetic beam focusing arrangement therefor.

Magnetic fields have been widely used in travelling wave tubes for concentrating the electron beam. One of the problems in such tubes has been the maintenance of a uniform field and the elimination or reduction of small spurious components of the field which introduce undesired effects in the operation of the tube. In dealing with certain of these spurious components there has been described in our U. S. application 366,288, filed July 6, 1953, for "Arrangement for Magnetic Beam Concentration" a means for reducing the spurious components by introducing a cylindrical mantle of paramagnetic material of low permeability.

The present application is concerned with another means for reducing certain of these spurious components. In accordance with a main feature of the present invention, the helix of the travelling wave tube is made of slightly magnetic material whose permeability has a maximum value suitable to the applied magnetic field to produce the desired concentration of the beam. The helix thereby also acts as a magnetic shunt so that since the helix partially extends into the wave guides that effect coupling-in and coupling-out, this produces several advantages. While in a tube with the helix of nonmagnetic material the helix axis must coincide very accurately with the field direction of the focusing field, a slightly magnetic helix will align the field inside thereof parallel to the helix axis even in the case of slight deviations of the field direction with respect to the helix axis. Thus the tube with the slightly magnetic helix is no longer sensitive to direction of the field to the same extent. Furthermore high permeability of the magnetic material of the helix would require an excessive external field in order to obtain the required useful field intensity in the axis of the helix. If the concentration field is too weak then the magnetic helix acts like a magnetic shield so that no further beam concentration is obtainable. This is the reason why slightly magnetic helices must be used.

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood, by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawing in which the figure is a schematic longitudinal sectional view of a travelling wave tube.

Referring now to the figure which shows a travelling wave tube 1 having a helix 2 for the concentration of the beam therein, there is provided around the magnetic coils an external mantle 5 of compressed powdered iron about 230 mm. long. The helix 2 is made of nickel manganese wire with 96% nickel and 4% manganese, 0.4 mm. in diameter of the wire, with the helix diameter of 2 mm. and a pitch of 1.7 turns per mm. The usual focusing coil is shown at 6.

The helix 2 partly extends into the hollow wave guides 3 and 4. The intensity of the magnetic focusing field amounts to approximately 300 gauss in the axis of the helix. Compared with the non-magnetic helix, only a slight increase of flux is required. However, the susceptibility of the tube to orientation as to position with respect to the magnetic field is substantially decreased. With the beam current of 3 mm. a beam transmission of about 97% has been measured.

While we have shown the tube used with a mantle, it may be dispensed with. However, the combination of the slightly magnetic helix with the low permeability mantle together serve to produce a vastly improved operation.

One advantage produced by having the slightly magnetic helix extend partially into the hollow wave guide is that large wave guide cross sections may be employed while still obtaining good beam concentration.

While we have described above the principles of our invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of our invention as set forth in the objects thereof and in the accompanying claims.

We claim:

1. In a travelling wave tube having means for producing an electron beam including means for focusing said beam, a wave transmission path extending substantially parallel to said beam for interaction between the wave and the beam comprising a helix of magnetic material consisting of a nickel-manganese alloy of at least 90% nickel.

2. In a travelling wave tube having means for producing an electron beam including means for focusing said beam, a wave transmission path extending substantially parallel to said beam for interaction between the wave and the beam comprising a helix of magnetic material consisting of a manganese-nickel alloy of at least 90% nickel, said means for focusing said beam comprising magnetic coils arranged around said tube and a shield of paramagnetic material interposed between said coils and said tube.

3. In a travelling wave tube according to claim 1, a construction wherein said coil is of an alloy consisting of substantially 4% manganese and 96% nickel.

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