

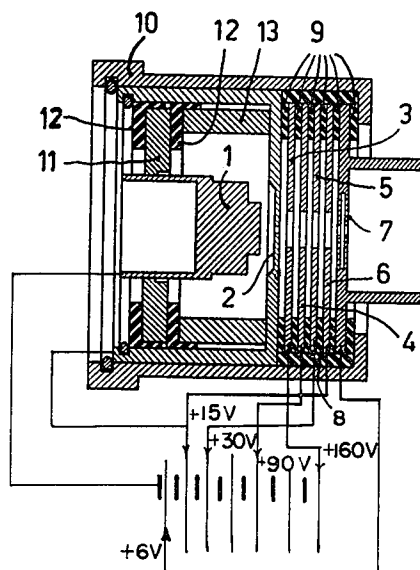
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ELECTRON GUN

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## ELECTRON GUN

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3 Claims. (Cl. 315—31)

The invention relates to a device comprising an electron-beam tube for signal amplification by the action of an inhomogeneous magnetic or an inhomogeneous electric field on an electron-beam emanating from an electron gun having at least two anodes, which beam is focussed by an axial magnetic field. In order to obtain a high amplification it is important that the electron beam should be satisfactorily focussed and should have a high space charge density. If this were not the case, the beam would be violently defocussed under the action of the inhomogeneous magnetic field. With the amplification by the action of an inhomogeneous magnetic or an inhomogeneous electric field it is usually desirable that the electron beam should have a low voltage, since in this case a high amplification per unit length can be obtained. With the high space charge density and the low voltage a comparatively high perveance (in a given case approximately  $3 \times 10^{-6}$  amperes x volts<sup>-3/2</sup>) is obtained already with small dimensions of the gun. It is moreover important that the axial electron velocity should be constant as far as possible throughout the sectional area of the beam. With a high space charge density this cannot be realized because of the potential depression in the beam.

These problems can be obviated by using Brillouin focussing in the gun. This means that the whole electron beam rotates about its axis with such an angular velocity that the divergence produced by the space charge and the centrifugal force is just neutralized by the focussing magnetic field. With the conventional structure of a gun with Brillouin focussing the last electrode of the gun is made from magnetic material, which electrode screens the further parts of the gun magnetically. With a gun of known structure of small size and comparatively high perveance this use of Brillouin focussing gives rise to difficulties, since due to the small size and the particular shape of the electrodes the required mechanical accuracy cannot be obtained. The embodiment of the invention obviates these disadvantages.

According to the invention the cathode of the electron gun is magnetically screened by the first anode, while the further anodes of the electron gun are located outside this magnetic screening. The gun is built up, accordingly, of a part with low perveance serving as a magnetic screen and a lens system outside the magnetic screen, which system enhances the perveance of the beam by reducing the voltage of the beam. Since the first-mentioned part has low perveance, the first anode operating as a magnetic screen may have a simple shape, which is important with a view to the small distance of the cathode from this anode and to the small opening of this anode. Also the lens system may be of a simple shape by building it up from a number of anodes instead of using one or more anodes of a particular shape. The first anode serves at the same time as a magnetic screen and may be made from iron.

The invention furthermore relates to an electron-beam

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tube for use in such device and to an electron gun for use in such an electron-beam tube.

The invention will now be described more fully with reference to the drawing, in which the figure shows a sectional view of an electron gun according to the invention. This gun comprises a cathode 1 and anodes 2, 3, 4, 5, 6 and 7. The anode 2 is made of iron. It has a very small opening and is prolonged cylindrically in the direction towards the cathode, so that the latter is magnetically screened substantially completely from the external magnetic field focussing the beam in the tube in which this gun is employed. The anodes 3 to 7 are held in ceramic tube 8 and are held at a given distance from each other by the ceramic rings 9. The ceramic tube 8 and the anode 2 are arranged in a constantan sleeve 10. The cathode support 11 of stainless steel is held between two ceramic rings 12, which are held at a given distance from the anode 2 by a molybdenum spacing member 13.

With a given embodiment of this gun in an electron-beam tube, in which the energy for the signal amplification was derived from an inhomogeneous electric field, the cathode voltage was 0 volt and the voltages of the anodes, in order of succession: 15 v., 160 v., 90 v., 30 v., 15 v. and 6 v. With a beam voltage of 6 v. and a beam current of 45  $\mu$ A, the maximum amplification was 50 db. If in the same tube use was made of the conventional gun, the maximum amplification was 35 db with a maximum beam voltage of 6 v. and a beam current of 35  $\mu$ A. In both cases the beam diameter was 0.4 to 0.5 mm.

What is claimed is:

1. An electron-beam forming element comprising a cathode, a first anode directly surrounding and magnetically shielding said cathode, said first anode having an aperture smaller than the diameter of the cathode for the passage of an electron-beam therethrough, and a second anode located beyond the first anode and outside the shield provided by the first anode, the space between the first anode and the cathode being free of other electrodes, means applying a positive potential to the first anode relative to the cathode, and means applying another positive potential to said second anode.

2. An electron-beam forming element comprising a cathode, a first anode of ferromagnetic material spaced from and directly surrounding and shielding said cathode from an axial magnetic focussing field, said first anode having an aperture smaller than the diameter of the cathode therein for the passage of an electron beam therethrough, and a second anode located beyond the first anode and outside the shield provided by the first anode, the space between the first anode and the cathode being free of other electrodes, means applying a positive potential to the first anode relative to the cathode, and means applying another positive potential to said second anode.

3. An electron-beam forming element as claimed in claim 2 including a plurality of anodes beyond the first anode and outside the shield provided by the first anode.

### References Cited by the Examiner

#### UNITED STATES PATENTS

2,619,611 11/1952 Norton et al. .... 315—5.35

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