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ELECTRON BEAM FOCUSSING DEVICE

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FIG. 1.

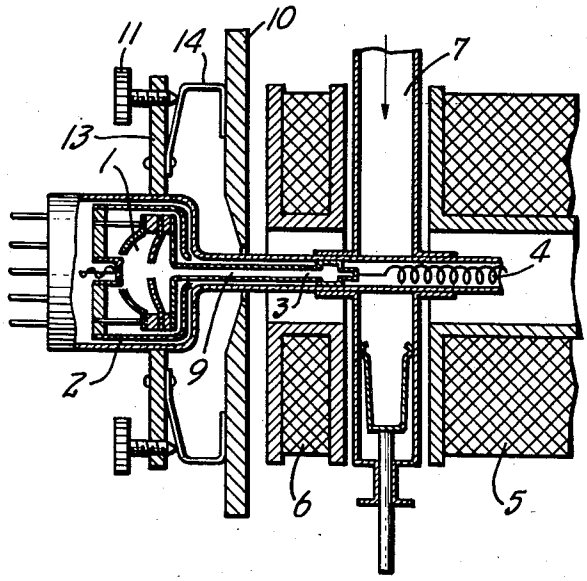
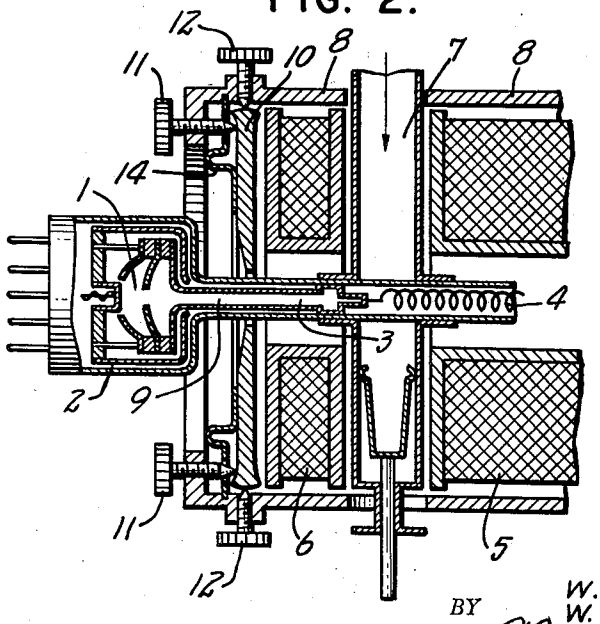


FIG. 2.



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ELECTRON BEAM FOCUSSING DEVICE

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3 Claims. (Cl. 313—84)

Electron beams, particularly those of high current density, and which are intended to maintain a constant cross-section over a certain length, are usually focussed by a homogeneous magnetic field extending over the entire length of the beam, and the vector of field intensity of which coincides with the direction of the beam. Usually the electron gun systems are designed so as to produce a convergent beam of electrons. By this means it is possible to obtain a minimum beam cross-section at a predetermined point along the beam axis, behind which the beam spreads out again on account of the space charge. In order to obtain a uniform beam contour over a greater length it would be necessary to suddenly permit the magnetic field to become effective in its full strength at that particular point where the cross-section of the beam is of a minimum size usually called cross-over point. This requirement is difficult to comply with in practice, although by employing suitable arrangements an approximation of this result may be obtained.

To this end there is arranged in most cases a so-called magnetic barrier, i. e. a disc of a material having a magnetic susceptibility which is as high as possible, positioned normal to the field direction, and in the centrally arranged aperture of which the electron beam will achieve in the shortest distance the rise of the magnetic field strength to the full intensity. Without this disc the transition zone from the field-free space to the point of the full field intensity would be undesirably large.

On account of the unavoidable tolerances with respect to the dimensions of the mechanical structure of the electron gun system, provison must be made for an adjustment serving to bring the electron beam into the exact direction when entering the magnetic field. For this purpose frequently a small or secondary magnetic field intensity vector is employed, arranged vertically to the beam axis. This vector is produced by a disc coil which embraces the electron beam and the axis which is capable of being tilted toward the beam axis at will. Another arrangement comprises two pairs of coils, the axes of which are arranged vertically above each other, and each one of which cuts the beam axis in its vertical direction. Thus according to the D. C. admission of the coil or coils, the intensity and direction of the auxiliary magnetic field may be adjusted, which is required for the adjustment of the beam. These arrangements, however, have the disadvantage that they produce a stray magnetic field, which spreads over the space required for adjusting the beam direction. This results in an undesired vortex motion of the beam in addition to the adjustment of the direction and results in a considerably deteriorated beam contour with respect to directing the beam through the steady magnetic field.

In cathode ray tubes it is known to use a permanent magnet, which is capable of being shifted along the neck of the cathode ray tube, for the adjustment of the beam.

According to the present invention, however, there is provided a disc of magnetic material for the adjustment

of the beam in electric discharge tubes which employ magnetic means for focussing of the electron beam. The adjusting disc is mounted in a way that the angle, which is constituted by the beam and the axis of the disc, may be variably adjusted. Consequently there results a small section in the hold of the disc in which, by tilting the disc, the magnetic field is provided in the beam axis with an additional component, which is determinable by the tilting position of the disc, and with the aid of which the beam may be adjusted.

Two embodiments of our invention as applied to an arrangement for projecting an electron beam into the coil space of a travelling wave tube are shown in Fig. 1 and Fig. 2, respectively, of the accompanying drawings.

Referring first to Fig. 1, the gun system **1** is surrounded by a screen **2** to screen it from interfering magnetic fields. The gun system is followed by a drift tube **3** of a non-magnetic material, to which the coil **4** is connected. The beam focussing coils **5** and **6** are interrupted by the wave guide **7** which constitutes the means for introducing input energy. At a point **9** in the drift space, which is substantially at or near the crossover point of the electron beam, the tube is surrounded by an adjusting disc **10** of magnetic material such as soft iron. The central aperture in the adjusting disc **10** embraces the tube as tightly as possible, and is chamfered at its edge to a knife edge in order to concentrate the magnetic lines of force. The screws **11** are threaded in mounting **13** to which are secured springs **14** fixed to the disc **10**. By adjustment of the screws **11** it is possible to exert a pressure upon the plane of the disc **10** via springs **14**. This results in an angular displacement or tilting of the disc **10** whereby a fine adjustment of field at point **9** is obtained. The disc **10** may be made with an outer diameter somewhat larger than that of the focussing coils **5**, **6**, in order to serve as a magnetic shield and at the same time as a means for keeping stray fields away from the gun system.

In the embodiment shown in Fig. 2 of the drawing, the arrangement is similar to that shown in Fig. 1, but for obtaining shielding against any external interference fields, the focussing coils **5** and **6** are entirely surrounded by an iron casing **8**. This casing at the same time, serves as a mounting for the adjusting disc **10** and constitutes the front sealing of the magnetic field. The air gap between the disc **10** and the iron casing **8**, is as small as possible. The disc **10** is suspended on the radially arranged flat springs **14** secured to the casing **8**. The plane of the disc **10** may be adjustably inclined by means of the screws **11**, whilst the screws **12** serve for centering of the disc, the screws **11** and **12** being threaded in the casing **8**. It is preferable to use three screws **11** and three screws **12**.

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.

What is claimed is:

1. An electron discharge device comprising means including an electron gun for projecting an electron beam along a path, magnetic focusing means for focusing said beam to maintain a substantially uniform diameter, mounted along said path, and means directing said beam into the magnetic field of said focusing means while shielding said gun from said field comprising a disc of magnetic material having an aperture through which the electron beam is directed, the edges of said aperture being closely adjacent to said beam, means for mounting said disc between said focusing means and said gun and adjusting means for varying the position of said disc.

2. An electron discharge device comprising means in-

cluding an electron gun for projecting an electron beam along a path, a magnetic focusing coil for focusing said beam surrounding the electron beam, a casing of magnetic material surrounding said coil for screening it from external fields, and means directing said beam into the magnetic field of said coil while shielding said gun from said field comprising a disc of magnetic material, substantially forming the closure for one end of said casing and having a central aperture through which the beam is directed, means for mounting said disc on said casing between said coil and said electron gun, and adjusting means for varying the position of said disc with respect to the axis of the beam.

3. An electron discharge device according to claim 2 in which said adjusting means comprises, a plurality of

spring members each having one end secured to said disc and the other end secured to said casing, means supported in said casing for moving said disc transversely of said beam path and means for varying the angle of the plane of said disc with respect to said path.

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