Nov. 3, 1959 O. HEIL 2,911,560

ELECTRON DISCHARGE DEVICE WITH ONE WAY GRID FOR ELECTRONS

Filed Oct. 17, 1958

FIG. 1

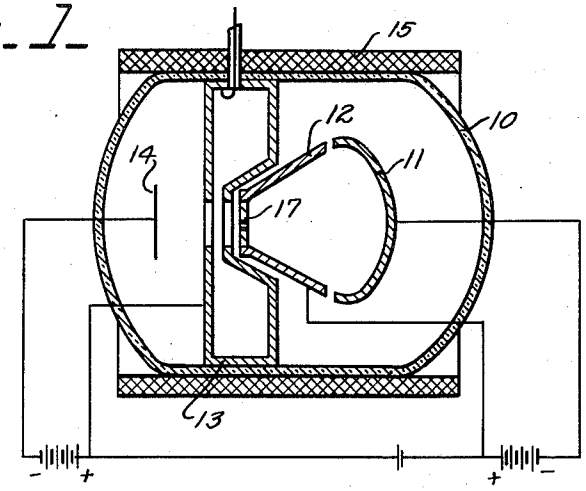


FIG. 2

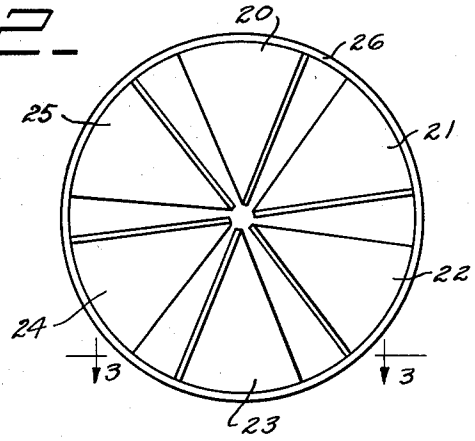
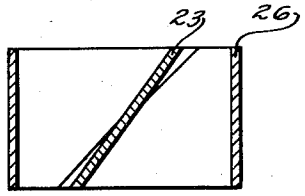


FIG. 3



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ELECTRON DISCHARGE DEVICE WITH ONE WAY GRID FOR ELECTRONS

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5 Claims. (Cl. 315—5.19)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

This invention relates to a one way grid for use in an electron discharge device.

One object of the invention is to provide a grid, which makes use of the rotation of the beam caused by magnetic focusing, to prevent the electrons from returning into the gun or cathode space.

This and other objects will be more fully understood from the following description taken with the drawing, wherein:

Fig. 1 is a sectional view of a reflex klystron which uses the one way grid of the invention.

Fig. 2 is a front view of the one way grid of Fig. 1.

Fig. 3 is a sectional view of the grid of Fig. 2 taken along the line 3—3.

In reflex klystrons and retarding field oscillators, the problem exists of preventing electrons from returning into the cathode space. To reduce the number of returning electrons, the electron beam is usually forced to spread by the action of its own space charge and by the use of pointed repellers. This requires the use of larger area electrodes, causes greater high frequency losses in the resonant cavity, and also sets a limit to the size of the electron gun aperture which can be used. This invention provides a new method, for preventing the electrons from returning into the cathode space, which is free of these disadvantages. The application of an axial magnetic field, such as that used in focusing, forces the beam to rotate around the beam axis. A grid with twisted plates radially arranged like the blades of a turbine is introduced into the nozzle aperture of the electron gun. The pitch of the blades is made to match the rotation of the electron beam, so that the beam passes through the grid spaces on its forward motion. On the return path, however, the electrons are intercepted by the grid plates and are not permitted to return to the cathode space. This is true since the electrons do not change their sense of rotation as their direction of propagation is changed. The number of blades and the width of the blades should be great enough to intercept substantially all of the returning electrons.

The drawing shows in Fig. 1, a reflex klystron **10** having a cathode **11**, an accelerating electrode **12**, a cavity resonator **13** and a repeller electrode **14**. A coil **15** is provided to focus the beam and to cause it to rotate about its axis. A grid **17** which has a plurality of radially arranged blades which are twisted so as to match the rotation of the beam is located in the end of the accelerating electrode **12**. These blades are made wide enough to intercept substantially all of the returning electrons.

Fig. 2 of the drawing shows the construction of the grid **17**. Six blades **20** through **25** are radially arranged within a support member **26**. A sectional view of one of these blades is shown in Fig. 3. In the construction of the grid, these blades are originally flat blades which

are twisted so as to match the rotation of the beam. Though six blades are shown in Fig. 2, it is obvious that a different number of blades could be used and that these blades could have different areas and be twisted through different angles than those shown.

Though the grid is shown as being used in reflex klystrons, it is obvious that the grid could be used in other type tubes and also that the grid could be used with other focusing means than that shown. Additional focusing means can be provided if desired. The energy of rotation in electron beams is useless for the generation of high frequency and is entirely transformed into heat when the electrons strike the blades, however, this energy is not great and is a small sacrifice as compared with the advantages gained from the use of the grid of the invention.

There is thus provided a grid in an electron discharge device which makes use of the rotation of the beam caused by magnetic focusing to prevent returning electrons from entering the cathode space.

While one specific embodiment has been described in some detail, it is to be understood that numerous changes may be made without departing from the general principles and scope of the invention.

What is claimed is:

1. A grid for an electron discharge device, comprising; an annular support member, a plurality of radially disposed plate members within said support member, said plate members having first edges lying along first radii and second edges lying along radii which are angularly disposed with respect to said first radii.

2. An electron discharge device, comprising; means for producing a beam of electrons, a resonant cavity, a repeller electrode, means for accelerating said beam through said resonant cavity toward said repeller electrode, means for causing said beam to rotate, means adjacent said accelerating means for passing electrons only in the forward direction.

3. An electron discharge device, comprising; means for producing beams of electrons, a resonant cavity, a repeller electrode, means for accelerating said beam through said resonant cavity toward said repeller electrode, means for causing said beam to rotate, a grid adjacent said accelerating means, said grid having a plurality of radially disposed plates, said plates having one edge angularly disposed with respect to the other edge to thereby match the rotation of the electron beam whereby electrons are allowed to pass only in the forward direction.

4. An electron discharge device, comprising; means for producing a beam of electrons, means for accelerating said electrons along a path within said discharge device, means for causing said beam to rotate, means for returning said beam along said path toward said beam producing means, means adjacent said accelerating means for passing said rotating beam only in the forward direction.

5. An electron discharge device, comprising; means for producing a beam of electrons, means for accelerating said electrons along a path within said discharge device, means for causing said beam to rotate, means for returning said beam along said path toward said beam producing means, a grid located adjacent said accelerating means, said grid having a plurality of radially disposed plates each having one edge angularly disposed with respect to the other edge.

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