May 11, 1937. R. H. VARIAN 2,079,884

PROTECTED GRID

Filed March 13, 1935

Fig. 1.

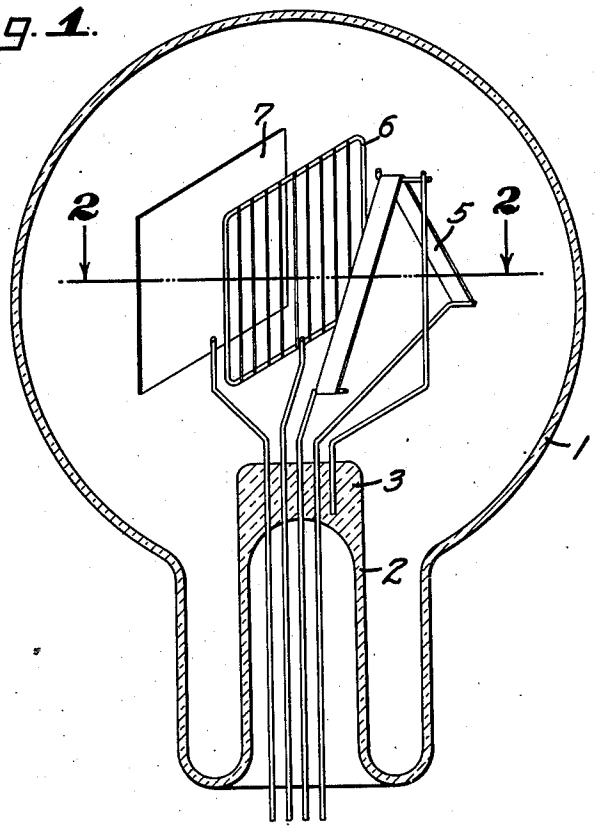
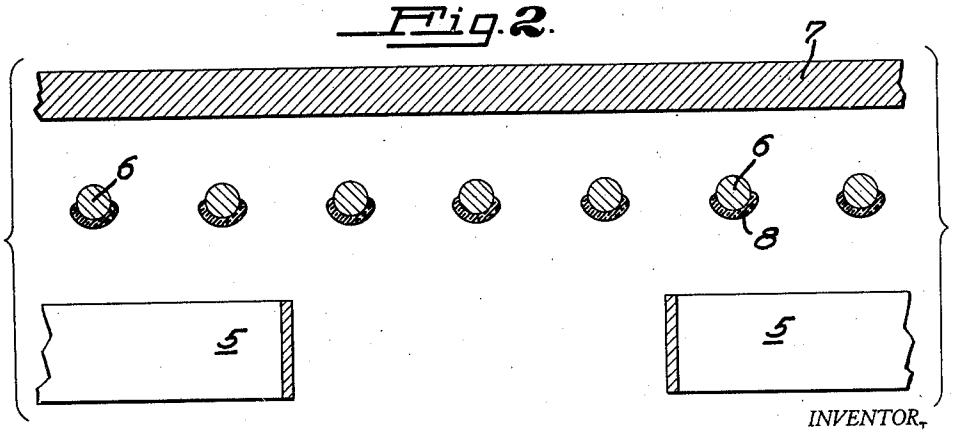


Fig. 2.



INVENTOR,
RUSSELL H. VARIAN.
BY Lippincott & Metcalf
ATTORNEYS.

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PROTECTED GRID

Russell H. Varian, San Francisco, Calif., assignor to Farnsworth Television Incorporated, a corporation of California

Application March 13, 1935, Serial No. 10,886

1 Claim. (Cl. 250—27.5)

My invention relates to a grid adapted to be used in a thermionic tube, and more particularly to a control grid which may be operated at positive potential.

Among the objects of my invention are: to provide a thermionic tube in which the grid may be operated at positive potential; to provide a thermionic tube in which the grid current may be held to a low value when the grid becomes positive; to provide a thermionic tube having a grid partially covered by an insulating film; and to provide a grid having unique characteristics when utilized in a thermionic tube.

Other objects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of the invention herein described, as various forms may be adopted within the scope of the claim.

It is well known that when a thermionic vacuum tube, as exemplified by the usual type of three electrode device having a cathode, anode, and interposed control electrode or grid, is used with a positive grid potential, excessive grid current is produced. This grid current is a direct loss on the output of the tube, and in many cases the fine wires of the control element become so heated that the tube is ruined. There are, however, many circuits in which it is desirable to operate the tube with the grid at positive potential, and if it were not for the fact that high grid currents are the result, the benefits of such operation could be realized. In broad terms, my invention comprises coating the surface of the grid control wires facing the cathode with a layer of insulating material, leaving the surface facing the anode exposed.

My invention may be more fully understood by reference to the drawing in which Figure 1 is a diagrammatic, perspective view of a typical arrangement of three electrodes in a tube, used for amplification, detection or oscillation generation, the envelope being shown in section. Figure 2 is a sectional view of the elements only, taken as indicated by the line 2—2 in Figure 1.

There has been no attempt to show actual tube construction, as my invention may be applied to any device of the class described wherein a control element is interposed between an anode and a cathode. In Figure 1, an envelope 1 is provided with a reentrant stem 2 having a pinch 3, through which various leads pass to support a ribbon filamentary cathode 5, a control grid 6, and an anode plate 7. These electrodes are shown in section in Figure 2, and the grid wires are provided with a layer of insulating material 8 on the side facing the cathode, but are not coated on the surface facing the anode.

I prefer to form the coating 8 upon the wires by depositing thereon finely ground willemite or a similar finely divided insulating material. I have, however, found that willemite is a good insulator and adheres well to the wires without the addition of any organic binder. By placing the grid structure some distance away from a spray gun and blowing the finely divided material at one side of the grid, in water suspension, I find that a uniform coating is deposited on the surface of the wire facing the gun and none at all on the opposite surface. I then mount the sprayed grid in the envelope with the sprayed side toward the cathode and the exposed side toward the anode.

I am well aware that attempts have hitherto been made to completely insulate grid wires to prevent them from taking current when positively charged. Under these circumstances, however, electrons are deposited upon the outer surface of the insulating material, and as the charge thereby produced increases, the tube ceases to function as no control can be obtained. When the grid of my invention, however, is used, such a charge will accumulate on the insulating material facing the cathode, but as the opposite surface of the grid wires are not covered, a charge cannot be held in that position. The anode-facing surface is still able, therefore, to exercise control on the electron stream, being free from any blanketing charge.

Electrons emitted from the cathode are drawn toward the grid wires and the anode when the grid is made positive. These electrons pass between the grid wires with such velocity that no substantial number of them can bend around to enter the bare surface of the grid, and they therefore continue on to the anode. The grid current is therefore exceptionally small, yet the control obtained is relatively good even when the outer surface of the insulating material 8 is highly charged by electrons deposited thereon. I have, therefore, been able to operate a tube having in it the grid of my invention with the grid at positive potentials, and have obtained good control without sufficient grid current to materially reduce the efficiency of the tube, and the power absorbed in the grid circuit is relatively small.

I do not, of course, wish to be limited to the particular insulating materials mentioned, nor to the way the material is to be deposited on the

control wires, as any insulating material having a sufficiently high melting point to be unaffected by the outgassing of the grid is satisfactory. It is also to be noted that the protected grid of my invention is ideally adapted for use as a space charge grid intercepting relatively few electrons.

I claim:

A vacuum tube having an envelope containing a cathode, anode, and interposed grid, a layer of finely divided adherent willemite covering substantially all of the grid surface facing said cathode, the surface facing said anode being uncovered.

RUSSELL H. VARIAN.