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SECONDARY ELECTRON AMPLIFIERS
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Fig.1.

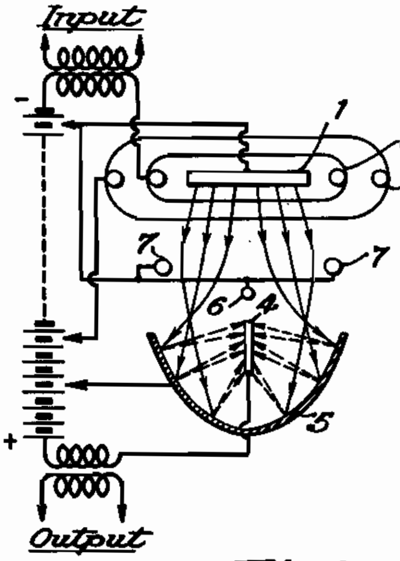


Fig.2.

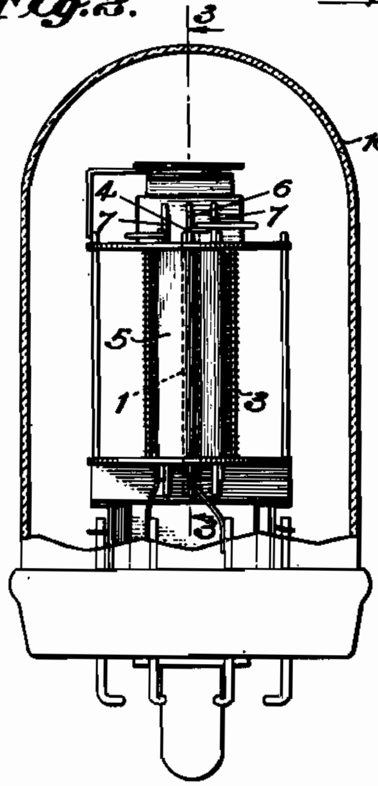
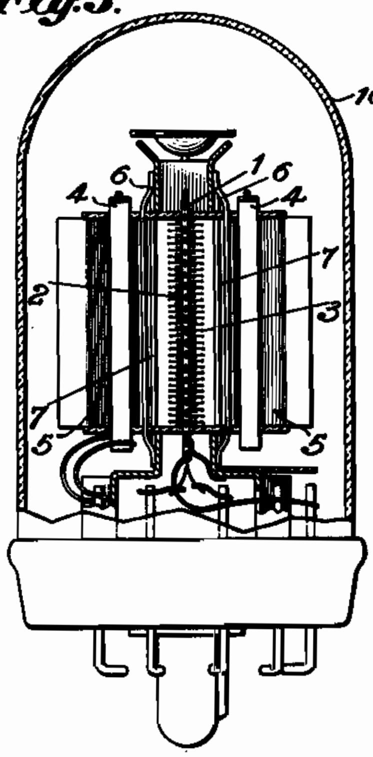


Fig.3.



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SECONDARY ELECTRON AMPLIFIERS

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This invention relates to an electron discharge tube comprising a secondary emission electrode having a surface which has the property of emitting secondary electrons when struck by a stream of primary electrons.

In electron discharge tubes comprising a secondary emission electrode located behind an apertured or grid-like anode the primary electrons traversing the anode will impinge upon the secondary emission electrode and the secondary electrons dislodged from the emitter find their way to the anode either directly or after traveling several times around the anode surface. Such constructions, more particularly where both the anode and the secondary emission electrode can be seen from the cathode, have the drawback that the interelectrode capacities, especially between the anode and the grids interposed between anode and cathode, may become fairly large. In addition, the internal resistance of the tube is greatly reduced especially in the case of short waves, because the secondary electrons, before finding their way to the grid-shaped anode, may oscillate several times to and fro around the anode.

The principal object of this invention is to provide a simple and sturdy secondary electron emission tube which has low interelectrode capacitance and in which the internal resistance does not change materially, even when the tube is used for short waves.

According to the present invention an electron discharge tube comprises an electrode system including a cathode or similar source of primary electrons, at least one secondary emission electrode, and an anode, preferably a rod or strip, so placed that as viewed from the cathode it is behind a shield member, preferably a rod parallel to and in front of the edge of the anode. The shield member is maintained at a constant, preferably cathode, potential. The primary electron stream may be controlled by a control grid near the cathode. To advantage the secondary emission electrode is concave or recessed, facing the cathode and surrounding the greater part of the anode, so that the secondary electrons go directly to the flat sides of the anode.

In a preferred and illustrative embodiment of the present invention the concave secondary emission electrode surrounds the anode, save on the side facing the cathode, and the primary electrons are formed into a beam by beam forming means, such as a number of rod-shaped members, preferably near the anode shield rod. The beam impinges on the inner surfaces of the secondary emission electrode at such a point that substantially all secondary electrons pass directly to the anode without oscillating around or near it, and practically none of them return to the vicinity of the control grid.

The invention will be more fully explained by reference to the accompanying drawing wherein one embodiment thereof is schematically represented in Figure 1, and in more detail in Figures 2 and 3.

The drawing shows an electron discharge tube having a source of primary electrons, such as an indirectly heated oxide coated thermionic cathode **1**, near which is a conventional control grid **2**. A conventional screen grid **3** may be used, and beyond the grids is an output electrode or anode **4**, preferably a flat strip or slat set edgewise to the cathode. Beyond the anode is a secondary emission electrode or emitter **5**, preferably concave or recessed, which partly surrounds the anode **4** and is open to the cathode **1**. Between the cathode **1** and the anode **4** there is a shielding member such as a rod **6** which is interposed between the cathode and the edge of the slat anode and protects the anode from the primary electron stream indicated by heavy arrows. The rod **6** is maintained at constant potential, such as cathode potential, either by a direct connection to the cathode inside the tube or by an external connection. I have found it advantageous to provide means, such as rods **7** which may also be connected to the cathode, to form the electron stream into a beam which impinges on the secondary emission electrode at points so situated that practically all of the secondary electrons emitted are drawn directly to the anode, as indicated by light arrows. As the inner or emitting surfaces of the concave emitter are the walls of a recess in which is the slot anode with its flat sides directly exposed to the emitting surfaces, substantially none of the secondary electrons from the emitter return to the vicinity of the control and screen grids. For convenience, the beam forming rods **7** may be parallel to and beside the shield rod **6**, which splits the beam into two parts, each of which impinges on an emitting surface of the emitter **5**.

Figures 2 and 3 show in more detail a tube made in accordance with the invention and comprising a highly evacuated bulb **10** enclosing the electrode assembly, which in general is of conventional construction, with the electrodes held between a pair of mica spacers secured to support rods. It is desirable, as shown in these figures, to provide by sheet metal shields good electrostatic shielding between the electrode leads and for the upper ends of the grid rods. The shields may conveniently be attached to electrodes 6 and 7, which may operate at ground potential. The emitters 5 may to advantage be approximately V-shaped in cross-section, and blackened on the outer surface, for example, by carbonizing, to facilitate heat radiation and thereby keep the emitters comparatively cool during operation. The inner surface of the emitters 4 may be made to have high secondary electron emissivity by well known expedients, such as oxidizing the surface and then caesiating it, or by coating the surface with a very thin film of alkaline earth oxide. For example, the emitter 4 may be made of copper, with the emitting surfaces oxidized and subjected to an atmosphere of caesium vapor. Such an emitter has good stability and is only slightly affected by material thrown off from the oxide coated cathode 1 during operation of the tube.

The accompanying drawing shows schematically only part of the electrode system, but obviously several parts, each comprising a secondary emission electrode and an anode, can be provided for a common cathode and on one electrode assembly.

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