

Feb. 6, 1934.

W. H. T. HOLDEN

1,945,639

DISCHARGE TUBE

Filed Nov. 8, 1932

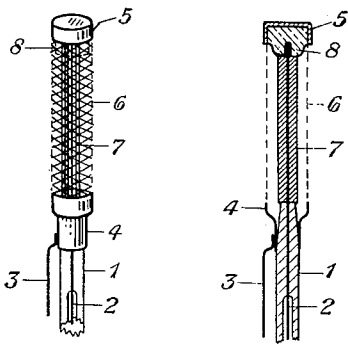


Fig. 1

Fig. 2

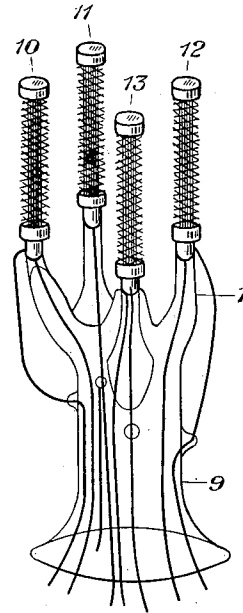


Fig. 3

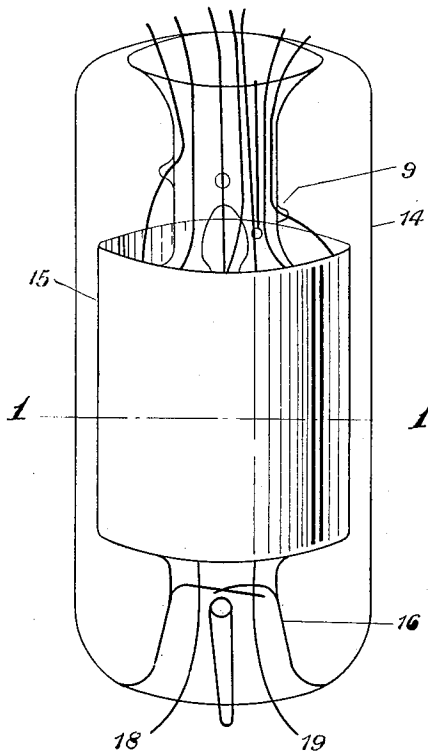


Fig. 4

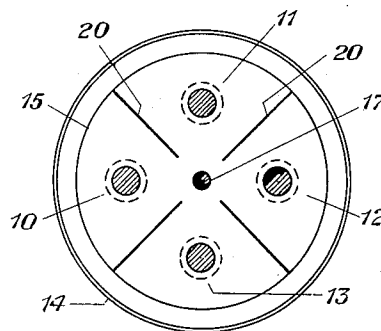


Fig. 5

INVENTOR
W. H. T. Holden
BY *W. H. T. Holden*
ATTORNEY

UNITED STATES PATENT OFFICE

1,945,639

DISCHARGE TUBE

William Henry Towne Holden, Brooklyn, N. Y.,
assignor to American Telephone and Telegraph
Company, a corporation of New York

Application November 8, 1932. Serial No. 641,796

3 Claims. (Cl. 250—27.5)

This invention relates to electrical discharge devices, and more particularly to that class of discharge devices containing a gaseous filling, such for example as a monatomic gas or metallic vapor, at a reduced pressure, and provided with a cathode, control electrodes and an anode so arranged that variations in potential of the control electrode cause corresponding variations in anode current.

Such devices have been described in the past, and have ordinarily required either a heated thermionically emitting cathode or an auxiliary mercury arc, the cathode of which also serves as the cathode of the controlled current. It is one of the objects of this invention to substitute a glow discharge between cold electrodes for the arc discharge between a thermionic or mercury pool cathode and the auxiliary anode, which is also employed. But by utilizing a cold cathode discharge I am enabled to so arrange the electrodes that a materially simpler construction is possible, avoiding the difficult construction required in the mercury arc type of amplifier. Other objects and features of this invention will become apparent from the following detailed description of the invention.

The invention may be more fully understood from the following description together with the accompanying drawing in the Figs. 1, 2, 3, 4, and 5 of which the invention is illustrated. Figs. 1 and 2 show the construction of control electrode assemblies. Fig. 3 shows a plurality of control electrode assemblies mounted on a single stem. Fig. 4 shows the arrangements of Fig. 3 sealed into a tube. Fig. 5 is a cross-section of Fig. 4. Similar reference characters have been utilized to denote like parts in all of the figures.

Referring to the appended drawing, Figures 1 and 2 illustrate the construction of a control electrode assembly. A glass tube 1 is sealed about anode lead 2 at its upper end. A ferrule 4 to which grid lead 3 is attached surrounds the upper end of this seal. At the top of the seal and fitting tightly against the end of the glass is anode 7. Lead wire 2 is carried through the anode and welded thereto at the top, forming a projection on which insulator 8 is supported. Metal cap 5 is supported by insulator 8. Grid 6, composed of fine mesh wire screen is welded to cap 5 and ferrule 4 in such a manner as to completely enclose anode 7. The meshes of this grid are fine enough so that the positive ion sheaths formed thereon when immersed in the positive column of a glow discharge will overlap and prevent positive ions from passing through

the grid meshes. Electrons, however, will pass freely into the interior of the hollow cylindrical grid structure and reach anode 7. The number of electrons thus reaching anode 7 may be controlled by the potential of grid 6. The space between anode 7 and grid 6 is of such dimensions that it is small compared with the mean free path of an electron in the gas at the pressures employed. Positive ions will, therefore, not be formed inside grid 6 and the current to anode 7 will be purely electronic and continuously controllable by the potential applied to grid 6.

The electrode assembly of Figs. 1 and 2 may be immersed in the positive column of a glow discharge by being sealed inside of a tube containing a monatomic gas and a cathode and anode with a suitable source of potential connected between them. Any desirable type of discharge tube may be used.

A plurality of the control electrode assemblies may be supported on a single reentrant stem 9, adapted to be sealed into a bulb 14, as shown in Figs. 3 and 4. Each of these electrode assemblies 10, 11, 12 and 13 has its own grid and anode leads. Fig. 4 shows how a stem such as that of Fig. 3 may be sealed into a bulb 14, into the other end of which has been sealed a stem 16, carrying a cathode 15 and an auxiliary anode 17, the latter being only visible in the Fig. 5 which represents a cross-section of the bulb shown in Fig. 4 along the section line 1—1. Projections 20 from the interior of cathode 15 shield the grids of the electrode assemblies 10, 11, 12 and 13 from each other.

An auxiliary source of potential applied by conductors 18 and 19 between anode 17 and cathode 15 respectively maintains a glow discharge therebetween, and in such a manner that the electrode assemblies 10, 11, 12 and 13 are immersed in the positive column thereof. Each of the said assemblies, consisting of a grid and anode, together with the common cathode constitute a three-element amplifier, and may be used independently, in cascade, or in parallel as required, if suitable input and output circuits be provided and if the anodes of these electrode assemblies be supplied with a suitable positive potential of 100 to 200 volts relative to the cathode 15. This cathode has preferably an activated inner surface prepared in the manner well known in the art, whereby the cathode fall is minimized.

The arrangements above described have referred to an embodiment of this invention, in which the control electrode and anode assemblies are immersed in the positive column of a glow

discharge between cold electrodes. As is well known, the positive column of an arc discharge and of a glow discharge are substantially alike in properties, and it therefore is evident that the principles of this invention may be applied to a tube in which the auxiliary discharge, from which the electron current for the control anode is obtained, is maintained between a hot cathode and a cold anode. Referring to Fig. 5, if 17 be assumed to be a thermionically emitting hot cathode and 15 the anode of the auxiliary discharge, it is obvious that this device will operate in the manner already described, when the cathode is heated to an emitting temperature and an arc is maintained between the said cathode and anode.

While the invention has been disclosed as embodied in certain specific forms which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A gas-filled discharge tube comprising a plurality of electrode assemblies supported inside of said tube, each of said electrode assemblies

comprising an anode and a grid completely enclosing said anode, and means for starting a glow discharge in said tube in which all of said electrode assemblies will be immersed.

2. A gas-filled discharge tube comprising a plurality of electrode assemblies supported inside of said tube, each of said electrode assemblies comprising an anode and a grid completely enclosing said anode, means for starting a glow discharge in said tube in which all of said electrode assemblies will be immersed, and means for shielding the grids of said electrode assemblies from each other.

3. A gas-filled discharge tube comprising a plurality of electrode assemblies supported inside of said tube, each of said electrode assemblies comprising an anode and a grid completely enclosing said anode, a cylindrical cathode surrounding all of said electrode assemblies, a cylindrical auxiliary anode coaxially placed with respect to said cathode whereby a glow discharge may be maintained in said tube in which all of said electrode assemblies will be immersed, and electrostatic shields between said electrode assemblies.

WILLIAM H. T. HOLDEN.

30

105

35

110

40

115

45

120

50

125

55

130

60

135

65

140

70

145

75

150