

UNITED STATES PATENT OFFICE

2,612,617

GASEOUS PULSE AMPLIFIER

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Application May 12, 1949, Serial No. 92,881

1 Claim. (Cl. 313-189)

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The present invention relates to pulse amplifiers and relates more particularly to a gaseous pulse amplifier tube and circuit.

In electronic computers, a large number of pulse amplifiers are customarily utilized, these amplifiers incorporating hot cathode electronic tubes to provide pulse amplification. As the hot cathodes are heated by passage of an electric current through the tube, the power required for filament use in the computer is high.

It is an object of the present invention to provide a gaseous glow discharge tube capable of pulse amplification.

It is another object of the present invention to provide a pulse amplifier tube utilizing a glow discharge in place of a filament or heated cathode.

It is a further object of the invention to provide a pulse amplifier tube having an exceptionally low cathode power requirement.

And it is still another object of the present invention to provide a pulse amplifier circuit utilizing a gaseous glow discharge tube as the amplifying element thereof.

Briefly, the present invention includes a gaseous conduction type of glow tube in which a glow discharge is constantly maintained between the cathode and a glow grid, as by a battery for example. This glow discharge combination acts as an effective cathode. An anode is provided having a neighboring electrode or control grid held at a potential with respect to the glow grid such that the cathode glow discharge is just prevented from continuing on to the anode. When a positive pulse is applied to this neighboring electrode, however, the glow discharge can continue on to the anode thus providing a glow discharge conducting path from the cathode to the anode. The anode current is supplied through a high resistance, causing a decrease in voltage on the anode, thereby quickly extinguishing the potential needed for urging the glow discharge to continue on to the anode. The change in voltage at the anode is taken as an output in the form of a sharp, high amplitude negative pulse. Thus a small positive voltage pulse at the input results in a large negative pulse at the output.

The invention may be more fully understood by reference to the ensuing description of the appended drawings in which:

Figure 1 is a longitudinal sectional view of one preferred form of glow tube having the desired pulse amplification characteristics in accordance with the present invention.

Figure 2 is a circuit diagram for operating the tube of Figure 1 as a pulse amplifier.

Referring first to the glow tube shown in Figure 1, an envelope 1 is provided with a cathode stem in the form of a hollow glass cathode tube

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or pipe 2 having an exterior pinch 3. Inside pipe 2 is a cylindrical cathode 4 having a cathode lead 5 extending through pinch 3. Around pipe 2, extending outside of and sealed to the end of envelope 1, is positioned and sealed a first grid cylinder or glow grid 6 having interior edges 7 turned over the end of pipe 2 to face the cathode 4. Grid cylinder 6 is held in a mounting clip 8 to which a first grid lead 9 is attached.

At the opposite end of the envelope 1 an anode tube or pipe 10 is passed through the envelope 1, coaxial with cathode pipe 2. Anode pipe 10 is longer than cathode pipe 2 and is also provided with exterior pinch 11. A cylindrical anode 12 is positioned in anode pipe 10 having an anode lead 14 passing through pinch 11. Anode 12, however, is not set close to pinch 11 but is spaced therefrom to provide room for a mass of gas adsorbing material such as activated carbon granules 15 back of anode 12. Inasmuch as anode pipe 10 is longer than cathode pipe 2, anode 12 can be set so that the spacing of the anode from the interior end of pipe 10 is substantially greater than the spacing of cathode 4 from the interior end of cathode pipe 2.

A second grid cylinder or control grid 16 is positioned and sealed around anode pipe 10 having intumed edges 18 bending around the inner end of anode pipe 10 to present surface to anode 12. Second grid cylinder 16 is also sealed to the end of envelope 1 and is held in a second mounting clip 13 to which a second grid lead 17 is connected.

After the tube has been assembled, it is baked out in the usual manner, evacuated, and gas filled. A preferred gas filling is helium gas at 100 mm. pressure of mercury.

The tube is used as a pulse amplifier in a particular circuit as shown in Figure 2.

Here the cathode 4 is connected to ground through a resistance 20 bridged by a capacity 21, and a battery 22 with its positive terminal connected to ground. First grid or control grid 6 is connected directly to ground through grid wire 24. Second grid or glow grid 16 is connected to ground through a series input high resistance 25, a shunt resistance 26, and an input battery 27 whose positive terminal is connected to ground. An input line 29 is connected to second grid 16 between resistances 25 and 26 through an input capacity 30.

Anode 12 is connected to an output line 31 through an output capacity 32, and anode 12 is grounded through an output resistor 34 and an anode battery 35 whose negative terminal is grounded.

In one preferred circuit, the potential of battery 22 is 200 volts, the potential of battery 27 is 30 volts, and the anode battery 35 potential is 400 volts.

In operation, a glow discharge is maintained constant throughout the operation of the tube, between cathode 4 and first grid 6.

By mounting the cathode 4 so that only the inner end thereof enters into the glow discharge and by operating the cathode and first grid at a voltage where the glow discharge covers the entire exposed end of the cathode, the negative resistance characteristics of the cathode glow discharge are, for all practical purposes, completely eliminated, and the device does not tend to oscillate. The metal from which the cathode is constructed may, for example, be of aluminum or similar metal so that sputtering is reduced to a minimum.

The second grid 16 is maintained at a negative potential to first grid 6, with the anode 12 maintained at a relatively high positive potential.

This prevents electrons from the glow discharge between first grid 6 and cathode 4 from entering the space between anode 12 and second grid 16. Under these conditions, the potential on anode 12 is not sufficient to initiate a glow discharge in the space between anode 12 and second grid 16. However, when a positive pulse is applied to second grid 16 the negative potential thereon is reduced, and electrons from the cathode glow discharge enter the space between anode 12 and second grid 16 due to the urge of the positive anode 12. When this happens, the gas between anode 12 and second grid 16 is ionized and the entire envelope becomes conducting.

The current from the glow discharge to anode 12, flowing through output resistance 34 causes a decrease in voltage at anode 12 sufficient to quickly quench the glow discharge between anode 12 and cathode 4. The change in voltage of the anode is then used as the output, in the form of a sharp, high amplitude negative pulse. In a circuit having battery voltages of the values outlined above, a 10 volt positive input pulse P_i (Figure 2) at the input, will cause a 300 volt negative output pulse, P_o . The voltage amplification factor is therefore 30.

One of the main advantages of the present invention is that the cathode glow discharge between cathode 4 and first grid 6 requires less current and less power than is normally consumed in the hot cathode circuit of most vacuum and gaseous amplifier tubes.

The life of the tube can be materially extended by the use of the activated carbon 15 or other material which adsorbs gas and releases it to prevent clean-up. In effect, the use of this adsorbing material permits the use of a very small tube, having an effective large gas capacity. For example, the tube used in the circuit described above and using the battery voltage set forth above, is only $\frac{3}{4}$ inches long and $\frac{1}{4}$ inches in diameter.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features

of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute, the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise a preferred form of putting the invention into effect, and the invention is, therefore, claimed in any of its forms or modifications within the legitimate and valid scope of the appended claim.

What is claimed is:

A pulse amplifier comprising: an envelope containing an inert gas at cold cathode glow discharge pressure; a pair of coaxial tubes of insulating material passing through opposite ends of said envelope, said tubes having their inner ends spaced and their outer ends sealed; a first cylindrical grid positioned and sealed around one of said tubes; a second cylindrical grid positioned and sealed around the other of said tubes, said cylindrical grids also being sealed through the ends of said envelope, both of said grids having edges intumed around the open end of the tubes in which they are positioned; a cold cathode inside the tube supporting said first grid; an anode inside the tube supporting said second grid, each of said grids and said cathode and anode having leads from said envelope said anode and said cathode having facing surfaces normal to the axes of said tubes and substantially filling the interior cross sections of said tubes, said facing surface also being located substantial distances within said tubes away from the intumed edges of said grids, the facing surface of said cathode being at a greater distance away from the intumed edge of the adjacent grid than the corresponding distance relation of the facing surface of said anode with its adjacent intumed grid edge.

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