Oct. 25, 1949. R. C. HILLIARD 2,486,025

RECTIFIER TUBE AND CIRCUIT

Filed Sept. 12, 1945

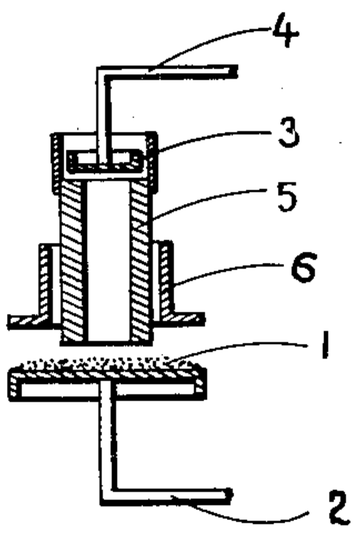

Fig. 1

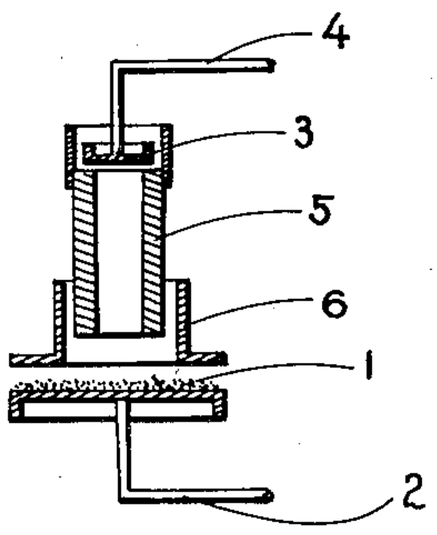

Fig. 2

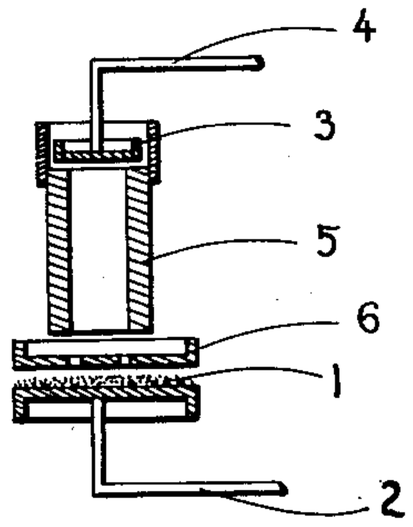

Fig. 3

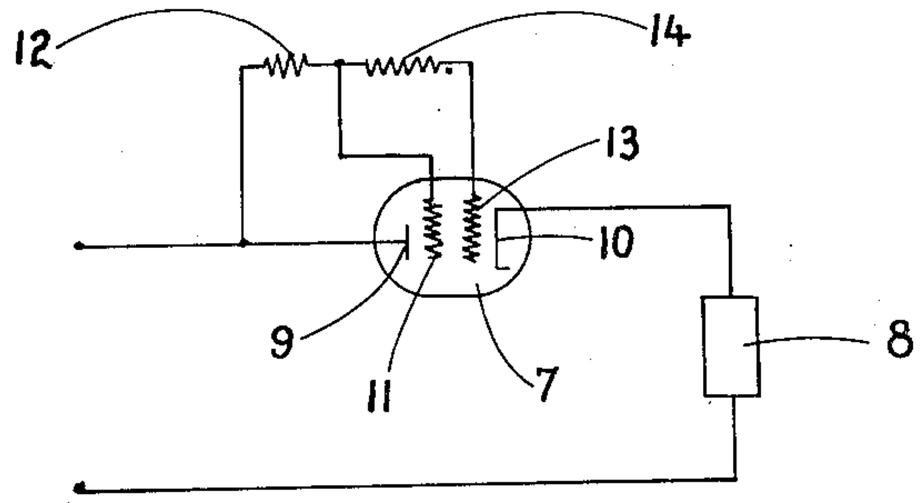

Fig. 4

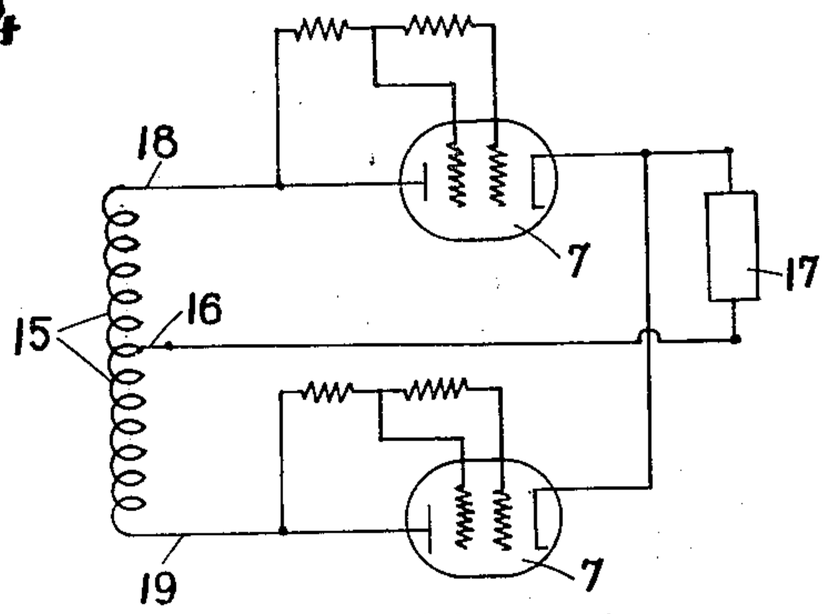

Fig. 5

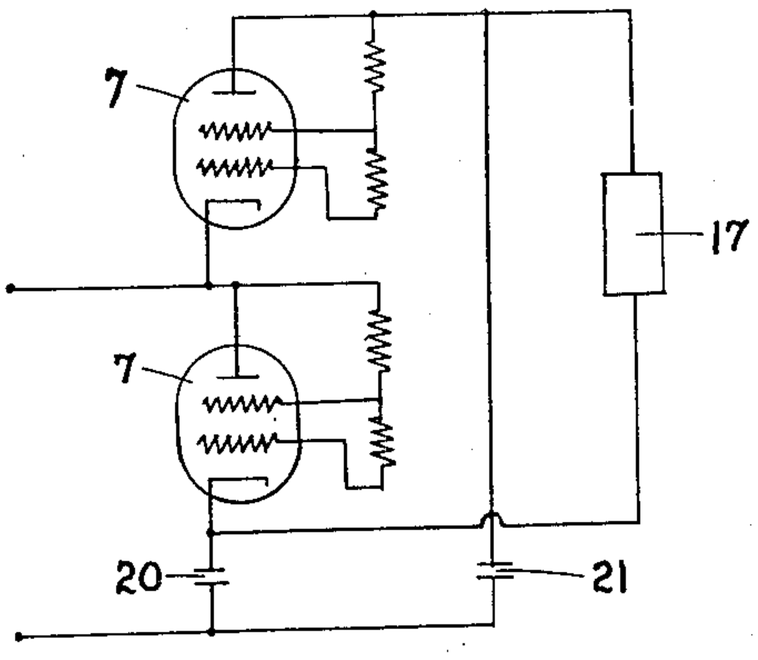

Fig. 6

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Patented Oct. 25, 1949

2,486,025

UNITED STATES PATENT OFFICE

2,486,025

RECTIFIER TUBE AND CIRCUIT

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Application September 12, 1945, Serial No. 615,898

1 Claim. (Cl. 315—261)

1

This invention relates to electric discharge tubes, and particularly to rectifier tubes and circuits therefor.

An especial object of the invention is rectification of high voltages with "cold-cathode" tubes, although certain features of the invention are applicable to "hot-cathode" tubes and the device is also useful on low voltages. Another object of this invention is to have lower starting voltage and a higher inverse voltage than previously attainable in normal cold-cathode rectifiers. A further object is rectification of high peak currents.

A feature of the invention is an electron-emissive, or low work function, grid near the cathode. Another feature is a grid near the anode and of high work function; for example, a carbon grid.

A particular feature is the combination of a low work-function grid at the critical distance from the cathode to give minimum striking potential and a second grid spaced from the cathode a distance greater than or less than said critical distance. The low work function grid tends to initiate the discharge because of its low striking potential.

A further feature is the connection of said grids back to the anode through resistors. By using these resistors, the voltage between the two grids is kept less than the striking potential between them when the low voltage grid acts as a cathode. The high work function grid is operated in such a way that it will not glow under negative voltage but acts only under positive voltage. Impedances, such as condensers or inductances, may often be used instead of resistances to connect the grids together and to the anode. In some cases the two grids may be directly connected together without a resistor, although this will not ordinarily be preferable.

Other features, objects and advantages of the invention will be apparent from the following specification and its accompanying drawings.

Figures 1, 2 and 3 show diagrammatic cross-sections of the rectifier with three different positions of the two grids so that the low work function grid is at a distance from the cathode to give minimum striking potential and the high work function grid is nearer to or farther from said cathode than the critical distance.

Figure 4 shows a half wave rectifier circuit according to the invention.

Figure 5 shows a full wave circuit of one type; and

2

Figure 6 shows a full wave circuit of the "voltage doubling" type.

In Figure 1, the cathode 1 of electron-emitting material is connected by wire 2 in the circuit and the anode 3 is connected to the lead-in wire 4. The grid 5 is made of high work function material such as carbon and is positioned between the anode and cathode; the low work function grid 6 is positioned at a distance from the cathode to give minimum striking potential and the high work function grid is nearer the cathode than the minimum striking potential distance.

In Figure 2, the cathode 1 and the anode 3 are connected to the circuit by lead-in wires 2 and 4 respectively, the low work function grid 6 is positioned at a distance from the cathode to give minimum striking potential and the high work function grid is farther from the cathode than the minimum striking potential distance.

In Figure 3, the low work function grid is positioned between the cathode 1 and the carbon grid 5 and shields the carbon grid from the cathode. In this case, the low work function grid may be placed at some distance other than the critical distance, if desired, although it may preferably be placed there for low striking voltage.

In Figures 1 and 2, the low work function grid may also be placed at some distance other than the critical one, providing it is placed in position to have a lower striking potential than the carbon grid.

In Figure 4, the rectifier tube 7 and the load 8 are connected in series with the alternating current line. The anode 9 is connected to one side of the line, and the cathode 10 to one side of the load 8, the other side of said load being connected to the alternating current line. The high work function grid 11 is connected back to the anode 9 through a resistance 12 and to the low work function grid 13 by a resistance 14. When the anode 9 is positive, the grids are positive. The first grid 13, being near the cathode, helps to start the discharge by producing ionization near the cathode, and the second grid 11 being more positive than the first grid produces ionization near the anode and thus helps to produce ionization throughout the tube. This facilitates the discharge. When the first grid 7 is negative, it acts as a cathode and allows a small discharge to the normal cathode. The resistance 14 should be great enough to keep the current flow from this grid 13 small. The grid 11 is then more negative than grid 13 and prevents any discharge through the remainder of the tube.

Figures 5 and 6 represent modifications to pro-

duce full wave rectification and full wave voltage doubling. In Figure 5, 15 is the usual center-tapped transformer, with the center tap 16 going to one end of the load 17, and the ends 18, 19 of the transformer winding going to the other end of the load through the tubes 7. In Figure 6, the condensers 20 and 21 are interposed in the usual voltage doubling manner.

A tube according to the modification of Figure 3 is also shown in my co-pending application Serial No. 612,217, filed on August 20, 1945, which issued December 30, 1947, as U. S. Patent No. 2,433,813.

What I claim is:

A rectifier circuit comprising: terminals for a source of alternating current; a tube having a gas filling, an anode connected to a terminal of said source, a high work function grid around said anode and connected thereto by a resistor to prevent a discharge to said anode when said anode is negative, a cathode connected to the other terminal of said source, a low work function grid near said cathode and between said cathode and said high work function grid and connected to said high work function grid through a resistor to permit a limited current

to said cathode when said cathode is positive and to aid in starting the discharge when said cathode is negative, and connections for a load in a series circuit that includes the anode and cathode of said tube and the alternating current terminals of said source.

ROBERT C. HILLIARD.

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The following references are of record in the file of this patent:

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