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A. CHRISTIE

2,201,979

CONSTANT VOLTAGE RECTIFIER CIRCUIT

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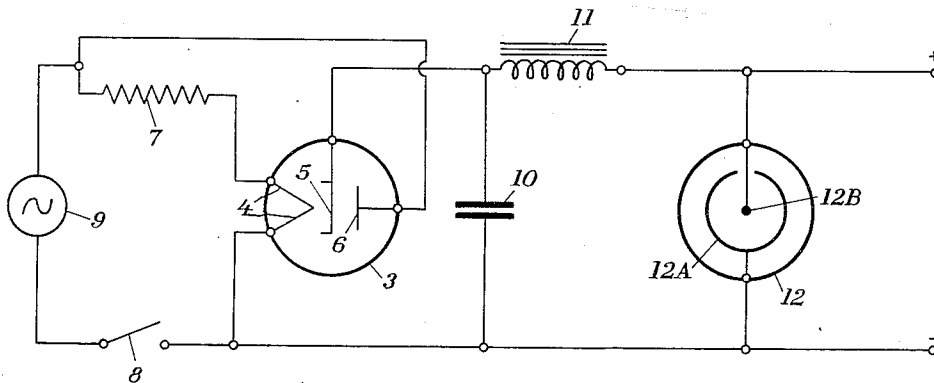


Fig. 1

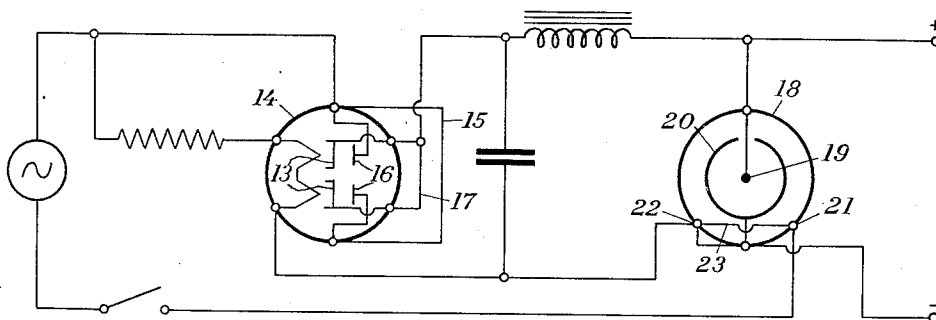


Fig. 2

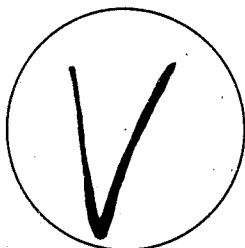


Fig. 3

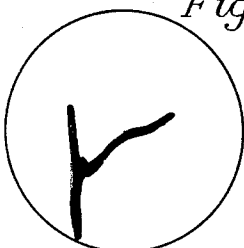


Fig. 4

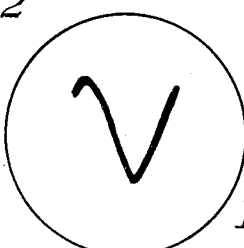


Fig. 5

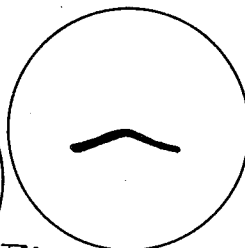


Fig. 6 Inventor

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UNITED STATES PATENT OFFICE

2,201,979

CONSTANT VOLTAGE RECTIFIER CIRCUIT

Alfred Christie, Washington Grove, Md., assignor
to Henry A. Wallace as Secretary of Agriculture
of the United States of America, and his suc-
cessors in office

Application May 2, 1938, Serial No. 205,517

1 Claim. (Cl. 175—363)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

This application is made under the act of March 3, 1883, as amended by the act of April 30, 1928, and the invention herein described, if patented, may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment to me of any royalty thereon.

This invention relates to electrical rectifiers and is more particularly concerned with such rectifiers which employ a thermionic valve.

One of the objects of this invention is the provision of such a rectifier for use with instruments which require a constant voltage potential output under varying conditions of input current such as is required by the Tag-Heppenstall moisture meter. See U. S. Patent No. 1,826,247.

One of the advantages of this invention over other types of rectifiers is that it does not require for its successful operation any transformers, auxiliary batteries, or other parts heretofore essential.

The following description considered together with the accompanying drawing will fully disclose this invention, its construction and operation of parts and further objects and advantages thereof will be apparent.

In the drawing:

Figure 1 is a diagram of the circuit employed in this invention in its simplest form.

Figure 2 is a diagram of a modification of the circuit shown in Figure 1.

Figures 3, 4, 5 and 6 are facsimile reproductions of oscillograph curves hereinafter fully explained.

Referring with more particularity to Figure 1, an ordinary rectifier tube 3 having the usual heater filament 4, cathode 5, and plate or diode 6, is of the half-wave type. The filament 4 is energized by the input alternating current through a line-cord resistor 7 and is controlled by the toggle switch 8. The diode 6 of the rectifier tube 3 is connected with the lead of the input between the line resistor and the input source 9. The cathode 5 is connected to the positive of the output lead through a choke coil 11. The negative lead of the output is connected to the filament circuit of the rectifier tube. The capacitance or filter condenser 10 is connected across the output of the rectifier tube and an electronic voltage regulator 12 having a cathode 12 A and an anode 12 B is shunted across the output of the filter system, which system comprises the capacitance 10 and choke 11. It is to be understood, however, that additional filter systems may be employed to reduce ripple characteristics. The electronic voltage regulator 12 may be of any of the types in common use, preferably

the voltage regulator tube described in U. S. Patent No. 1,760,524.

For a constant 90 volt potential, such as is required by the above-mentioned Tag-Heppenstall moisture meter, the voltage regulator tube commercially designated as the "874" is found to be satisfactory. Also, better and more economical results are obtained by using a voltage doubler rectifier tube, instead of an ordinary rectifier tube, and mutually connecting the two diodes and the two cathodes, respectively. These connections are accomplished outside of the tube. With these modifications the circuit is substantially as shown in Figure 2. In this figure the cathodes 13, 13 of the voltage doubler rectifier tube 14, are mutually connected by means of the wire 15, and the two diodes 15, 16 are mutually connected by means of the wire 17. The electronic voltage regulator tube 18 is shunted across the output with the electrodes 19 and 20, said electrodes being the anode and cathode, respectively, of said regulator tube. It is preferable, however, to utilize two additional terminals 21, 22, on said voltage regulator tube 18, as a switch. These terminals are mutually connected internally by means of a wire 23 so that by placing these terminals in series with the filament circuit of the rectifier tube the system will not work unless the voltage regulator tube is present in the circuit. This prevents any damage to the system which may result from the absence of the tube.

Where it is desired to maintain a voltage of 90 volts from an alternating potential of substantially 90 to 120 volts, the above-mentioned specified tubes are preferred and in addition thereto the capacitance or filter condenser 10 should have a working voltage of 250 volts. The line-cord resistor should be of sufficient value to reduce the current for the filament of the rectifier tube to a satisfactory limit.

If desired the capacitance 10 may be used on the choke output instead of the choke input. Also, it may be found advantageous in some cases to employ two capacitances, one on the input and the other on the output of said choke. It is to be understood that such modifications are within the scope of this invention.

As it is above stated, one of the advantages of this invention is that it does not require any transformers, auxiliary batteries or other parts heretofore considered necessary in other types of rectifiers. This is the essence of the invention. For example, while other types of rectifying circuits employ electronic voltage regulator tubes or, as they are commonly termed, "glow

discharge tubes", they do not employ a choke in series with the tube. This choke serves to insure and maintain the glow tube with a safe operating current above its extinction potential and it also reduces output ripple characteristics. This is very essential especially in half-wave rectification because an off-phase-in-phase cycle is delivered by the output of the rectifier tube and unless some provision is made the glow tube will become damaged. While a pure resistance might be used to protect the tube from damage, it will not maintain the required voltage for continuous operation of the glow tube.

To more clearly illustrate the distinguishing characteristics of this invention over other half-wave rectification circuits, experiments have been conducted using an oscillograph to show the alternating current component of the output of various rectification circuits in contrast to the circuit of the present invention. Figure 3 shows the characteristic curve obtained using an equivalent pure resistance instead of the choke and an equivalent bleeder resistance instead of the glow tube in the circuit illustrated in Figure 2. Figure 4 is the result of the same circuit with the bleeder resistance replaced by a glow tube. Figure 5 is the result of using a choke in combination with the bleeder resistance and Figure 6 is the characteristic curve of the present invention where the choke in combination with a glow tube demonstrates substantially a direct current characteristic approaching very closely the kind of a current normally drawn from batteries. All of the above results were obtained

under identical conditions of input and output and under exactly the same scale ratios of the oscillograph. In all of these four figures the vertical displacement represents the voltage of the alternating current component of the output and the horizontal displacement is a function of time. Accordingly, each figure represents a complete wave cycle. From these facsimiles it may be seen that the voltage of the alternating current component of the output in Figure 6 is practically negligible in comparison to those of Figures 3, 4 and 5.

It is to be understood that while the above invention has been described as being applicable to an alternating current input it may also be employed with direct current input.

Having thus described my invention, I claim:

A constant voltage rectifier consisting of an output circuit and an input circuit in combination with a thermionic valve tube, said tube having twin cathodes mutually connected exterior to said tube, twin diodes mutually connected exterior to said tube, and a filament circuit energizable by said input circuit through a line cord resistor; a glow discharge tube and a condenser in parallel with said output circuit and a choke coil in series with said output circuit between said condenser and said glow discharge tube, whereby said glow discharge tube is maintained and insured with a safe operating current above its extinction potential, that part of the circuit between the glow discharge tube and the load of the circuit being shuntless and non-inductive.

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