Oct. 9, 1928. 1,686,974

F. H. KROGER

RECTIFYING AND FILTERING SYSTEM

Filed Feb. 6, 1925

Fig. 1

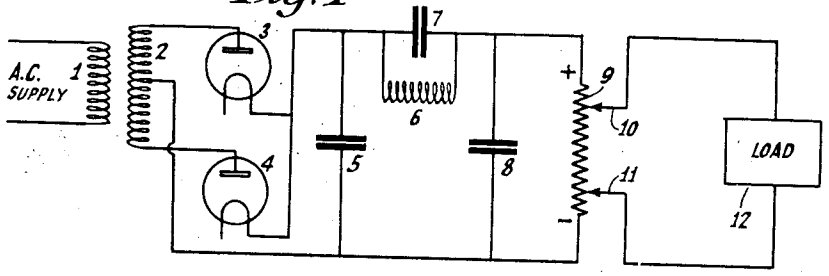


Fig. 2

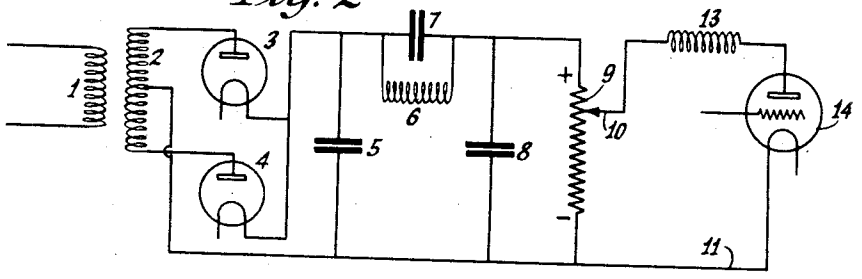


Fig. 3

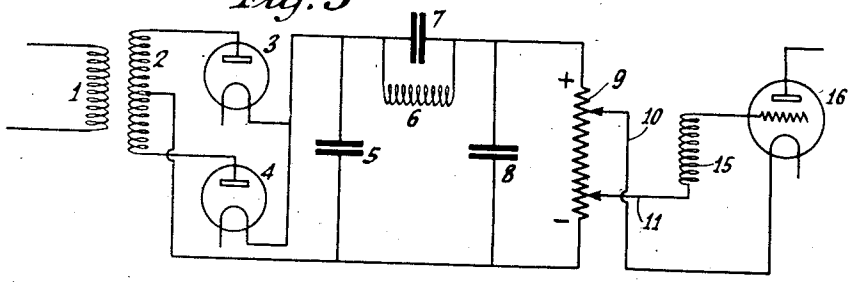
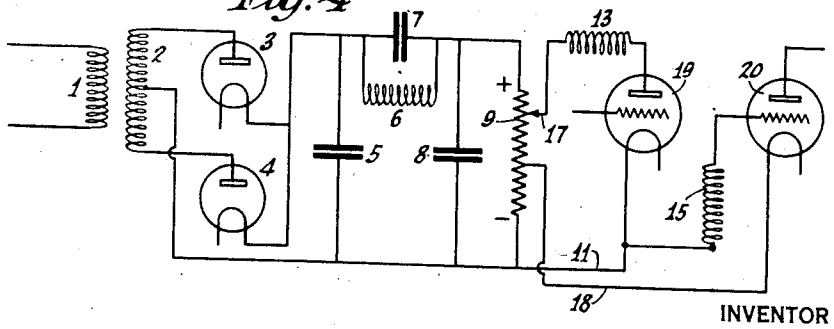


Fig. 4



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FRED H. KROGER, OF BROOKLYN, NEW YORK, ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE.

RECTIFYING AND FILTERING SYSTEM.

Application filed February 6, 1925. Serial No. 7,229.

This invention relates to an improvement in rectifying and filtering systems, and, while it is capable of general use for all purposes for which such systems are used, it is more especially adapted for and intended to be used with an alternating current supply line for supplying direct current voltage to thermionic vacuum tubes.

It is an object of this invention to provide a system which shall be simple to install and operate and at the same time dependable and reliable.

It is a further object of this invention to provide a system which will suppress or smooth out fluctuations in the rectified voltage to a greater extent than systems known in the art.

It is a further object of my invention to provide a rectifying and filtering system capable of deriving from alternating current a non-fluctuating direct potential of sufficient freedom from modulation or fluctuations to be applied to the grid of a vacuum tube amplifier as a bias voltage.

It is a still further object of my invention to provide a new and improved system for supplying unmodulated uni-directional voltage and current at a plurality of potential differences simultaneously.

It is a still further object of my invention to provide a new and improved system for supplying unmodulated uni-directional voltage and current from the same alternating current supply at a potential difference which may be varied at will.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims; my invention itself however, both as to its organization and method of operation, will best be understood by reference to the following description taken in connection with the accompanying drawing, in which

Fig. 1 shows the fundamental circuit arrangement utilized in my invention;

Fig. 2 shows the application of my invention to furnish plate voltage for a thermionic vacuum tube;

Fig. 3 shows the application of my invention to furnish a grid bias voltage to a thermionic vacuum tube; and

Fig. 4 shows the application of my invention to furnish simultaneously plate voltage and grid bias voltage to a plurality of thermionic vacuum tubes.

Referring to Fig. 1, my invention comprises a double or full wave rectification system of the type shown in patent to Hull, No. 1,251,377, consisting of a transformer which may have a primary 1 and a secondary 2. The opposite ends of the secondary 2 are connected to similar elements of rectifiers 3 and 4 which may be and preferably will be thermionic rectifiers of the type generally known as "Fleming valves," while the primary 1 is energized from any convenient source of alternating or fluctuating current.

As is well known, if a connection is made to the midpoint of the secondary of the transformer and a connection is likewise made to the common point of the filaments of the rectifiers, a uni-directional voltage will be obtained between these two points. This voltage, however, cannot be used for the energization of thermionic vacuum tubes on account of its highly fluctuating nature, but must be smoothed out. For the purpose of smoothing this voltage to the point desired, I provide a filter which may consist of condensers 5 and 8 shunted across the direct current lines, and an impedance element interposed in one of the lines between condensers 5 and 8. This impedance element may take the form of a trap consisting of condenser 7 and impedance 6 so chosen that substantially infinite impedance is offered to any frequency desired to be eliminated, but it is to be understood that my invention is not limited to the precise form of filter shown and that other suitable arrangements may be used if desired.

Connected across the positive and negative supply lines, I connect a resistance 9 as shown so that a continuous current flows from one end thereof to the other, providing a continuous voltage drop thereacross. The load 12, requiring such continuous voltage,

is connected to suitable points on this resistance by means of leads 10 and 11. Resistance 9 may be made variable if desired and will preferably be so arranged that the voltage drop across a variable portion of it may be utilized for feeding the load 12.

It must be understood that if good regulation of the load voltage is desired; that is to say, if constant voltage is desired at the load under a varying current, resistance 9 must be chosen of such value with respect to the resistance of the load and the value of the potential difference between the positive and negative supply lines that fluctuations in current drawn by the load have relatively little effect upon the voltage across the load; that is to say, if it is desired that the voltage at the load shall not fluctuate more than 10%, due to changes in the current taken by the load, the resistance 9 must be of such value that the current therethrough is approximately 10 times the maximum current through the load.

Similarly, if a fluctuation of 1% is desired, the current through resistance 9 must be approximately 100 times the current through the load. Under these conditions, constant voltage within the limits desired will be applied to the load and by proper choice of values of the elements of the filter, the fluctuations of the rectified voltage may be eliminated.

In Fig. 2 I have shown how such an arrangement as shown in Fig. 1 may be utilized to supply plate voltage to a thermionic vacuum tube designated as 14. As shown, lead 11 is connected to one terminal of the filament of the vacuum tube and also to the negative terminal of resistance 9. The plate circuit of the tube 14 may include any suitable or desired translating device, such for instance as the primary of an amplifying transformer, diagrammatically shown as coil 13. The terminal of this translating device, remote from the plate of tube 14, is connected through lead 10 to a suitable point on resistance 9.

Referring to Fig. 3, I have shown the application of my invention to furnish a grid bias voltage to a vacuum tube designated as 16. In this arrangement, it is generally desired that the grid of the tube be maintained at a negative potential with respect to the filament and, therefore, the filament of tube 16 is connected through lead 10 to a suitable point on resistance 9 as shown. The grid of the tube is connected through any suitable means for changing the grid potential, such for instance as coil 15, which may be the secondary of an input transformer, through lead 11 to a suitable point on the resistance 9, negative with respect to the point at which lead 10 is connected to resistance 9.

It should be pointed out in this connection that it will not be necessary in this arrangement to calculate carefully the value of resistance 9, since the load in this case is essentially an open circuit and takes practically only charging current, since, as is well known, the use of a negatively biased grid in a thermionic vacuum tube prevents the flow of electrons from the filament to the grid and therefore prevents any flow of direct current between these electrodes.

Referring to Fig. 4, I have shown an arrangement adapted to supply plate voltage to a thermionic tube designated as 19, and grid bias voltage to a second thermionic tube designated as 20. It will be noted that the arrangements of the circuits associated with tube 19 are substantially the same as those shown in Fig. 2 and the arrangements of circuits associated with tube 20 are essentially the same as those shown in Fig. 3.

While I have shown in each case only a single thermionic vacuum tube as being supplied with current, it will be clear that a number of these may be operated in parallel, if desired. For instance, in a multi-stage amplifier, all of the amplifying elements may be supplied with plate potential from resistance 9 at the same potential or at progressively increasing or decreasing potentials, as the case may be, and likewise in a system embodying radio frequency amplifiers, detectors and audio frequency amplifiers, all of the vacuum tubes may be supplied with plate potential at proper values by suitably tapping different points of resistance 9.

Having described my invention, what I claim is:

1. In a direct current supply system for vacuum tubes and the like, the combination of a source of power adapted to be energized by alternating current, means for rectifying said alternating current, means for smoothing out fluctuations in said rectified current comprising a filter, a resistance connected across the output side of said filter, a vacuum tube, a plate circuit and filament return therefor tapped across one portion of the resistance, a second vacuum tube and a grid filament circuit therefor tapped across another portion of said resistance the grid being energized at the same potential as the filament return of said first named tube.

2. In a direct current supply system for vacuum tubes and the like, the combination of a source of power adapted to be energized by alternating current, means for rectifying said current, means for smoothing out fluctuations in said current comprising a filter and a resistance connected across the output side thereof, output terminals connected at intermediate points on said resistance, a load connected to said output terminals of such a value that the current used thereby is relatively small with respect to the current flowing in said resistance, said

load including a vacuum tube having a plate circuit and a filament return therefor connected to certain ones of said output terminals and completed through a predetermined portion of said resistance, a second vacuum tube and a grid filament circuit therefor connected to others of said output terminals and completed through another predetermined portion of said resistance, the grid of said last named tube being energized at the same potential as the filament return of said first named tube.

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