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VOLTAGE REGULATOR FOR RADIOTRANSMITTERS

Filed Nov. 12, 1923

Fig. 1

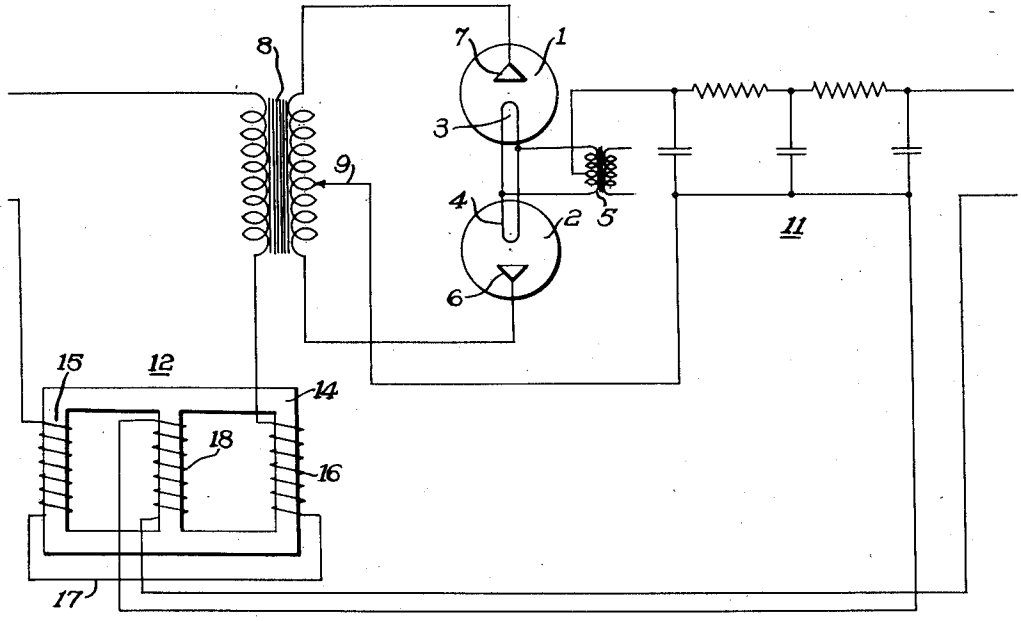
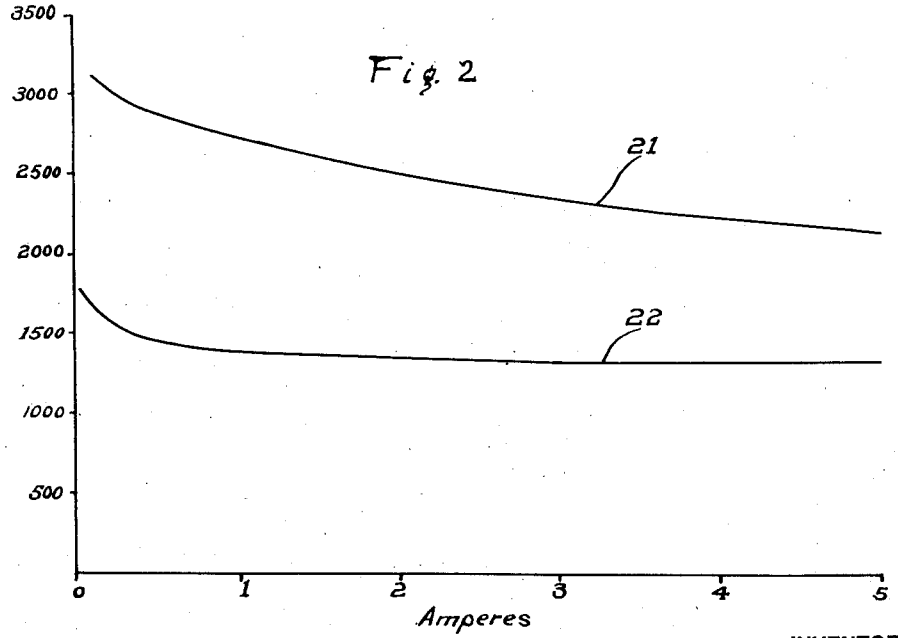


Fig. 2



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UNITED STATES PATENT OFFICE

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VOLTAGE REGULATOR FOR RADIOTRANSMITTERS

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My invention relates to the regulation of the output voltage of a thermionic rectifier and filter combination.

The object of my invention is to provide a means for use in conjunction with thermionic rectifiers that will reduce the voltage change experienced when the load demand upon the thermionic rectifiers is changed.

More specifically, my invention provides means whereby the output current of a thermionic rectifier is made to vary the impedance of the input circuit to the transformer which supplies high voltage energy to the rectifier, in such way that an increase in load upon the rectifier permits a rise in the voltage supplied to the rectifier without reducing the steady voltage of the filtered rectified current.

As constructed in the prior art, the thermionic rectifier tube has a high impedance. When a load is supplied, absorbing the output of the rectifier, it is found that the presence of the high impedance in the tube causes its regulation to be poor, that is, an increase in load produces a considerable decrease in direct-current potential in the output circuit even though the voltage in the input circuit be held constant.

To counteract this effect, my invention provides means whereby an increase in load upon the output circuit will permit an increase in the potential applied to the rectifier tubes, thereby substantially compensating the drop in potential, produced by the rectification.

Other objects and structural details of my invention will be apparent from the following description and claims when read in connection with the accompanying drawings, wherein:

Figure 1 is a diagrammatic view of the elements of my invention, and

Fig. 2 shows the regulation curves of a thermionic rectifier with, and without, my invention applied thereto.

The system shown in Fig. 1 comprises two thermionic rectifiers 1 and 2. Their respective filaments 3 and 4 are connected in parallel relation to the secondary winding of a filament transformer 5. The plates 6 and 7 are connected to the secondary of a power transformer 8, the midpoint of which is provided with a tap 9. A filter system 11 may be provided in a manner common in the prior art. An impedance device 12 is provided which comprises a laminated iron core 14 having three parallel legs connected by two yokes, as shown, the two outer legs being provided with coils 15 and 16 having two corresponding terminals connected by a wire 17. The coils 15 and 16 are wound in the same direction to produce a magnetic flux in the core 14 which tends to circulate only through the legs upon which they are mounted and the connecting yokes and are connected in series with the primary winding of the transformer 8.

The third leg of the core 14 is provided with a coil 18 which is connected in the output circuit of the rectifier between the filter system and the load. One terminal of the filter system 11 is connected to the midpoint of U secondary winding of the filament transformer 5 and, through the respective halves of the winding, to filaments 3 and 4.

In operation, the filaments 3 and 4 of rectifier tubes 1 and 2 are excited by energy supplied through transformer 5 from a source of commercial frequency.

The primary coil of transformer 8 is connected to a supply of energy at commercial frequency through coils 15 and 16 of impedance device 12, whereby a voltage is induced in the secondary coil of transformer 8 and impressed upon the plates 2 and 6 of rectifiers 1 and 2. Alternate half cycles then take alternate paths through the rectifier in the usual manner, upon the application of a load to the rectifier.

The output of direct current from a rectifier being unsteady, as is well known, it may be steadied and smoothed out by the filter system 11 which constitutes a by-pass for the alternating-current component of the rectifier output. The connection from the output terminal of the filter system 11 to the saturating coil 18 of the device 12 permits a steady direct-current output to flow. The construction of the device 12 is such that no alternating-current effect is impressed upon

the coil 18 by currents flowing in the coils 15 and 16.

With energy applied through device 12 to the primary of transformer 8 and no load upon the output circuit of the rectifier, no current will flow through coil 18 of the device 12. Under these conditions, the full permeability of core 14 is available for magnetic flux, thereby producing maximum impedance in coils 15 and 16 which will substantially reduce the charging current flowing through the primary of transformer 8, thereby reducing the voltage applied to the rectifier and, in consequence, reducing its output voltage. If a small load is applied to the output circuit of the rectifier, a small current will flow through the secondary of transformer 8, the plate circuits of the rectifiers, the electron streams, the filaments, the filament transformer secondary, the one branch of the filter system 11, the load, coil 18 and the other branch of the filter system to tap 9 of the transformer 8. The current through coil 18 will magnetize the core 14, thereby reducing the magnetic permeability available for producing impedance in coils 15 and 16. This reduction in impedance permits a larger charging current to flow through the primary of transformer 8 and also permits a load current to flow, thereby raising the output potential of the transformer and thus of the input to the rectifier and, in turn, of the output of the rectifier and thus compensating for the drop in potential with load which occurs when current passes through the rectifier tubes.

A still greater load upon the output circuit of the rectifier will cause a greater current to flow through coil 18 to thereby increase the magnetization of core 14, and still further reduce its permeability and the consequent impedance of coils 15 and 16. Coil 18 may be so proportioned with respect to core 14 and rate of flow of current thru the rectifier assembly that, at full load, the impedance in coils 15 and 16 may be almost destroyed, whereupon the potential of the output current of the rectifier will be substantially the same as it would be in the absence of impedance device 12.

Fig. 2 shows the change in the characteristic curve of rectifier output regulation produced by my invention. In Fig. 2 output current is plotted upon the horizontal axis and output voltage upon the vertical axis. The characteristic curve of the rectifier without the device of my invention is shown by curve 21. It will be observed that, with no current in the output circuit, the maximum voltage obtains. A small current drawn from the rectifier causes a substantial drop in output voltage, the voltage dropping off rapidly with the increase in load, until full load voltage is approached. Curve 22 shows the characteristic curve of the voltage of the same rectifier equipped with my invention. It will be noticed that the voltage at no load has a value much below that of an unregulated rectifier, that a small current in the output circuit gives only a slight drop in output voltage and that as greater load current is drawn, a substantially constant voltage is maintained at full-load current of the rectifier.

By means of the device described, I am able to operate a thermionic rectifier at a much more nearly uniform output potential for a variety of output loads than has previously been possible.

The alternating-current art employs arrangements consisting of elements, each comprising an admittance in shunt across a line and an impedance in series with the line, the two coacting to separate an input current into two components through by-passing part of the current via the shunt admittance while the remainder passes through the series impedance to the load. In the following claims, such an arrangement is termed a filter of the by-pass type.

I am able to operate a thermionic rectifier and a filter system simultaneously in such manner as to produce a very high-voltage, low-amperage, direct-current output which is of substantially constant voltage and free from alternating-current fluctuations.

While I have shown only one embodiment of my invention in the accompanying drawings and have indicated it for a single purpose, it is capable of various changes and modifications without departing from the spirit thereof and it is also capable of application to other purposes. It is desired, therefore, that only such limitations shall be placed thereon as are indicated in the prior art or in the appended claims.

I claim as my invention:

1. In combination with a device possessing uni-lateral electrical conductivity interconnecting an alternating-current circuit and a direct-current circuit, impedance means comprising a magnetic core in magnetic inductive relation with a winding in the direct-current circuit and carrying a winding in the alternating-current circuit and a second magnetic core in magnetic inductive relation with the winding in the direct-current circuit and carrying a winding in the alternating-current circuit, the electromotive force introduced in the direct-current circuit by said first alternating current winding being equal and opposite to the electromotive force introduced therein by said second alternating current winding.

2. In combination with a device possessing a uni-lateral electrical conductivity, an alternating-current circuit and a direct-current circuit, an impedance comprising a magnetic core having two end yokes joined by three limbs, identical windings on two of said

limbs connected in series with one of said circuits in such direction that said yokes are at the same magnetic potential, and a winding in series with the other of said circuits on the third limb.

3. In combination with a rectifier, an alternating-current supply circuit, a direct-current load circuit and a filter in said direct-current circuit, a regulator comprising a magnetic core having three limbs joined by yokes at each end, a winding in series with the direct-current circuit on one limb, and two windings in series with the alternating-current circuit on the other limbs so wound as to induce equal and opposite electromotive forces in the direct-current winding.

4. In combination with a uni-directional current-carrying device interconnecting an alternating-current circuit with a continuous-current circuit, an impedance comprising a magnetic core energized by a winding in the first circuit and controlled by a winding in the second circuit so arranged as to prevent the introduction of alternating currents in the second winding by the first winding.

In testimony whereof, I have hereunto subscribed my name this 6th day of November, 1923.

ROBERT L. DAVIS.