Sept. 19, 1933. B. F. MIESSNER 1,927,689

ELECTRICAL FILTER SYSTEM

Filed May 3, 1929

Fig. 1.

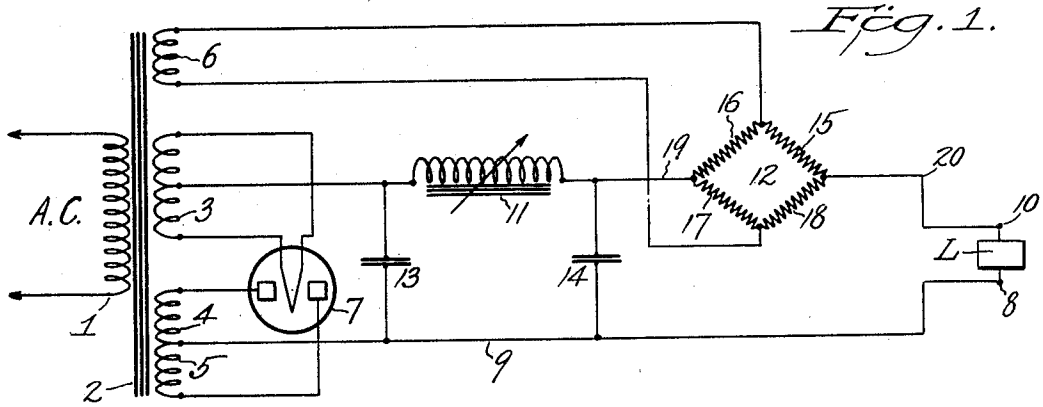


Fig. 2.

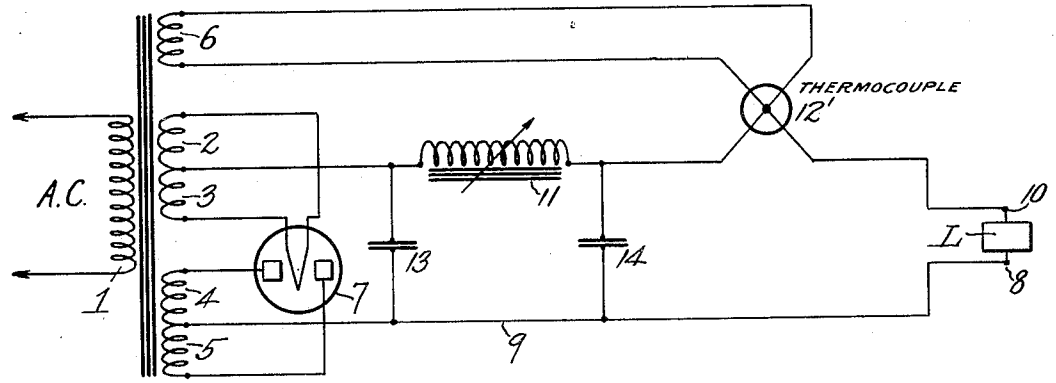


Fig. 3.

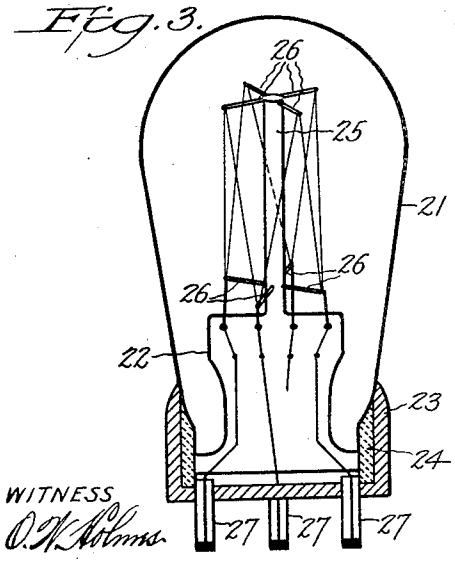
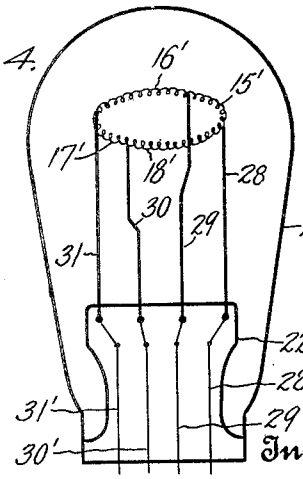


Fig. 4.



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ELECTRICAL FILTER SYSTEM

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Application May 3, 1929. Serial No. 360,041

6 Claims. (Cl. 178—44)

My present invention relates to electrical filter systems for smoothing out pulsating unidirectional current.

The primary object of the present invention is to provide a filter system in which there is produced a substantially constant potential unidirectional current output from a pulsating current input.

Another object of my invention is the provision of a filter system which delivers unidirectional current substantially free from alternating current ripple for use in energizing the vacuum tubes of radio receivers and transmitters from a commercially available alternating current source, and for use in all other apparatus in which steady unidirectional current is desirable.

A feature of this invention is the provision of novel apparatus and arrangement for introducing into a source of unidirectional pulsating current auxiliary pulsations of corresponding frequency and of phase opposed to the pulsations of said unidirectional current, and automatically determining the magnitude of such auxiliary pulsations with respect to the magnitude of the pulsations of said unidirectional current.

Further objects of my invention will be apparent from the description of the accompanying drawing in which like reference characters indicate corresponding parts throughout the several figures, and in which

Fig. 1 is a circuit diagram of one embodiment of my invention,

Fig. 2 is a modification thereof,

Fig. 3 is a sectional view of my improved resistance tube, and

Fig. 4 is a modification thereof.

Referring to Fig. 1, the primary 1 of a transformer 2 is connected to a source of alternating current A. C. The transformer 2 is provided with a plurality of secondaries 3, 4, 5, and 6. The secondary 3 supplies filament heating current for a full wave rectifier 7, the anodes of which are connected to the terminals of the power secondary 4, 5. The midpoint of the secondary 4, 5 serves as the reference or negative terminal of the system to which all potentials will be hereinafter referred and from which I have provided an output terminal 8 connected thereto by a lead 9, and to which terminal 8 the work load or loads L, such as plate circuits of vacuum tubes, may be connected.

The mid-point of the secondary 3 serves as the high or positive potential terminal of the rectifier tube 7, and is connected to the filter output terminal 10 through a variable choke coil 11 and my improved ripple suppressing device 12 to be described in detail hereinafter. The choke coil 11 is shunted to the lead 9 with filter condensers 13 and 14.

In this instance my improved ripple suppressing device consists of a bridge resistance consisting of four sections 15, 16, 17 and 18 of very fine resistance wire having an extremely high temperature coefficient of resistivity and very small thermal inertia, together with high heat loss characteristics at the frequency of the current of the source A. C. I have provided for the increase of heat loss and stability of the resistances by making this unit as a replaceable tube having a sealed envelope surrounding the resistance, the envelope being filled with hydrogen as will be described in detail with reference to Figures 3 and 4.

The electrical characteristics of each of these resistance sections 15, 16, 17 and 18 are identical. Between the sections 15, 16 and 17, 18, I have connected the terminals of the transformer secondary 6 and between the sections 16, 17 and 15, 18 I have connected the leads 19 and 20 to the terminals of choke coil 11 and the filter output terminal 10, respectively.

As the alternating potential across the terminals of the secondary 6 varies the sections 16, 17 and 15, 18 alternately heat and cool, and thus as the pulsations occur in the filter system the resistances therein, namely 16, 15 and 17, 18, alter in value to compensate for the pulsations and maintain the potential across the work load constant.

This arrangement thus provides a means for automatically increasing and decreasing the resistance in the high potential lead from the rectifier 7 without introducing the heating current potential set up across the sections into the filter supply to the work load.

The circuit shown in Fig. 2 is identical with that of Fig. 1 except for the ripple control device 12', which I now illustrate as a thermocouple arranged to produce a pulsating potential opposing the ripple potential of the filter supply to the load circuit, and which opposing potential is determined by the variation in temperature of the thermal junction resulting from current heating changes with variation in potential across the secondary 6. This system likewise maintains the potential at the terminals 8 and 10 satisfactorily constant for practical uses.

In Figs. 3 and 4 numeral 21 indicates a glass envelope with the usual seal 22 and filled with hydrogen. Each tube is provided with a four pronged base 23 of insulating material secured to the envelope 21 by means of wax 24, as is customary in the production of vacuum tubes.

The press 22 of Fig. 3 carries a glass mast 25 at the top and bottom of which are four alternately spaced supports 26. Wound upon these supports are four inverted V filaments, the lower terminals of each of the V's being connected to its corresponding prong 27 on the base of the tube.

The press shown in Fig. 4 carries four metallic supports 28, 29, 30, 31 rigidly sealed into the press 22, and each in conductive relation to its appropriate wire 28', 29', 30', 31' leading to the prongs on the base of the tube.

The upper extremities of these supports 28, 29, 30, 31 have welded thereto the ends of the resistances 15', 16', 17', 18'. In this particular device I have shown the sections coiled in order to obtain the same length and effective electrical characteristics as those of 15, 16, 17 and 18 of Figure 3.

These resistances may be filaments of iron or tungsten. The operation of my device is as follows: since the frequency of the fluctuating component of the filter output is double the frequency of the alternating current source when a full wave rectifier of the type shown at 7 is used, and since the effect of the ripple suppressing devices 12, 12' upon the load current varies also at double the source frequency and in phase with the filter output ripple, the periodic increases in the resistance or opposing potential in the devices 12, 12' occur at the same time as the increases in the filter output voltage. The variations therefore in the devices 12, 12' compensate for attempted changes in the potential of the filter so that the potential at the terminals 8 and 10 is maintained substantially constant. It should be noted that under certain conditions the fluctuating component in the output of the filter circuit and the fluctuations controlling the resistance bridge 12 or the thermocouple 12' as the case may be are not so related that an exact compensation of the fluctuating components takes place. In order to provide proper control for such cases choke 11 has been made variable. By changing the value of the coil 11 through the adjustments provided and shown diagrammatically in Figs. 1 and 2, a sufficiently exact balancing action may be obtained so that the current fed to the working circuit L may be made as smooth as desired.

It is to be understood that while I have described only two specific forms of my invention, it is not intended to limit the scope thereof to the forms herein shown, since detail changes may be made therein without departing from the spirit of my invention as defined in the claims appended hereto.

Having described my invention what I claim is:

1. In an electrical current supply system the combination of a source of fluctuating unidirectional current, a work circuit adapted to be energized by said source, a filter circuit comprising an adjustable network of reactive elements for coupling said work circuits with said source, a resistance controlling device series connected between said filter circuit and said work circuit, and means for varying the value of said resistance in consonance with the fluctuating component of said source whereby said work circuit is protected from said fluctuating component of said source.

2. In an electrical current supply system the combination of a source of fluctuating unidirectional current, a work circuit adapted to be energized by said source, a filter circuit comprising a reactive network for coupling said work circuit with said source, a resistance controlling device series connected between said filter circuit and said work circuit, means for varying the value of said resistance in consonance with the fluctuating component of said source, and means comprising the elements of said network for varying the magnitude and phase of the energy transferred therethrough with respect to the variations of said resistance whereby said work circuit is protected from said fluctuating component of said source.

3. In an electrical supply system the combination of a source of fluctuating unidirectional current, a work circuit connected so as to be energized by said source, a filter circuit comprising a network of reactive elements for coupling said work circuit to said source, a resistance bridge having a plurality of diagonally opposed terminals, one pair of said terminals being series connected between said filter circuit and said work circuit, the resistance elements of said bridge consisting of filaments having high value temperature resistance coefficients for currents of a frequency at least as high as audible frequency and means for impressing a potential across a second pair of said diagonally opposed terminals, said potential having the same fluctuating characteristics as those of said source for varying the resistance characteristics of the bridge in such sense that the fluctuating component of said source is isolated from said work circuit.

4. In an electrical supply system, the combination of a source of fluctuating unidirectional current, a work circuit connected for energization from said source, a filter circuit comprising a variable network of reactive elements for coupling said work circuit with said source, a resistance bridge having a plurality of diagonally opposed terminals, one pair of said terminals being series connected between said source and said work circuit, the resistance elements of said bridge consisting of filaments having high valued temperature resistance coefficients for currents of a frequency for at least as high as audible frequency, and means for impressing a potential across a second pair of said diagonally opposed terminals, said potential having the same fluctuating characteristics as those of said source, means comprising the elements of said network for varying the magnitude and phase of the energy transferred through said network with respect to the phase and amplitude impressed across said second pair of diagonally opposed terminals whereby the fluctuating component of said source is isolated from said circuit.

5. In an electrical current supply system the combination of a source of fluctuating unidirectional current, a work circuit connected for energization from said source, a circuit comprising a filter network for coupling said work circuit with said source, a resistance bridge having diagonally opposed terminals series connected between said source and said work circuit, and means for equally varying the resistance of opposed legs of said bridge in

consonance with the fluctuating component of said source whereby the voltage across said work circuit is maintained substantially constant.

6. In an electrical supply system the combination of a source of fluctuating uni-directional current, a work circuit connected for energization from said source, a filter circuit comprising a network of reactive elements for coupling said work circuit to said source, a resistance bridge having diagonally opposed terminals series connected between said filter circuit and said work circuit, the resistance elements of said bridge having a low co-efficient of thermal-inertia for currents of a frequency at least as high as audible frequency, and means for varying the temperature of said elements in consonance with the fluctuating component of said source for varying the resistance of said elements in accordance with said fluctuating current component.

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