

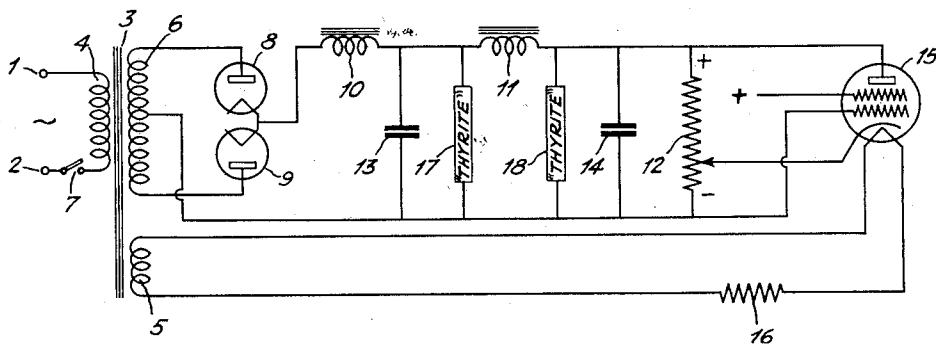
Nov. 2, 1937.

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2,097,882

POWER SUPPLY CIRCUITS

Filed June 9, 1933



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2,097,882

POWER SUPPLY CIRCUITS

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Application June 9, 1933, Serial No. 675,062

1 Claim. (Cl. 178-44)

The present invention relates to electrical networks and particularly to networks including thermionic tubes.

In the usual method of energizing the electrodes of electronic tubes from the power supply mains of the normal alternating current network it is common practice to raise the voltage of the alternating current, rectify the resulting energy and then filter the rectified energy so as to remove the undesirable fluctuating component thereof. The usual set-up in such instances comprises a full wave rectifier the output of which feeds into a filter circuit which is composed of choke coils and condensers. The output of the filter circuit is then impressed across a voltage divider resistance element and the various desired voltages for the energization of the thermionic tubes of a radio receiver or the like are derived from the voltage divider. In the cases where the energization of thermionic tubes provided with indirectly heated cathodes is contemplated it is common to supply the rectifying and filtering system with current at the same time that the heater element for the indirectly heated cathode of the thermionic tube is energized. In the tubes of this nature, that is, tubes provided with indirectly heated cathodes, a certain time period elapses after the heating circuit energy is supplied before the cathode assumes its normal action, that is, before the cathode is raised to a temperature which is sufficient for electrons to boil off, so to speak. During this time period current obviously does not flow through the thermionic tubes with the result that the voltage built across the filter condensers is greatly increased over the normal voltage and sometimes causes the condensers to break down. Many systems have been devised to, so to speak, delay the energization of the rectifier tubes until after the cathodes of the indirectly heated thermionic tubes assume normal operation. However, in such systems as are now known, various complications arise and it is a fact that the expense of delay circuits for this purpose is considerable.

It is an object of the present invention to provide an electrical network whereby the harmful effects of the delay characteristics of a tube provided with an indirectly heated cathode do not affect the filter system in any way harmful to the elements thereof. Another object of the present invention is to provide an electrical network that shall compensate for the increase in voltage during the aforementioned time lag.

The foregoing objects and others ancillary thereto are attained in a preferred embodiment

of the present invention by causing the output current of a rectifier filter system to traverse an electrical network that does not obey Ohm's law. For the purposes of this invention one or more elements having such characteristics that the rate of change of potential thereacross is not linearly related to the rate of change of current therethrough, are interposed in the filter system.

More specifically, across the filter circuit there is provided a current path meeting the above named conditions, that is, a current path having such characteristics that the rate of change of potential thereacross is not linearly related to the rate of change of current therethrough. A material that very satisfactorily answers the purpose is commercially known as "Thyrite" and is described in the United States Patent #1,822,742 to McEachron.

"Thyrite", according to the patent referred to above, is a material somewhat similar to dry process porcelain throughout the mass of which appear minute particles of conducting material. The substance is substantially an insulator at low potentials and becomes a continuously better conductor as the current through it is increased. For a better understanding of the general characteristics of the substance "Thyrite" reference is made to an article entitled "Thyrite; A New Material for Lightning Arrestors" by K. B. McEachron, appearing in General Electric Review, February 1930, page 92. From a reading of the above mentioned article it may be gathered that "Thyrite" has a hyperbolic resistance-ampere characteristic.

The material "Thyrite" is usually utilized in the form of discs each face of which is provided with a sprayed metallic coating for contact purposes, however, it should be understood that the shape of the material is not a controlling factor. It should be noted, however, that the resistance of "Thyrite" varies directly with its thickness but not inversely with area as does that of resistor materials such as carbon or metals which have heretofore been utilized.

The novel features that are believed to be characteristic of the present invention are set forth in particularity in the appended claim. The invention itself, however, both as to its organization and its method of operation together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawing, the single figure of which represents a preferred embodiment of the invention showing the rectifier

and filter circuit energizing an indirectly heated cathode thermionic tube. While the circuit in the drawing has been shown as energizing a single tube it is, of course, evident that any number of tubes or like devices may be energized by suitable taps on the voltage divider resistance as is now customary in the art.

Referring to the drawing, a power transformer 3 including a primary 4 and two secondaries 5 and 6 respectively is connected to a suitable source of alternating current through the terminals 1 and 2 associated with the primary 4. A suitable switch 7 is provided for turning the power on and off as desired in customary fashion. One end of the secondary 6 is connected to the anode of a rectifier tube 8 while the other end of the secondary 6 is connected to the anode of rectifier tube 9. The cathodes of the rectifier tubes 8 and 9 have one side common as shown and are connected to a suitable source of energizing current not shown. The output of the rectifier tubes is taken as is usual in such cases from the center point of the secondary 6 which is the negative side of the output and a point common to the two mentioned cathodes which is the positive side of the output in accordance with the usual conventions.

The positive side of the rectifier output is connected to one end of a voltage divider resistance 12 through a pair of choke coils 10 and 11 while the negative side of the rectifier output is connected to the other end of the voltage divider resistance 12. While choke coils 10 and 11 have been shown connected to the positive side of the rectifier output it is to be distinctly understood that they may be just as well connected in the negative side of the rectifier output, and in fact, in some instances, connection in the negative side is desirable. The usual filter condensers 13 and 14 are provided connected across the positive and negative lines on either side of the choke coil 11. So far it is evident that the system described comprises the usual rectifier and filter circuit. A load adapted to be energized from the output of the filter circuit may comprise a tube 15 of the screen grid type and provided with an indirectly heated cathode. The heater circuit for the indirectly heated cathode includes the secondary 5 and a suitable resistance 16. It should be noted that tube 15 is connected so that the potential on the cathode is higher than the potential on the grid, hence, there is provided a so-called automatic bias for the grid in customary fashion. The anode of the tube is connected to the top of the voltage divider resistance 12 although it may be connected to any point of resistance 12 depending upon the value of voltage desired. From what has thus far been described it is obvious that when switch 7 is closed energy is supplied to the rectifiers 8 and 9 at the same time it is supplied to the heater circuit for the cathode of tube 15. The tubes 8 and 9 are usually of the type that have no time lag and hence a high voltage is immediately available across the resistor 12 and hence across the condensers 13 and 14. Due to the fact that the cathode of the tube 15 is not

readily energized immediately upon the closing of switch 7 it is obvious that the load which comprises the tube 15 is, in reality, zero with the result that a very much higher voltage exists across the condensers 13, 14 than the voltage existing across these condensers when the whole system is in normal operation. Accordingly, it has been found that the condensers 13 and 14 must be built to withstand this added voltage with the attendant increase in cost and size.

To overcome this drawback there are provided across the two condensers the two "Thyrite" resistances 17 and 18. While two of such resistances have been shown it is obvious that one may be sufficient for the purpose. As connected, the two elements 17 and 18 protect the filter condensers 13 and 14 during the interval of time required by the tubes such as 15 to warm up and take a load. The two elements 17 and 18 will also protect the network against surges and in addition they have a filtering effect when used in the position shown because the "Thyrite" elements present a lower impedance with increase of applied potential thus tending to smooth out ripples.

The present invention is of particular importance in transmitter apparatus since in such cases the use of a device in which the load is not taken immediately subjects associated equipment to voltage overload.

It is to be understood that the present invention is not limited to the use of "Thyrite" or an equivalent material since many modifications will at once be apparent to those skilled in the art to which the invention pertains, hence, the invention is not to be limited by the specific exemplifications shown for purposes of illustration but only by the prior art and by the spirit of the appended claim.

I claim:

A filter circuit for use in connection with power supply systems utilized to energize thermionic tubes provided with indirectly heated cathodes and wherein an appreciable period of time is required for energizing the indirectly heated cathodes, said filter system including a choke and at least one filter condenser, an additional filter means shunted across the filter condenser comprising a device for protecting the filter condenser during the period of time required to energize the indirectly heated cathodes, said device comprising an element composed of a granular material having a hyperbolic resistance-ampere characteristic which is unaffected by variations in the rate of change of voltage applied to the element to produce a flow of current therethrough, the resistance of said element being always substantially the same for a given density of current flow through it whether the value of the said current density is attained by increasing or by decreasing the current flow, said additional filter means having a decreasing impedance with increasing applied potential across it whereby the additional filter means operates to smooth out current passing through the filter circuit.

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