

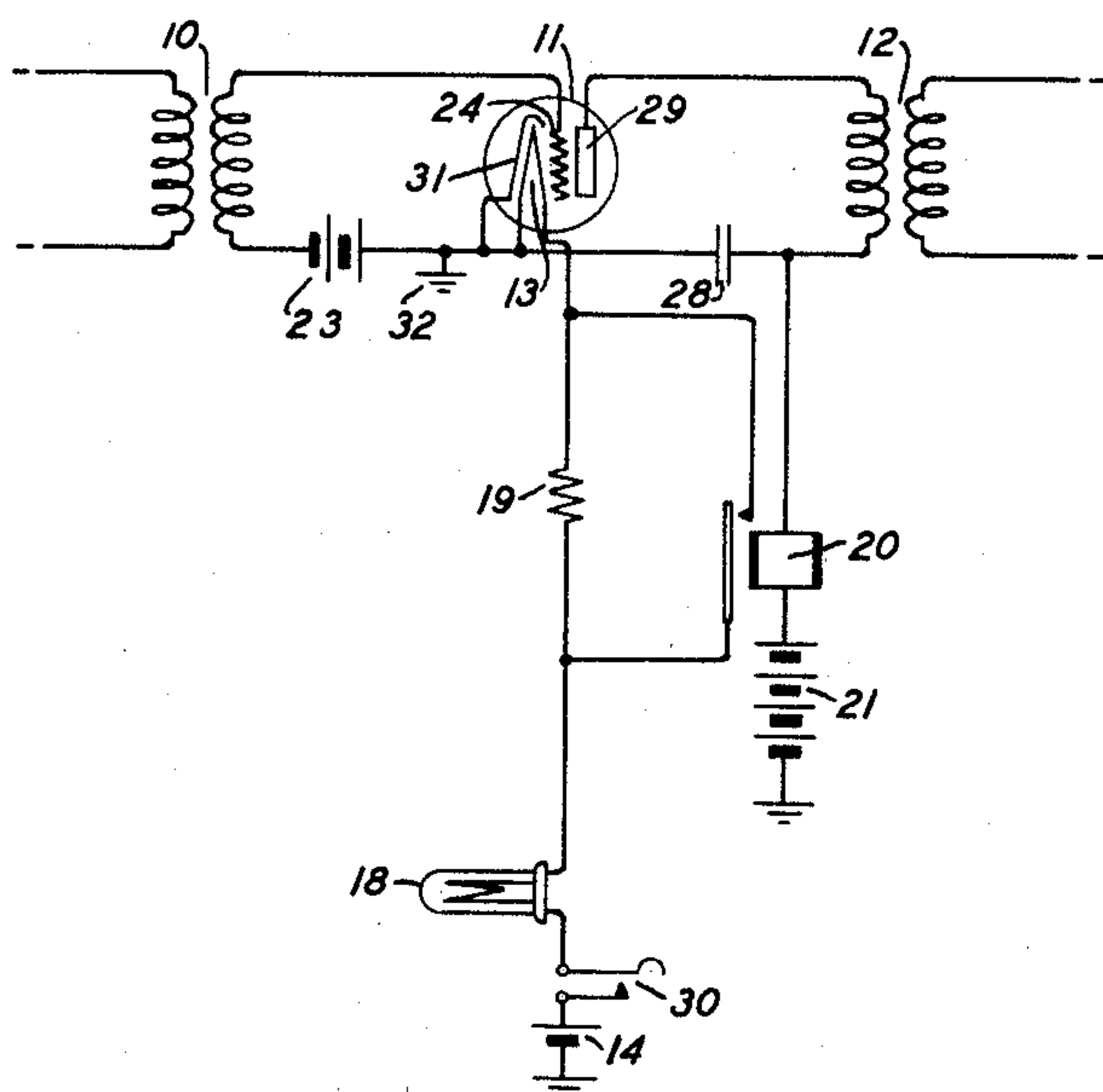
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VACUUM TUBE CIRCUITS

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VACUUM TUBE CIRCUITS

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5 Claims. (Cl. 250—27)

This invention relates to a vacuum tube circuit and particularly to such a circuit in which a ballast lamp is included.

5 An object of the invention is the prevention of damage to ballast lamps due to excessive voltage.

The use of ballast lamps in vacuum tube circuits is common, such devices ordinarily being connected in series with the cathode and the energizing source thereof, and serving to regulate the current supplied to the cathode.

10 It has been observed that in such circuits the ballast lamp is sometimes damaged due to excessive voltage and applicant has determined that this damaging condition exists when the cathode energizing circuit is first closed and is due to the fact that at this time the resistance of the cathode or the cathode heater which is "cold" is only a small fraction of its normal resistance when heated. This is particularly troublesome in the case of tubes provided with heater type cathodes as the ceramic material in which the heater is embedded tends to retard the rate at which the temperature of the heater rises, practically a full minute sometimes being required for the heater to reach its full operating temperature. During this period in which the resistance of the cathode is below its normal value the ballast lamp, being in series with the cathode heater and the energizing source thereof, is subjected to an excessive voltage and as the heat inertia of the lamp is much less than that of the tube, this excessive voltage is apt to raise the temperature of the lamp filament to such a high point that the filament is damaged and may be burned out.

30 In accordance with a feature of the present invention the full voltage of the cathode battery is not applied to the energizing circuit until the cathode has been heated to practically its normal operating temperature and the heater has almost attained its full resistance whereupon excessive voltage across the ballast lamp does not occur and damage to the ballast lamp is prevented.

40 In accordance with a further feature of the invention inductance is added to the plate supply circuit and acts as a filter element therefor.

50 In accordance with a specific embodiment of the invention a resistance is included in series with the cathode, ballast lamp and source of cathode potential during the initial period of cathode heating. Upon the cathode approaching the temperature of normal emission, however, the completion of the cathode-to-anode circuit with-

in the tube is effective to cause the operation of a relay which operation, in turn, shunts the resistance out of the cathode circuit. The resistance of the cathode heater has by this time, however, reached its approximate normal value which is sufficiently high to prevent excessive voltage which might result in damage to the ballast lamp.

A full understanding of the invention and of the various valuable features thereof may be had from consideration of the following detailed description and the single figure of the drawing which shows a typical vacuum tube circuit embodying the present invention.

Referring now to the drawing, a simple vacuum tube amplifier circuit is shown including an input transformer 10, the secondary winding of which is connected to the input circuit of vacuum tube 11. The output circuit of the tube is connected to the primary winding of output transformer 12.

Vacuum tube 11 is of the heater cathode type, one side of heater 13 being connected to a suitable source of voltage 14 and the other side being connected to ground 32. Ballast lamp 18 and resistance 19 are connected in series with heater source 14. The operating winding of relay 20 is connected in series with source of anode potential 21 and with anode 29 of tube 11. Battery 23 provides a suitable negative bias for control element 24 of the tube. Condenser 28 in cooperation with the inductance of the winding of relay 20 serves as a filter to prevent the fluctuations in the anode circuit due to the amplified signal from being transmitted to the anode battery 21, and by-passes the fluctuations directly to the cathode. A key 30 is provided for controlling the heater energizing circuit. Cathode 31 is connected in the conventional manner in the circuit including a connection to ground 32.

Let us now assume by way of example that, in order to place the circuit in operative condition, key 30 be closed thereby completing the energizing circuit for heater 13 which circuit may be traced from battery 14, make contact of key 30, filament of ballast lamp 18, resistance 19, heater 13 to ground 32. At this time the resistance of heater 13, which is "cold", is much lower than its normal value and should the full voltage of battery 14 be applied, the filament of ballast lamp 18 would be heated to an undesirably high and possibly damaging value. However, due to the fact that resistance 19 is connected in series with the battery and the ballast lamp, the voltage is sufficiently reduced so that no damage can result

to the ballast lamp filament. The value of resistance 19 is such that, while an excessive voltage is prevented, sufficient voltage is applied to the heater element to raise the temperature almost to the point of full emission without undue delay.

It will be noticed that relay 20 is at this time unoperated as completion of an energizing path therefor from battery 21 is prevented on the one hand by condenser 28 and on the other hand by the fact that the space current path from cathode 31 to anode 29 has not yet been established.

Now after elapse of the normal "heating" period, cathode 31 approaches its normal emission temperature and the usual space current path is then established between cathode 31 and anode 29. We now, therefore, have an operating circuit for relay 20 established, which circuit may be traced from battery 21, winding of relay 20, primary winding of output transformer 12 to anode 29 and thence to cathode 31 and ground 32. Relay 20 thereupon operates and completes through its make contact an obvious shunt path which effectively removes resistance 19 from the heater path. Heater 13 has by this time reached practically its normal operating temperature, however, and its resistance is sufficiently high to prevent an excessive voltage and no damage to the ballast lamp filament results.

In order to prevent undesirable fluctuations in the anode voltage it is advantageous to provide some filtering means in the anode supply circuit. In accordance with the present invention the inductance of the winding of relay 20 is, as evident from the above description, in series with the anode supply battery 21 while the capacity of condenser 28 is in parallel thereto. This inductance-capacity combination is effective to provide an efficient filter for the plate supply circuit.

It will be apparent from the above that applicant's invention provides a simple and effective arrangement for preventing damage to a ballast lamp during the initial heating period of the cathode.

While a specific embodiment of the invention has been described, the invention is not, of course, limited in its application to the specific embodiment described. For example, the arrangement may be used with other than heater type tubes, it may be used in circuits comprising a plurality of vacuum tubes, contacts may be added to the relay to control obvious circuits such as an alarm to indicate an open in either the cathode heater or anode circuits or failure of the supply voltages, and so on. In short, the embodiment described should be taken as illustrative rather than restrictive.

What is claimed is:

1. In a vacuum tube circuit, a vacuum tube, a cathode and an anode therefor, a source of energy for heating said cathode, a ballast lamp connected in series with said cathode energy

source, a resistance normally connected in series with said ballast lamp and means effective at the time said cathode approaches its normal operating temperature for shunting said resistance.

2. In a vacuum tube circuit, a vacuum tube, a cathode and an anode therefor, a source of energy for heating said cathode, a source of energy for said anode, a ballast lamp connected in series with said cathode energy source, a resistance normally connected in series with said ballast lamp and means effective at the time said cathode reaches its approximate normal operating temperature for shunting said resistance, said means comprising a relay connected in series with said anode and said anode energy source.

3. In a vacuum tube circuit, a vacuum tube, a cathode and an anode therefor, a heater for said cathode, a source of voltage for said heater, a source of voltage for said anode, a ballast lamp connected in series with said heater and said heater voltage source, a resistance normally connected in series with said ballast lamp, and a relay connected in series with said anode and said anode voltage source, completion of the energization circuit of said relay being controlled by the space current circuit within the vacuum tube, said heater circuit passing sufficient current while said resistance is connected in series with said ballast lamp to permit completion of said space current circuit, operation of said relay being effective to shunt said resistance.

4. In a vacuum tube circuit, a vacuum tube, a cathode and an anode therefor, a source of energy for heating said cathode, a source of energy for said anode, a ballast lamp connected in series with said cathode energy source, a resistance normally connected in series with said ballast lamp, and a relay in series with said anode and said anode source, said relay being effective upon operation to shunt said resistance, the operating circuit of said relay being controlled by the space current circuit within the vacuum tube.

5. In a vacuum tube circuit, a vacuum tube, a cathode and an anode therefor, a source of energy for heating said cathode, a source of energy for said anode, a ballast lamp connected in series with said cathode energy source, a resistance normally connected in series with said ballast lamp, means effective at the time said cathode reaches its approximate normal operating temperature for shunting said resistance, said means comprising a relay connected in series with said anode and said anode energy source, a condenser connected in parallel to said anode and said anode energy source and means for filtering the energy supplied to said anode from said anode energy source, said means comprising the inductance of the operating winding of said relay and the capacity of said condenser.

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