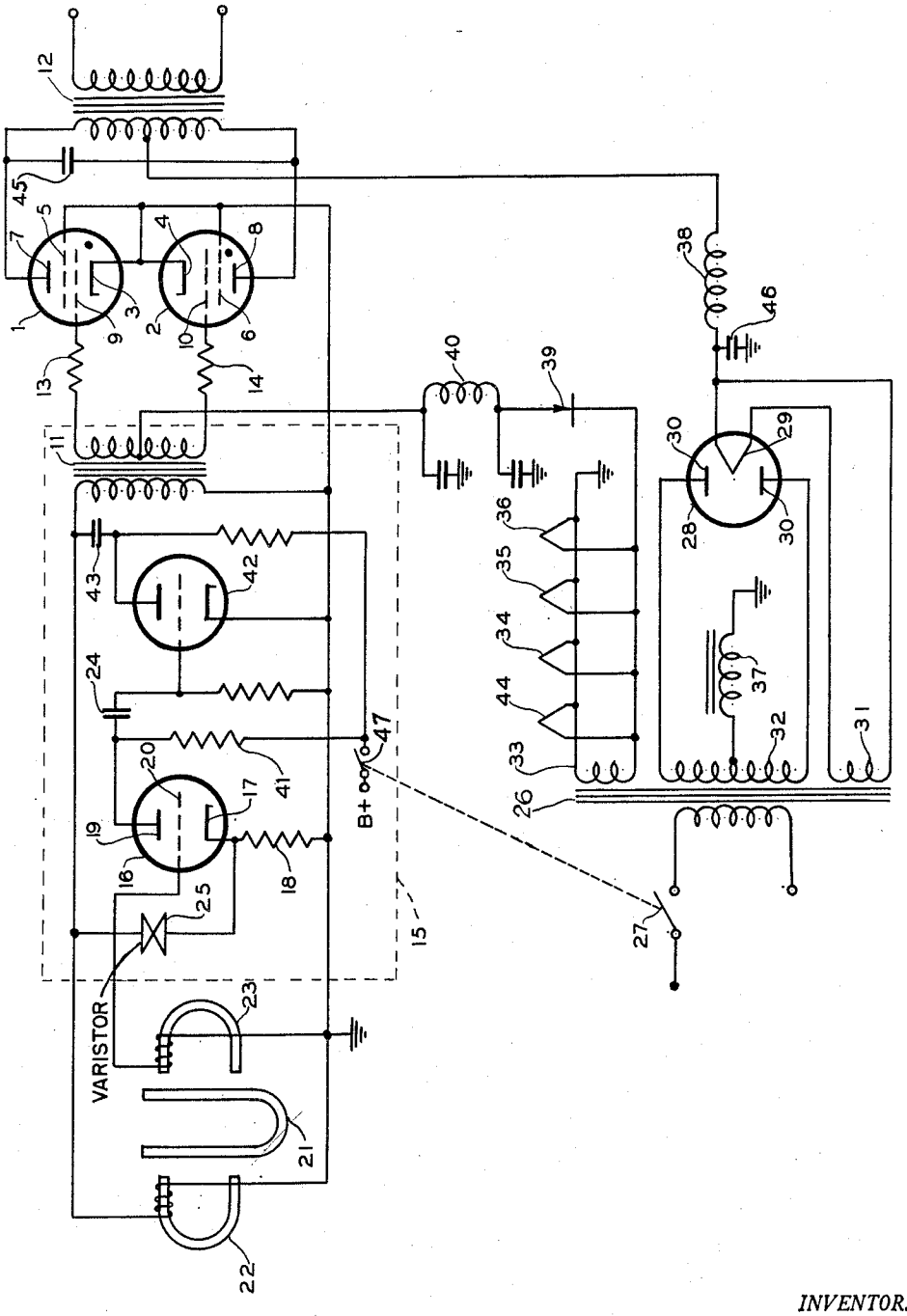
April 24, 1951 J. N. HEED 2,549,807

INVERTER TUBE PROTECTIVE DEVICE

Filed July 26, 1946



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Patented Apr. 24, 1951

2,549,807

UNITED STATES PATENT OFFICE

2,549,807

INVERTER TUBE PROTECTIVE DEVICE

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Application July 26, 1946, Serial No. 686,279

1 Claim. (Cl. 250—36)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

In the applications of gas filled electronic tubes it is necessary to insure that adequate negative bias voltage be applied to the control grids before plate voltage is applied, otherwise the tube may not operate as intended and destructive discharge may take place. I have devised a method by which the gas filled tubes of an inverter are always adequately biased and no destructive discharge can occur.

Accordingly, it is a purpose of my invention to provide a protective device for use with inverter tubes.

It is another purpose of my invention to provide an inverter in which the gas-filled inverter tubes automatically receive a blocking bias on the control grids before plate voltage is applied.

It is another purpose of my invention to provide a fork controlled generator of constant frequency alternating current power in which the build-up time of the fork and of the fork amplifier introduce delays which prevent premature discharge of electron tubes.

It is another purpose of my invention to apply rectified filament current as a bias on the control grid of a thermionic tube to prevent premature discharge.

It is another purpose of my invention to provide a generator of alternating current power which is very constant in frequency and reliable in operation.

In the sole figure, there is shown the circuit of a thermionic inverter controlled by a tuning fork with a discharge protective circuit, in which inverter my invention is embodied.

There are shown two gas tetrodes 1, 2, having their cathodes 3, 4 and screen grids 5, 6 at ground and their plates 7, 8 in push-pull across the primary of an output transformer 12. The control grids 9, 10 are connected through current limiting resistors 13, 14 in push-pull across the secondary of an interstage transformer 11.

Transformer 11 is the output transformer of a power frequency amplifier 15. For simplicity this is shown as comprising two stages of amplification. If desired, more stages may be added. The first stage comprises an amplifier tube 16. The cathodes 17 thereof is grounded through cathode bias resistor 18. The plate 19 thereof is connected through dropping resistor 41 to the positive terminal of a direct current plate voltage supply and through blocking capacitor 24 to

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the control grid of the second amplifier tube 42. The output of tube 42 is connected through blocking capacitor 43 to the primary of transformer 11 and to the driving coil 22 of a self-driven tuning fork 21. The pick-up coil 23 of tuning fork 21 is connected to the grid 20 of tube 16. Between cathode 17 and the high side of the primary of transformer 11 is connected a varistor 25.

The primary of power transformer 26 is connected to an external A. C. power supply through a switch 27. Of the three secondaries of this transformer, one secondary feeds the plates 30 of a fullwave rectifier tube 28, a second secondary 31 feeds the filament 29 of tube 28, and a third secondary 33 feeds the filaments 34, 35, 36, 44 of tubes 1, 2, 16, 42 respectively. The center of secondary 32 is grounded through choke 37. Filament 29 is connected through filter 38 to the center of the primary of transformer 12. One side of secondary 33 is grounded, the other is connected through copper oxide rectifier 39 and filter 40 in series to the center of the secondary of transformer 11.

It is to be understood that all circuits are completed through ground if not shown otherwise.

In operation, with switch 27 open, all filaments are cold and tubes 1 and 2 are without plate voltage. Upon closing switch 27 there is immediately applied from transformer 26 and through rectifier 39, filter 40, secondary of transformer 11, and resistors 13 and 14 a direct bias voltage to control grids 9 and 10 negative with respect to cathodes 3 and 4. This negative bias is sufficient to block and quench tubes 1 and 2 for any plate voltage which may be applied to plates 7 and 8 at any time that the system is in operation.

Upon closure of switch 27, filaments 34, 35, 29 begin to heat up in a finite interval of time, and when filament 29 is hot, direct plate voltage is generated by the rectifying action of full wave rectifier tube 28. This voltage is smoothed in filter 38 and applied through the primary of transformer 12 to the two plates 7 and 8 of tubes 1 and 2. However, because of the fact that the negative bias has been applied to the grids immediately upon the closure of the master switch, while the application of plate voltage has been delayed an appreciable time thereafter, there is as yet no discharge of the tubes.

Upon closure of master switch 27, filaments 36, 44 of tubes 16, 42 heat up in a finite interval of time. After this delay, amplifier 15 is in operable state since the direct plate voltage sup-

ply is on continuously, or may be applied by a switch 47, ganged to close with switch 27.

Due to the regenerative connection of driving coil 22 and pick-up coil 23 with the amplifier 15 the tuning fork builds up oscillations which result in the development of alternating voltage in the secondary of transformer 11. This voltage has the frequency of the fork.

The time required for this voltage to build up beyond the time required for tubes 16, 42 to become operative is determined by the amount of regenerative feed-back voltage supplied to driving coil 22 by amplifier 15, and by the Q of the fork. This time is controlled by the design and positioning of driving coil 22 and pick-up coil 23, the gain of amplifier 15, and by the amount of bleeder current taken by varistor 25.

The alternating voltage developed in the secondary of transformer 11 is applied in push-pull through current limiting resistors 13 and 14 to control grids 9 and 10, being superposed on the constant voltage negative bias. This alternating voltage is of sufficient magnitude to cause both of tubes 1 and 2 to discharge plate capacitor 45 in alternation and in opposite direction as each tube fires. The charging current for capacitor 45 alternates in the primary of transformer 12 as the capacitor 45 is discharged in alternation by tubes 1 and 2. Thus capacitor 45 is charged by the direct current supply of rectifier tube 28 applied thereto through the center-tap of the primary winding of transformer 12, and due to the opposite successive discharges of capacitor 45 as tubes 1 and 2 alternately fire, this results in an alternating voltage of fork frequency in the primary of transformer 12. This alternating voltage is supplied to an external load circuit from the secondary of transformer 12.

It is seen that the order of application of voltages to inverter tubes 1, 2 is: (1) negative bias on control grids 9, 10; (2) plate voltage on plates 7, 8; (3) alternating driving voltage on control grids 9, 10. Thus the inverter tubes are prevented from premature or continuous firing, but can fire only in short pulses and alternately.

The purpose of varistor 25 is to limit the amplitude of oscillation of fork 21 and to delay build-up of oscillation still further. This is accomplished by passing a part of the alternating output of tube 42 through varistor 25 and cathode bias resistor 18 in series. Owing to the existing phase relations this feed back through resistor 18 is degenerative and tends to reduce the output of amplifier 15. Inasmuch as the resistance of varistor 25 decreases with increasing voltage, there is a tendency for increasing degeneration as the oscillation builds up. Thus the build-up is made slower and the build-up time is longer, and the oscillations are stabilized at a limiting

value. At the same time there is a strong feed back signal at the start of oscillation so that the start of oscillation is certain and definite. The fork cannot be over-driven, so there is a very constant frequency output signal, and, as has been recited, the inverter tubes are prevented from firing until they are ready.

It is within the scope of my invention to make changes in the above described apparatus without departing from the spirit of the invention.

What is claimed is:

In an alternating current generator: a tuning fork; a vacuum tube amplifier means having a cathode bias resistor therein; means connected to the output of said amplifier means for driving said fork; means responsive to vibrations of said fork and connected to the input of said amplifier means; gas-filled thermionic tube means having an input that is coupled to the output of said amplifier means; power supply means for applying anode and heater potentials to said amplifier and gas tube means; switch means for activating said power supply means; means for applying negative bias to the input of said gas tube means instantly with closure of said switch means, said power supply means becoming activated a finite time after said switch means is closed and thereby delaying the application of voltage to the plate of said gas tube means; said tuning fork, said means responsive to said fork, and said means for driving said fork determining by their effective time constants the time of discharge of said gas tube means after power is applied thereto; and a varistor connected between the output of said amplifier means and said cathode bias resistor, whereby a degenerative signal is applied to the input of said amplifier means as an inverse function of the output thereof, to further delay the discharge of said gas tube means.

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