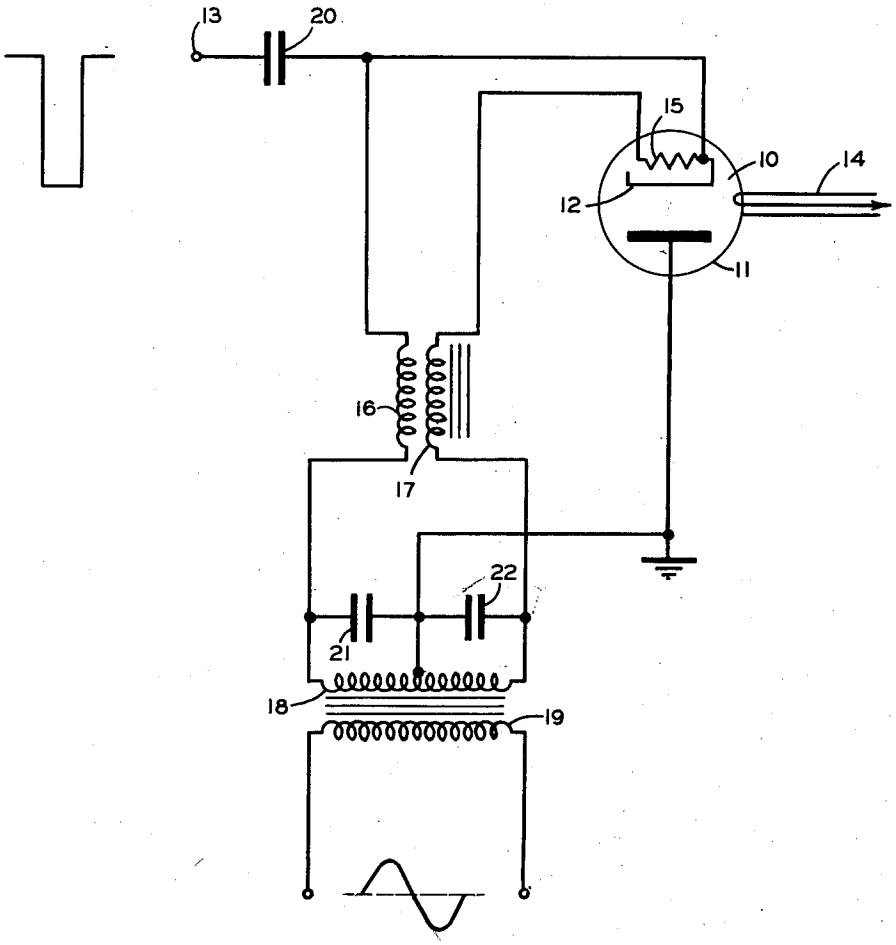
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HIGH-VOLTAGE CHOKED FILAMENT FEED

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HIGH-VOLTAGE CHOKED FILAMENT FEED

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4 Claims. (Cl. 332—9)

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This invention relates to modulator circuits and more particularly to modulator circuits using very high modulation potential.

Radio frequency oscillators often require the continuous circulation of current through an internal filament electrode. Certain of these oscillators may require the additional application of a modulating voltage to this same filament electrode. To take an example, a usual type of magnetron oscillator may contain a filament-cathode structure, various anode segments, and an output coupling loop. It is common practice to provide direct electrical connection between filament and cathode of such an oscillator to avoid problems of high voltage insulation. Methods of operating this type of oscillator frequently depend on grounding the anode and applying modulating voltages to its cathode. Since these modulating voltages may take the form of very high amplitude voltage pulses, it will be evident from the foregoing considerations that any filament voltage source connected directly to the oscillator filament will be subjected to and must withstand the application of such voltage pulses. Since these voltage pulses may attain several thousand volts in amplitude, it is clear that for proper operation a filament voltage source connected in this manner must be designed to have proper electrical protection against such high voltages even though its primary function is one of supplying relatively low voltages to operate the oscillator filament.

If the above mentioned filament voltage source is, for example, a transformer, it can be seen that the high voltage protection requirement necessitates a type of transformer construction more complex than that for a conventional filament voltage transformer not designed to withstand high voltages. There are certain disadvantages arising from the necessity of using a high-voltage-insulated transformer, such as increased weight, size and cost. Connecting a transformer directly to the oscillator filament terminals also increases their capacity to ground.

It is an object of this invention to provide a modulator circuit which protects the source of oscillator filament voltage against the modulating signals.

It is a further object of this invention to provide a means for utilizing a standard low-voltage-insulated filament transformer for oscillators which require application of high modulating voltages to their filaments.

It is a further object of this invention to provide a means for utilizing a standard low-voltage-insulated filament transformer for magnetron oscillators which may undergo pulsed operations.

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It is a still further object of this invention to provide means for controlling the characteristics of a modulating voltage signal applied to the filament of a radio frequency oscillator.

It is a still further object of this invention to avoid the distributed capacity to ground introduced by connecting a transformer directly to the filament terminals of a radio-frequency oscillator.

These and other objects will become more apparent from the following description of the invention, which is accompanied by a drawing showing one embodiment of the invention.

The operating principle of the invention can best be understood by consideration of the drawing. In the present instance a magnetron 10 is shown as the oscillator. The electrical arrangement of the magnetron electrodes is conventional, the anode 11 being connected to ground and the cathode 12 being coupled via capacitor 20 to a source of negative voltage pulses at terminal 13 which serve to place the tube in an oscillatory condition. The resulting radio frequency oscillations are extracted from the magnetron by means of a coupling loop 14. The magnetron filament 15 and cathode 12 are shown connected together in conventional manner. The high voltage negative pulses applied to terminal 13 are derived from some external source which in the instance shown determines the potential of terminal 13 according to a rectangular voltage envelope.

Two inductors 16 and 17 are inserted in series with the filament leads. Inductor 16 is connected between one magnetron filament terminal and one terminal of the secondary winding 18 of the filament transformer. Inductor 17 is connected between the corresponding opposite magnetron filament terminal and the corresponding opposite terminal of the secondary winding 18 of the filament transformer. It will be evident that these two inductors may be combined in a single mechanical assembly to form a bifilar choke as indicated in the drawing. Such mechanical construction, however, is not absolutely essential to the operation of the invention, although this results in a compact arrangement which is generally desirable. In the operation of the invention the bifilar choke acts to prevent the high voltage negative pulses applied to the cathode of the magnetron from developing high voltages at the secondary of the filament transformer and yet said

choke permits the normal flow of filament current to the magnetron filament. Those familiar with the art will be aware that the ability of the bifilar choke to accomplish these purposes will depend on the proper choice of electrical constants for the inductors 16 and 17.

The high voltage modulating pulses applied to the cathode and filament of the magnetron are frequently of extremely short duration compared to the period of the usually low audio frequency filament voltage applied to the primary winding 19. It is known that voltage pulses of the character described may be considered to consist of the combination of numerous components of frequency high compared to the audio range. Thus it follows that the combination of the inductors 16 and 17 will offer a relatively high parallel impedance to the high voltage modulating pulses but a relatively low series impedance to the low frequency filament voltage.

As a result of the above action the filament transformer need not be designed to withstand such high voltage pulses. The consequent simplification in the design of the filament transformer yields certain definite advantages such as decreased size, weight, cost and lower effective capacity to ground. Furthermore, this invention permits grounding the filament transformer secondary winding 18 at any desired point. Capacitors 21 and 22 serve to bypass the secondary winding 18 in conventional manner.

It is known that the resultant shape of modulating pulses applied to a magnetron oscillator is definitely influenced by the impedance encountered by the pulses between their termination and ground. Some circuits have previously employed an inductor connected between the magnetron cathode and ground in parallel with the magnetron filament leads. The purpose of such an inductor was essentially to enable the unavoidable distributed capacitance of the circuit to ground to be discharged more rapidly at the end of the applied modulating pulse and thus improve or steepen the trailing edge of the pulse. Briefly, such an arrangement produced between the inductor and the distributed capacitance an oscillatory discharge, the start of which could be used to control the trailing edge of the applied pulse. The subsequent oscillation cycles may be damped out by known means. It should be noted that the parallel combination of the inductors 16 and 17 of the embodiment may be used to accomplish these results.

A further possibility inherent in this invention is the utilization of the inductors 16 and 17 to provide auxiliary voltage pulses which could be obtained by suitable coupling means to an external device from one or more points on either or both inductors 16 and 17. Such pulses may be used for sampling, monitoring, triggering and other purposes.

The invention is to be limited only by the appended claims.

I claim:

1. A pulse modulated ultra-high frequency magnetron transmitter circuit comprising a magnetron oscillator having electrically connected cathode and heater elements and a grounded anode, a heater power source, a coupling capacitor connected to said cathode for applying negative voltage pulses to modulate said oscillator, inductance elements included in a circuit shunting said magnetron to discharge the residual charge in said circuit at the termination of the transmitted pulse of high frequency oscillations, and heater leads connecting said heater to said source including said inductance elements.

2. A pulse modulated ultra-high frequency magnetron transmitter circuit comprising a magnetron oscillator having electrically connected cathode and heater elements and a grounded anode, a heater power source, heater leads connecting said heater to said source, a coupling capacitor connected to said cathode for applying negative voltage pulses to modulate said magnetron oscillator, and inductance elements in a circuit shunting said magnetron to discharge the residual charge in said circuit at the termination of the transmitted pulse of high frequency oscillation, said inductance elements being included as a bifilar choke in said heater leads to isolate said heater power source from said voltage pulse.

3. A pulse modulation circuit for an ultra high frequency transmitter comprising, a magnetron oscillator having a grounded anode and electrically connected cathode and heater, a capacitor connected to said cathode to couple high voltage modulation pulses to said oscillator, a heater voltage transformer, leads connecting the transformer secondary winding to said heater, and a bifilar wound radio frequency choke in series with said heater leads, one of the paired inductors of said choke being in series with each lead, whereby high voltage modulation pulses are isolated from said transformer.

4. A pulse modulation circuit for an ultra high frequency transmitter comprising, a magnetron oscillator having a grounded anode and electrically connected cathode and heater, a capacitor connected to said cathode to couple high voltage modulation pulses to said oscillator, a heater voltage transformer having separate primary and secondary windings, the secondary winding having a center tap connected to ground thereby dividing said winding into two halves, a capacitor shunting each half of said secondary winding, heater leads connecting the secondary winding of said transformer to said heater, and a bifilar wound radio frequency choke in series with said heater leads, one of the paired inductors of said choke being in series with each lead, whereby high voltage modulation pulses are isolated from said transformer.

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