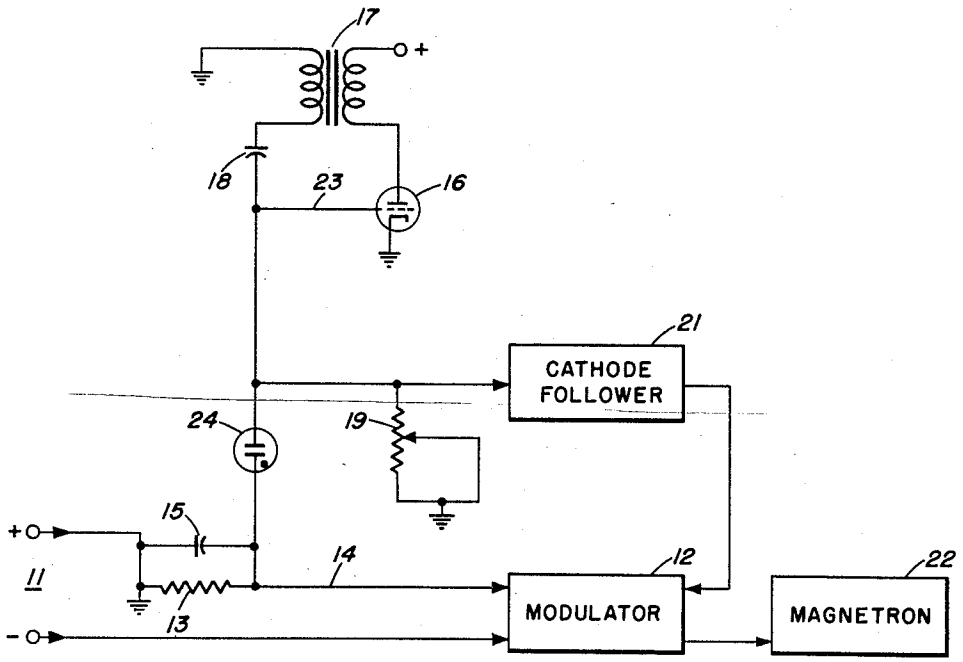
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MAGNETRON OVERLOAD PROTECTION CIRCUIT

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MAGNETRON OVERLOAD PROTECTION CIRCUIT

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to a magnetron overload protection circuit for use in radar sets and more specifically to a magnetron overload protection circuit in which the trigger generating means for the magnetron modulator is biased by the magnetron current.

Because of the danger of damage to the magnetron or other parts of the system when the magnetron misfires, radar sets requires some type of protection device. A common type of device utilizes a relay controlled by a small bias voltage developed across a resistor placed in the high voltage D. C. power supply line ahead of the magnetron modulator. When the magnetron misfires or some other overload occurs, the bias voltage is increased, thereby actuating the relay which opens the D. C. power supply to the magnetron modulator. The magnetron then ceases to function, thereby reducing the bias voltage to zero and allowing the relay to close again. If the overload has not been removed, the circle is repeated and the relay chatters on and off. The operation of devices of this type is unpredictable because of the complexity and relatively low degree of reliability of mechanical relays. The overload protection circuit of the present invention avoids the use of mechanical relays, thereby overcoming the disadvantages of the earlier known protection devices.

An object of the present invention is the provision of a simple but reliable magnetron overload protection circuit.

Another object is the provision of a magnetron overload protection circuit which does not rely upon interruption of the power supply to the magnetron modulator when an overload or short circuit occurs.

An additional object is to provide a magnetron overload protection circuit which reduces the repetition rate of the trigger generating means for the magnetron modulator when an overload occurs.

A further object is to provide a magnetron overload protection circuit which cuts out the trigger generating means for the magnetron modulator when an overload occurs.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawing wherein:

The figure shows a circuit diagram, partly in schematic, of the present invention.

Referring more particularly to the drawing, shown schematically at **11** is a high voltage D. C. power supply having its positive and negative terminals connected to ground and to a magnetron modulator **12**, respectively. One end of a resistor **13** is connected to the positive terminal ground connection and the other end is joined to the magnetron modulator by lead **14**. Magnetron modulator **12** may be a conventional trigger pulse controlled

magnetron modulator of a type will known in the art and described, for example, in chapter VI of Principles of Radar, second edition, M. I. T. Radar School, McGraw-Hill Book Company, New York, 1946, or in chapter III of Principles of Radar, third edition, M. I. T. Radar School Staff, McGraw-Hill Book Company, New York, 1952. A capacitor **15** is connected in parallel with resistor **13** providing a by-pass for high frequency pulse signals. A trigger generating means, such as a master blocking oscillator consisting of triode **16**, blocking oscillator transformer **17**, capacitor **18** and variable resistor **19** is connected through the cathode follower **21** of the magnetron modulator, which is in turn coupled to the magnetron **22**. The magnetron modulator develops a D. C. voltage across the resistor **13** proportional to the high voltage supply current under normal conditions. This voltage is utilized to bias the master blocking oscillator and is applied to the grid of triode **16** through lead **23**. When an overload occurs in the circuit illustrated, the high voltage supply current increases and the bias voltage increases proportionally. The increased bias voltage applied to the grid of triode **16** reduces the repetition rate of the master blocking oscillator, thereby reducing the overload current. At a particular repetition rate, an equilibrium will attain where the abnormally large current in resistor **13** will maintain a low repetition rate in the master blocking oscillator until the fault has cleared and the operation returns to normal. If the overload current is sufficiently high, the master blocking oscillator will be cut off entirely, thereby stopping operation of the magnetron modulator. This, of course, cuts off the current in the resistor **13**, so that the blocking oscillator quickly resumes operation. If the fault continues, the blocking oscillator is again cut off for a short period. In this way, by repeated cycling, the current is held to a safe value until such time as the fault clears and normal operation is automatically resumed.

Ordinarily, the master blocking oscillator is adjusted, by means of variable resistor **19**, so that its repetition rate remains constant when the high voltage supply current is one to one-and-one-half times its normal value. When the current increases further, the repetition rate decreases due to the increased bias, and when the current reaches about twice its normal value, the blocking oscillator ceases to operate completely. However, when other factors make it necessary to keep the repetition rate constant, a gaseous discharge tube, such as the neon bulb **24**, is placed between the overload bias resistor **13** and the grid of triode **16**. In such case, the blocking oscillator may be operated without external bias, and small normal current variations through resistor **13** are isolated from the grid of triode **16** by tube **24** and have no effect upon the repetition rate of the blocking oscillator. However, any sufficiently large overload current developed across resistor **13** causes tube **24** to fire, thereby biasing triode **16** to cut off, thus stopping operation of the blocking oscillator. This in turn eliminates the overload current in resistor **13** causing tube **24** to extinguish and allowing normal operation to be resumed. So long as abnormal conditions exist in the magnetron or the magnetron modulator, the cycle will be repeated, thereby limiting overload current to a safe value.

The cathode follower **21** is merely an isolating device, such as a common cathode follower circuit, to prevent feedback between the magnetron modulator and the master blocking oscillator.

The magnetron modulator **12** can be any of several well known devices, such as a thyratron type line modulator or a hard tube modulator, for producing high voltage pulses to be applied to the magnetron.

Obviously many modifications and variations of the present invention are possible in the light of the above

teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In a radar set, a modulator coupled to a magnetron; a high voltage power supply connected to the modulator; oscillator means, including a triode, connected to the modulator; means connected between the power supply and the modulator for developing a bias voltage proportional to the high voltage power supply current, said means being coupled to the grid of the triode; whereby upon occurrence of an overload in the set the bias voltage biases the grid of the triode to reduce the repetition rate of the oscillator.

2. The combination recited in claim 1, wherein said means comprises a resistor and capacitor connected in parallel.

3. A protection circuit for a magnetron comprising: two terminals for connection to a high voltage power supply, a magnetron modulator connected to said magnetron, high-frequency by-passed impedance means, circuit means connecting said magnetron modulator in series with said impedance means to said two terminals whereby during operation a voltage is developed across said impedance means which is proportional to the magnetron load current, bias-controlled trigger generating means connected to pulse said modulator, and circuit means coupling the voltage developed by said impedance means to said trigger generating means to bias said trigger-generating means whereby upon a magnetron overload the frequency of the pulsing of said modulator is diminished and for large overloads is stopped.

4. The protection circuit of claim 3 wherein: the circuit means for coupling the voltage developed by said impedance means to said trigger means includes means for isolating from the trigger generating means the voltage developed by normal current variations through said impedance means but for passing voltages due to magnetron overload currents.

5. A protection circuit for a magnetron comprising: input terminal means adapted to be connected to a high voltage power supply, a resistor and a capacitor connected in parallel, a magnetron, a magnetron modulator connected to said magnetron, circuit means connecting said magnetron modulator in series with said parallel connected resistor and capacitor to said input terminal means, a blocking oscillator circuit including a triode, circuit means including a cathode follower circuit coupling the output of said blocking oscillator circuit to said magnetron modulator, and circuit means including a gaseous discharge device connecting the side of said resistor adjacent said modulator to the grid of said triode.

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