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HYDROGEN THYRATRONS WITH HEAT SHIELDS AND PRIMING ELECTRODES

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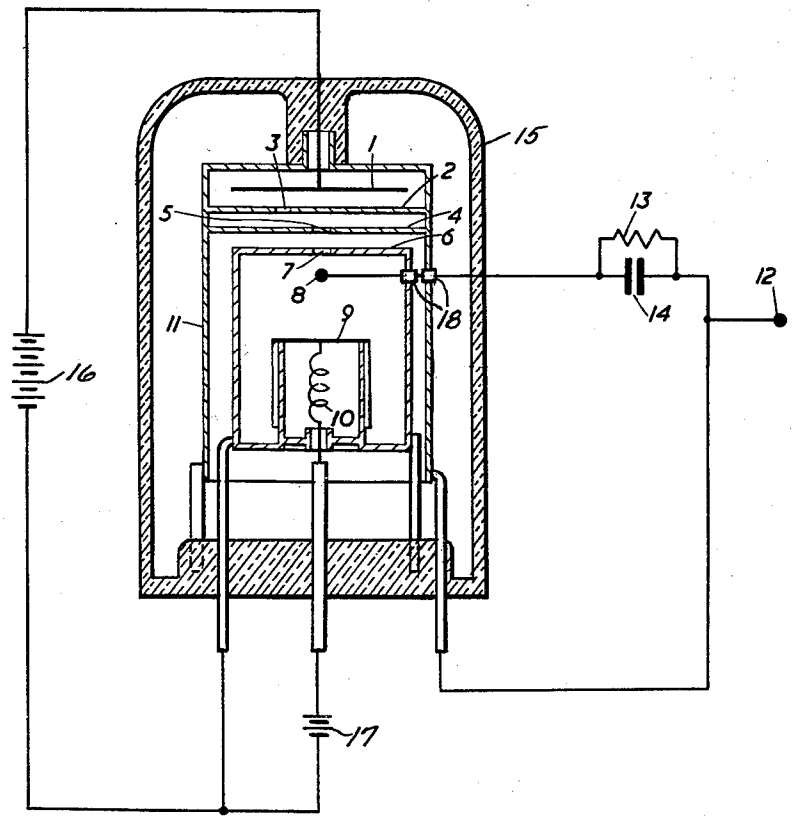

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HYDROGEN THYRATRONS WITH HEAT SHIELDS AND PRIMING ELECTRODES

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5 Claims. (Cl. 313—189)

This invention relates to hydrogen thyratron switches, i.e. to ionic switch devices of the hydrogen thyratron type such as are commonly used in so-called pulse modulators for magnetrons and other high frequency oscillator tubes as employed in radar sets.

It is usually important, in hydrogen thyratron switches used for pulse modulation of magnetrons, for example, to keep the defects known as "anode delay time drift" and "jitter" (which are, respectively, a slow change in and a random variation of, the time taken to build up the current pulse after the triggering signal is applied) to a minimum. At present this is usually done by employing a hydrogen thyratron switch of the tetrode type with two control electrodes, the second being nearer to the anode than the first, and applying a priming signal to the first control electrode and the actual firing signal, shortly afterwards, to the second control electrode. The conventional tetrode structure used at present in larger thyratrons is expensive to construct and is not suitable for use in smaller thyratrons. The present invention seeks to provide improved hydrogen thyratron switches which shall be relatively inexpensive, of long life, and able to be made satisfactorily in a wide range of sizes.

According to this invention a hydrogen thyratron switch includes in the order stated and starting with the cathode: a cathode, a priming electrode; a heat shield having an aperture; a first baffle having an aperture; a second baffle having an aperture; and an anode; the apertures in the heat shield and in the first baffle being at least approximately aligned with one another and with the priming electrode, and the aperture in the second baffle being out of alignment with the heat shield and first baffle apertures so that the anode field, which is present when the switch is in use, cannot penetrate to any substantial extent through the first baffle in the direction of the priming electrode.

Preferably the heat shield, which acts as a reservoir of electrons, is a tubular structure which is closed (except for its aperture) at one end by an apertured end wall and which (again except for said aperture) encloses the cathode and the priming electrode.

Preferably also the apertured baffles are in the form of apertured diaphragms extending across and mechanically and electrically united with an enclosing pot-like structure which encloses the anode on one side of said baffles and the heat shield, with the priming electrode and cathode within said shield, on the other side of said baffles.

A preferred operating circuit in accordance with this invention comprises a switch according to the said invention and connections for applying operating signals from a signal source to the priming electrode and to the baffles, the connection to the priming electrode including a differentiating network. The purpose of the differentiating network is to ensure that the required step-voltage waveform is applied to the priming electrode without excessive collection of current by that electrode during the pulse. In the simplest and preferred form of operating circuit the pulse is applied directly to the baffles and the differentiating network is a resistance-shunted condenser interposed in the connection to the priming electrode.

The invention is illustrated in the accompanying drawing which is a diagrammatic representation of a preferred switch in accordance with the invention connected in a preferred form of operating circuit.

Referring to the drawing, 1 is a disc-shaped anode next to and parallel with which is a baffle 2 in which is an aperture 3. Next to and parallel with the baffle 2 and on the side thereof remote from the anode 1 is a baffle 4 in which is an aperture 5. Next to and parallel with the baffle 4 is the end wall 6 of a tubular heat shield, the said end wall having an aperture 7. On the cathode side of the end wall 6 is a priming electrode 8 which is between the aperture 7 and the cathode 9 which is of the indirectly heated type having a heater 10. The baffles 2 and 4 are in the form of diaphragms across a pot-like enclosing structure 11 which substantially encloses the anode, the two baffles, the heat shield and the cathode, the heat shield being of tubular form and itself substantially enclosing the cathode and the priming electrode 8. The said priming electrode 8 and the apertures 7 and 5 are substantially aligned but the aperture 3 is well offset so that the anode field is substantially unable to penetrate through the aperture 5.

Operating pulses appearing at an input terminal 12 are applied directly to the two baffles as shown and are also applied to the priming electrode 8, which is insulated as shown in the drawing at 18 from the heat shield and the enclosing structure 11, through a differentiating network comprising a resistance 13 in parallel with a condenser 14 which may, to give a practical example, be of 100 pf.

The action of the priming electrode when pulsed causes electrons to pass through the aperture 7 so that they may then be drawn upwards through the aperture 5 in the baffle 4 under the influence of the field produced between the baffle 4 and the heat shield 6 by the driving pulse and thus come under the influence of the field penetrating the aperture 3 in the baffle 2 which causes them to be drawn to the anode and so build up the main discharge.

The structure described above is wholly enclosed within a glass envelope 15, which has a conventional base with the electrode supports and external connection pins shown in the drawing. The envelope 15 is sealed after being filled with hydrogen at a normal thyratron operating pressure. The cathode 9 is held at a negative potential with respect to the anode 1, as shown schematically in the drawing, by means of a battery 16. A further source 17 of electrical power, for example another battery, is provided to supply heating power to the heater element 10.

An arrangement as illustrated has, in practice, a substantially longer operating life than known equivalent arrangements of the tetrode or triode type when operating at the same power level, and build up times comparable with tetrodes of similar rating. While the full explanation of this is not known at present, it appears probable that two major contributing factors are (1) the action of the priming electrode in accelerating concentration of electrons in the baffle volume at the beginning of the pulse and (2) the effect of the heat shield in providing a fraction of the pulse current and so reducing current density at the cathode, and in minimising grid emission caused by evaporation of cathode coating on to the baffles.

I claim:

1. A hydrogen thyratron switch including in the order stated and starting with the cathode: a cathode, a priming electrode; a heat shield having an aperture; a first baffle having an aperture; a second baffle having an aperture; an anode; and mounting means positioning said cathode, said heat shield, said baffles and said anode in the order stated and with the apertures in the heat shield

and in the first baffle being at least approximately aligned with one another and with the priming electrode, and the aperture in the second baffle being out of alignment with the heat shield and first baffle apertures so that the anode field, which is present when the switch is in use, cannot penetrate to any substantial extent through the first baffle in the direction of the priming electrode.

2. A hydrogen thyratron switch as claimed in claim 1 wherein the heat shield is a tubular structure which is closed, except for its aperture, at one end by an apertured end wall and which again, except for said aperture, encloses the cathode and the priming electrode.

3. A hydrogen thyratron switch as claimed in claim 1 wherein said mounting means comprises a pot-like structure enclosing the anode on one side of said baffles and the heat shield, with the priming electrode and cathode within said shield, on the other side of said baffles, and wherein the apertured baffles are in the form of apertured diaphragms extending across and mechanically and electrically united with said pot-like structure.

4. An operating circuit for a hydrogen thyratron switch as claimed in claim 1, said circuit comprising said switch and connections for applying operating signals from a signal source to the priming electrode and to the baffles, the connection to the priming electrode including a differentiating network.

5. A circuit as claimed in claim 4 wherein the signals are applied directly to the baffles and the differentiating network is a resistance-shunted condenser interposed in the connection to the priming electrode.

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