

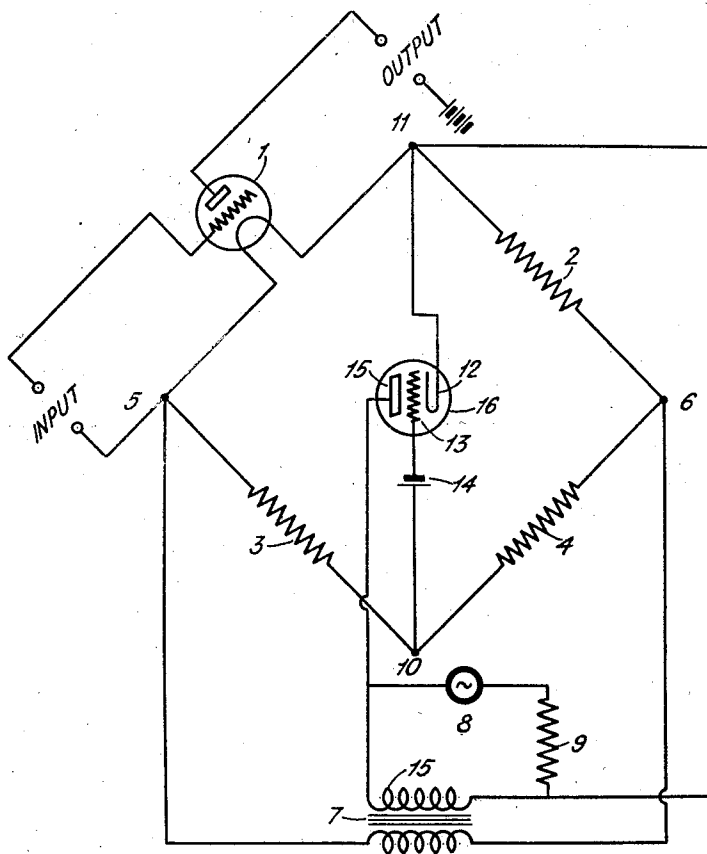
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TEMPERATURE CONTROL

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TEMPERATURE CONTROL

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The present invention relates to a filament heating control arrangement for hot-cathode discharge tubes. More in detail the present invention is concerned with discharge tubes or thermionic tubes having a heated cathode or a filament heater wire. In tubes of this type it happens frequently that the emitting electrodes and the other electrodes which do not emit electrons as well as other parts of the tube such as the wall become markedly heated by the electric load and thus contribute appreciably to the growth of temperature of the cathode or filament. Inasmuch as this re-heating is a function of the load and since it is therefore subjected to marked fluctuations, there arise undesirable reactions upon the operation of the tube. The said phenomenon plays a particularly marked part in the case where the temperature of the non-emitting electrodes is extremely high, for instance, in tubes having a hard glass or quartz vessel, and in the case where the temperature of the filament is particularly low, for instance, with thorium, oxide or similar filaments.

Now, according to the present invention the temperature of the hot cathode is kept constant by maintaining its resistance, or, in the case of indirectly heated tubes, the resistance of the heater body at an invariable or constant value by means of an automatic regulator device, the action or operation of the latter being such that in the presence of an increase in temperature of the heater wire owing to the change in resistance associated therewith the energy supplied to the filament is automatically reduced until the normal temperature has been restored.

An embodiment of the idea is shown in the illustration. The filament of the thermionic tube 1 the temperature of which is to be controlled is enclosed in one arm of a Wheatstone bridge the other arms of which consist of constant resistances 2, 3, 4, at points 5, 6 the heating potential for the filament is applied by way of a transformer 7. This heating potential may be derived from any source as for example an alternating current source 8 by way of a resistance 9. The bridge arrangement is so balanced that between the points 10 and 11 there will be no potential difference as long as the filament of the tube 1 has the temperature which arises when the tube carries no load. By means of a relay connected at points 10 and 11, conditions can be made so that in case of a rise of the temperature of the filament of tube 1 the primary winding 15 of the transformer 7 is short-circuited for a length of time until the filament of tube 1 has been cooled to its nor-

mal temperature. In the embodiment shown in the drawing, the relay consists in a controlled gaseous-discharge tube 16 of the thyatron type. The cathode 12 of the relay tube 16 is connected with the point 11 on the bridge the control grid 13 of tube 16 is connected by way of a biasing potential source 14 with the point 10 of the bridge and plate 15 is connected with one pole of the alternating current source 8. The biasing potential of source 14 is so chosen that the tube 16 will block the flow of current as long as there is no potential drop between points 10 and 11. If the temperature and thus the resistance of the filament of the tube 1 experiences a growth beyond the normal value, then the correspondingly changed potential difference across the points 10 and 11 pre-supposing proper polarity of transformer 7, will make conditions so that the thyatron 16 becomes conductive to the flow of current during a phase and short-circuits the primary winding of transformer 7. In case of a decrease of the temperature below normal, the thyatron would not respond since in that case a growth in the grid potential beyond the normal value would coincide or be associated with a negative plate potential. Hence, there is no danger of a reduction in temperature by the short-circuiting of the transformer resulting in a further reduction in the temperature. On the other hand, the purpose of the arrangement is to compensate temperature rises of the filament.

The tube 1 may be connected in any relay or work circuit known at the present time.

We claim:

1. A temperature regulator comprising a Wheatstone bridge arrangement having four arms, three arms of which consist of fixed resistances each having substantially constant values, the fourth arm containing the impedance of a device, the temperature of which is to be controlled, means for controlling said device comprising a thermionic relay having an anode, grid and cathode, said thermionic relay having its cathode and grid connected to a first pair of conjugate nodal points on said bridge, an electric energy supply source, a transformer having a primary and secondary winding, the primary winding being connected to said supply source, said secondary winding connected to a second pair of conjugate nodal points on said bridge to energize said device, a connection between one end of said primary winding and the anode of said thermionic relay, and a connection between the other end of said primary winding and the cathode of said thermionic relay.

2. A temperature regulator comprising a Wheatstone bridge arrangement having four arms, three arms of which consist of fixed resistances each having substantially constant values, the fourth arm containing a cathode circuit of a thermionic device having input and output circuits, the temperature of which is to be controlled, means for controlling said thermionic device comprising a thermionic relay having an anode, grid and cathode, said thermionic relay having its cathode and grid connected to a first pair of conjugate nodal points on said bridge, an electric energy supply source, a transformer having a primary and secondary winding the primary winding being connected to said supply source, said secondary winding connected to a second pair of conjugate nodal points on said bridge to energize said device, a connection between one end of said primary winding and the anode of said thermionic relay and a connection between the other end of said primary winding and the cathode of said thermionic relay.

3. An automatic temperature regulator comprising a Wheatstone bridge arrangement having four arms, three arms of which consist of fixed resistances each having substantially constant values, the fourth arm containing the resistance of a vacuum tube device which is to be controlled, said vacuum tube device having an anode grid and cathode, an input and output circuit connected to said vacuum tube device, means for controlling the cathode resistance of said vacuum tube device comprising a thermionic relay having an anode, a control grid and cathode, said thermionic relay having its cathode and grid connected to a first pair of conjugate nodal points on said bridge, an electric energy supply source, a transformer having a primary and a secondary winding, the primary winding being connected to said supply source, said secondary winding connected to a second pair of conjugate nodal points on said bridge to energize said device, a connection between one end of said primary winding and the anode of said thermionic relay and a connection between the other end of said primary winding and the anode of said thermionic relay, a potential biasing source to prevent a decrease in the temperature of said device to be controlled, said potential biasing source comprising a direct current source connected in series from said relay control grid and one of said first pair of conjugate nodal points on said bridge at a point which is opposite the point where said relay cathode is connected.

4. An automatic temperature regulator comprising a Wheatstone bridge arrangement having four arms, three arms of which consist of fixed resistances each having substantially constant values, the fourth arm containing the resistance of a vacuum tube cathode circuit which is to be controlled, said vacuum tube cathode circuit hav-

ing an anode, grid and cathode, an input and output circuit connected to said vacuum tube cathode circuit, means for controlling the cathode resistance of said vacuum tube cathode circuit comprising a thermionic relay having an anode, a control grid and cathode, said thermionic relay having its cathode and grid connected to a first pair of conjugate nodal points on said bridge, an alternating current supply source, a series resistor, a transformer having a primary and a secondary winding, the primary winding being connected to said alternating current supply source and through said series resistor, said secondary winding connected to a second pair of conjugate nodal points on said bridge to energize said vacuum tube cathode circuit, a connection between one end of said primary winding and the anode of said thermionic relay and a connection between the other end of said primary winding and the anode of said thermionic relay, a potential biasing source to prevent a decrease in the temperature of said vacuum tube cathode circuit to be controlled, said potential biasing source comprising a direct current source connected in series from said relay control grid and one of said first pair of conjugate nodal points on said bridge at a point which is opposite the point where said relay cathode is connected.

5. A temperature regulator for controlling the heating of a vacuum tube cathode comprising a resistance bridge circuit having four arms, one of the arms being the resistance of the vacuum tube cathode circuit whose temperature is to be regulated, the three other arms each having substantially constant resistance of the same value as the vacuum tube cathode circuit at normal temperature, means for controlling the temperature of said vacuum tube circuit comprising a thermionic relay having an anode, a control grid and cathode, said thermionic relay having its cathode and grid connected to a first pair of conjugate nodal points on said bridge, an electric energy supply source, a transformer having a primary and a secondary winding, the primary winding being connected to said supply source, said secondary winding connected to a second pair of conjugate nodal points on said bridge to energize said vacuum tube circuit, a connection between one end of said primary winding and the anode of said thermionic relay and a connection between the other end of said primary winding and the anode of said thermionic relay, a potential biasing source to prevent a decrease in the temperature of said vacuum tube circuit to be controlled, said potential biasing source comprising a direct current source connected in series from said relay control grid and one of said first pair of conjugate nodal points on said bridge at a point which is opposite the point where said relay cathode is connected.

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