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GASEOUS DISCHARGE TUBE

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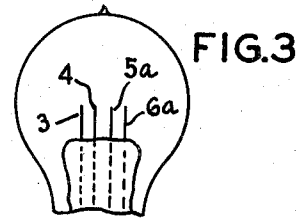
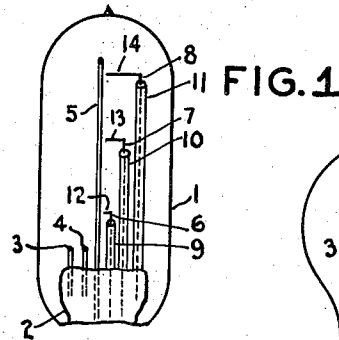
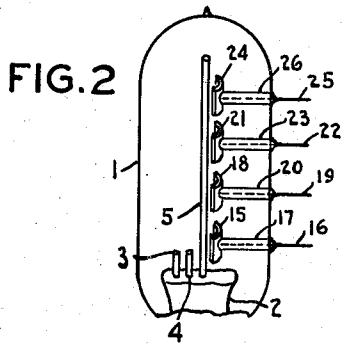


FIG 5

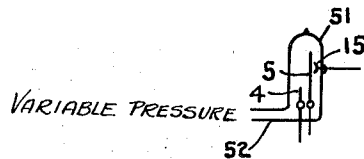
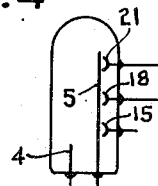


FIG. 4



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GASEOUS DISCHARGE TUBE

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Application August 23, 1933, Serial No. 686,331

7 Claims. (Cl. 250—27.5)

This invention relates to gaseous discharge tubes, and more particularly to improvements in gaseous discharge tubes particularly adapted for automatic control of electrical functions, and physical conditions. The tubes contemplated herein are to a certain extent similar to the tubes shown in Patent No. 2,026,102, granted December 31, 1935, on application Serial No. 653,795 filed January 27, 1933 for Silent tuning system for radio receivers.

In accordance with one aspect of my invention I utilize a gaseous discharge tube having a multiplicity of electrodes, one of the electrodes being a relatively long cathode on which there is produced a climbing discharge, the length of which may vary as a function of the voltage applied to the tube.

In cooperation with the said long electrode there may also be provided one or a plurality or multiplicity of supplementary electrodes positioned at various points along the long electrode and adjacent thereto, which supplementary electrodes draw current when the climbing discharge on the long electrode has reached a predetermined level. The current flow through the supplementary electrode circuit is utilized for the purpose of controlling desired functions in one or more additional circuits under the control of the discharge on the long electrode which may be caused to operate in response to desired functions, or in response to the arrival at, or departure of a system from predetermined desired conditions.

It is an object of this invention to provide a new and improved tube of the class described which is capable of functioning with nicety and exactitude to maintain desired conditions.

Still further objects and advantages of my invention will be apparent from the specification.

The features of novelty which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention, itself, however, both as to its fundamental principles and as to its particular embodiments, will best be understood by reference to the specification and accompanying drawing in which

Fig. 1 is a front elevation view of one form of tube in accordance with my invention,

Fig. 2 is a similar view of a modified form of tube,

Figs. 3, 4, and 5 are similar views of further modified forms of tubes.

Referring now more particularly to tube construction, reference numeral 1 indicates an envelope of the usual type, such for instance, as

glass, within which there are sealed a multiplicity of electrodes. In one form of tube, according to my invention, the various electrodes are sealed in a suitable press 2. There may be provided a short or main anode 4, a short cathode 3, and a relatively long cathode 5, all of which may be in the form of metal rods or wires. The construction thus far described is that customarily employed in the gaseous discharge tubes known to the radio art and obtainable on the market as the "Tun-A-Lite".

In the manufacture of the tubes the envelope is exhausted according to the usual process, after which a relatively small quantity of gas is admitted to the tube and the envelope sealed. In the preferred embodiment I utilize neon at a relative low pressure such as a few millimeters.

In addition to the electrodes thus far described, there may be included the supplementary electrodes 6, 7, and 8, each of which may be in the simple form shown in Fig. 1, consisting of a wire having its free end bent into juxtaposition with the long cathode 5, and surrounded by an insulating sleeve, such as a glass tube 9, 10, or 11. The short or auxiliary cathode 3 and the main anode 4 are thus disposed at one end of the elongated cathode 5. The main anode is relatively small, that is, may be described as substantially point-like.

In the operation of the tubes a voltage may be applied between the cathode 3 and the anode 4, which is sufficient to maintain a state of ionization or incipient ionization between these two electrodes. In addition another voltage may be applied between the anode 4 and the long cathode 5, this latter voltage being controllable or variable as the result of some particular circuit function. As this latter voltage increases, there is produced a visible glow or discharge upon the long cathode 5, which starts at the base thereof adjacent to anode 4, and gradually creeps up the cathode 5 as the voltage on cathode 5 increases. By control of the parameters of the tube and by control of the voltage applied, this discharge may be caused to crawl all the way up to the top of the long cathode 5, and to follow very closely in its up and down travel on cathode 5, the fluctuations of voltage applied to the tube.

It will be found that when the discharge or glow on cathode 5 has climbed to the level of point 12, the electrode 6 will suddenly begin to draw current, and will continue to draw current thereafter as long as the discharge is at that or a higher level, and it will be noted that no potential need be applied to the supplementary elec-

trodes to cause them to take current. If the discharge on the cathode 5 falls below that level, current will no longer be drawn by the electrode 6. Similarly, when the glow reaches the point 13, electrode 7 will begin to draw current, and when it reaches point 14, the electrode 8 will begin to draw current.

The form of tube shown in Fig. 2 is basically similar to that shown in Fig. 1. The differences, however, are that the area of the supplementary electrodes may be increased in this instance as by making these supplementary electrodes in the form of plates; thus the lowest supplementary electrode 15 may be secured to the lead 16, which in this instance may pass in through the wall of the envelope rather than through the press and if desired, an insulating shield 17 such as a glass tube may be placed over the lead wire 16. Additional supplementary electrodes 18, 21, and 24, may be provided, mounted on lead-in wires 19, 22, and 25, and each, if desired, provided with the insulating shields 20, 23, and 26.

Each of the supplementary electrodes, if desired, may be given a cylindrical shape, and may be made concentric with the long cathode 5. The electrodes 15, 18, 21, and 24, may vary in size as desired but I have found that very satisfactory results are obtained in the case of a cathode 5 of the order of 2 to 3 inches when the supplementary electrodes are made about $\frac{1}{8}$ " x $\frac{1}{4}$ ". While I have shown the supplementary electrodes in this instance as being arranged all on one side of the long cathode, it will be understood that this is not essential and that they may be spaced around the cathode, and the supplementary electrodes may be made larger or smaller, or may completely surround the cathode if desired. Also the number of supplementary electrodes may be increased or decreased as desired, and the distance between them may be varied in accordance with the operation desired.

Referring now to Fig. 3, I have shown a still further modification of tube according to my invention. In this instance, it may be desired to have current drawn by the auxiliary electrode immediately when the discharge strikes on main cathode 5, without waiting for the discharge to climb to a predetermined point on the cathode 5. In fact it may be desired to omit the climbing feature entirely. In such instance, the tube may have the form shown in Fig. 3, where 5a represents the main cathode, 4 the anode, 3 the "keep-alive" cathode, and 6a the auxiliary electrode. In the simplest form the tube may comprise an envelope containing neon at low pressure as before, with four short wires projecting into the tube through the press.

In operation, a "keep-alive" voltage may be kept impressed between electrodes 3 and 4, which I term "tickler" electrodes, and which serves to maintain a condition of incipient ionization within the tube, and the variable voltage which is to cause the discharge to strike on cathode 5a may be impressed between anode 4 and cathode 5a. As soon as this voltage becomes sufficient to cause the discharge to strike on cathode 5a, it immediately jumps to auxiliary electrode 6a, and when the voltage drops so that the discharge on cathode 5a ceases, electrode 6a ceases to draw current.

It will be understood that in the modification herein described, the cathode 5a may be made longer if it is desired to utilize the climbing characteristic of the tube, and that additional aux-

iliary electrodes may be provided as in Figs. 1 and 2 to be energized at predetermined positions of the climbing discharge.

Referring now more particularly to Fig. 4, I have indicated a modified form of tube according to my invention. Here the control tube is provided with electrodes 4, 5, 15, 18 and 21, as already described. In this embodiment, however, there is provided no keep alive cathode, such as the electrode 3 in each of the embodiments of the previously described figures. If desired, an initial potential may be applied between the anode 4 and cathode 5 to initiate ionization, so that the discharge will climb along the cathode in response to increases in a control potential applied between the electrodes 4 and 5 in substantially the same manner as described with reference to the embodiment shown in Figs. 1 and 2.

Referring now more particularly to Fig. 5, I have shown another form of tube according to my invention which may be employed to maintain a desired gas pressure in a gas system. Here the control tube 51 may be sealed to a line or vessel of the system by means of a connection 52, so that the pressure within the tube 51 is the same as that in the gas line or vessel. In this instance the tube 51 may utilize only three electrodes—an anode 4, a long cathode 5, and an auxiliary electrode 15. A suitable source of potential preferably is provided for connection between the electrodes 4 and 5 so that the current through the tube is substantially constant and, when the pressure in tube 51 is equal to that desired, the discharge reaches a point approximately in line with the electrode 15 or a little below it. Under such conditions the length of the discharge on the cathode 5 is a function of this pressure within the system.

When the pressure decreases, the discharge crawls upwardly on the cathode 5, and when it increases the discharge shrinks down on the cathode 5.

When the pressure within the tube drops below the desired level, the discharge crawls upwardly on the electrode 5 until it reaches the point opposite electrode 15 at which time this electrode begins to draw current and, when the pressure reaches a predetermined value, the discharge is depressed along cathode 5, electrode 15 ceases to draw current, and the desired controls may be effected in accordance with the current in the circuit of the electrode 15.

While I have described what I at present consider to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

I claim:

1. A gaseous discharge tube comprising an envelope containing gas at relatively low pressure, an anode, a main elongated cathode having the characteristic of producing a discharge variable in length along said cathode in response to changes in amplitude of applied anode-cathode voltages, and an auxiliary electrode therein, said auxiliary electrode having a portion located in juxtaposition to said main cathode and at a point intermediate said anode and the remote end of said cathode and having its other portions protected from current passing thereto, whereby current will not flow to said auxiliary electrode until

the discharge on said cathode has reached the juxtaposed portion of said auxiliary electrode.

2. A gaseous discharge tube comprising an envelope containing gas at relatively low pressure, and having electrodes therein, said electrodes comprising an anode, an elongated main cathode having the characteristic of producing a discharge variable in length along said cathode in response to changes in amplitude of applied anode-cathode voltages, and a plurality of auxiliary electrodes each having a discharge portion, said portions being located in juxtaposition to said cathode and at points intermediate said anode and the remote end of said cathode, whereby current will flow to said auxiliary electrodes only when the discharge on said cathode has reached such juxtaposed portions of said auxiliary electrodes.

3. A gaseous discharge tube comprising an envelope containing gas at a relatively low pressure, and having electrodes therein, said electrodes comprising an anode, an elongated cathode having the characteristic of producing a discharge variable in length along said cathode in response to changes in amplitude of applied anode-cathode voltages, and an auxiliary electrode, said auxiliary electrode comprising a plate located in juxtaposition to said cathode in discharge conducting relationship therewith and at a point intermediate said anode and the remote end of said cathode, whereby current will flow to said auxiliary electrode only when the discharge on said cathode has reached the juxtaposed portion of said auxiliary electrode.

4. A gaseous discharge tube comprising an envelope containing gas at relatively low pressure, and having electrodes therein, said electrodes comprising a short electrode and a long electrode having the characteristic of producing a discharge variable in length along said cathode in response to changes in amplitude of applied anode-cathode voltages, and a plurality of auxiliary electrodes each having a discharge portion in juxtaposition to said long electrode, said auxiliary electrodes being spaced longitudinally of said long electrode at points longitudinally spaced from said short electrode, whereby current will flow to said auxiliary electrodes only when the discharge on said cathode has reached the juxtaposed portions of said auxiliary electrode.

5. An electron discharge device adapted to function as an automatic control device comprising an envelope containing gas at a relatively low pressure, an elongated cold cathode, an anode adapted to be maintained at a positive potential relative to said cathode to produce a discharge between said anode and cathode, the length of said discharge being variable along said

cathode in response to variations of either said pressure or said anode potential, an auxiliary cathode mounted in juxtaposition to said anode and adapted to maintain incipient ionization within said envelope, and an auxiliary electrode adapted to be connected to a point at cathode potential, said auxiliary electrode having a portion located in juxtaposition to said main cathode and within the region of ionization of said discharge, whereby current will flow to said auxiliary electrode only upon said discharge reaching the juxtaposed portion of the cathode.

6. An electron discharge device adapted to function as an automatic control device comprising an envelope containing gas at a relatively low pressure, an elongated cold cathode, an anode adapted to be maintained at a potential positive relative to said cathode to produce a discharge between said anode and cathode, the length of said discharge being variable along said cathode in response to variations of said anode potential, and a plurality of auxiliary electrodes adapted to be connected to points at cathode potential, each of said auxiliary electrodes having a portion located in juxtaposition to said cathode, said portions being spaced at points intermediate said anode and the remote end of said cathode, whereby current will flow to the respective auxiliary electrodes only upon said discharge reaching the respective portions of said cathode juxtaposed to said auxiliary electrode portions.

7. An electron discharge device adapted to function as an automatic control device comprising an envelope containing gas at a relatively low pressure, a main elongated cold cathode, an auxiliary cathode at one end of said main cathode, a substantially point-like anode at said end adapted to be maintained at a potential positive relative to said cathodes to produce a discharge between said auxiliary cathode and said anode for maintaining incipient ionization within said envelope, whereby a discharge may be effected between said main cathode and said anode when said anode potential exceeds a predetermined value, the length of the last said discharge being variable along said cathode in response to variations of said anode potential, and a plurality of auxiliary electrodes adapted to be connected to points of cathode potential, each of said auxiliary electrodes having a portion located in juxtaposition to said cathode, said portions being spaced at points intermediate said anode and the remote end of said cathode whereby current will flow to the auxiliary electrodes only upon said discharge reaching the respective portions of said cathode juxtaposed to said auxiliary electrode portions.

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