

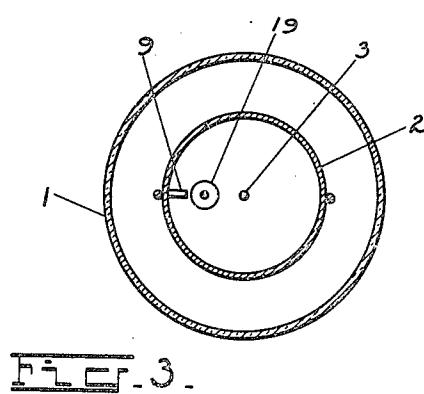
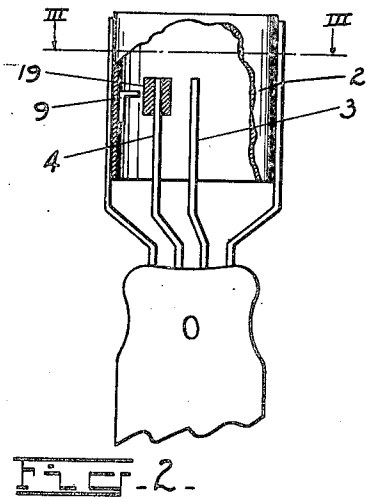
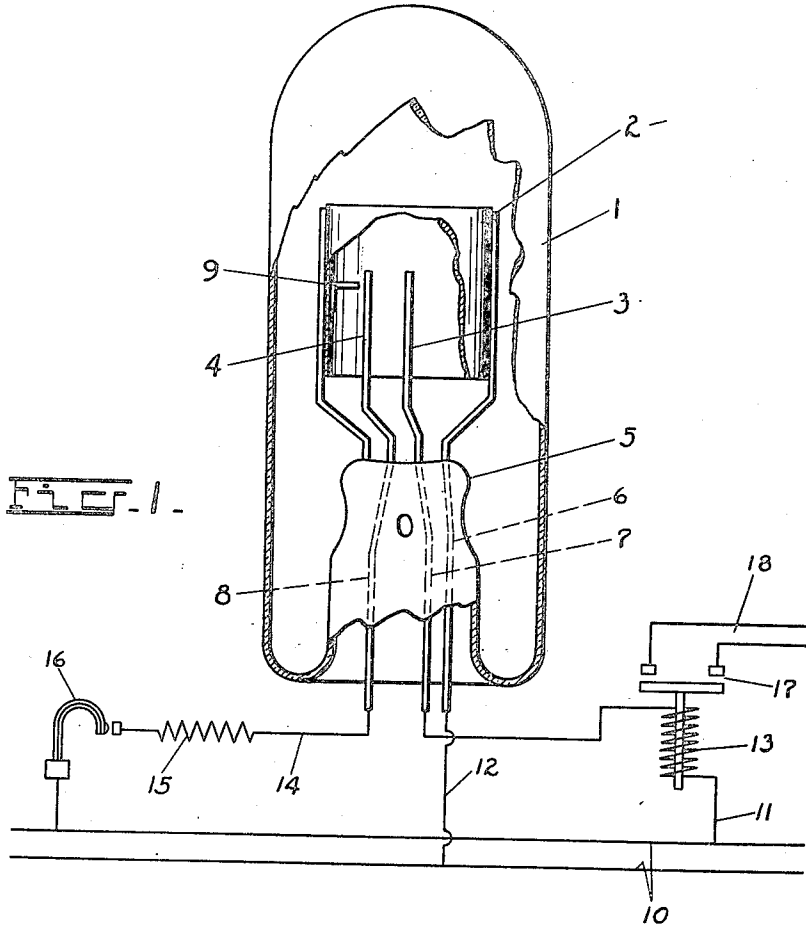
Aug. 30, 1932.

H. C. RENTSCHLER

1,875,151

GLOW RELAY TUBE

Original Filed Feb. 7, 1928



INVENTOR
H. C. RENTSCHLER
BY *M. J. Rye*
ATTORNEY

UNITED STATES PATENT OFFICE

HARVEY CLAYTON RENTSCHLER, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WEST-
INGHOUSE LAMP COMPANY, A CORPORATION OF PENNSYLVANIA

GLOW RELAY TUBE

Original application filed February 7, 1928, Serial No. 252,437. Divided and this application filed March 27, 1929. Serial No. 350,164.

This application is a division of application Serial No. 252,437, Rentschler filed February 7, 1928 and entitled "Glow relay tube."

This invention relates to an electrical discharge device of the gaseous conduction type and more particularly to such a device in which the discharge takes place between cold electrodes in a gaseous atmosphere at a reduced pressure.

One of the objects of this invention is to provide a gaseous conduction discharge device having extremely sensitive means for controlling the discharge therethrough.

Another object is to provide a gaseous conduction discharge device capable of delivering relatively large currents and having means operated by extremely feeble current changes for controlling the discharge.

A further object is to provide a gaseous conduction device which normally interposes a high resistance to the passage of current therethrough at a predetermined voltage and which has means operative by extremely feeble currents in a supplementary circuit for reducing such resistance so as to permit a relatively large flow of current at said predetermined voltage.

A still further object is to provide a gaseous conduction relay which will operate at relatively low voltages and which is extremely sensitive to current changes in a supplementary circuit.

Other objects and advantages will hereinafter appear.

It is well known that the voltage required to initiate an electrical discharge in a glow discharge device is higher than that required to maintain the discharge once it has started.

Thus, for instance, in voltage regulators, alternating current rectifiers, lamps, etc., employing spaced apart electrodes in a gaseous atmosphere and operating in the absence of thermionic emission, by a proper choice of electrode materials, electrode space, gas pressure, etc., the discharge may be made to start at a potential of around 120 volts, while the discharge once started will continue at potentials as low as 85 to 90 volts, depending somewhat upon the current passing through the tube. This difference in starting and op-

erating potential is due largely to the high resistance imposed by the cathode dark space. Upon initiation of a discharge in the device, this resistance layer is broken down and permits the discharge to continue on a voltage lower than the starting potential or another independent discharge to be started at a materially lower voltage.

It has also been found that there is a definite spacing of the electrodes for a particular gas and a particular pressure thereof at which the voltage required to initiate the discharge is a minimum. Moreover, whereas, devices of this nature may readily carry currents up to several hundred milli-amperes, the amount of current required to start the discharge is exceedingly small, that is, in the nature of only a few micro-amperes.

I may use of the above phenomena for the production of a sensitive glow relay tube and in accordance with my invention I provide such a gaseous conduction device having a cathode of relatively large area and a main anode and control anode of small areas. The main anode is so shaped and positioned with respect to the cathode that a considerably higher voltage is required to start a discharge between said electrodes than is available, whereas, the control anode is differently positioned with respect to said cathode and is so constructed that a discharge may be initiated between said control anode and the cathode at a considerably lower potential than that required to start the discharge from the main anode.

In the specific embodiment illustrated hereinafter, the control anode is positioned at the critical distance from the cathode at which the minimum voltage is required with the particular gas at the pressure employed to start the discharge to the cathode. The main anode is arranged at a sufficient distance from the cathode to prevent the starting of a discharge therefrom except at materially higher voltages. As a consequence of this construction, if a predetermined voltage is impressed between the main anode and cathode, below that necessary to initiate a discharge therebetween but sufficiently high to maintain such discharge once it has started

and if a second source of potential is applied between the control anode and cathode of sufficient potential to initiate a discharge between said electrodes in response to some external condition, the main discharge may be started through the initiation of the discharge from the control anode. Since only a very feeble current is required to initiate this auxiliary discharge, such as that obtained from a photo-electric cell, it is possible in this manner to cause such feeble current change to create a current flow of much greater magnitude in the circuit containing the main anode and cathode.

In order that the invention may be more fully understood, reference will be had to the accompanying drawing in which:

Fig. 1 is an elevation, partly in section, of a tube employing my invention associated with electrical apparatus for controlling the operation thereof;

Fig. 2 is an elevation, partly in section, of a modified form of electrode arrangement; and

Fig. 3 is a sectional view on the line 3—3 of Fig. 2.

The device shown in Fig. 1 comprises an envelope 1 containing a cathode 2, main anode 3 and control anode 4. The electrodes 2, 3 and 4 are suitably supported by a press 5 and are joined to leading-in wires 6, 7 and 8 respectively. A metallic projection 9 extends outwardly from the cathode 2 into proximity to the control anode 4. The space between the control anode and the end of the projection 9 should be such as to enable the minimum potential to be obtained for starting the discharge between the electrodes 2 and 4. This distance is dependent upon the particular gas employed and the pressure thereof. For instance, with a filling of argon gas at a pressure from 5 to 8 millimeters of mercury, a spacing of approximately 1 mm. has been found to give the requisite low potential starting condition. If other pressures are used or other gases employed, it may be necessary to vary the spacing of the control anode from the cathode.

The main anode 3 is spaced a much greater distance from the cathode than the control electrode. In the practical embodiment of the invention employing the gas pressure specified above, excellent operating characteristics were obtained with a cylindrical cathode 2 of 1 inch in diameter having the main anode 3 located at the axis thereof. In order to reduce the starting and operating potentials of the device, an electro-positive metal, such as one of the alkali metals or alkaline earth metals or a less volatile metal such as misch metal may be vaporized on to the cathode to form a surface layer thereon. The misch metal is satisfactory for operation on 110 volt lines but for lower line voltages the alkali metals are more suitable.

The main anode 3 is joined to one side of an alternating current line 10 through a conductor 11 and the cathode 2 is joined to the other side of said line through conductor 12.

An electro-magnetic relay 13 is interposed in the line 11 so as to be operated when a discharge is created between the electrodes 2 and 3 of the device. The resistance to current flow between the anode 3 and the cathode 2 is such that no discharge will normally pass therebetween at the voltage available from the line 10.

The control anode 4 is also connected to one side of the line 10 opposite from that of the cathode by a conductor 14, through a high resistance 15 and a switch 16. The resistance 15 limits the current which may pass between the electrodes 4 and 2 to a small value. The voltage of the line 10 is such that when the switch 16 is closed, the small current passing the resistance 15 at low voltage will start a discharge from the control anode to the cathode, thus ionizing the gaseous filling and breaking down the cathode resistance. Immediately this occurs, the resistance between the main anode 3 and the cathode become sufficiently decreased to cause a discharge therebetween, thus permitting a relatively heavy current to flow through the line 11 and the winding of the relay 13. This operates the switch 17 and energizes the circuit 18 for any desired purpose.

In the embodiment shown in Fig. 1 the switch 16 may take the form of a bi-metallic thermostatic element which, upon attaining a predetermined temperature closes or opens, thereby starting or stopping the discharge from the main electrodes and rendering available relatively heavy currents for operating the relay 13 without necessitating the passage of such relatively heavy current directly through the switch 16.

Fig. 2 illustrates a modified form of relay in which the control anode 4 is provided with a head 19 of a material which is more active than that of the electrode 3.

For instance, electrode 3 may be composed of a metal such as nickel and the anode head 19 of a material such as thorium, titanium or uranium which has the property of still further decreasing the potential required to initiate a discharge. In this manner the differential of potentials required to start the main and control or trigger discharge is increased. The active material constituting the control anode head 19 also exercises a clean-up action or gas purifying effect to maintain the gaseous filling in a more pure condition. If desired, the anode head may be coated with barium oxide which is reduced by the thorium or other active material, to liberate barium metal. The barium metal vaporizes onto the surface of the cathode 2 and serves to maintain the cathode drop of this electrode at a lower value.

While I have shown several applications of my invention, it is to be understood that it may be employed in other connections for various purposes and that the details of construction may also be varied within wide limits without departing from the invention.

What is claimed is:

A glow discharge relay device comprising an enclosing dielectric envelope containing a gaseous atmosphere at a reduced pressure therewithin and cold electrodes within said envelope comprising a cathode, a main anode and a starting anode, said cathode being of large surface area with respect to said anodes and including a projection extending towards said starting anode, the distance between said starting anode and said cathode being small as compare to the distance between said main anode and said cathode.

In testimony whereof, I have hereunto subscribed my name this 22 day of March, 1929.

HARVEY CLAYTON RENTSCHLER.

25

30

35

40

45

50

55

60

65