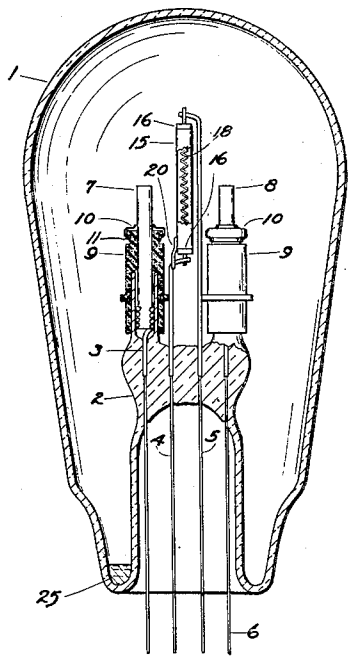
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GASEOUS DISCHARGE DEVICE

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GASEOUS DISCHARGE DEVICE

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This invention relates to gaseous discharge devices and more especially to rectifiers having a thermionic cathode operating in the presence of substantial ionization. Rectifiers having a thermionic filament operating in a gas or vapor at a high pressure have been known and used for some time. Prior to the development of this particular type of rectifier, great difficulty had been experienced in operating a rectifier with a thermionic filament in a gas. Because of the presence of a large number of ions, the thermionic filament was subject to considerable bombardment. As a rule, the discharge in the form of an arc would settle on some particular spot of the filament and bombard the filament there until finally a break would occur. This difficulty was overcome in a greater or less degree by having the gas or vapor at a high pressure of anywhere between 10 centimeters up to atmospheric pressure. In addition to this, the filament was operated at a very high temperature so that ions had but little energy when striking the cathode.

This type of tube labors under the disadvantage that cathode losses are large. Furthermore because of the very high pressures employed and the intense ionization, such rectifiers can not withstand any high potentials in the reverse direction.

An object of my invention is to devise a rectifier of the gaseous conduction type in which destruction of the cathode by bombardment is rendered practically impossible. A further object is to devise a rectifier of this type in which the cathode will have a long useful life. Another object is to avoid the use of extremely high gas pressures and thus allow the rectifier to withstand high reverse potentials. A further object is to accomplish the above objects and still maintain the drop through the tube at a low value.

In general I contemplate the use of an equipotential thermionic cathode cooperating with one or more anodes in a region of low gas pressure. This low gas pressure may be obtained by the use of rare gases at desirable pressures or by the use of easily vaporizable metals associated with condensing surfaces of the proper magnitude. Thus a drop of mercury within the rectifier may furnish mercury vapor at a pressure of about .01 m.m. The pressure need not be restricted to precisely this figure and may easily vary up to one or two millimeters. The ionization in a tube of this character, while not intense, is preferably just enough to neutralize the repulsive forces existing among the electrons. In this way, the space charge effect is destroyed and the cathode-anode drop is low even with large currents. The drop across a rectifier of this character is very low and usually of the order of magnitude of the ionization potential of the gas or vapor used. Thus in the case of mercury, the drop across a rectifier was about ten volts. With such a low difference in potential between anode and cathode in the direction of conduction, it is evident that ions will not be accelerated to sufficient speeds to destructively bombard the cathode. Furthermore, even if the cathode surface is bombarded, the discharge settles upon one spot of the entire surface and when this spot is no longer useful for emitting electrons, shifts to another spot. In this way a marked improvement over the filamentary cathode is obtained. In a filamentary cathode, the filament would part at the spot where the discharge destroyed it. With an equi-potential cathode any portion of the cathode which may be rendered inoperative as far as electron emission is concerned will not result in the suspension of operation of the tube.

Instead of mercury, it is evident that other vapors such as the alkali metals may be used. Furthermore, gases especially of the inert group may be used either alone or in combination with metallic vapors.

Referring to the drawing, the single figure is a sectional elevation of a rectifier embodying my invention. Within a glass envelope 1 is an upstanding press 2 having wires 3, 4, 5 and 6 sealed therein. Wires 3 and 6 are suitably connected to anodes 7 and 8. These anodes are preferably cylindrical rods of carbon, or any other suitable non-sputtering material. Anodes 7 and 8 are suitably supported by insulators 9 of lava or the like, tele-

scoping over tubular projections from press 2. These insulators serve to protect anode leads 3 from discharge from the anodes, this discharge happening in the absence of the insulators during operation of tubes of this character owing to potential drop during such operation. This discharge in time destroys the contact between the leads and the respective anodes, the connection being thereby broken and the tube rendered inoperative. The insulator projecting over the joint between the lead and the anode prevents such discharge. In order to protect anodes 7 and 9 from bombardment, metal shields 10 are disposed around said anodes where they emerge from the insulators. These metal shields are spaced from the anodes and are crimped over annular slots 11 in the insulators. Supported between wires 4 and 5 is a cathode. This cathode comprises an outer hollow cylindrical member 15 having its outer surface coated with suitable chemicals such as barium and other alkaline earth metal oxides for the promotion of electron emission. Inserted in each end of cylindrical member 15 are insulating plugs 16. Through the center of these plugs are lead wires of a filament heater 18. In order to provide a connection between the electron emitting cathode surface and the outside of the tube, wire 4 has a small metal member 20 connecting it to the cylinder 15. The tube is exhausted and freed of occluded gases in accordance with the usual practice. If mercury vapor is desired, a drop of mercury 25 may be disposed within the tube and the tube thereafter sealed. In lieu of this, argon, helium or any other gas may be used along or in conjunction with the mercury. If mercury is used it is preferable to make envelope 1 of sufficient size so that during the discharge the pressure within the device will not rise very high.

Suitable heating current being led through the wires 4 and 5 and energizing the cathode, electrons are copiously emitted from cylindrical member 15. A discharge will pass between one or both anodes to cathode member 15. The two anodes 7 and 8 may be connected so that together with the cathode, full wave rectification is effected. Due to the very large electron emitting area and the comparatively low gas pressure, such a rectifier will function in a very efficient manner during a long useful life. A rectifier of this type with mercury therein in operation has a drop of about ten volts, while capable of withstanding high reverse potentials of several hundred volts. Alkaline earth oxides may be used on the cathode with desirable results since mercury vapor has substantially no effect thereon.

If the vapors of alkali metals are used, either alone or in combination with any other gas or vapors, it is desirable that instead of a Wehnelt type of cathode that a thoriated tungsten cathode be used.

I claim:

A thermionic gas discharge device comprising, a gas tight vessel having a reentrant glass stem with a press, an equipotential cathode having a heating element in the interior supported on said stem, leads sealed through said press for energizing said heating element and providing a connection to said cathode, a plurality of anodes on said stem having leads sealed through said press, said anode leads being joined to the ends of said anodes facing said stem, a gas filling in said vessel at a pressure sufficient to neutralize the space charge during operation of the device, said press having tubular glass extensions surrounding the ends of the anode leads, and insulating members overlapping said extensions and surrounding the lower ends of said anodes to prevent ionization of the gas in the space where the anode and anode leads emerge from the press.

In testimony whereof, I have signed my name to this specification.

PERCY L. SPENCER.