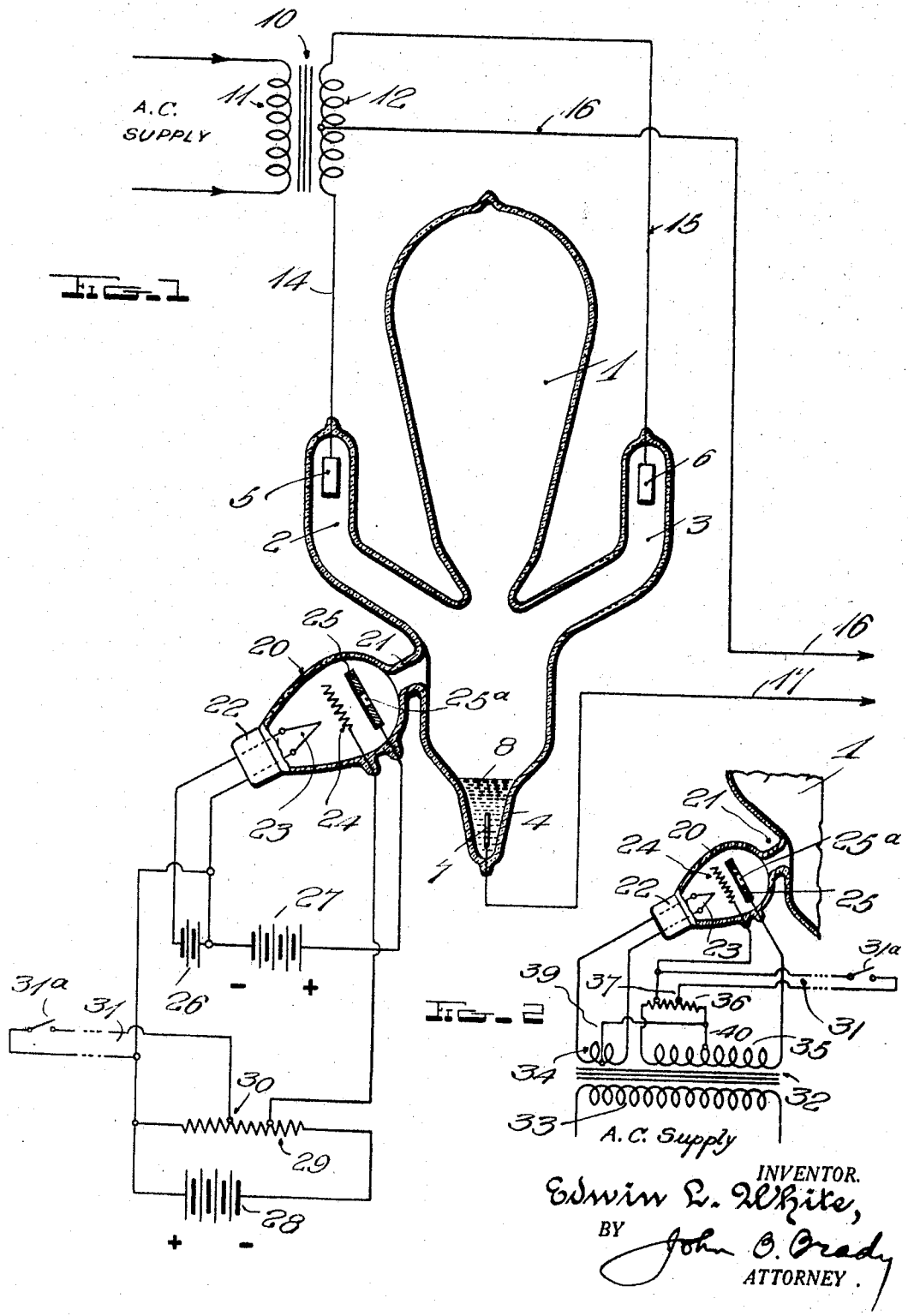
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METHOD AND APPARATUS FOR CONTROLLING MERCURY ARC RECTIFIERS

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METHOD AND APPARATUS FOR CONTROLLING MERCURY ARC RECTIFIERS

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My invention relates broadly to mercury arc rectifiers and more particularly to means for controlling the operation of mercury arc rectifiers.

One of the objects of my invention is to provide a construction and arrangement of control means for a mercury arc rectifier by which a high power rectifier may be controlled from a remote position without mechanical movement of the rectifier.

Another object of my invention is to provide a construction of mercury arc rectifier associated with a grid glow tube so arranged with respect to the electrodes of the mercury arc rectifier that ionization may be established within the mercury arc rectifier for initiating the operation of the rectifier.

Still another object of my invention is to provide a construction of grid glow tube device associated with a mercury arc rectifier and having control circuits connected therewith for controlling the operation of the rectifier from a remote position.

Other and further objects of my invention reside in the construction of mercury arc rectifier and grid glow tube associated therewith as set forth more fully in the specification hereinafter following by reference to the accompanying drawing, in which:

Figure 1 schematically shows a mercury arc rectifier and associated grid glow tube constructed and arranged in accordance with my invention and illustrating the circuits associated with the mercury arc rectifier; and Fig. 2 illustrates a modified circuit arrangement for the grid glow tube employed in the system of my invention.

My invention employs a grid glow tube in association with a mercury arc rectifier with control circuits extending from a remote position to the grid glow tube for controlling the operation of the grid glow tube and correspondingly controlling the ionization within the mercury arc rectifier. The grid glow tube is arranged in such position with respect to the mercury arc rectifier that the grid glow tube may be operated to ionize the gap between the electrodes of the mercury arc rectifier for establishing a discharge path through the rectifier and starting and maintaining operation of the arc without mechanical movement of the rectifier. The grid glow tube is associated with the mercury arc rectifier in such manner that the electrodes of the grid glow tube are adjacent the discharge path of the mercury arc rectifier. Normally, a large blocking or bias potential is applied to the grid electrode of the grid glow tube, as a result of which no mercury ions will be formed in either the grid glow tube or the mercury arc rectifier tube. If the grid bias is lowered, the gas between the cathode and anode of the grid glow tube is broken down and a current flows through the cathode and anode circuit. The ions so produced are projected into the mercury arc rectifier tube through an opening in the anode. A conductive discharge path is thereby established between the mercury pool electrode and the other electrodes within the mercury arc rectifier tube thereby establishing the discharge path between the electrodes within the mercury arc rectifier tube. The mercury arc rectifier is then maintained in operation by the continued supply of energy thereto. In large size mercury arc rectifier tubes employing a single pole rectifier instead of a multiple pole rectifier, the arc is self extinguishing and in order to maintain the arc, I so arrange the circuit that the grid glow tube operates each semi-cycle to maintain the arc discharge. In this case, the mercury arc rectifier tube is operated only as long as the bias is off the grid of the grid glow tube. A very small current is required for controlling the grid glow tube while permitting the control of large currents through the mercury arc rectifier without mechanical movement. The small current which is required to operate the grid glow tube may, therefore, be obtained through the operation of a thermostat or a small switch device.

Referring to the drawing in more detail, reference character 1 designates the mercury arc rectifier tube having extensions 2 and 3 thereon and including a central portion 4 which encloses the mercury pool 8 and to which electrical connection is made through electrode 7. Electrodes 5 and 6 are arranged in the extensions 2 and 3 of the mercury arc rectifier tube. Power is supplied to the mercury arc rectifier tube through transformer 10 comprising primary winding 11 and secondary winding 12. The opposite ends of secondary winding 12 are connected through leads 14 and 15 with electrodes 5 and 6 respectively. The center point of secondary winding 12 is connected through lead 16 with the output of the mercury arc rectifier. The electrode 7 connects through lead 17 to the output of the mercury arc rectifier.

The grid glow tube is represented at 20 formed in an extension on one side of the mercury arc rectifier tube and connected through tubular portion 21 with the mercury arc rectifier tube 1. An insulated terminal block 22 is provided on the envelope of the grid glow tube 20 and pro-

vides for the passage of conductors to the cathode 23 inside the tube. Grid electrode 24 is mounted inside the envelope 20 and is connected to the external control circuit as shown. The anode 25 is arranged within the grid glow tube and is connected with the external circuit as shown. It will be observed that the anode 25 has a central aperture 25a which is aligned with the tubular portion 21, thus permitting the projection of electrons into the discharge paths within the mercury arc rectifier tube 1. The cathode 23 is heated from current supplied from source of potential 26. The anode 25 is given an initial positive potential from battery 27 connected in series between the cathode 23 and anode 25 as shown. The grid 24 is normally biased from source of potential 28 by connection to a point of negative potential on the potentiometer 29, the potentiometer shunting the potential source 28. A tap 30 is provided on potentiometer 29 and connected with the control circuit 31 which may lead to a remote point and be controlled by switch 31a located at the remote point. Closing of switch 31a decreases the bias potential on grid 24 thus controlling the discharge of electrons from cathode 23 to anode 25 and the projection of such electrons through the aperture 25a in the anode 25 and into the discharge path within the mercury arc rectifier tube 1. Upon opening switch 31a, the blocking potential is again restored to the grid electrode 24 thus preventing the further propagation of electrons into the discharge path within the mercury arc rectifier tube.

I may employ alternating current in lieu of the direct current sources illustrated in Fig. 1. Fig. 2 illustrates the manner of employing alternating current for the control of the grid glow tube. A power transformer 32 having primary winding 33, connected with the alternating current source, is provided with secondary windings 34 and 35. Secondary winding 34 provides heating potential for cathode 23. Secondary winding 35 provides a source of potential for charging the anode 25 and biasing the grid electrode 24. A tap 40 in secondary winding 35 connects with tap 39 in secondary winding 34 thus completing the external circuit connection from anode 25 to cathode 23. Potentiometer 36 is connected in shunt with the portion of secondary winding 35 between tap 40 and the end of the secondary winding. Taps 37 on the potentiometer 36 lead to the remote control circuit 31 which includes the control switch 31a at the control position. The control circuit connects to grid 24 and when closed, operates to reduce the bias potential and allow the projection of electrons through the aperture 25a in anode 25 for ionizing the discharge paths within the mercury arc rectifier tube 1.

As heretofore noted, a single pole type of rectifier which will be normally self-extinguishing may be maintained in operation by the cyclic operation of the grid glow tube so long as the bias potential on the grid is of reduced value.

While I have described the control system in certain preferred embodiments, I desire that it be understood that modifications may be made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A mercury arc rectifier including a tube enclosing a plurality of discharge paths, an extension on said tube, a grid glow tube connected with said extension with the axis of said grid glow tube aligned with at least a portion of one of said discharge paths, a plurality of electrodes within said grid glow tube including a cathode, a control grid and an anode, and means for projecting electrons from said grid glow tube through said anode into the discharge paths in said mercury arc rectifier for ionizing the paths in said mercury arc rectifier tube.

2. A mercury arc rectifier comprising an enclosing vessel, a plurality of electrodes disposed within said vessel and arranged in gaseous discharge paths, an extension at one side of said vessel in alignment with at least a portion of one of said discharge paths, a tube connected with said extension, a cathode in the remote end of said tube, a centrol grid adjacent said cathode, and an anode adjacent said control grid and immediately adjacent the gaseous discharge paths in said vessel and circuits electrically connected with said cathode, control grid and anode for projecting electrons through said anode into said mercury arc rectifier tube and ionizing the discharge paths therein.

3. A mercury arc rectifier comprising a vessel enclosing a plurality of discharge paths, an extension at one side of said vessel co-linear with at least a portion of at least one of the discharge paths in said vessel, a tube connected with said extension, a cathode disposed in one end of said tube, a control grid mounted adjacent said cathode, an anode disposed adjacent said control grid and arranged immediately adjacent the connection of said tube with said vessel, and means for exciting said electrodes for projecting electrons into said vessel through said anode and ionizing the discharge paths therein.

4. A mercury arc rectifier comprising a vessel enclosing a plurality of discharge paths, an extension at one side of said vessel co-linear with at least a portion of at least one of the discharge paths in said vessel, a tube connected with said extension, a cathode disposed in one end of said tube, a control grid mounted adjacent said cathode, an anode disposed adjacent said control grid and constituting a target for bombardment by electrons emitted by said cathode and arranged immediately adjacent the connection of said tube with said vessel, and direct current means for exciting said electrodes for projecting electrons into said vessel through said anode and ionizing the discharge paths therein.

5. A mercury arc rectifier comprising a vessel enclosing a plurality of discharge paths, an extension at one side of said vessel co-linear with at least a portion of at least one of the discharge paths in said vessel, a tube connected with said extension, a cathode disposed in one end of said tube, a control grid mounted adjacent said cathode, an anode disposed adjacent said control grid and arranged immediately adjacent the connection of said tube with said vessel, said anode having a central aperture therein, and alternating current means for exciting said electrodes for projecting electrons into said vessel through said anode and ionizing the discharge paths therein.

6. A mercury arc rectifier comprising a vessel enclosing a plurality of discharge paths, an extension at one side of said vessel co-linear with at least a portion of at least one of the discharge paths in said vessel, a tube connected with said extension, a cathode disposed in one end of said tube, a control grid mounted adjacent said cathode, said anode comprising a plate apertured at

its center and extending in a plane normal to the axis of the connection of said tube with said vessel, and means connected with said electrodes whereby said electrodes operate to project electrons into said vessel through the apertured anode for ionizing said discharge paths.

7. A mercury arc rectifier comprising an enclosing vessel, a plurality of discharge paths within said vessel, a tube connected with one side of said vessel co-linear with at least a portion of at least one of the discharge paths in said vessel, a cathode in one end of said tube, a control grid electrode in said tube adjacent said cathode, an anode in said tube adjacent said control grid electrode, external circuits for energizing said cathode and establishing a predetermined potential between said cathode and said anode, means for establishing a predetermined negative potential upon said control grid electrode for normally blocking the discharge of electrons from said tube into said vessel, and means for reducing the negative potential on said control grid electrode for projecting electrons into the discharge paths within said vessel through said anode for ionizing said paths.

8. A mercury arc rectifier comprising an enclosing vessel, a plurality of discharge paths within said vessel, a tube connected with one side of said vessel co-linear with at least a portion of at least one of the discharge paths in said vessel, a cathode in one end of said tube, a control grid electrode in said tube adjacent said cathode, an anode in said tube adjacent said control grid electrode, external circuits for energizing said cathode and establishing a predetermined potential between said cathode and said anode, means for establishing a predetermined negative potential upon said control grid electrode for normally blocking the discharge of electrons from said tube into said vessel, a remote control circuit, a switch located at a remote point and connected with said remote control circuit and connections between said remote control circuit and said last mentioned means whereby the potential on said control grid may be reduced and the electron discharge into said vessel may be reduced for effecting the projection of electrons into said vessel and ionizing said discharge paths.

9. A mercury arc rectifier comprising an enclosing vessel, a plurality of discharge paths within said vessel, a tube connected with one side of said vessel co-linear with at least a portion of at least one of the discharge paths in said vessel, a cathode in one end of said tube, a control grid electrode in said tube adjacent said cathode, an anode in said tube adjacent said control grid electrode, external circuits for energizing said cathode and establishing a predetermined potential between said cathode and said anode, a source of potential, a potentiometer connected with said source of potential, connections between points of widely different potential on said potentiometer with said cathode and control grid electrode, a remote control circuit, a switch in said remote control circuit in a remote control position, and connections between said remote control circuit and points on said potentiometer for effectively reducing the potential on said control grid electrode when said switch is closed and effecting the discharge of electrons into said vessel for ionizing the discharge paths therein.

10. A mercury arc rectifier comprising a vessel enclosing a plurality of discharge paths, a tube connected with one side of said vessel co-linear with at least a portion of at least one of the discharge paths in said vessel, said tube enclosing a cathode, a control grid and an anode, a source of alternating current, a power transformer having a primary winding connected with said source of alternating current, a pair of secondary windings, connections between said cathode and one of said secondary windings, a potentiometer connected between one end of said second mentioned secondary winding and a tap in said second mentioned secondary winding, taps on said potentiometer, a connection between one of said taps and said control grid, a connection between the anode and the other end of said secondary winding, a remote control circuit, a switch at a remote point in said remote control circuit, connections between said remote control circuit and the aforesaid tap on said potentiometer and to a second tap at an intermediate point on said potentiometer, whereby closing of said switch operates to reduce the effective potential on said control grid for effecting the propagation of electrons into said vessel and ionizing the discharge paths therein.

11. A mercury arc rectifier comprising a vessel enclosing a plurality of discharge paths, a tube connected with one side of said vessel co-linear with at least a portion of at least one of the discharge paths in said vessel, a cathode in one end of said tube, a control grid electrode adjacent said cathode, an anode adjacent said control grid electrode, said anode being apertured for the projection of electrons into the discharge paths in said vessel, a source of alternating current, a power transformer having its primary winding connected with said source, a pair of secondary windings, one of said secondary windings connected with said cathode and the other of said secondary windings connected with said control grid and said anode for normally charging said electrodes and biasing said control grid for blocking the projection of electrons into said vessel, and means connected with said last mentioned secondary winding for reducing the biasing potential upon said control grid for effectively propagating electrons into said vessel for ionizing the discharge paths therein.

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