June 21, 1938. R. E. BARCLAY 2,121,333

GASEOUS CONDUCTION DEVICE

Filed June 23, 1934

FIG. 1.

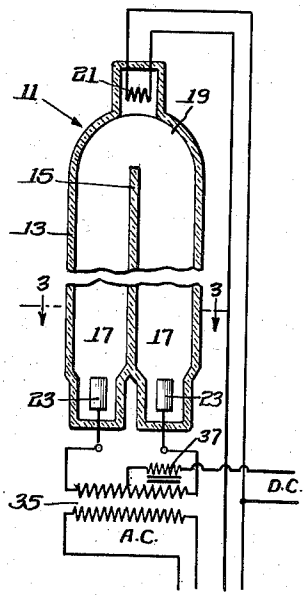


FIG. 4

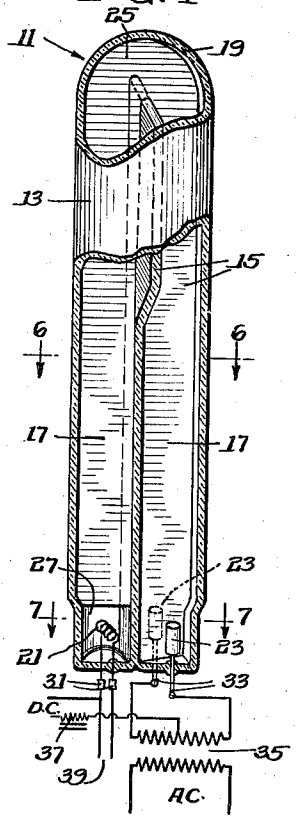


FIG. 5.

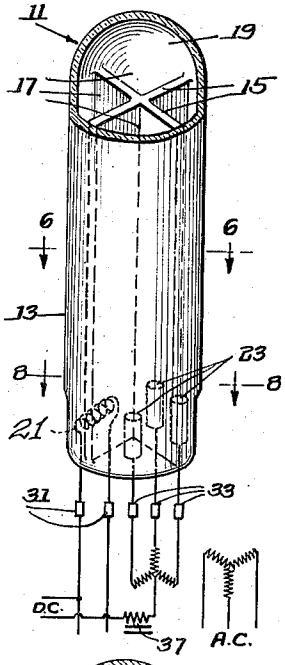
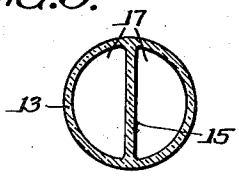


FIG. 3.



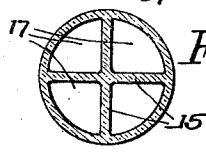


FIG. 6

FIG. 2.

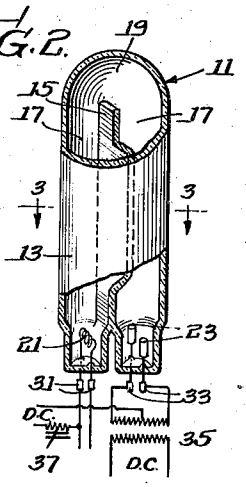


FIG. 7.

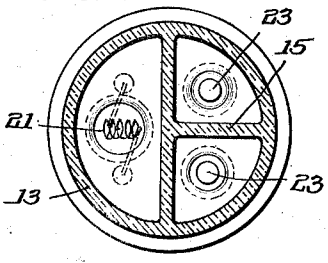


FIG. 9.

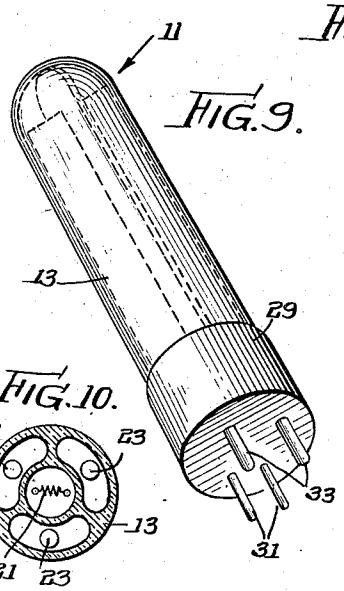


FIG. 8.

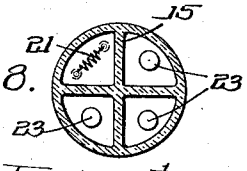


FIG. 10.

Inventor:
Robert E. Barclay
By: Cox & Moore Attys.

Patented June 21, 1938

2,121,333

UNITED STATES PATENT OFFICE

2,121,333

GASEOUS CONDUCTION DEVICE

Robert E. Barclay, Chicago, Ill., assignor to Federal Electric Company, Inc., Chicago, Ill., a corporation of New York

Application June 23, 1934, Serial No. 732,093

7 Claims. (Cl. 250—27.5)

My invention relates to electrical rectification and has more particular reference to a rectifier of novel construction embodying means to produce an electron flow in an ionized gaseous field of the character ordinarily employed in so-called discharge illumination.

When an electrical potential difference is applied at spaced points in a gaseous medium comprising neon, argon, crypton, xenon, mercury vapor, carbon dioxide and certain other gases, an electron flow in an ionized path between said spaced points of application of electrical potential difference is initiated and it is an important object of my present invention to utilize such an electron flow for the purpose of rectification.

Another important object resides in providing a device comprising a sealed envelope containing a gaseous medium adapted to be energized for electron flow therein and means, including electrodes, disposed in suitable position with respect to the envelope so that electron flow within the envelope may be utilized for the purpose of rectifying electrical currents passing along the electron flow path.

Another important object is to provide a rectifier, which, when in operation, functions as an illuminating device

Another important object is to provide a discharge lamp adapted to function as a rectifier when in operation.

Another important object is to provide a discharge element, adapted to function as a rectifier, comprising means forming an elongated channel containing a gas adapted for excitation to sustain electron flow therein, the ends of the channel being disposed in adjacent relationship and connected in a support base preferably in the form of a socket adapted for removable connection in an external electrical net work whereby to accomplish rectification of the electrical currents flowing in said net work.

Another important object is to provide a rectifier comprising envelope means forming a sealed channel having a substantially U-shaped channel portion or portions with electrode means disposed at the opposed, adjacently arranged, ends of the channel so as to facilitate connection, at one end of the device, of said electrodes in an external electrical net work, in which rectification is to be accomplished, a further important object being to form the envelope with integral means forming a partition common to arms of the channel.

Another important object is to provide a device of the character mentioned, in which the discharge channel is arranged in serpentine fashion, with one or more U-shaped portions, the opposed ends of the channel being disposed in adjacent relationship at one end of the element; a further object being to arrange the channel with an intermediate or mid-section extending adjacent the opposite ends of the channel.

Another important object is to provide a multiphase rectifier of the character mentioned.

A still further object is to provide a rectifier comprising an envelope having integral partition means defining a plurality of channels in the envelope and including a connector portion or portions for inter-connecting the ends of certain adjacent channels so as to form a discharge path or paths having U-shaped or serpentine portions.

Numerous other objects, advantages, and inherent functions of the invention will become apparent as the same is more clearly understood from the following description, which, taken in connection with the accompanying drawing, discloses preferred embodiments of the invention.

Referring to the drawing:

Figure 1 is a view in longitudinal section through a device embodying my present invention;

Figure 2 is a perspective view, partially in longitudinal section, of a device embodying my invention;

Figure 3 is a sectional view taken along the lines 3—3 in Figures 1 and 2;

Figures 4 and 5 are perspective views, partially in longitudinal section, of devices embodying my present invention;

Figure 6 is a sectional view taken along the lines 6—6 in Figures 4 and 5;

Figures 7 and 8 are sectional views taken respectively along the lines 7—7 and 8—8 in Figures 4 and 5;

Figure 9 is a perspective view of the device shown in Figure 4 as arranged with means whereby the same may be removably connected in an external electrical system; and

Figure 10 is a sectional view along the line 8—8 in Figure 5 to show a modified arrangement of the envelope.

To illustrate my invention, I have shown on the drawing, discharge devices 11 comprising envelope means preferably formed of translucent material, such as glass, the envelope means being formed to provide a sealed container for a gaseous medium adapted to be energized to initiate electron flow therein, the device having electrodes whereby the gaseous medium may be excited.

The envelope may be formed in a variety of

ways and preferably comprises a sealed tubular element of glass defining an elongated channel in which the electrical discharges occur between the electrodes, which are arranged in spaced apart position on the channel. The envelope may be formed as a straight tubular element sealed at its opposite ends, preferably, however, the envelope is arranged so that the gas sealed discharge channel therein has a U-shaped portion or portions. To this end, the envelope may comprise an elongated tubular element bent intermediate its ends to the desired configuration. I prefer, however, to form the envelope of a suitable length of preferably glass tubing **13** having integral portions forming a partition **15** dividing the bore of the tube into a plurality of parallel and adjacently extending channels **17**. In the embodiment illustrated in Figures 1, 2, and 3, the partition means **15** divides the bore of the tube **13** into two channels **17**, while in the embodiments shown in Figures 4 through 9, the partition means **15** forms more than two channels in the envelope. The partitioned tube **13** may be made in any suitable way as by inserting a partition in a tubular member and fusing the side edges of the partition to the wall of the tube, or by fusing two tubes together laterally while plastic but I prefer to form the partition as a unitary integral structure of the envelope substantially as taught in my United States Letters Patent No. 1,904,348, issued April 18, 1933.

The devices shown in Figures 1 and 2 of the drawing are made from a suitable length of partitioned tubing, which is provided at one end with a dome **19**, which seals the end of the tube and interconnects the ends of the channel portions **17**. The lower end of each channel **17** is provided with an electrode of suitable form and is sealed in any suitable or preferred manner, the electrodes having connections extending out through the sealed ends of the channel to permit connection thereof in an external electrical circuit.

Rectifiers, embodying my present invention, comprise at least one cathode electrode **21** and a plurality of anode electrodes **23**. The cathode electrode may be of any suitable form and construction and preferably comprises a filament whereby the same may be energized from an external source in order to promote electron emission at the cathode electrode. It is, however, within the contemplation of my invention to utilize other than an artificially excited cathode electrode. In the form shown in Figure 1, the cathode electrode is carried in the dome **19** opposite the end of the partition **15**, an anode electrode **23** being disposed in the remote end of each of the channel legs **17**. In the form shown in Figure 2, the cathode electrode is disposed in the remote end of one of the legs **17**, the anode electrodes being disposed in the remote end of the other leg.

The device shown in Figure 4 of the drawing is made from a suitable length of partitioned tubing, in which the partition is arranged to form four channels **17**. The tubing is provided at one end with a dome **19**, which seals the end of the tube, the portions **25** of the partition being extended into the dome and sealed thereto so that the channels are inter-connected in pairs within the dome. The opposite end of one leg of each pair of inter-connected channels is sealed and provided with an anode electrode **23**. The partition means, at the end of the tube opposite from the dome, is cut away as at **27** between the remaining legs of each inter-connected pair and a cathode electrode **21** is disposed in said cut away portion so that a serpentine discharge path having U-shaped portions is provided between the cathode electrode and each of the anode electrodes. Obviously, the serpentine path may be duplicated by suitably configuring a suitable length of tubing having a single channel.

The devices illustrated in Figures 2 and 4 facilitate the making of connections between the electrodes **21** and **23** and an external electrical network, with which the device is connected for operation, since all the electrodes are disposed at one end of the envelope **11**. I prefer also to assemble a base **29**, preferably comprising a cup-shaped element adapted to receive the electrode-carrying end of the envelope and having terminal means **31** and **33** by which the electrodes **21** and **23** respectively may be connected in the external electrical network, the electrodes, of course, being electrically connected with the terminals. The end of the envelope may be secured at the support **29** in any suitable fashion as by pouring a thermo-plastic insulating compound into the cup-shaped element **29** after the end of the envelope has been inserted and electrical connections made between the electrodes and the terminals.

Rectifiers, embodying my invention, may be operated by connecting the anode electrodes **23** in an alternating current network comprising in the illustrated embodiment, a transformer **35**, the primary winding of which is connected with a suitable source of alternating current power and the secondary winding of which is connected with the anode electrodes. Direct current will be delivered in a circuit extending between the cathode **21** and the mid-portion of the secondary winding of the transformer **35**, a choke coil **37** being preferably arranged in the direct current circuit to regulate current flow therein and subdue current fluctuations. The cathode electrode **21**, if desired, may be electrically energized by means of a circuit **39**, the electrode being connected in the circuit by means of the terminals **31** carried by the base **29**.

In the embodiment shown in Figure 5 of the drawing, I have illustrated one form of three-phase rectifier. In this form, the envelope is made from a suitable length of partitioned tubing in which the partition defines four channels. One end of the tube is provided with a dome **19** arranged to seal the end of the tube and to place all of the channels in communication with each other. The opposite ends of each channel are sealed and one channel is provided with a cathode electrode **21**. The ends of the remaining channels are each provided with an anode electrode **23**. I may form the envelope with the channel containing the cathode electrode **21** surrounded or encircled by the remaining anode channels as shown in Figure 10.

It is within the contemplation of my present invention to provide a multi-phase rectifier, in which the envelope has only two channels as shown in Figure 2 of the drawing by simply arranging one or more additional anode electrodes **23** in addition to those shown in Figure 2. However, in building a multi-phase rectifier, I prefer to provide a separate channel for each anode electrode. The multi-phase rectifier may be formed with a supporting base similar to that shown in Figure 9 and having terminals **31** connected with the cathode electrode and terminals **33** each connected with one of the anode electrodes. The multi-phase rectifier may be oper-

ated by connecting the anode electrodes in a three-phase alternating current system, which, in the illustrated embodiment, comprises a transformer, the several phases of the secondary winding of which are arranged in star connection, the direct current circuit extending from the neutral point of the star-connected secondary and the cathode electrode 21. Suitable means, of course, are provided for energizing the cathode electrode if an artificially excited cathode is used as is the case in the illustrated embodiment.

It is thought that the invention and numerous of its attendant advantages will be understood from the foregoing description, and it is obvious that numerous changes may be made in the form, construction, and arrangement of the several parts without departing from the spirit or scope of my invention or sacrificing any of its attendant advantages, the forms hereinbefore described comprising preferred embodiments for the purpose of illustrating the invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is as follows:

1. A gaseous conduction device comprising a tubular envelope having longitudinally extending partition means defining a plurality of adjacent channel portions in the envelope, said envelope comprising means sealing the ends of certain of said channel portions at one end of the envelope, a cathode electrode at the sealed end of one of said channel portions, and an anode electrode at the sealed end of each of several others of said channel portions, said envelope comprising means interconnecting the adjacent ends of certain of said channel portions whereby to form a discharge path having a V-shaped portion in the envelope between the cathode electrode and each of said anode electrodes.

2. A gaseous conduction device comprising a sealed tubular envelope having integral internal partition means extending longitudinally of the envelope and defining a plurality of channel portions extending longitudinally in said envelope, said partition means comprising integral intersecting wall portions defining the channel portions within a pair of said intersecting wall portions and a portion of the tubular wall of said envelope, said partition means having an opening connecting a pair of said channel portions at one end of the envelope to provide a channel having a U-shaped portion, a cathode in said channel at one end of said envelope and a plurality of anodes in said channel at said end of the envelope and each separated from said cathode by said partition means.

3. A discharge device comprising a tubular envelope having integral partition means defining a plurality of adjacent channel portions in said envelope, certain of said channel portions encircling one of said channel portions, means interconnecting said channel portions at one end of the envelope to form a plurality of U-shaped channels, and means sealing the opposite ends of each of said channel portions, a cathode electrode in the sealed end of the encircled channel portion and an anode electrode in each of the sealed ends of certain of the encircling channel portions.

4. A gaseous conduction device comprising an envelope defining a cathode chamber and a plurality of elongated channel portions containing a gaseous conduction medium and each having an end connected with the cathode chamber, an anode in the other end of each of said elongated channel portions, and a cathode in said cathode chamber, said anodes and cathode being carried by the envelope at one end of the device with the anode containing ends of the channel portions disposed adjacent the cathode, and the channel portions extending at the end of the device opposite that at which the cathode and anodes are positioned.

5. A gaseous conduction device comprising an envelope defining a cathode chamber and a plurality of anode chambers adjacent the cathode chamber at one end of the device, said envelope also defining a plurality of U-shaped channels containing a gaseous conduction medium and communicating each, at one end, with one of said anode chambers, the other ends of said channels communicating with said cathode chamber, a cathode in the cathode chamber and an anode in each of said anode chambers all at one end of the device to simplify connection thereof in external electrical circuits.

6. A gaseous conduction device comprising an envelope means defining a plurality of parallel and adjacent channels containing a gaseous conduction medium, one end of each of said channels being sealed and the other ends of the channels being interconnected, a cathode in the sealed end of one channel and an anode in the sealed end of each of several of the other channels.

7. A gaseous conduction device comprising an envelope means defining a plurality of parallel and adjacent channels containing a gaseous conduction medium, certain of said channels being disposed circumferentially with respect to another of said channels, one end of each of said channels being sealed, and the other ends of the channels being interconnected, a cathode in the sealed end of one channel and an anode in the sealed end of each of several of the other channels.

ROBERT E. BARCLAY.